Scientific Programme Abstracts

Monday 19 May

0800–0845
Refresher Course
Diagnosis of Venous Thromboembolism
Hall 9

0800
Invited Review
Diagnosis of venous thromboembolism
J H Reid
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Venous thromboembolism in all its guises poses a major diagnostic and management dilemma in modern hospital practice. It is estimated to be the third commonest cause of death in the USA. Clinical assessment is fraught with difficulty and heavy reliance is placed on imaging. Unfortunately, the backbone of radiological diagnosis, the lung perfusion—ventilation scintigram suffers from such poor specificity that more than 50% of patients have an indeterminate scan. What other imaging modalities may then be usefully employed to refine the diagnosis? Ideally, as with deep vein thrombosis (DVT), direct visualization of emboli should be the ultimate goal. This may not be possible because of local limitations of expertize or imaging equipment. Indirect methods of confirming the diagnosis by demonstrating the culprit DVT may then be employed. This strategy then raises its own questions. Doppler or phlebography? Is below knee DVT relevant? Is a negative study helpful? Recent research has shed some light on these difficult areas. Pulmonary angiography is still the reference standard for direct visualization of emboli, but has had its role diminished by out-of-date figures for morbidity and mortality, and its reputation for inaccessability. Other less invasive techniques, such as helical CT, MR and transoesophageal echocardiography, have been usefully employed. Of these, helical CT certainly looks the most promising, with sensitivity and specificity rates approaching pulmonary angiography. All of these radiological techniques will be considered and potential algorithms for District General Hospital and tertiary centres will be presented.

0800–0850
Scientific Session
Spinal MRI
Hall 10a

0800
Fast scanning of the lumbar spine—use of a single T_2 sagittal sequence
[1]J J Rankine, [1]C E Hutchinson and [2]D G Hughes
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PURPOSE: To determine whether a single T_2 sagittal sequence can replace the conventional three sequence examination of the lumbar spine. METHOD: The T_2 sagittal images of 79 lumbar spine MRI examinations were retrospectively reported by three radiologists. Features related to degenerative disease were recorded and an assessment of whether further sequences were likely to add information was made. On a separate occasion, the T_1 and T_2 sagittal and T_2 axial sequences were reported blind to the initial assessment. Areas of disagreement were resolved by consensus opinion. The T_2 sequence was compared with the three sequences, taking the three sequence examination as the standard. RESULTS: The T_2 sagittal images diagnosed disc protrusions with a sensitivity of 40% and a specificity of 97%. 22 discs reported as a disc bulge on the T_2 sequences were re-classified as a disc protrusion on axial images because of their focal nature. Central canal stenosis was diagnosed by the T_2 sagittal sequence with a sensitivity of 60% and a specificity of 95%. After assessing the T_2 sequence it was thought unlikely that further sequences would add extra information in 60% of cases (48/79). However, further information was obtained in 21% of cases (10/48) when all the sequences were assessed. CONCLUSION: It was shown that three sequences provide additional information over the sagittal T_2 sequence in assessing disc protrusions and central canal stenosis. The extra information gained by using all three sequences was considered to be of greater benefit than the time saved by using a single T_2 sagittal sequence. Other diagnoses where the additional sequences proved helpful are discussed.

0810
Lumbar spine MRI: can fast spin echo proton density replace spin echo T_1 axial scans?
W C G Peh, T H Siu, J H M Chan and F L Chan
Department of Diagnostic Radiology, The University of Hong Kong, Queen Mary Hospital, Hong Kong
PURPOSE: Spin echo (SE) T_1 axial scans are routinely obtained in MRI of the lumbar spine in many centres. This study directly compares matched SE T_1 and fast SE (FSE) proton density (PD) axial scans. MATERIALS & METHODS: Both SE T_1 and FSE PD (first echo of a dual echo sequence) axial scans were prospectively performed in 116 consecutive patients referred for MRI of the lumbar spine. The imaging parameters (field of view, slice thickness, interslice gap, number of excitations and matrix size) and scan levels were identical for each pair of sequences. At two selected levels, L4/5 and L5/S1, the following structures were independently graded (on a one to three scale) by two observers: bone marrow, epidural fat, disc, thecal sac, cauda equina, nerve root, facet joint and psoas muscle. RESULTS: In 232 lumbar levels analysed, the following structures were equally well seen by both observers: bone marrow, epidural fat, disc, nerve root and facet joint (mean gradings 2.93–2.99). The thecal sac was marginally better depicted on FSE PD images (mean grades 2.96 *vs* 2.88). The psoas muscle was adequately visualized for diagnostic purposes on both sequences (mean grades 2.30–2.32), although there was considerable interobserver variability. The cauda equina were better seen on FSE PD (mean grade 1.92) than on SE T_1 (mean grade 1.00) images, with moderate interobserver variability for FSE PD images. CONCLUSION: FSE PD scans are comparable with and may potentially replace SE T_1 axial MRI scans of the lumbar spine.

0820
Pathological findings on MRI of the lumbar spine in junior cricket fast bowlers
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Spinal injury is common in cricket fast bowlers. Degenerative disc disease, facet joint syndromes and stress fractures of the pars interarticularis have all been described. We report initial results from a controlled longitudinal study of elite junior fast bowlers ($n=56$) recruited from the Under 13, Under 15 and Under 17 development squads of the Queensland cricket association. Male control subjects were recruited from state swimming squads ($n=23$). All subjects underwent an MRI examination of the lumbar spine. RESULTS: Four out of 56 bowlers had healed stress fractures (zero out of 23 controls). 47/49 bowlers with asymmetric cortical bone thickness showed these changes in the side opposite the bowling arm (zero out of 23 controls showed asymmetry). Eight out of 56 bowlers and five out of 23 swimmers had bilateral pars defects of the L5 vertebra. Disc degeneration was seen in 34% of bowlers, but in 48% of controls. CONCLUSIONS: Spinal asymmetries similar to those seen in senior fast bowlers are found even at junior level, with stress fractures occurring on the side opposite the bowling arm. Lumbar disc degeneration is no more prevalent in fast bowlers than in a control group of athletic subjects. Both bowlers and swimmers show high rates of pars defects at L5 compared with a Caucasian population prevalence of 5%.

0830
MR vertebral end plate changes and back pain
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PURPOSE: The vertebral end plate is pain sensitive and is thought to contribute to back pain and its reproduction at discography. Vertebral MRI signal changes adjacent to degenerative lumbar discs are well-described, but discographic assessment of pain in patients with abnormal end plate changes has not been extensively studied. This prospective study addresses the relationship between discographically-induced pain and MRI end-plate changes. METHOD: 70 patients with long-standing low back pain, with or without

sclerotomal leg pain, were assessed clinically and subjected to an MRI examination of the lumbar spine. The status of the end plates was recorded and the abnormal levels were classified as either Modic Type 1 (low T_1 signal, high T_2 signal) or Modic Type 2 (high T_1 and T_2 signal). The induced pain at lumbar discography was graded as non-symptomatic, partial symptoms, or complete reproduction. The MRI and discograms were reviewed randomly by three experienced spine radiologists. RESULTS: 200 disc levels were assessed. Type 1 changes were demonstrated at 24 levels, with Type 2 changes in 21 levels. The remaining 155 levels showed no change in vertebral end plate signal. At discography, 10 of 24 Type 1 levels produced total symptomatic reproduction, 11 had partial reproduction and the remaining three levels were asymptomatic. 10 Type 2 levels were asymptomatic, nine had partial reproduction, and only two had total pain reproduction. Discography performed on discs with normal end plates on MR revealed 110 with no symptoms, 23 with partial reproduction and 22 with total pain reproduction. CONCLUSION: The MR characteristics of Modic Type 1 changes are similar to other pathologies, such as bone bruise and inflammation. This study shows that a relationship exists between discographically-induced symptomatic back pain and Type 1 change, which suggests that the fibrovascular process may result in back pain. The Type 2 changes suggest a more quiescent process.

0840

Dynamic function MRI of the cervical vertebral column in patients with rheumatoid arthritis

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PURPOSE: To determine the value of dynamic function MRI in patients with rheumatoid arthritis (RA) of the cervical vertebral column. MATERIALS & METHODS: We used a device which allows MRI examinations in infinitely variable degrees of flexion and extension for functional studies of the cervical spine. Dynamic functional MRI was performed on 10 volunteers and 25 patients with RA. RESULTS: Functional MRI is able to show the degrees of vertebral instability of the occipitoatlantal or atlantoaxial level. With functional MRI we were able to demonstrate the extent of synovial tissue ventral, dorsal and superior to the dens, with impingement and displacement of the spinal cord during flexion and extension. The basiliar impression, cord impingement into the foramen magnum, cord compression and angulation of the cord were much more evident in functional MRI. CONCLUSION: Functional MRI provided additional information in patients with RA and may be indicated in patients who have a normal MRI study in neutral position. Functional MRI is important in the planning of stabilizing operations of the cervical spine.

0800–0850
Categorical Course
Musculoskeletal Ultrasound 1
Hall 10b

0800
Invited Review
Shoulder ultrasound

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High resolution US provides a cost-effective and accurate means of assessing the shoulder. The commonest uses are in imaging the rotator cuff in patients with impingement, imaging the biceps tendon and assessing effusion. This review will describe the techniques, pitfalls and pathology encountered.

0825
Invited Review
Ultrasound of elbows, hands and wrists

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This presentation outlines the sonographic technique, anatomy and common pathologies found in the elbows, hands and wrists. *Elbow*: This is a common site for repetitive strain injuries to the common extensor and common flexor origins, as well as the distal triceps insertion. All of these have typical patterns readily identifiable on US, which not only allow confirmation of the diagnosis but also provide pointers as to the underlying injury mechanisms. *Wrist*: The sonographic anatomy of this region is difficult to understand, even for an experienced investigator, and the role of US regarding joint disease and injury will be discussed. Juxtaarticular tendon disease and benign soft tissue masses, however, are much more readily diagnosed on US. Common examples of these conditions will be demonstrated. *Hands*: Many inflammatory joint diseases present in hands, most of which have distinct patterns sonographically. Joint and tendon sheath inflammatory processes will be discussed regarding their sonographic appearances. It will also be shown how US may distinguish different patterns of bone erosion associated with primary inflammatory arthropathies. The US appearances of crystal arthropathies will also be highlighted. The presentation aims to demonstrate the versatility of musculoskeletal US in the examination of the distal upper limb.

0800–0845
Categorical Course
Vascular Interventional Radiology 1
Hall 11a

0800
Invited Review
Venous intervention

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Whilst there are numerous indications for venous intervention, this presentation will concentrate upon techniques of central venous access. There has been a tendency in many centres for all long-term venous catheters, whether used for dialysis or infusion, to be inserted by radiologists under image guidance. There are several reasons for this, including shorter procedure times, improved success rates and fewer complications when compared with a surgical approach. Furthermore, radiologists are in an ideal position to provide a full venous access service; many of the early and late complications of these central venous catheters may be successfully managed radiologically. The more usual, as well as the less common, venous access routes will be discussed, as well as the potential complications of central venous catheters and their management. Other venous interventional techniques, including recanalization (angioplasty, thrombolyis and stent insertion), and the less common procedures of embolization and venous sampling (to aid in the localization of hormone-secreting tumours) will also be described.

0800–0850
Refresher Course
Sedation & Resuscitation
Hall 11b

0800
Invited Review
Sedation

G Lyons

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Mortality due to anaesthesia alone, without any surgical contribution, is given as 1:180000. Mortality for gastrointestinal endoscopy is reckoned to be between 1:7500 and 1:20000. This is admissible because, although the endoscope competes with the airway, some form of sedation is invariably used. One investigator writes that a mortality of 1:1000 is acceptable for children sedated for imaging procedures. Evidence suggests that sedation administered by a non-anaesthetist is associated with a significantly greater risk than a general anaesthetic in the hands of an anaesthetist. Most problems occur as a result of loss of airway or cardiorespiratory depression. Children and the elderly seem to be at greatest risk. Guidelines for safe practice have been promoted in the UK, but are rarely followed. In the US, morbidity has been reduced when departments of anaesthesia have been made responsible for policing sedation standards in radiology departments. Standards of care in the UK are variable, often poor, and universally need improvement.

0825
Invited Review
Resuscitation of patients in an imaging department
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Radiological examinations incorporating the use of iv contrast media occur daily. Large volumes of contrast media are administered in a complex pattern, not only by radiologists but increasingly by paramedical staff, specifically trained for this task. Sooner or later every person administering radiographical contrast media will precipitate a severe reaction that can be life-threatening. The ability to recognize a severe reaction, manage the situation and treat appropriately is essential. Anaphylactoid reactions result when contrast media activates directly or indirectly the complement system, coagulation, fibrinolytic and kinin systems, leading to the release of multiple mediators all capable of producing adverse effects. This may be responsible for significant respiratory, cardiovascular and cutaneous abnormalities. Reactions can be divided into: minor reactions, limited to nausea and vomiting, urticaria and puritis; moderate reactions, where urticaria is more generalized, severe vomiting occurs and bronchospasm is progressive; and severe reactions, with profound hypotension and rapid accelerating angio-oedema. Mild reactions require only observation, moderate reactions may respond to stemetil, piriton and hydrocortisone. Bronchospasm may be treated with salbutamol. Severe reactions require a rapid response with correction of the volume depletion and the use of adrenaline. The designated person in charge of the administration of radiographical contrast media must be able to recognize and differentiate the various types of reactions to contrast media. Appropriate and specific treatment should be started rapidly and effectively. A familiarity with a limited number of drugs, allows treatment that will rapidly reverse reactions and prevent their progression to life-threatening severity.

0845–1015
Scientific Session
Chest Imaging
Olympian Suite

0845
Radiological presentation of traumatic pneumothoraces on admission: supine chest radiographs
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INTRODUCTION: The Helicopter Emergency Medical Service (HEMS) provides an emergency service to greater London (inside the M25). The supine chest X-ray (CXR) is always performed on these polytraumatized patients with high ISS scores, who are managed on ATLS guidelines. One of the main reasons for performing supine CXR in these patients is to detect and, in particular, to exclude traumatic pneumothoraces. AIMS & PURPOSE: The aim of this study was to describe the radiological presentation of traumatic pneumothoraces on admission supine CXRs. METHOD & RESULTS: A retrospective review of admission supine CXRs was performed on all patients admitted via HEMS. There were 1560 patients admitted over a 6 year period and 202 patients had pneumothoraces demonstrated on the HEMS database, 163 male: 39 female, with a mean age of 39 years (age range 1–86), and a mean ISS of 33.2 (range 9–55). CONCLUSIONS: The study confirms the difficulty that can sometimes be experienced in trying to diagnose and, in particular, to exclude pneumothorax in view of their atypical presentation on supine CXR.

0855
How do clinicians interpret the indeterminate VQ scan report?
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PURPOSE: To evaluate clinicians' understanding of an indeterminate VQ scan result and how it affects subsequent management. MATERIALS & METHODS: The reports of all patients referred for VQ scan over a 9 month period with suspected pulmonary embolism (PE) were reviewed retrospectively. The case-notes of patients with indeterminate scans were reviewed to determine subsequent clinical management. RESULTS: 413 scan reports were reviewed. 196 scans (47%) were reported as normal or low probability, 86 (21%) were reported as high probability and 131 (32%) were reported as indeterminate. The case-notes of 111 patients with indeterminate scan were reviewed. 20 patients (18%) were thought clinically to have had PE and were anticoagulated. 26 patients (23%) were thought clinically not to have had PE and were not anticoagulated. Six patients (5%) were deemed unsuitable for anticoagulation regardless. 12 patients (11%) were investigated further, nine by lower limb Doppler US and three by contrast venography. Eight cases (7%) were not anticoagulated but it was not documented in the case-notes why that decision had been taken. In the remaining 39 patients (35%) the VQ scan report was misinterpreted. In 37 cases (33%) the result was misquoted in the case-notes as negative for PE and none of these patients were anticoagulated. In two cases (2%) it was misquoted as positive for PE and anticoagulant therapy was instituted. This misunderstanding was observed in all clinical firms. CONCLUSION: Clinicians are misinterpreting the significance of an indeterminate VQ scan. Such misinterpretation may have significant implications; 30–40% of patients with indeterminate scans may have had PE.

0905
Evaluation of CT prior to bronchoscopy in patients with bronchial carcinoma
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PURPOSE: To assess the ability of chest CT in patients presenting with an abnormal chest X-ray (CXR) (mass or lobar collapse) and a high clinical index of suspicion for malignancy, to predict the likelihood of a positive bronchoscopy, or demonstrate an alternative site for biopsy. MATERIALS & METHODS: 80 consecutive patients having had a CXR, CT and bronchoscopy and with a confirmed diagnosis of bronchial carcinoma were included. The CXR and CT scans were evaluated without knowledge of the bronchoscopy findings. Mass, size, edge, distance from pleural surface and from lobar bronchi were evaluated. Presence of effusion, bone, liver or adrenal metastases recorded. RESULTS: There were 49 male and 31 female patients, age range 34–85 years. 24 patients had lobar collapse. Of the 56 remaining patients, nine had pleural effusions, four were not visible on CXR. 19 patients had metastatic disease to solid organs. CONCLUSION: Performing chest CT prior to bronchoscopy in patients with a high index of suspicion for carcinoma may obviate the need for bronchoscopy, 28 of 56 patients in our series without lobar collapse were suitable for radiologically-guided non-pulmonary biopsy or pleural fluid aspiration.

0915
Patterns of local recurrence in non-small cell lung cancer following curative radiotherapy
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PURPOSE: To assess the plain film and CT patterns of disease recurrence in patients with non-small cell lung cancer (NSCLC) who had received curative radiotherapy, where recurrence occurred after stabilization of radiotherapy changes. Radiotherapy changes should stabilize after 12 months. Change following this suggests recrudescence or recurrence, despite the confounding effects of radiotherapy. MATERIALS & METHODS: 113 patients with histologically-proven NSCLC treated with radiotherapy were reviewed. 40 had evidence of local tumour recurrence, a minimum of 1 year post-completion of therapy. 27 patients were treated with radiotherapy alone. 13 received both radiotherapy and surgery. RESULTS: Recurrent disease took the form of: new soft tissue mass (75%); nodal disease (63%); pleural effusion (55%); filling-in of previously patent bronchi (53%); pleural nodularity (43%); volume loss (38%); distant metastases (35%); alterations in contour and pericardial effusion (33%); and pulmonary metastases (30%). The new soft tissue mass represented recrudescence in 75% of the non-surgical patients, but true recurrence in 58% of the surgical patients. Pleural nodularity was more common in the surgical (64%) than the non-surgical (31%) group. CONCLUSION: Patterns of recurrence are different in the surgical and non-surgical groups. Local recrudescence of disease is the most common presentation after radiotherapy alone. Recurrence as pleural nodularity is more common after surgery. Filling of previously patent bronchi, in an area of radiation-induced fibrosis/bronchiectasis is a very useful and reliable sign and is highly suspect for recurrence.

0925

MRI of treated thymic lymphoma—a comparison with CT

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PURPOSE: To determine the MRI appearances of treated thymic lymphoma and to compare the results with post-therapy CT and clinical outcome. MATERIALS & METHODS: MRI and CT scans in 25 patients with thymic lymphoma were reviewed. Dimensions of residual masses on MRI and CT were compared. Signal intensity on MRI was assigned to four patterns: low heterogenous; low homogenous; high heterogenous; and high homogenous. The presence of cysts, calcification and fatty infiltration were noted. Enlarged intrathoracic nodes were also documented. RESULTS: The measured dimensions of residual thymic masses were greater on MRI than CT. Signal intensity pattern was low homogenous or heterogenous in 19 patients. Two of these patients relapsed within 1 year. A high heterogeneous signal intensity was observed in five patients, four of whom relapsed. Cysts were demonstrated in six patients by MRI, of whom one relapsed, but in only one patient by CT. CONCLUSION: Successfully treated thymic lymphoma usually has a low signal intensity on MRI, irrespective of the size of the residual mass, and very high signal intensity cysts may be seen. Most relapses occurred in patients with masses of large volume and/or a high hetergenous signal intensity, suggesting that close follow-up or biopsy should be considered.

0935

Cine or video MRI of the mediastinum: demonstration of rigidity in cases of malignancy

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OBJECTIVES: MRI of the mediastinum has advantages over CT in imaging of cases of malignant involvement due to the high inherent tissue contrast. However, the resolution of MRI does not match that of CT and, in addition, the latest spiral CT permits sub-second scanning whilst injecting contrast medium, thus providing high quality images of the great vessels. It may, however, still be difficult to tell whether or not the mediastinum has been directly invaded, or if the tumour abuts, but does not invade, the mediastinum. Video or cine MRI can easily be used as an additional sequence when examining the mediastinum, providing further information about the involvement of the heart and great vessels. The sequence that is used at the Bristol Royal Infirmary is a gated gradient echo sequence (turbo flash 6rb 195wfa) providing "white blood" images of the vasculature. Two levels are usually scanned at the same time. The total additional time for scanning is dependent on the patient's heart rate, but does not usually exceed 90 s. Whilst this sequence is viewed in cine mode, it provides a demonstration of the movement of the mediastinum. In the normal mediastinum there is considerable movement related to systole/diastole and to respiration. If the great vessels and mediastinum are invaded by neoplasia there is considerable dampening due to increased rigidity. The results from 25 cases of chest MRI with malignancy will be presented. Video sequences of neoplastic invasion will be compared with those from normal subjects.

0945

Invited Review

The changing face of industrial lung disease

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The application of radiology to industrial lung disease is uniquely linked to economic and social developments. The last two decades have seen the decline of many industries, such as coal mining, ship building and heavy engineering, which have been associated with a high incidence of lung disease. At the same time, new industries and processes have developed which have brought fresh hazards into the work-place. Since the early 18th century the legislative framework has been continually adapted in response to political and social pressures. The earliest effective legislation was the Factories Act (1833) but more recent laws, in particular the Health and Safety at Work Act (1974), have demanded that the employer becomes proactive in assessing risks. A comprehensive structure of industrial injury compensation is now in place and this may be supplemented by civil action against employers. Against this background, radiology is often indispensable in establishing the cause of lung disease and assessing its severity. The development of HRCT has been a powerful tool in this respect.

0900–1020
Scientific Session
Musculoskeletal Imaging 1
Hall 1

0900

MRI *vs* bone scintigraphy in the early diagnosis of occult scaphoid fracture: a comparative study

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Bone scintigraphy is currently accepted as the investigation of choice for the detection of occult scaphoid fractures. Pressure on nuclear medicine services frequently makes it difficult to perform scans at an appropriate time. MRI has been used in other occult fractures, *e.g.* of the hip. It can be carried out quickly and easily, and has the added advantage that there is no radiation dose. There has been no formal evaluation of its accuracy in the detection of scaphoid injuries. 43 patients with signs of scaphoid injury, but normal plain radiographs, were investigated by both bone scintigraphy and MRI. Scans were performed between 10 and 35 days with a mean of 19 days from the date of injury. Individual investigations were blind reported by an expert musculoskeletal radiologist. There were 12 osseous carpal injuries of which six were scaphoid waist fractures. Fractures and bone bruises of other carpal bones and the distal radius were detected in a further six patients. MRI demonstrated all osseous injuries clearly with no false positives or false negatives. Bone scintigraphy was less helpful giving two false positives and one false negative for scaphoid fracture. In conclusion, MRI should become the investigation of choice for the detection of occult scaphoid injuries as it is more sensitive and specific than bone scintigraphy.

0910

The use of MRI in the detection of radiographically-occult scaphoid fractures

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A prospective study was performed to evaluate the use of MRI in the early detection of radiographically-occult scaphoid fractures. 43 individuals (age range 11–67 years) were studied over a 12 month period. All patients attended the Casualty Department following a fall on an outstretched hand with subsequent pain and swelling in the anatomical snuffbox. Radiographs of the wrist including scaphoid views were reported as negative for scaphoid fracture. A limited MR scan was performed on the same day of attendance with follow-up radiographs obtained 10–14 days post-injury. MRI was performed on a 0.5 T IGE Max system using a 5 inch surface coil. Coronal T_1 weighted spin echo (500/21) and T_2 weighted gradient echo (640/25/35°) images were obtained with 3 mm section thickness and 17 cm field of view. MRI identified 12 scaphoid fractures, with other carpal bone or distal radial fractures in seven. The remainder had soft tissue oedema and fluid but no bone injury, confirmed on follow-up radiographs. The early detection and management of wrist fractures is important in improving patient morbidity and preventing potential complications. The exclusion of bone injury is particularly helpful in allowing early mobilization.

0920

MRI in brachial plexus avulsion injury: evaluation of a new technique

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MRI is the technique of choice in evaluating patients with brachial plexus avulsion injuries. Diagnosis depends on the finding of pseudomeningeocoeles in the area of the brachial plexus nerve roots. These can be difficult to see on standard MRI. We evaluated an MRI myelographic sequence for this purpose. Nine patients were referred with suspected brachial plexus avulsion injuries. Conventional coronal and sagittal T_2 weighted images were performed and a myelographic sequence using the following parameters: FSE T_2W (TR/TE 7000/270), 3 mm thick coronal slices, FOV 24 × 18 cm, matrix 256 × 192. MR myelography was compared

with conventional MRI. Six of nine patients had brachial plexus avulsions diagnosed on MRI. The pseudomeningocoeles were better seen with MR myelography than conventional MRI. Pseudomeningocoeles were elegantly displayed on coronal MR myelographic sequences. MR myelography is the technique of choice in evaluating patients with potential brachial avulsion injuries.

0930
The role of echo time in reducing the MR magic angle signal artefact in tendons
W C G Peh and J H M Chan
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PURPOSE: Increased signal intensity in normal tendons due to the "magic angle" phenomenon has increasingly been recognized as a significant artefact in clinical MRI. This study aims to evaluate the effect of varying the echo time (TE) upon this artefact. MATERIALS & METHODS: Fresh bovine tendons were imaged utilizing spin echo (SE) T_1 and PD weighted sequences, with the tendon orientated at 55° to the main magnetic field (B_o). Constant TR and progressive incremental TE values were obtained for each sequence. Quantitative measurements of signal intensity were made on corresponding images for each TR/TE value and compared with the signal intensities of tendons imaged when orientated at 0° to B_o, acquired using minimum TE values. The Achilles tendon of a human volunteer was similarly imaged and evaluated. In addition, certain structures (muscle, tendon, bone marrow and subcutaneous fat) were subjectively assessed for anatomical clarity. RESULTS: For bovine and human tendons orientated at 55° to B_o the signal intensities decreased exponentially with increasing TE. A critical TE value exceeding 37 ms, for each sequence, was required to reduce the signal intensities to those obtained with tendons orientated at 0° to B_o, *i.e.* in order to avoid the magic angle phenomenon. At this critical TE value, anatomical structures were found to be of acceptable quality. CONCLUSION: In tendons orientated at 55° to B_o, there is a critical TE value of 37 ms, above which the tendon signal decreases to the levels of those orientated at 0° to B_o.

0940
A preliminary study of *in vivo* proton magnetic resonance spectroscopy in chronic polymyositis and dermatomyositis
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PURPOSE: Polymyositis (PM) and dermatomyositis (DM) are inflammatory chronic muscle diseases of unknown aetiology which cause muscle weakness and disability. *In vivo* proton MR spectroscopy was used to assess whether biochemical abnormalities, such as lipid, creatine and choline metabolites can be detected in the more distal muscles of chronic PM/DM patients (as the diseases predominantly affect proximal muscles). MATERIALS & METHODS: MRI and localized proton MR spectroscopy were carried out on the calf muscle of 12 chronic PM/DM patients and nine healthy controls. An axial T_1 weighted image (TE/TR 17/500 ms) at the mid-calf level was acquired. An 8 cm^3 volume localized water-suppressed proton PRESS localized spectrum (TE/TR 50/3000 ms, 128 averages) was then obtained from a region prescribed well within the soleus muscle. RESULTS: From the T_1 weighted MR images, fat infiltration into the muscle of PM/DM patients was consistently observed. Muscular atrophy with a variable distribution was also noted in all patients. The biochemical profile of the localized proton MR spectra of soleus muscle showed significant ($p < 0.0005$) reduction of both "choline" to lipid and "creatine" to lipid ratios in chronic PM and DM patients, when compared with controls. DISCUSSION: Significant anatomical and biochemical changes were shown in the more distal muscular group, even though the disease is believed to affect mainly the proximal musculature. These MR changes may be a consequence of one or more factors, namely, active disease, disuse atrophy or side effects from the corticosteroid treatment.

0950
Invited Review
The unstable ankle
L A Williams
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The ankle relies for its stability on the mortise of the malleoli, supplemented by the medial (deltoid) ligament, the lateral ligament complex and the subtalor and interosseous ligaments. Acute instability usually results from damage to the medial and lateral sides of the joint, although isolated lateral ligament damage is also a very common cause. 90% of acute ligament injuries will heal, the 10% of cases that become chronic problems require further investigation. These chronic problems may be due to osteoarthritis, loose bodies, osteochondral fractures, peroneal tendon or ligament damage. Insufficiency of the lateral ligament complex is the commonest problem. Investigations available are: stress radiography (inversion and anterior drawer), arthrography, tenography, MR and MR arthrography (direct and indirect). Stress radiography is the recommended screening test, with MR arthrography reserved for difficult cases or to enable pre-operative planning.

0900–1010
Scientific Session
Radiotherapy & Oncology 1
Hall 10a

0900
Invited Review
Conformal radiotherapy
G Read
Cancer Services, Royal Preston Hospital, Sharoe Green Lane North, Preston PR2 9HT, UK
The realization of conformal radiotherapy (CRT) has been made possible by the increase in computing power and hardware developments, such as the multileaf collimator. Further developments, such as the 3D CT simulator and intensity modulated beams, offer promise for the future. The rational for CRT has been based upon two premises: (1) that by conforming the target accurately to the shape of the tumour the consequent reduction in the volume irradiated will allow an escalation of radiation dose and hence an improvement in local control; (2) that toxicity will be reduced by diminishing the irradiation of adjacent normal tissues. This review will consider the clinical results which have been thus far observed. The following questions will be addressed. Is there a need for improved local control? Does increasing local control reduce metastatic outcome? Are there sites which will benefit from CRT? Which sites will benefit from CRT? Arguments against CRT: that reducing the volume irradiated leads to a greater chance of missing the tumour; errors in set-up, compounded by organ movement, may be so large as to outweigh the possible reduction in the volume of adjacent tissues irradiated; and that variation in individual radiosensitivity may be so large as to swamp the benefits of CRT, will be considered. Clinical studies of four types will be reviewed: theoretical studies, studies showing tolerance to dose escalation, non-randomized comparisons with historical data and randomized studies. CRT offers considerable promise—a number of non-randomized studies have shown a reduction in acute toxicity and some recent studies show an improvement of local control. Challenges for the future include the development of planning systems which take into account organ and patient movement.

0930
Invited Review
3D planning and simulation
P J D K Dawes
Northern Centre for Cancer Treatment, Newcastle-upon-Tyne NE4 6BE, UK
The advent of modern 3D radiotherapy dose-planning algorithms and image processing on CT simulators has suggested that the replacement of conventional simulators by CT scanners is feasible and possibly appropriate. This paper will explore the current position of both simulators and CT scanners as simulators, and whether replacement of one by the other is appropriate. 3D planning affects simulation; the reconciliation of practical field placement and 3D dose-distributions will be attempted. This will include examining the potential for time-saving of 3D CT-based planning.

1000
Optimization of beam orientations in radiotherapy treatment planning
C G Rowbottom, M Oldham and S Webb
Joint Department of Physics, The Royal Marsden NHS Trust and The Institute of Cancer Research, Sutton SM2 5PT, UK
PURPOSE: Many aspects of treatment planning have already been optimized using computers. However, little work has been done on the optimization of beam angles, an area which could potentially yield great benefits. We present a method for optimizing beam orientations in 3D. METHOD: The method is based on evaluating a cost function (a measure of "goodness") for a range of beam orientations. The cost function for each beam models the dose deposited to organs at risk (OARs), the volume effect of the OARs and the average primary dose to the planning target volume (PTV). Within the cost function, different weights can be assigned to the OARs and PTV to incorporate their relative importance. A series of single beam calculations can be made and used as a visual aid to the determination of the multiple beam angles needed for a treatment plan. The method has been evaluated on five field plans over a cohort of prostate patients. A plan with standard beam angles was compared with a second plan with optimized beam angles via measures of normal tissue complication probability (NTCP) and tumour control probability (TCP). RESULTS: Optimization leads to an average increase in the TCP of 6% for a rectal NTCP of 1%.

0900–1045
State of the Art Symposium
Synchrotron Radiation
Hall 10b

0900
Invited Review
Synchrotron radiation, how, why and what?
R A Lewis
Synchrotron Radiation, Central Laboratory of the Research Councils, Warrington WA4 4AD, UK
Few health care professionals have even heard of synchrotron radiation and its use is not widespread in medicine. Synchrotron radiation covers a huge range of photon energies from infrared through to hard X-rays. It is extremely intense, highly collimated and tuneable and has had a major impact in many areas of science. There are currently about 50 synchrotron radiation sources throughout the world which vary in size from huge rings with circumferences measured in kilometres, to machines which can fit on the back of a lorry. A single synchrotron radiation source produces many beams of radiation which, when directed along beam-lines into experimental areas, enable many investigations to be simultaneously performed. The unique combination of properties has revolutionized a whole range of techniques such as imaging, X-ray diffraction, spectroscopy and microscopy. Several medical applications of these techniques are currently under active investigation in the UK and throughout the world. For example, the directionality and tunability of synchrotron X-ray beams offers the capability to produce diagnostic images of higher quality at much lower dose than is possible with conventional equipment. On a microscopic level, microsecond resolved information on molecular structure can be obtained from tissue samples which can be in near physiological conditions, or even alive. It is clear that the medical applications of synchrotron radiation will become far more widespread as more sources are constructed and the medical community becomes more aware of the possibilities that it offers.

0925
Invited Review
Clinical applications of synchrotron radiation
C R M Boggis
Manchester Breast Screening Unit, Withington Hospital, Manchester M20 0PT, UK
Synchrotron radiation (SR) is a powerful tool that can provide information on atomic, molecular and visual scales. Clinical research using SR comprises *in vitro* studies involving the breast, cornea, bone, brain and nervous tissue and *in vivo* angiography. Applications of SR in breast disease include determination of X-ray attenuation coefficients for the varying types of breast tissue, enabling improvements to be made in image optimization and radiation exposure data; important in mammographic breast screening programmes and for high risk patients. Mammographic microcalcifications represent a spectrum of benign to malignant disease and are a diagnostic problem. SR techniques can investigate small samples, providing considerable atomic and molecular information potentially determining benign from malignant samples. SR is of proven value for investigation of collagen structure and packing in the cornea, leading to alteration in clinical practise. Accumulation of metals in the brain is associated with neurological disorders, *e.g.* iron deposition in Parkinson's disease. SR has revealed the precise method of iron storage associated with this disease. The most advanced clinical application is iv enhancement of the coronary arteries using dual energy imaging, thus avoiding coronary catheterization, with full clinical trials due to start in 1997. There are, currently, several dedicated medical beam lines in existence, Hamberg, Trieste, Brookhaven and Grenoble. If, through research, a molecular fingerprint of a disease can be identified, it is foreseeable that a UK medical beam line could be constructed for practical analysis of small samples in an automated computerized diagnostic system.

0950
Initial studies of breast tissue microcalcification structure using synchrotron radiation
K Rogers, E Towns-Andrews, C Boggis, R Lewis and A Hufton
Postgraduate Centre of Medical Sciences, Cranfield University, Swindon SN6 8LA, UK
The purpose of this ongoing work is to characterize the structure of breast tissue inorganic deposits (microcalcifications) and correlate this to histopathological diagnosis. Surprisingly, the precise nature of these deposits is unknown; definitive studies have rarely been performed and findings are contradictory. It is generally believed that the calcific deposits are of two basic types: calcium oxalate dihydrate and calcium hydroxyapatite (HAP). The absence of the oxalate from tissue with infiltrating carcinoma has led to speculation concerning the use of the specific calcific phase as a predictive marker. Conventional laboratory diffraction studies are difficult and time-consuming, as deposits are often poorly crystalline and generally small in mass. Synchrotron X-rays offer the combination of high intensity and a small area probe and are thus ideal for acquiring diffraction data from pathological specimens. We have used wide-angle scattering to produce diffraction patterns from samples of reduction mammoplasty tissue and biopsy specimens. The use of whole pattern fitting, refined against a structural model (Rietveld method), has enabled us to determine precisely material characteristics such as lattice parameters, crystallite size and strain estimates (anisotropically) and some stoichiometric data. Although our data set is limited to date, we have some evidence that the calcific hydroxyapatite breast deposits are significantly different from those formed within other tissues. The calcium hydroxyapatite of "popcorn" calcifications have been measured as possessing extremes of lattice parameter and crystallite size.

1000
Monochromatic beam mammography using synchrotron radiation
W Thomlinson, R E Johnston, D Washburn, C Burns, E Pisano, L Chapman, N Gmur, R Menk, Z Zhong, F Arfelli and D Sayers
Brookhaven National Laboratory, Upton, New York 11973, USA
Monochromatic synchrotron radiation beams are nearly ideal for imaging the soft tissue of the breast. The high photon flux, tunable energy and intrinsic collimation of the radiation can enhance image contrast and spatial resolution, decrease the degrading effects of scattered radiation and provide the opportunity for the development of new imaging technologies. Monochromatic X-rays at the National Synchrotron Light Source have been used to study the optimization of mammography images. Images of phantom objects have been recorded on conventional mammographic films and on image plate detectors. These images have been compared qualitatively and quantitatively with images obtained from conventional polyenergetic X-ray systems. The synchrotron images show improved contrast. Recently, we have developed a new imaging system, which we call X-ray refraction imaging, in which the beam is diffracted by an analyser crystal after passing through the sample. The resulting reduction of noise, due to the rejection of scatter, small angle scattering and index of refraction effects, produces images with astounding contrast. Comparisons of these images with conventional images and our non-analyzer synchrotron images will be presented. Images have been obtained of phantoms and of samples of excised breast tissue; this will allow us to begin to determine the applicability of this imaging technology to mammography.

1025
Mapping the organic and inorganic components of osteoporotic bone
C Buckley, N Khaleque, S J Bellamy, M Robbins and X Zhang
Physics Department, King's College, University of London, London WC2R 2LS, UK
The quantitative mapping of calcium and protein in normal and osteoporotic mouse femoral neck bone has been performed using X-ray absorption difference imaging. Quantitative calcium and protein maps were made by combining X-ray optical constants with a series of scanning transmission images made using energies which span the calcium L and carbon K absorption edges. In both the organic and inorganic mapping, near-edge X-ray absorption fine structures (NEXAFS) are used to provide the contrast between elemental and chemical components of the specimen. Images at the pre- and post-ionization energies are used to provide quantitation. Thin sectioning of hard tissues requires embedding in hard resin. This resin then adds a component to the optical density of the specimen. To account for its presence and thereby accurately calculate the protein components of the specimen, the NEXAFS features of the embedding medium were characterized and used to separate its effect. Analysis by these techniques have resulted in the quantitative mapping of both the calcium and protein content of normal and osteoporotic bone in embedded but unstained sections.

1035
Work in Progress
See p. 117.

0900–1040
Scientific Session
Vascular Interventional Radiology
Hall 11a

0900
Invited Review
Interventional radiology in the chest
R F Dondelinger and B Ghaye
Department of Medical Imaging, University Hospital Sart Tilman, Liege B-4000, Belgium
Indications for percutaneous catheter drainage of thoracic collections include pleural empyema, haemothorax, recurrent malignant pleural effusion, pericardial effusion, lung abscess, mediastinal abscess, pneumothorax and tension pneumomediastinum. Ultrasonography, fluoroscopy, CT, or a combination of these methods can be used as guidance for the percutaneous approach. The disadvantages and advantages of the radiological techniques are stressed. Particular emphasis is placed upon the combined interactive CT and angiography unit, using a single patient support pivoting on its axis. Techniques of percutaneous drainage of fluid collections are described. The selection of catheters, complications and patient management following catheter insertion are discussed. The use of fibrinolytic injections in pleural empyema is emphasized. Results obtained in various clinical indications are presented and compared with the literature and surgical alternatives. Indications, technique and results of percutaneous fine needle sampling in the lung are reviewed. The results of a randomized study comparing sequential *vs* spiral CT in lung biopsy are presented. It appears that spiral CT does not reduce the time of the procedure, nor its complications, and is more irradiating to the patient. The technique of percutaneous chemical nerve block of the upper thoracic sympathetic chain with CT control is described. Main indications are primary axillary and palmar hyperhydrosis, and vasomotor syndromes. Best long-term effects are obtained in excessive sweating. The most feared side effect of the procedure is Horner syndrome, which tends to be incomplete and transient in most cases.

0930
Randomized comparison of central venous catheter insertion with and without ultrasound guidance
S McPherson, L H Berman and R Sewell
Department of Radiology and Renal Medicine, Addenbrooke's Hospital and the University of Cambridge, Hills Road, Cambridge CB2 2QQ, UK
PURPOSE: To determine whether US guided central venous line insertion is more rapid, with fewer immediate and long-term complications than unguided insertion. MATERIALS & METHODS: 159 patients were prospectively evaluated in a randomized trial of three groups: (A) radiologist with US guidance; (B) clinician trained in US using US guidance; (C) the same clinician without guidance. The time taken to perform the procedure was assessed, as well as immediate and delayed complications. The reason for eventual line removal was documented. Bayesian statistical analysis was undertaken. RESULTS: Immediate complications included pneumothorax, haematoma, misrouted lines and complete failure of insertion. The likelihood of successful line insertion for both US guided groups was 1.27 times that of unguided insertion. The length of time taken over the procedure was decreased in the US guided groups, but the radiologist using guidance was more likely than the US guided clinician to produce a misrouted line. When delayed complications were assessed the US guided lines were more likely to require removal for poor flow, occlusion or line sepsis than the lines inserted blind. This has not been noted in previous studies. CONCLUSION: US guided central line insertion leads to more successful and rapid procedures with fewer immediate complications but also to an increase rate of line removal due to late complications. Insertion by a radiologist rather than clinician conferred no advantage.

0940
Loss of respiratory phasicity and cardiac pulsatility as a predictor of central neck vein occlusion
M C Patel, L H Berman and H A Moss
University Department of Radiology, Addenbrooke's Hospital, Cambridge CB1 2QQ, UK
PURPOSE: Previous studies have confirmed the value of grey scale and colour Doppler sonography in the demonstration of upper limb thrombus. Loss of respiratory phasicity and cardiac pulsatility in the spectral tracing have been considered an unreliable indicator of central venous occlusion. We have investigated whether these changes in the spectral Doppler signals predict central occlusion in subjects with suggestive clinical findings but ultrasonographically clot-free subclavian or internal jugular veins. MATERIALS & METHODS: We prospectively scanned all patients with suspected arm or neck vein thrombus. Those patients with visible thrombus were excluded and the remainder (17) underwent US and basilic vein venography (one patient had magnetic resonance angiography (MRA)). Following US the presence and site of the thrombus was predicted. The venographer was unaware of the US findings. Each site, consisting of a subclavian, jugular and brachiocephalic vein unit, was analysed separately. RESULTS: 31 arm/neck units were analysed: in 19 sites the spectral tracing and subsequent venogram were normal (sensitivity and specificity 100%). In 12 sites the tracings suggested thrombus at a specific site and the venogram (one MRA) confirmed this (sensitivity and specificity 100%). In this preliminary series there have been no false negative or false positive examinations. CONCLUSIONS: We conclude that loss of respiratory phasicity and/or cardiac pulsatility is a reliable predictor of non-visualized central occlusion and that these parameters should be assessed when inserting US guided central lines into apparently clot free jugular and subclavian veins.

0950
Salvage of the solitary kidney by renal artery stenting
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PURPOSE: To evaluate the use of renal artery stents in the solitary kidney with impaired renal function secondary to atherosclerotic renovascular disease, by assessing primary patency, renal function outcome and complication rates during a mean follow-up period of 15 months. METHODS: The Palmaz stent was placed in 21 arteries of solitary kidneys. All patients had impaired renal function (creatine $>150\,\mu l^{-1}$ and four patients were undergoing dialysis. Indications for stenting were: recoil following PTA ($n=18$), arterial dissection following PTA ($n=2$) and restenosis following PTA ($n=1$). The lesions were ostial ($n=17$) and non-ostial ($n=4$). Follow-up angiography was performed in 16 patients (76.2%). RESULTS: Initial technical success was achieved in all patients (residual stenosis <20%). At follow-up (range 6–25 months) renal function had returned to normal in five patients (23.8%), improved in four patients (19%), stabilized in six patients (28.6%), and deteriorated in six patients (28.6%). Dialysis has been discontinued in the long-term in all four presenting dialysis patients. Significant complications occurred in three patients (14.3%) including the only patient death within 30 days post-procedure, attributable to renal failure following contrast nephrotoxicity. No significant restenoses were demonstrated at follow-up angiography, 6–12 months post-procedure. CONCLUSION: Renal artery stent placement in the solitary kidney has led to improvement in renal function in 42.9% ($n=9$) of cases and stabilization of function in 28.6% ($n=6$). In

this high risk group of patients we would advocate renal artery stenting as a relatively safe procedure, in experienced hands, for salvage of the solitary kidney.

1000

Complications of thrombolysis for acute and subacute lower limb ischaemia: a single centre experience over 12 years

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Departments of [1]Diagnostic Imaging and [2]Vascular Surgery, University Hospital, Nottingham NG7 2UH, UK

Intraarterial thrombolysis for acute limb ischaemia was first performed in the UK in the early 1960s. The technique fell out of favour with the advent of the Fogerty catheter. Interest in thrombolysis has been rekindled in recent years and the technique has become increasingly refined. We present our experience of 440 consecutive patients receiving thrombolysis at our institution over the last 12 years. Seven separate regimens were used over this interval. The merits and specific complications associated with each are presented. Our initial experience with iv infusion was associated with a limb salvage rate of 50% and an amputation rate of 18%. Current modern techniques using intraarterial (infusion/pulse-spray) rt-PA is associated with a limb salvage rate of 78–85% and an amputation rate of 9–20% in our series. There were 51 (12%) deaths in our series. 23 of these were due to myocardial infarction or cardiac failure. Major complications occurred in 96 patients (22%). These included major bleeding 39 (9%), cardiovascular arhythmias seven (1.6%), catheter-related 30 (7%), distal embolization 13 (3%) and renal failure four (0.9%). We believe that intraarterial thrombolysis achieves limb salvage rates comparable with the best surgical series. This can be achieved with a significant reduction in mortality, when compared with the surgical series. A multidisciplinary approach is essential, involving close cooperation between vascular surgeons and radiologists. This results in optimal treatment, maximization of limb salvage rates and the early recognition of potential complications.

1010

Mechanical high-speed thrombolysis in acute popliteal artery occlusions

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Departments of [1]Radiology and [2]Cardiovascular and Thoracic Surgery, Wels General Hospital, Wels A-4600, Austria

PURPOSE: To determine the clinical efficacy of high-speed mechanical thrombolysis by means of the Amplatz thrombectomy device (ATD) in acute popliteal thromboembolic occlusion. MATERIAL & METHODS: In a prospective trial 15 patients presenting with acute occlusions of the popliteal artery were treated with the ATD. All patients were at Stage III according to Fontaine's classification, duration of symptoms was 1–22 days. RESULTS: Technical and clinical success was achieved in 14/15 patients (93.3%). In the one patient with a history of 22 days occlusion the ATD was unsuccessful. Mean running time of the ATD was 3 min. Additional balloon-dilatation of the popliteal artery was performed in one patient, aspiration-embolectomy from anterior tibial artery in another patient. No procedure-related complications occurred. CONCLUSIONS: The ATD is helpful in removing acute popliteal artery occlusions which have been present for less than 15 days. Additional interventions may be necessary. More clinical experience is needed.

1020

Late displacement of prosthesis following endovascular aneurysm repair

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Departments of [1]Radiology and [2]Vascular Surgery, University Hospital, Nottingham NG7 2UH, UK

INTRODUCTION: A number of different techniques have been devised for the endovascular repair of abdominal aortic aneurysms and these hold great promise for improved management of this condition. The short-term reported results are generally good, but the long-term behaviour of endovascular prosthesis has yet to be determined. This is particularly important since the object of elective repair of an asymptomatic aneurysm is to prevent its rupture in the long term. PATIENTS & METHODS: We have performed a total of 102 endovascular aortic aneurysm repairs since March 1994, 14 with a unitary bifurcated endoprosthesis (Chuter system), three with a modular bifurcated endoprosthesis (Perth System), two with an aorto–aortic prosthesis (Chuter system), one thoracic and 82 with an aorto uni-iliac prosthesis (Ivancev–Malmö system). Follow-up has been performed with contrast enhanced CT, with particular attention to endoleaks, patency of prosthesis, size of aneurysm and position of the stents. RESULTS: 24 month follow-up is available on 14 patients, 12 months follow-up on 51 and 6 months follow-up on 72 patients respectively. A significant displacement of the endoprosthesis has occurred in five patients, two of whom have since undergone surgical intervention. All these patients underwent endovascular repair with the Chuter system, and all procedures were performed more than 18 months ago. These five cases will be discussed in detail. CONCLUSION: Late displacement of the prosthesis can occur after initial satisfactory aneurysm exclusion. Long-term follow-up is essential to detect this problem.

1030

Endovascular repair of aortic aneurysms: case selection, procedural outcome and follow-up

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Departments of [1]Radiology and [4]Surgery, Royal Liverpool University Hospital, and Departments of [2]Radiology and [3]Surgery, Freeman Hospital, Newcastle upon Tyne, UK

PURPOSE: To evaluate patient suitability, technical feasibility and early clinical results in endovascular repair (EVR) of abdominal aortic aneurysm (AAA) using the Vanguard device (Boston Scientific Ltd). MATERIALS AND METHODS: 100 patients with known AAA in one centre were evaluated by spiral CT and calibrated angiography (CA) to determine suitability for attempted EVR using the Vanguard device. Selection criteria were: infrarenal neck length >14 mm and diameter <26 mm, common iliac diameter <12 mm and neck angulation of $<75°$. EVR of AAA was attempted in 28 patients in two centres. RESULTS: CT provided insufficient data for graft sizing which required additional CA. 21% of patients in a single centre matched selection criteria for EVR. EVR was attempted in 28 cases in two centres (mean age 68 years) with 27 bifurcated and one tube graft. Four patients were considered high risk for surgical repair. 18 procedures were performed in the theatre, 10 in the radiology suite. Completion angiography demonstrated exclusion of the aneurysm sac in 25 cases. Further, primary, endovascular intervention was performed in three cases (1 angioplasty, 2 stentgraft extensions). One patient who required surgical correction of a proximal leak died following myocardial infarction 3 days post-operatively. Pre-discharge CT showed three persistent endoleaks; two resolving spontaneously by 1 month, one requiring iliac limb stentgrafting. Other complications were: two femoral pseudoaneurysms, one raised creatinine, one ureteric obstruction and one iliac occlusion requiring crossover graft. No late leaks were demonstrated within 12 months follow-up. CONCLUSION: EVR of AAA is technically feasible in up to 21% of cases. Early clinical results indicate that successful exclusion of the sac can be achieved.

0900–1000
Scientific Session
*info*RAD™ 1
Hall 11b

0900

Invited Review

Using the Internet: a simple guide for you

G R Plant and N J A Cook
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This presentation will explain what the Internet is, what facilities are available and how you get onto it. This is a simple, non-technical presentation to explain how to connect your PC or Mac computer to the Internet using a modem and conventional phone line. Connection via institutional access will be mentioned only with envy. Information will be available about suitable local Internet access providers (the people you pay to give you access to the Internet). There will be guidance as to how to get connected and a brief demonstration of the use of the Internet to access a number of medical and non-medical sites. It might not be as much fun as surfing in Maui, but if you want to surf in Birmingham in May, it will be a lot more comfortable to do it with us than to try the canal!

0940
A radiology "intranet" using Web technology
D J Lomas, M J Graves and M P Hayball
Department of Radiology, Addenbrooke's Hospital and University of Cambridge, Cambridge CB2 2QQ, UK
PURPOSE: To use freely available World Wide Web (WWW) technology to establish an "intranet" within a radiology department that can provide 24 h access to departmental information, teaching materials for specialist registrars, digital image museum facilities and support for radiology research activities. MATERIALS & METHODS: The existing internal ethernet network linking our MRI and CT systems has been expanded to provide a local area network accessible in several locations in the department. A WWW server (Apache 1.2) has been established on a Sun Sparc20 workstation which allows access from any networked PC, Macintosh, or Unix system equipped with a Web browser. Teaching and department information content has been placed on the server. A digital image museum has been established which allows users to submit images and text directly from the CT and MRI systems into templated HTML pages. These are later vetted and linked into the museum. Access to sections of the Web can be password-restricted and this allows form-based submission of research data from any network location back to the main server. CONCLUSION: A WWW-based intranet has been established on an existing local area ethernet network within a radiology department. This has the potential to improve the dissemination of information, simplify maintenance of a digital image museum and provide support for radiology research.

0950
Discussion

1000–1215
State of the Art Symposium
Professional Development
Hall 9

1000
COR Opening address
J Henderson, President, College of Radiographers

1015
Invited Review
Evaluation of the implementation and management of skill mix in diagnostic imaging centres—research in progress
M J Lovegrove, H B Bentley and A Taket
Faculty of Health and Social Science, South Bank University, London SE1 0AA, UK
This research, funded by the Department of Health, commenced in April of 1996 and is scheduled to be completed by June 1998. The study aims to evaluate the level of success of the implementation of skill mix programmes in eight different diagnostic imaging departments. It will identify the range of skills and abilities of staff extending their practice in this field and the organizational/managerial issues associated with these changes in working practice. It will evaluate the costs and effects as far as possible. The study uses an embedded, multiple-case, study design methodology, involving a combination of longitudinal and cross-sectional elements. Elements studied in detail will include: changes over time at each site; staff attitudes to skill mix implementation; education and training offered to staff; and the quality of the diagnostic examination resulting from the implementation of the skill mix. The findings of the research to date will be presented.

1100
Invited Review
Developing practice in radiography: its impact on the curriculum
R C Price, A R T Higgs, J High and L Miller
Departments of Radiography and Psychology, University of Hertfordshire, Hatfield AL10 9AB, UK
Research undertaken between August 1995 and December 1996 was set against a background of change stemming from the use of new technology in imaging and oncology; the structure and culture of the NHS; and professional and vocational education. The research investigated changing roles and skills, role boundaries and issues surrounding education and assessment. Three approaches were used, desk research, practitioner survey and action research. Desk research consisted of a content analysis of UK degree course documents to identify major themes and issues in radiography education. Action research set out to examine competence-based education and training in radiography. It explored the feasibility of suggested change and innovation for the development of good practice in the design, delivery and assessment of competence-based education and training. Radiographers, business managers, radiologists, oncologists and medical physicists were surveyed by interview and questionnaire. The survey identified occupational roles and tasks and causal factors of role variation. Educators were contacted via a telephone survey. This ascertained the educator's viewpoint on themes emerging from the survey of clinical staff and on issues surrounding assessment of competency, course content and shared learning. Triangulation between the sources and types of data was undertaken to maximize validity and reliability of the research. Research outcomes will enable a strategic view to be taken of factors impacting upon practice in order to inform curriculum development. The project was sponsored by the College of Radiographers and the Council for Professions Supplementary to Medicine.

1145
Open forum

1030–1145
Special Focus Session
How to Get Your Paper Published
Hall 1

1030
Invited Review
How to publish a clinical paper
G H Whitehouse
Department of Medical Imaging, University of Liverpool, Liverpool L69 3GB, UK
Having decided that they have something which is original and worth publishing, authors should: (1) precisely and concisely state the aims of their study; (2) describe their method comprehensively and without ambiguity; (3) present their data with clarity; and (4) set their work in the context of existing knowledge and opinion. There are other considerations in regard to the submission process: (1) factors which influence the choice of journal, including readership, publication time, presentation of journal and impact factors; (2) the structure and content of the article, including choice of title, authorship, ethical issues, illustrations; (3) style; (4) the mechanism of submission; (5) the refereeing process; and (6) reasons for rejection.

1045
Invited Review
Writing a scientific paper
K Faulkner
Regional Medical Physics Department, Newcastle General Hospital, Newcastle-upon-Tyne NE4 6BE, UK
PURPOSE: To encourage individuals to write and publish scientific papers. METHOD: Many individuals perform scientific work which could be written up and published in a peer-reviewed scientific journal, but most work is never published. The reasons why the work is never published will be analysed. However, the publication of scientific findings should be regarded as being integral to the process of scientific endeavour. Research-sponsoring organizations now expect publication of findings in peer-reviewed journals. Publication of results is equivalent to an external, independent audit of the entire research process. This presentation will review: (1) the process of writing a paper, what constitutes good style, writing a structural abstract; (2) how to select the most appropriate journal to publish the paper; (3) the peer review process; (4) replying to referees; (5) how to reply to the journal; (6) what to do in the event that the journal receives a letter. RESULTS/CONCLUSION: It is hoped that individuals will find the process of publishing more open and easy to understand. As a result, it is hoped that more of the abstracts published at this conference will subsequently appear written up as a paper in a scientific journal.

1100
Invited Review
Statistics for publication
R P A'Hern
Department of Computing and Information, The Royal Marsden NHS Trust, London SW3 6JJ, UK
Statistical reviewers frequently read manuscripts backwards, turning first to the tables of numerical data, to get an impression of the conclusions that can be drawn from the results, and then comparing these with the author's own conclusions. On the simplest level, statistical reviewers look for an appreciation of the basic principles of estimation and hypothesis testing. For example, if statistics such as means or percentages have been estimated, has a measure of their uncertainty been quoted? Do the authors take this into account when discussing their results? If a hypothesis has been tested, *e.g.* testing whether the difference between two means is non-zero, then has a *p*-value been given and properly interpreted? Have authors carrying out several hypothesis tests used the correct methods to allow for such multiple comparisons? The design of studies is important to their interpretation, well known phenomena, such as lack of blinding of investigators and failure to allow for a placebo effect, can clearly affect the weight that can be given to conclusions. As a further example, it is important that studies designed to compare imaging techniques are adequately sized, since commonly both sensitivities and specificities will be compared and each of these independent comparisons will need to have sufficient subjects; this is often overlooked by authors. Typically, the condition to be identified will be relatively rare and so it is the sensitivity that will determine the number of subjects.

1115
Invited Review
Publishing your paper
T R Hogan
Publications Department, British Institute of Radiology, London W1N 4AT, UK
Journals provide authors with strict and often extensive instructions on how to prepare manuscripts. This presentation will aim to help authors prepare material for submission, and will cover topics such as: what to include on the title page; the reference list; presentation of information in tables; how to supply figures; handling mathematics. The mechanics of the refereeing and production processes will be explained: how the peer review process is administered and a decision reached, and how an accepted manuscript is transformed to a published paper. The opportunities presented by electronic publishing will also be considered, with particular reference to HTML and Acrobat formats.

1130
Discussion

1030–1140
Scientific Session
Bone Densitometry
Hall 11b

1030
Marfan syndrome, osteopenia and fractures
[1]M D J Harake, [1]J E Adams, [2]P L Selby and [3]K Lipscomb
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PURPOSE: Recent studies have suggested that there are deficits in bone mass in subjects with Marfan syndrome. To determine the extent and significance of this, we have measured bone mass in a variety of skeletal sites in 25 subjects with Marfan syndrome and related bone mass to gender and past history of fractures. PATIENTS & METHODS: 16 women (aged 36.4 ± 11.4 years) and nine men (aged 38.7 ± 10.9 years) with Marfan syndrome had bone mineral density (BMD) measured in the lumbar spine by quantitative CT (QCT) and dual energy X-ray absorptiometry (DXA), in the proximal femur by DXA, and in the forearm by single energy X-ray absorptiometry (SXA). The BMD results were compared with age- and sex-matched mean values of normal subjects and expressed as standard deviates (Z scores). RESULTS: QCT lumbar spine BMD (vertebral trabecular bone) was significantly reduced in women ($p = 0.0002$) and men ($p = 0.008$) with Marfan syndrome. DXA lumbar spine BMD (integral bone) was also reduced in women ($p = 0.032$) as was SXA distal forearm BMD (cortical bone) ($p = 0.003$). Reduction in BMD was significantly greater in women than in men ($p < 0.0001$). 12 subjects had suffered fractures with trauma and BMD in all sites was reduced in these subjects compared with those without fractures ($p < 0.0001$). CONCLUSION: Marfan syndrome is associated with a deficit in vertebral trabecular bone in both men and women and in forearm cortical bone in women. Deficits in bone mineral density were more significant in women and in subjects with a past history of fractures.

1040
A follow-up study of osteoporosis in anorexia nervosa
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PURPOSE: To determine the prevalence of osteoporosis in anorexia nervosa and identify changes in bone mineral density (BMD) 18 months after assessment. MATERIALS: 46 female anorexia nervosa patients were assessed using bone densitiometry and patient data. METHOD: Dual energy X-ray absorptometry (DXA) scans of lumbar spine and hips were compared with normative data. A repeat DEXA scan was performed on 20 patients after 18 months. Patients were categorized according to weight recovery and hormone treatment. Severely osteoporotic patients also had Didronel. Group 1 were weight-recovered patients receiving hormone treatment, Group 2 were weight-recovered, receiving hormones and Didronel, and Group 3 were non-weight-recovered, receiving hormones. RESULTS: 70% demonstrated significant bone loss. Strong correlations were found for duration of anorexia, lowest body-weight and onset age. At follow-up, spine BMD increased in all Group 1 (mean 9%), and Group 2 (11%) patients. All but one patient in Group 3 had increased spine BMD (by a mean of 10%). In the left hip, all Group 2, 84% of Group 1 and 50% of Group 3 patients increased BMD. In the right hip, 50% of Group 1 increased BMD, and Group 2 remained unchanged or increased (up to 38%). CONCLUSION: Duration of anorexia, lowest body weight and age of onset are important in development of low bone mass. Weight-recovery and hormone therapy appear to maximize bone recovery. Hormone therapy has the greatest effect on the spine, even in patients not regaining weight. Femoral bone density may be more dependent on weight recovery. Didronel could be an important addition in patients with severe osteoporosis.

1050
Value of DXA measurement in Turner's syndrome
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Turner's syndrome (TS) is characterized by somatic anomalies in a female of short stature and sexual infantilism. Early recognition of TS is important to allow prompt initiation of hormone replacement therapy (HRT) and to assess its effectiveness in the prevention/reversal of osteoporosis. 46 patients, age range 17–68 years (mean age 25) referred for bone mineral density (BMD) measurement were studied on a Lunar DPX L system. The mean initial BMD values were for femoral neck (FN) 0.803 g cm^{-2} (80% of the age-matched controls and 80% of the young adult values) and lumbar spine (LS) 0.953 g cm^{-2} (85% of the age-matched controls and 79% of the young adult values respectively). 28 patients had attended for two or more visits at yearly intervals at the time of this review. Although the average increase in BMD in these patients per year was FN 2.54% and LS 2.61%, in four patients the LS BMD decreased by 0.75% per year and in seven patients the FN BMD decreased by 1.25% per year, suggesting that the dose of HRT was suboptimal and needed to be increased. CONCLUSION: Sequential annual measurements of BMD in patients with TS provide a useful means of monitoring appropriateness of HRT dosage.

1100
A comparison of MXA and spinal radiography in the detection of vertebral fracture
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PURPOSE: To determine whether morphometric X-ray absorptiometry (MXA) is equal in sensitivity to spinal radiography in identifying spinal abnormalities, including vertebral fractures. PATIENTS & METHOD: 71 patients who attended for bone mineral densitometry (BMD) also had lateral spinal radiographs for

suspected osteoporosis. BMD was performed by dual energy X-ray absorptiometry (DXA) in the lumbar spine (L1–4) (Lunar DPX-L or Hologic 4500). MXA was performed on Hologic 4500 scanner. The radiographs and MXA images were scored for the presence and severity of vertebral fractures, hyperostosis, aortic calcification and disc disease. Fractures were defined as reduction in vertebral height of >25%. The WHO criteria for osteopaenia and osteoporosis (T scores of between −1 and −2.5 and below −2.5 respectively) were used. The MXA images were analysed on a work-station. RESULTS: 923 vertebra were analysed; 134 were fractured (14.5%). The detection of fractures, as defined, was equal with MXA and spinal radiography, and was not influenced by BMS. Identification of hyperostosis was also similar in both techniques. MXA identified more aortic calcification, and spinal radiographs more disc disease. Body mass index (BMI) influenced MXA image interpretation, the image quality being reduced in those of patients with a BMI > 30 kg m^{-2}. CONCLUSION: MXA was as good as spinal radiography in detecting vertebral fracture and could also demonstrate other spinal pathologies. There is thus the potential for MXA to replace spinal radiography in studies of osteoporosis, with consequent reductions in cost and radiation dose.

1110

Structural analysis of the cortical shell in lumbar vertebrae based on HRCT data

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PURPOSE: The aim of the study was to investigate the correlation between the structure of the cortical shell and the cortical bone mineral density (cBMD) in subjects with different degrees of mineralization. MATERIALS & METHODS: HRCT was performed on 16 lumbar vertebrae from four cadavers (Somatom DRH: continuous slices, 2 mm thickness, voltage 125 kV). The cBMD was determined by single energy quantitative CT (125 kV). The corticalis was segmented and a 10 mm section around the mid-vertebral slice was analysed at an external workstation. Areas of high cBMD were eliminated by thresholding. Clusters (connected pixels) of the remaining low-BMD areas were counted using different threshold values resulting in the number of clusters n_c as a function of the threshold value T. RESULTS: The number of clusters in dependency of the normalized threshold value $n_c(T)$ shows a relative maximum slightly below the cBMD. The maximum values of $N_c(T)$ allow discrimination between subjects with the first stages and those with severe osteoporosis. These maximum values show a high correlation with the cortical BMD (correlation coefficient: $r = -0.88$). CONCLUSION: The cluster analysis allows a structural description of the cortical shell. This new parameter is independent of the BMD and allows discrimination between different degrees of osteoporosis.

1120

Radiomorphometric indices of the mandible in female patients

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PURPOSE: To establish the range of a number of radiomorphometric indices in a female population and assess change with age. This enables us to identify normal patterns and develop criteria for the identification of patients with low bone density in future studies. MATERIALS & METHODS: Dental panoramic radiographs (DPR) of 100 female patients aged 25–74 years were examined. Details of dentition and social class were recorded and an ordinal classification of cortical appearance was made. Using a 400% magnifying graticule, with an incorporated 25 mm scale, bilateral measurements of cortical width in three regions of the inferior mandibular cortex (gonion, antegonion and below the mental foramina) and the distance between the inferior border of the mandible and the inferior and superior borders of the mental foramina were recorded to the nearest 0.1 mm. These were then analysed for patterns of change in mean cortical width and panoramic mandibular index (PMI) in relation to age, dentition and social class. RESULTS: All cortical width measurements were negatively correlated with age, as was the derived PMI. t-tests using the Bonferroni criteria demonstrated a significant difference in the means of these measurements between the younger and older age groups. The foraminal distances, however, showed no significant correlations with age. Regression analysis demonstrated no significant relationships between any of the measured variables or the derived PMI and either dentition or social class. CONCLUSION: Age-related skeletal bone loss may be reflected by changes in mandibular radiomorphometric indices; it may be feasible to use DPRs to identify patients at increased risk from osteoporosis if their mandibular measurements are significantly lower than the mean for their age. This study provides the basis for a comparison of these indices between normal and osteoporotic populations.

1130

Densitometric analysis of the healing of broken bones in rabbits in low frequency magnetic fields

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Young male "White New Zealand" rabbits had an artificial osteotomy of the femur of the right hind leg in narcosis after which they were exposed for 31 days to a low frequency magnetic field. Field parameters were: frequency 15.3 Hz; curve form, sinus; magnetic field power, 50 μT maximum. The purpose of the study was to find out if in this magnetic field accelerated callocity. Eight animals per group were exposed to a simple blind test in three groups at random. Control animals were placed in a cage with no magnetic field effect, one group of animals was placed in a pseudo-Helmholtz spool with a horizontal magnetic field. Another group was placed in a cylinder spool (vertical magnet field). The daily exposure in the experimental arrangement was 30 min. During the rest of the time the animals were placed in single cages, standard food and water were offered. At the end of the test CT was used to determine the progress of break-healing by measuring bone thickness on the site of the break. Statistical relevance of the differences in the densitometric values were examined. Both animal groups exposed to the magnetic field showed significantly improved bone-break healing in comparison with the control group.

1030–1150
State of the Art Symposium
Imaging Drug-induced Disease
Olympian Suite

1030

Invited Review

Imaging drug-induced disease in the gastrointestinal tract

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Imaging can be valuable in the diagnosis of drug-induced disease. Subjects for discussion include: drug-related ulceration and strictures; cytotoxic drugs; immune suppression and opportunist infection; anticoagulant haematomas; ischaemic changes; allergic reactions; miscellaneous enteropathies; motility disorders; drug abuse; bowel residues and narcotic smuggling; and peritoneal involvement. Drug-related changes of the liver, biliary tract and pancreas will also be considered.

1045

Invited Review

Imaging drug-induced disease—the chest

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The list of drugs that are potentially toxic is ever-expanding. Many are in common use and although in some patients there is a clear temporal relationship between the onset of symptoms and the introduction of drug therapy, in others there may be a lag time of several years before lung disease becomes clinically apparent. As a result, the development of toxicity may go undetected. When interpreting a chest radiograph with diffuse shadowing it is important to be aware of what therapy the patient has received, or is undergoing. Some drugs are intrinsically toxic (*e.g.* many cancer chemotherapeutic agents) and their effects may be dose-related or cumulative. Other drugs seem to cause pulmonary abnormalities in a minority, due to a hypersensitivity or idiosyncratic response. Since the lung is able to respond to insult in only a limited number of ways most drug reactions can be classified according to pathological response. HRCT has been shown to be more sensitive then chest radiography in the detection and characterization of parenchymal changes. These may be broadly divided into pulmonary fibrosis, pulmonary eosinophilia/hypersensitivity reaction, ARDS, bronchiolitis obliterans, SLE-type reaction and non-cardiogenic pulmonary oedema. In addition, drugs that cause immunosuppression may result in opportunistic infection or neoplasia. Finally, drug abuse may result in a wide variety of pulmonary complications.

1100
Invited Review
Radiology of adverse reactions to drugs and toxic hazards: urogenital system
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A large variety of substances have an adverse effect upon the urogenital system. Although not all these substances will have an effect on the imaging of the urogenital system, when they do it is important to recognize the radiological features. Imaging may demonstrate an abnormality which may then be associated with the ingestion of a drug. Awareness of the radiological features of the adverse reactions to drugs and toxic hazards may aid the interpretation of any abnormal image. A variety of substances cause acute renal failure. The list includes antibiotics, cytotoxic drugs, radiological contrast agents as well as poisons, heavy metals and venom. Analgesic nephropathy is a well-recognized complication of the ingestion of phenacetin and to a lesser extent aspirin and paracetamol. Appearances on IVU and CT may be characteristic. Renal calculi may be precipitated by a number of drugs. Renal artery spasm and narrowing may result from ingestion of poisonous mushrooms or ingestion of ergotamine. Retroperitoneal fibrosis is known to be associated with a number of drugs. Retroperitoneal lipomamatosis, uretheral inflammatory changes, neoplastic changes and radiation all produce characteristic changes on images of the urological system. An overview of the radiology of these adverse reactions will be discussed, with examples demonstrated on plain radiography, CT, MRI and US.

1110
Invited Review
Toxic hazards: central nervous system
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The distribution of neural damage may provide an indication of the nature of a chemical or physical insult. Direct effects on the neural substance tend to be symmetrical, distribution depending on selective vulnerability of neuronal grey matter, myelinated fibres and oligodendroglia, endothelium and the blood–brain barrier to disruption. *Grey matter.* Interference with oxidative metabolism and acidosis damages grey matter (basal ganglia) which may progress to necrosis. This may follow respiratory depression by narcotics, cytotoxic anoxia (carbon monoxide, methylene chloride, cyanide, hydrogen sulphide, toluene) or acidosis (methyl alcohol-formaldehyde). The white matter is less vulnerable and the effects may be delayed with a watershed distribution in carbon monoxide intoxication. High density in the basal ganglia is commonly due to incidental calcium deposition. It is also a feature of vitamin D intoxification and heavy metal deposition. Excess manganese in parenteral nutrition causes high T_1 signal with normal T_2 excluding fat T_2 effects. Methyl mercury (fungicide, minamata) tends to involve occipital and cerebellar cortex and alters susceptibility on MRI. *Leukoencephalopathy.* Methotrexate (±cranial irradiation) affects the cerebral white matter. Potentially reversible, it may progress to mineralizing microangiopathy also involving basal ganglia. High dose intravenous chemotherapy for advanced cancer may cause delayed but asymptomatic, potentially reversible centro sylvian white matter changes. Cyclosporin A and cytaramine cause potentially reversible acute encephalopathy, often occipital, and 5-fluorouracil multifocal demyelination. Symmetrical irreversible spongiform encephalopathy complicates inhalation of contaminated heroin or cocaine and systemic absorbtion of topical hexachlorophene. Focal or multifocal myelinolysis, particularly of the pons, complicates hyponatrimia with over-correction and the corpus callosum in Marchiafava Bignami. *Brain shrinkage.* In chronic alcoholism this is potentially reversible. It also occurs with other drugs (toluene, amphetamine, cocaine) and phenytoin (cerebellum). *Vascular damage.* (1) Arterial spasm may also affect the heart, uterus and the fetus (ergot LSD, cocaine). (2) Arterial occlusion (oestrogens, Amicar, trichloroethylene, cocaine, Reye's syndrome). (3) Vasculitis (actinomycin, cocaine, crack). (4) Venous occlusion (oestrogens, cytotoxics, asparginase, cytosinarabinoside, hypertonic fluids). (5) Mycotic aneurysms (intravenous drugs). (6) Haemorrhage—intracranial, spinal, fetal (anticoagulants cocaine, amphetamines, alcohol). *Therapeutic radiation.* (a) During therapy: reversible hyperpermeable blood–brain barrier. (b) Early delayed: reversible demyelination. (c) Late delayed: irreversible endothelial damage. (d) Focal granuloma: nerve root swelling. (e) Arteritis: moyamoya. *Raised intracranial pressure.* (Steroids, vitamin A, tetracycline, Negram, oestrogens, organochlorines, lead.) Central venous occlusion. Cranio synostosis (thyroid hormone, vitamin D). *Fetus.* 0–3 months: malformations of neural tube, brain. 3–5 months: abnormal neuronal proliferation and/or migration. 6–9 months: abnormal myelination.

1120
Invited Review
Imaging of drug-induced disease: skeleton system and soft tissue
J P Lawson
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Certain drugs may have teratogenic or non-teratogenic effects on the musculosketal system. Examples discussed will include thalidomide, prostaglandin E, methotrexate, phenytoin, vitamin A and synthetic retinoids, iphosphamide, deferoxamine and steroids.

1140
Discussion

1045–1135
Scientific Session
Radiotherapy & Oncology 2
Hall 10a

1045
Invited Review
Pharmacological modulation of radiation-induced normal tissue injury
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Radiation-induced late normal tissue effects reduce the dose that safely can be administered to tissues unavoidably included within the treatment volume, thereby reducing the likelihood of tumour control. Classically, late effects have been viewed solely in terms of a delayed reduction in the number of surviving clonogens of either parenchymal or vascular target cell populations; they are considered to be inevitable, progressive, and untreatable. It is now clear that this hypothesis is over-simplistic. The characterization of radiation-induced normal tissue morbidity has undergone a paradigmatic shift. Pathophysiological data from a variety of late responding normal tissues indicate that the expression of injury involves complex and dynamic interactions between several cell types within a particular organ. Parenchymal and vascular cells are viewed not as passive bystanders, merely dying when attempting division, but rather as active participants in an orchestrated, albeit limited, response to injury. Cells can serve as autocrine, paracrine, endocrine, and/or juxtacrine targets of biological mediators, including cytokines and growth factors. This new paradigm offers an exciting new approach to improving the therapeutic ratio: pharmacological intervention using biological response modulators (BRMs) directed at modulating the cascade of events leading to the clinical expression of normal tissue injury. Data utilizing various BRMs will be presented in which pharmacological modulation has significantly reduced the severity of radiation-induced normal tissue injury. The ability to selectively ameliorate normal tissue injury offers the promise of translating advances in normal tissue radiobiology into significant improvement, both in long-term survival and quality of life for radiotherapy patients.

1115
DNA damage assays for normal tissue radiosensitivity testing
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PURPOSE: There is considerable interest in measuring normal tissue radiosensitivity as a means of predicting morbidity following radiotherapy. Clonogenic assays of fibroblast survival have been widely used and several promising correlations have been reported between fibroblast radiosensitivity *in vitro* and the severity of late normal tissue reactions. There is increasing interest in more rapid tests of radiosensitivity, in particular those that measure DNA damage. The latter assays are diverse and there have been few reports studying the relationship between the different methods available. In this work a comparison has been made of fibroblast radiosensitivity measured using a clonogenic assay and three gel electrophoresis techniques: pulsed field, graded voltage and constant voltage gel electrophoresis. MATERIALS: 11 fibroblast strains were

studied comprising two radiosensitive human strains and nine strains established from vaginal biopsies from pre-therapy patients with carcinomas of the cervix. METHODS: Cells were labelled with tritiated thymidine for 72 h and grown to confluence. After 10 days they were irradiated at a dose rate of 1.87 Gy min^{-1} to doses between 30 and 180 Gy. Residual DNA damage at 24 h was measured as the fraction of activity released (FAR) into the gels. RESULTS: For all three methods there were highly significant correlations between cell surviving fractions at 2 Gy (range 0.027–0.32) and the slope of FAR, $r > 0.88$, $p < 0.01$. The correlations among the three gel electrophoresis methods were also highly significant, $r > 0.89$, $p < 0.01$. CONCLUSIONS: The future of DNA damage assays in predicting normal tissue radiosensitivity appears to be promising.

1125

α/β value for radiomyelopathy from animal experiments

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PURPOSE: Radiobiological experiments concerning radiomyelopathy are not ethical in man. We have therefore determined dose–effect curves after conventionally fractionated and hyperfractionated radiotherapy and the α/β value for radiomyelopathy in animal experiments. MATERIALS & METHODS: The cervical spinal cords of 276 healthy rats were irradiated using soft Roentgen rays with total doses of 45–120 Gy (single doses 1.5–4.0 Gy, conventional fractionation, applied within 6 weeks), and total doses of 45–150 Gy (single doses 0.75–2.5 Gy, hyperfractionation, applied within 6 weeks). The animals were examined neurologically three times a week and followed-up for 1 year after the end of radiotherapy. Immediately after the onset of paralysis, the animals were sacrificed, the spinal cord was removed and examined histologically. Dose–effect relationships and α/β values were computed using PROBIT analysis. RESULTS: The dose after which 50% of the animals show paralysis (ED50) was 72.75 Gy after conventional fractionation, but 91.65 Gy after hyperfractionation. This results in a therapeutic ratio of 1.26. The α/β-value was 1.92 Gy. CONCLUSIONS: These results fit well with those published in the literature. α/β values, mostly independent of species, are reported within the range 1.0–2.5 Gy. In our opinion, this α/β value can be applied to practical radiotherapy of man when comparing fractionation schemes according to the linear-quadratic model.

Space resulting from late withdrawal of abstract.

1050–1225
State of the Art Symposium
Particle Therapy
Hall 10b

1050

Invited Review

A hundred years—and more—of the electron

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The electron was discovered and named in 1897 and a foundation was laid on which to build an understanding of the behaviour and effects of ionizing radiation. Radiotherapy treatment with electrons began to be investigated in the 1940s, soon after the construction of the first betatron. This early work established electron beam therapy as a clinically-useful modality within a few years. However, electron treatment only became more widespread in conjunction with the wider availability of linear accelerators having electron facilities, a trend which began in the early 1970s and is still continuing. Throughout this time there has been an increasing appreciation of the role of electron beam treatment in radiotherapy and its clinical usefulness. This has been coupled with developments in both physical and clinical electron beam dosimetry. One of the most significant problems in both these areas arises from the large perturbation effects, due to electron scatter, which can be present in situations involving non-uniform shape and composition of patient structures (or of dosimetry systems) and many developments have been associated with improved understanding and modelling of these effects. This presentation is intended to consider the current status of electron beam radiotherapy; to review some of the problems in clinical dosimetry which are associated with electron beam use and to discuss some of the tools available to deal with them. It will also draw attention to some recent developments in the field, with a view to looking ahead to future possibilities in clinical applications.

1125

Invited Review

The clinical applications of high energy proton therapy: present and future

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Proton radiotherapy offers the possibility of radiation dose escalation, to achieve improved tumour control without increased normal tissue toxicity, due to the attenuation characteristics of proton beams in tissues. This has been demonstrated for choroidal melanoma and sarcomas of the base of skull and is under investigation at a number of other tumour sites, including in early prostate cancer. MATERIALS & METHODS: We propose the development of proton radiotherapy in the UK within a hospital-based cancer centre. This is intended to be a national resource, to provide treatment for those established indications and to engage in clinical research to identify other tumour sites which may be better treated with protons than with existing treatment modalities. The principal tumour site to be investigated with this project will be early prostate cancer. Conventional photon radiotherapy often fails to eradicate the primary tumour and it may be that dose escalation to 75–80 Gy, which is achievable with conformal proton therapy, will substantially improve local control and survival, without any increase in normal tissue effects. CONCLUSION: We believe that the development of specialist techniques, such as proton therapy, will offer improved outcomes for certain cancers. In the light of the *Expert Advisory Report on Cancer*, clinical oncologists in the UK should strongly support this proposal. In addition to the investigation of proton therapy itself, it is likely that this project will stimulate the implementation of technical advances in 3D conformal therapy, which will have wide application in conventional proton therapy.

1155

Invited Review

Current applications of proton radiotherapy

A Kacperek

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Until recently, proton therapy was one of many activities at nuclear physics facilities. Today, there are 12 centres involved in regular proton therapy and two others providing heavy ion therapy. In the

UK the only facility is at Clatterbridge, where a 62 MeV proton beam is used for treatment of uveal melanomas. However, there are two plans for higher energy proton facilities, one based on boosting the energy of an existing cyclotron with a proton linac and the other based at an existing accelerator laboratory. Modern proton therapy facilities are designed with multiple isocentric gantries, fast beam switching and high reliability, as well as being sited in hospitals. The principal advantage of proton beams lies in their inherent physical dose conformity. Protons are very little deflected in their passage through tissue: maximum dose is deposited at their range limit, resulting in the sharp fall-off at the Bragg peak. This is typically 1 mm at 60 MeV to 8 mm at 200 MeV. Uniformity (±2%) of proton dose is obtained by combining individual Bragg peaks by means of variable range-shifting. The use of "spot-scanning" with narrow 200 MeV proton beams at PSI (Switzerland) will provide a remarkable degree of dose conformity. Proton beams are used for treating radio-resistant, irregular, well-defined tumours, close to critical tissues. Over the last 20 years, the advantages of tight dose distributions have been amply demonstrated in treatments of rare tumours, *e.g.* base of skull, choroidal melanomas and large AVMs. The treatment of commoner disease states with protons, such as prostate cancers and macular degeneration of the eye, is being pursued.

1050–1150
Scientific Session
Vascular Imaging
Hall 11a

1050
Complex superficial femoral veins: a source of diagnostic error in the investigation of venous thrombosis

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PURPOSE: Duplex superficial femoral veins (SFV) are common (up to 20% in the literature) and may be the source of false negative US or conventional venographic examination in the investigation of patients with possible deep venous thrombosis (DVT). At our institution all patients with normal US examination of the popliteal and femoral veins undergo contrast venography, patients with isolated calf thrombus receive anticoagulation. This provides a unique opportunity to assess the frequency and type of complex SFV, and their contribution to the specificity of femoral US. METHODS: We reviewed all contrast venograms performed over a 21 month period. RESULTS: A total of 410 contrast venograms were performed in patients in whom the proximal veins were deemed sonographically normal, but clinicians wished to exclude calf thrombus. 399 venograms were available for review. In these studies thrombus was demonstrated in 84 cases; 64 in calf veins only, nine in popliteal and/or femoral veins and 11 in both calf and popliteal and/or femoral veins. The false negative US rate for femoral/popliteal thrombus was thus 20 out of 399 (5%). Complex SFV were demonstrated in 171 cases (43%); 142 being duplex, 19 triplex and 10 more complex than triplex. Six out of 20 (30%) of all the false negative cases resulted from missed thrombus in a complex SFV system. CONCLUSION: Complex SFV systems are more common than previously reported and account for 30% of false negative US examinations. Previous studies claim that clot-free SFV are easily identified by US. Our study suggests that when they contain thrombus, clot will be missed.

1100
Surveillance of the PTFE graft—is it worthwhile?

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The benefits of surveillance for synthetic as opposed to vein grafts remain controversial. Recent studies suggest that the majority of PTFE graft occlusions occur without duplex warning. 91 PTFE grafts in 74 patients were scanned over 28 months (mean 13.5 months). 56 angiograms were performed for duplex-detected abnormality. Progression of atherosclerotic inflow and outflow tract disease and proximal/distal anastomotic narrowing (neo-intimal hyperplasia) accounted for the majority of abnormal findings in these grafts. Four grafts with otherwise normal flow parameters showed intraluminal filling defect consistent with thrombus and this was a poor prognostic factor. Angiography did not detect any significant abnormalities not predicted by duplex. 68 grafts remain patent, 26 after intervention. 37 occlusions occurred in 27 grafts. Only four of these are now patent. Although only four grafts on regular surveillance occluded without prior duplex warning, only five grafts (13.5%) underwent elective intervention prior to occlusion. The reasons for this and other factors associated with graft occlusion will be discussed. CONCLUSION: Graft occlusion can be accurately predicted by duplex in the failing PTFE graft, and is associated with progression of native atherosclerosis and anastomotic neo-intimal hyperplasia. Intervention, however, may not be feasible as these patients often have end-stage multiple-vessel arterial disease. In our study, failure of implementation of the programme and patient non-compliance were also important contributory factors associated with occlusion and these must be addressed.

1110
Carotid stenosis: variability of observer measurements from digital subtraction arch angiography

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AIMS: To assess the variability between observers in measuring the degree of stenosis on digital subtraction arch angiography (DSA). To evaluate the correlation achieved in the measured stenosis of internal carotid arteries in symptomatic patients between DSA and colour Doppler (CD) US. MATERIALS & METHODS: Three independent observers took Vernier caliper measurements from the DSA of 50 patients and calculated the degree of stenosis according to the ECST and NASCET study methods. CD scans were performed by one of three experienced vascular technologists. The percentage stenosis was graded in deciles according to the measured frequency shift. RESULTS: From the DSA, the variation between observers was wide across all degrees of stenosis (mean 16.96% using NASCET, 20.96% using ESCT). However, when the estimated stenoses were categorized into four clinically pertinent groups, agreement between all three observers was found in 69% of cases using NASCET criteria and 60% using ECST criteria. Within the same groupings, the level of agreement between each pair of observers using κ was good. Comparing the DSA results obtained by the most experienced observer with CD, agreement was found in 53% of measurements, with CD over-estimating the degree of stenosis in 38% of the remainder. CONCLUSIONS: This variability between observers is further evidence that angiography should not be considered the "gold standard" in the assessment of carotid stenosis. This has considerable implications for categorizing which patients need medical or surgical treatment.

1120
Assessment of carotid stenosis: comparison of CT angiography and digital subtraction angiography in 106 arteries

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PURPOSE: To assess the accuracy, advantages and disadvantages of CT angiography (CTA) *vs* digital subtraction angiography (DSA) in the assessment of symptomatic carotid stenosis. MATERIALS & METHODS: In a prospective, comparative study, all symptomatic patients with significant carotid stenosis on Doppler US referred for DSA, also underwent CTA. DSA was performed using conventional techniques following selective common carotid catheterization. CTA of the carotid bifurcation was performed using spiral CT, slice thickness 3 mm, pitch 1.0, 23 s scan during contrast enhancement. Both DSA and CTA (axial and 3D) images were each assessed by two independent observers, unaware of the results of the other technique. Features assessed included examination quality, complications, percentage carotid stenosis, disease in other vessels, plaque morphology, radiation dose, cost and patient preference. Interobserver variability was also assessed for each technique. RESULTS: Diagnostic scans were obtained in all cases. Four patients suffered significant complications of DSA (one stroke, one myocardial infarction, one haematoma, one ischaemic limb). 106 bifurcations were assessed in 53 patients undergoing both investigations. There was close agreement between the degree of stenosis as measured by CTA and DSA. Calcified and circumferential plaque was better depicted on CTA. CTA was preferred by patients, and significantly less expensive than DSA. CONCLUSIONS: CT angiography is an accurate, comparatively cheap, non-invasive technique. It can be performed as an out-patient procedure and should replace DSA in the pre-operative assessment of symptomatic carotid stenosis.

1130
Major artery wall thickness: is there any relationship to diameter?
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There is currently great interest in the status of the vascular endothelium and its effect on the condition of the vessel wall. There have been many papers published on the measurement of thickness of the arterial wall, particularly the carotid and to a lesser extent the femoral arteries, in health and disease. We are not aware, however, of any study attempting to show whether the intimamedial thickness is proportionately related to the vessel diameter. Such a relationship could affect the interpretation of the measurement, both in individuals and, particularly when comparing study groups, in epidemiological surveys. We studied 85 Chinese subjects with angiographically-proven normal coronary arteries. Findings demonstrated a correlation between diameter and thickness. Incremental intimamedial thickening (mm per mm increase in diameter) was different in each of the major arteries. Right common carotid 0.044, left common carotid 0.022 mm mm^{-1}. This may account for some of the differences reported by different groups. Vessel wall thickness must be related to diameter.

1140
Cerebral oedema in acute liver failure: the role of carotid Doppler waveform analysis
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PURPOSE: Acute liver failure (ALF) has a mortality of 50–80% with cerebral oedema (CO) occurring in up to 60% of cases. Cerebral blood flow and cerebral perfusion pressure are important in the pathogenesis of CO. Mean arterial pressure and intracranial pressure are monitored in patients at risk of CO and manipulated to maintain cerebral perfusion. The aim of this preliminary study was to determine whether carotid Doppler US (CDUS) could identify patients with raised intracranial pressure and developing CO. MATERIALS & METHODS: 10 patients with ALF (six female and four male) were analysed prospectively with CDUS (Acuson 128/XP10 7 MHz probe). The ages ranged from 16–54 with a mean of 31 years. The cause of ALF, mean arterial pressure, intracranial pressure, biochemical indices and clinical outcome were recorded. CDUS of the carotid circulation was performed recording the peak systolic velocity, end diastolic velocity and resistive index (RI) in the common and internal carotid arteries. The internal carotid waveform was analysed for any characteristic pattern. RESULTS: The aetiologies of ALF included paracetamol ingestion ($n=8$), viral hepatitis ($n=1$), and carcinomatous infiltration ($n=1$). Four of the seven patients that died developed CO compared with only one of the three survivors. The RI in the patient group that developed CO was significantly higher than the RI in the remaining patients (mean 0.86 *vs* mean 0.58 p value 0.003). A characteristic "diastolic slope reversal pattern" was demonstrated in all five patients with CO but did not occur in patients without this complication. CONCLUSION: CDUS using the RI and waveform pattern may allow early identification of raised intracranial pressure in patients with ALF and prompt earlier clinical intervention.

1200–1245
British Institute of Radiology
Mackenzie Davidson Memorial Lecture
Hall 1

1200
Eponymous Lecture
Radiology in the best of times and the worst of times
A R Margulis
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Cross-sectional imaging, which started being used clinically about 20 years ago, is now an indispensable part of diagnostic medicine. It owes its progress, to a great extent, to the explosive forward surges of computer technology; computers have unbelievably increased in power while dramatically decreasing in price. US is an example of this progress. It is ubiquitous and the most widely-used cross-sectional technique. Versatility and relatively low price make it unique. CT with helical and electron beam technology, is about to replace many conventional approaches and MRI is a technique with the greatest potential, offering morphological detail, functional and metabolic studies and, eventually, tissue-specific contrast media. Interventional radiology has inspired videoscopic surgery and is gradually merging with it, using all modalities for guidance. Conventional radiology is becoming digital, leading to PACS and teleradiology. Yet all these advances connected with high technology equipment have been blamed for the vertiginous increases in health expenditures. Health costs in the USA have exceeded one trillion dollars and are consuming more than 15% of the gross domestic product (GDP). 22% of the US federal budget is spent on health. The rate of growth of radiology services exceeds that of other health care costs by a factor of 2–3. The high cost of health has brought managed-care medicine to the USA and it will probably eventually spread to most of the industrialized world. This has brought about a scarcity of jobs, reduction in income, outside controls and diminished appeal to medical students to enter the specialty training. Yet this is happening at a time when imaging diagnoses are among the most important factors in treatment decision-making. Cost-effectiveness and outcome studies are, and will be, essential to convince physicians, society, and governments that medical imaging is a precious bargain.

1300–1345
College of Radiographers
William Stripp Memorial Lecture
Hall 1

1300
Eponymous Lecture
Backs to the future—protons or photons?
C A Westbrook
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Low back pain is a very common complaint, affecting 60–80% of people at some time. In the vast majority of cases, symptoms settle down after conservative treatment. Plain radiography is regularly used in general practice as a screening tool. Hospital clinicians have, in the past, resorted to more expensive and invasive modalities, such as myelography and CT. However, the diagnostic value of these investigations, along with exposure to ionizing radiation, complications and cost, have caused many to question this practice. MRI is now considered to be the best diagnostic test to evaluate low back pain. Benefits, such as inherent safety, sensitivity to disease processes and multiplanar capabilities, have contributed to this. However, the high capital cost of MRI has, in the past, ruled out its use as a screening tool for low back pain. The purpose of this lecture is to evaluate the potential of MRI as a screening modality in the lumbar spine. The aetiology of back pain and an outline of diagnostic strategies will be investigated. The technique for examining the lumbar spine using MRI will be evaluated, including pulse sequence selection and artefact reducing strategies. Finally, the concept of sequence limitation to increase patient throughput, and therefore decrease costs, and an analysis of how this could effect clinical referral, will be discussed.

1345–1445
State of the Art Symposium
Japanese Radiology Now
Hall 9

1345
Invited Review
Use and abuse of abdominal helical CT in Japan
Y Hiramatsu
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PURPOSE: To clarify use and abuse of the abdominal helical (spiral) CT in Japan. MATERIALS: As at October 1996, 9670 CT scanners are in use in Japan and 1769 of them have helical function.

This high availability of CT facilities means that scans can be performed relatively easily, even at small institutions in rural areas or private clinics. GE CT HiSpeed Advantage has been used at our institution for about 3 years. Helical scans are performed to detect small lesions, such as small neoplasms or small lymph node metastases. Complicated structures, such as vessels or biliary anomalies, are clearly demonstrated after various 3D reformations. Representative cases will be reviewed and shown. DISCUSSION: In many institutions CT scans are requested by clinicians and scannings are performed beyond the control of radiologists. The total number of CT scans could be significantly reduced by correct interpretation of abdominal plain radiographs and by timely use of US following plain radiographs. Guidelines for CT scans are now available from many organizations, but unfortunately they are not fully applied in practice. CONCLUSION: Patients are being exposed to unnecessary radiation not only from CT, but also because of abuse of various imaging examinations. Japanese radiologists should immediately take steps to reduce unnecessary examinations and to lower the cost of insurance.

1410
Invited Review
Clinical application of electron-beam CT to cardiovascular diseases
T Sekiya
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PURPOSE: To evaluate the clinical usefulness of electron-beam CT (EBCT) for diagnosis of various cardiovascular diseases. MATERIALS: 30 patients with hypertrophic cardiomyopathy (HCM) and 16 patients with tissue valve prostheses were examined by EBCT. In the former patients, various manifestations of HCM were assessed on EBCT. In the latter, EBCT appearances were compared with radiographs of surgically resected specimens. Patients with coronary arterial diseases, pulmonary embolisms and aortic dissections were also examined by EBCT. METHODS: Electrocardiographically-gated EBCT (Imatron C-100) was performed with iv injection of contrast material. Cine mode, with a scan time of 50 ms and volume mode 100 ms, was used for the examinations. RESULTS: In 30 patients with HCM, 15 had asymmetric septal hypertrophy, nine had apical hypertrophy and six had diffuse hypertrophy. Right ventricular hypertrophy was noted in 12 patients and left atrial dilatation seen in 13. In the detection of calcifications with EBCT among 16 patients with 18 tissue valve calcifications, sensitivity was 76.9%, specificity 80.0% and accuracy 77.8%. Literature on coronary arterial diseases, pulmonary embolisms and aortic dissections will be reviewed. CONCLUSION: EBCT gave unique information in the diagnoses of cardiovascular diseases.

1435
Discussion

1345–1530
State of the Art Symposium
Physics of Radiotherapy
Hall 10a

1345
Invited Review
Dynamic modulation with a prototype NOMOS multileaf intensity-modulating collimator apparatus
S Webb
Joint Department of Physics, Institute of Cancer Research and Royal Marsden NHS Trust, Surrey SM2 5PT, UK
PURPOSE: By superimposing intensity-modulated beams (IMBs) it is possible to generate high-dose volumes in which the treatment volume can have an invaginated surface. This could aid the radiotherapy of tumours with complex shape. Methods of calculating IMBs are well-developed and now equipment to deliver them is also becoming available. MATERIALS: The technique of using the NOMOS multileaf intensity-modulating collimator (the MIMiC) will be reviewed and compared with other techniques for dynamic therapy, including the dynamic multileaf collimator. METHODS: Radiation therapy with the MIMiC has been modelled by a technique known as "component delivery". This describes the way in which the open elements of the MIMiC are coupled during treatment, possibly leading to 3D dose distributions which are slightly different from those planned. RESULTS: The results of a study comparing the planned and modelled-delivered dose distributions show that the distributions are most closely matched when the elemental bixel dose distribution incorporated into the planning stage is fitted to a "stretched" function, as in PEACOCKPLAN. However, even then, there will be small differences due to some bixels being surrounded by entirely closed bixels during treatment. Using film and BANG-gel dosimetry, a high correlation between measured distributions and modelled–delivered distributions was also found. CONCLUSION: The method is a promising way to use IMBs under very closely controlled conditions.

1410
Invited Review
Beam intensity modulation by dynamic multileaf collimation
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PURPOSE: In recent years a large research effort has been devoted to developing techniques for highly conformal radiotherapy treatments using intensity-modulated fields. Of particular interest has been the use of dynamic multileaf collimators (MLCs)—that is, MLCs in which the individual leaves can move during irradiation—to generate these potentially very non-uniform fields. This paper will review the use of such fields, with particular emphasis on dosimetric aspects. METHODS: Models of intensity-modulated fields created by dynamic multileaf collimation are developed. These are used both in the determination of the leaf motion required to generate an intended beam intensity modulation and in the calculation of relative dose distributions and dose per monitor unit within the field. The separation of primary, head scatter and phantom scatter components and their handling is discussed, together with the use of leaf synchronization to avoid "tongue and groove" artefacts within the field. Treatment delivery accuracy is also investigated. RESULTS: Comparisons of calculated and measured distributions will be given and initial results with a commercial dynamic multileaf collimator presented. CONCLUSIONS: Dynamic multileaf collimation is a feasible and practical technique for the efficient delivery of intensity-modulated beams for conformal radiotherapy. Dosimetric aspects are reviewed and progress towards their routine clinical use presented.

1435
Invited Review
Enhanced dynamic wedge: the introduction of intensity-modulated radiation therapy into widespread clinical practice?
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An enhanced dynamic wedge system (EDW) has been installed on our Clinac 600C (6 MV) linear accelerator. This novel tool for beam modulation is an initial attempt to introduce dynamic modulation of the radiation beam intensity into our clinical practice. The beam modulation mechanism is intensity-modulated radiation therapy (IMRT) in one of its simplest forms. More complicated and resource-intensive methods are currently being investigated and used in limited centres world-wide. For the majority of centres, experience with therapy tools, such as EDW, can provide an introduction to dynamic intensity modulation and help develop confidence before investigating other exciting (more ambitious) developments. We will demonstrate that the philosophy behind EDW enables simple implementation into most planning systems, offering the chance of gaining experience necessary for our acceptance of future techniques. EDW provides access to "any desired" wedge angle and wedge optimization on an individual patient basis, the seven EDW "angles" are merely pre-set special cases. Whereas the idea of using "one degree" increments may at first seem excessive when finalizing a clinical plan, a subtle change in planning philosophy makes the benefit of the facility more obvious. Each "wedged" field portal is delivered as an open beam and a 60° wedged beam. The optimal plan distribution is found by variation of the relative weightings of wedged and open field pairs, not by choice of "one wedge" over another. This process could be considered as an iterative inverse planning protocol.

1500
Experimental verification of beam intensity modulated conformal radiotherapy using patient specific compensators
[1]O C L Haas, [2]J A Mills, [1]K J Burnham, [3]D E Bonnett, [3]A R Farajollahi, [1]M H Fisher, [3]A G Glendinning and [3]R J Aukett
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A hybridized optimization procedure, involving a heuristic genetic algorithm method and an analytical technique derived from iterative least squares, has been developed to achieve conformal

radiotherapy. The procedure takes into account the shape of a target volume, tissue inhomogeneity, critical organ doses, normal tissue doses and surface contour. The beam orientation is optimized geometrically using a genetic algorithm which includes problem specific operators. A method has been developed to determine compensator profiles from the intensity-modulated beam profiles, using an exponential attenuation factor, coupled with a point-spread convolution function, to account for the scatter in the compensator. The compensators are then manufactured from a recyclable low melting-point alloy, using an industrial standard computer numerically controlled (CNC) machine and tool path generating code. Conformal dose distributions have been successfully produced and measured in a torso phantom using both slow film and polymer gel dosimetry. Conformal distributions will be presented for concave treatment volumes at energies of 6 and 25 MV.

1510
Film verification study of a nine field intensity-modulated plan
M Oldham and S Webb
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PURPOSE: There is much interest in understanding how to simulate the delivery of intensity-modulated (IM) radiation profiles and accurately deliver the profiles in practice. We present a planning and verification study based on delivering radiation in "static-tomotherapy" mode, via the NOMOS multileaf intensity-modulating collimator (NOMOS MIMiC). METHODS: An inverse-planning algorithm was used to compute IM profiles for a nine-coplanar-field plan for a body phantom. The algorithm makes several approximations about the form of the elementary fluence profile through pixels during delivery, these will be discussed. These assumptions were made irrelevant when comparing the predicted *vs* the delivered dose. This was achieved by a final dose calculation which takes into account the penumbral characteristics of the delivery technique, by decomposing the intensity profiles into delivery components and assigning the appropriate penumbral characteristic to each component. The nine intensity-modulated fields were delivered to a Perspex phantom with the same geometry, which contained a verification film. RESULTS: In general, good agreement was found between the predicted and the measured delivered dose distributions. The 90% isodoses were consistently in spatial agreement to within 3 mm. At the 50% isodose level, consistent spatial agreement was again found to within 3 mm, the largest deviation being about 5 mm. CONCLUSION: Our results indicate the level of dose conformation that is achievable in practice with the MIMiC system and the accuracy of the dose-computation algorithms. However, we cannot as yet comment on what happens to the dose distribution away from the central film-plane.

1520
Discussion

1345–1505 Scientific Session **Magnetic Resonance Techniques** Hall 11b

1345
Implementation of a black-blood cardiac MRI pulse sequence using double inversion prepulses
[1]J P Ridgway, [2]A Kassner and [1]U M Sivananthan
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PURPOSE: To optimize the imaging parameters of a breath-hold, black-blood cardiac MRI pulse sequence. METHODS: An ECG triggered, single-phase, breath-hold, black-blood imaging pulse sequence has been implemented on a 1.5 T Philips ACS NT clinical MRI system. This uses a selective/non-selective inversion pulse pair to invert the magnetization of the blood outside the image slice. Images are acquired in the short axis plane of the left ventricle using a segmented k-space gradient echo technique (16 heart beats, FOV = 320 mm, 256 × 154 matrix). The following parameters have been varied on healthy volunteers to investigate the effect of different R–R intervals and through-plane motion of the left ventricle: inversion time TI (350–600 ms); thickness of the selectively inverted slice I (6–40 mm); and the thickness of the imaging slice S (6–30 mm). Images have been assessed for general image quality, signal-to-noise ratio of the myocardium and contrast-to-noise ratio between myocardium and the blood pool. RESULTS: In the majority of volunteer studies the best image contrast-to-noise ratio between myocardium and blood pool signal is achieved by using TI = 500 ms, I = 30 mm and S = 10 mm. S > 10 mm results in a reduced image quality due to partial volume effects. I < 30 mm results in signal drop-out due to motion of the ventricle through the image plane for basal slices. Sensitivity to R–R interval and arrhythmias is noted. CONCLUSION: Breath-hold black blood imaging of cardiac anatomy offers a potentially robust technique. Good image quality can be achieved with careful selection of imaging parameters.

1355
An algorithm for measurement of left ventricular function from MRI
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PURPOSE: To develop an image processing method to simplify extraction of left ventricular functional information from spatially and temporally resolved ECG-gated cine MRI. MATERIALS & METHODS: A semi-automated algorithm for the delineation of the myocardium and blood pool boundaries allowing the production of a 3D cast of the left ventricle (LV) blood volume at multiple time points throughout the cardiac cycle has been developed. Multiple short axis breath-hold ECG gated cine images are acquired from the cardiac apex to the base using a segmented k-space technique with contiguous 10 mm sections (IGE Signa 1.5 T with torso coil). Additional horizontal and vertical long axis breath-hold cine images are obtained to allow accurate definition of the valve plane and apex. By modifying existing software (RWS, GE, Milwaukee), an interactive display has been developed. Reframed datasets are created from the 3D dataset to match the long axis views. The operator manually identifies the valve plane and the outer boundary of the myocardium on each long axis view. Utilizing these boundaries, a 3D blood pool cast at each point in the cardiac cycle is generated automatically using class variance to distinguish blood from myocardium and the valve plane. This cast can be used with the outer border of the myocardium to determine wall function and mass. CONCLUSION: A semi-automated processing algorithm has been developed which permits the extraction of quantitative functional information from cardiac MR images rapidly and with minimal operator intervention.

1405
Multispectral classification of tagged tissue in cardiac MRI
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PURPOSE: Tagged MRI is a technique for imaging cardiac motion by magnetically saturating thin planes of tissue orthogonal to the slice plane. To analyse cardiac motion tags must be identified and tracked through the cardiac cycle, but the contrast of tagged tissue to untagged tissue varies throughout the frames—comprising a cine-acquisition. Analysis can be made more robust if preprocessing can accurately classify pixels as being "tagged" or "untagged". METHOD: We routinely accquire two sets of data, with tags oriented orthogonally, to resolve two components of in-plane cardiac motion. Hence, two channels of image-data are available and a multispectral classification can be attempted. In this study, classifiers available in the image-analysis program Analyze™ were applied to simulated and real tagged data. The classifiers could be broadly split into "automatic" methods (where sample regions of each tissue type are drawn on the data) and "unsupervised" (where classification is based on statistical properties of the data). RESULTS: Automatic classifiers proved superior to unsupervised classifiers. Both types of classifiers work well in early phases. CONCLUSIONS: Multispectral classification of two-channel tagged data is possible, but becomes increasingly inaccurate as the tag–untagged tissue contrast declines. Automatic classifiers benefit from having cluster centres pre-defined using sample regions, but require more interaction.

1415
Measuring synovial volume from MR images in rheumatoid arthritis

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PURPOSE: In rheumatoid arthritis of the knee synovial hypertrophy (pannus) is indicated by the uptake of gadolinium contrast medium under MRI. Measurements of enhancement are compromised by mis-registration of pre- and post-contrast scans. An interactive registration procedure is described allowing measurement of the volume of pannus in the suprapatellar pouch; comparison is made with assessment of a single sagittal slice. MATERIALS: 30 4 mm thick transverse T_1W SE images (TR400, TE14, Philips 1.5T ACS NT) were acquired from six patients immediately before treatment and at 6 weeks post-treatment with an anti-inflammatory drug under investigation, or a placebo. METHODS: Image volumes were registered by surface-matching of the segmented femur; percentage enhancement images were calculated. Quantitation was performed with reference to anatomic landmarks, and volumes within an observer-defined region enhancing to over $\pm 20\%$, $\pm 50\%$ and $\pm 100\%$ calculated. Measurements of negative enhancement were used to estimate artefacts for all thresholds. Intraobserver reproducibility was assessed. RESULTS: Few observations were made of enhancement beyond -50%; all the remaining results relate to threshold $+50\%$. There was high correlation between the total pannus volume and the volume within 11 slices centred on the upper patellar pole ($r=0.98$; $p<0.001$; $n=10$). The standard deviation of the measurement error for the 11 slice volume was 1.1 ml. Correlation with measurements from a single sagittal slice was poor ($r=0.3$, $p=0.3$, $n=12$). CONCLUSION: Registration allows calculation of percentage enhancement in cases where movement has occurred. Serial monitoring of pannus volume is feasible using a limited scan volume.

1425
Ventricular volume change computation methodologies and their application in schizophrenia

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PURPOSE: Changes in brain volume are noted in schizophrenic patients; the most prominent variation occurs in the ventricular system. Two automated methods have been developed to compute ventricular volume changes from MRI and have been applied to a phantom mimicking the brain ventricular system. We have studied normal volunteers and schizophrenic patients. MATERIALS & METHODS: T_1 weighted whole volume scans were acquired. Subjects had an initial baseline scan and a follow-up scan within 12 months. The first technique for volumetric change computation employed ventricle segmentation from both the scans using thresholding and contour extraction, then computing the volumetric variation. The second technique operated on the difference image which was produced using voxel-based intensity subtraction of the initial scan from the accurately registered follow-up scan. A noise region was defined in the difference image and all pixels with intensities above the noise threshold and lying within a predefined area were monitored, in conjunction with the mean brain and ventricle voxel intensities, to compute the volumetric change. RESULTS: Measurements performed on the phantom images showed that the first technique was accurate to 0.0045% and the second to 0.165% of the baseline phantom volume. Normal volunteers showed average changes of 1.52% and 1.54% while nine schizophrenic patients had mean changes of 10.78% and 9.43%, employing the first and second procedures respectively. All measurements were in agreement with the visual assessment by a radiologist. CONCLUSION: Robust, objective, fast, easy-to-use and fairly accurate procedures have been developed and validated to quantify ventricular volume changes from MRI scans.

1435
Non-invasive vascular occlusion using focused US surgery monitored by MRI and MRA

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PURPOSE: Using MRI methods to investigate focused US surgery (FUS) as a non-invasive technique for occluding blood vessels. MATERIALS & METHODS: A 1.7 MHz, 100 mm diameter piezoelectric focused bowl US transducer with a radius of curvature of 150 mm was used. The femoral artery and vein in one thigh of anaesthetized male and female rats ($n=11$) were treated: two rows of four exposures at a free field spatial peak intensity of 4660 W cm^{-2} for 2 s. 3D FISP magnitude contrast angiograms (MRA) and fat suppressed 3D FLASH images were obtained using a Siemens Vision MR System (1.5 T) and extremity coil. Contrast enhanced images (0.05 mmol kg^{-1} polylysine-Gd-DTPA) were obtained following FUS treatment. RESULTS: US damage was visible immediately after exposure in all animals. In eight out of 11 animals some external haemorrhage occurred during exposure, but had ceased before the final exposure. In 10/11 cases, the post-US MRA suggested significantly reduced blood flow in the exposed thigh compared with the pre-US MRA and the untreated thigh. In four out of 11 animals both MRA and 3D FLASH images demonstrated the total cessation of flow to the treated limb. CONCLUSIONS: This work has demonstrated the ability of FUS to occlude blood vessels approximately 1 mm in diameter, suggesting a wide variety of applications for non-invasive FUS. The use of 3D angiograms in conjunction with contrast enhanced 3D FLASH images provides a sensitive method for observing the effects of FUS.

1445
Model based analysis of contrast enhanced dynamic MR breast images

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[1]Robotics Research Group, University of Oxford and [2]Department of Radiology, University of Oxford, Oxford OX1 3PJ, UK

PURPOSE: The use of a pharmacokinetic model for quantitative analysis of breast MRI requires assumptions to be made about the way in which the contrast agent is injected into the patient's bloodstream. Previous work has modelled the injection as either instantaneous, or as a continuous infusion over a long period of time. We derive a pharmacokinetic model using Laplace transforms which allows us to experiment with and compare different injection models. MATERIALS & METHODS: MRI images were obtained on a 1.5 T machine using a bilateral breast coil. Gd-DTPA, at a standard dose of 0.1 mmol kg^{-1} was injected as a bolus with saline flush into a peripheral vein. A 16 slice, 47 s duration, 2D GRE acquisition was performed before, immediately, and every 60 s after Gd injection. Images were transferred to a remote work-station for off-line processing. RESULTS: A comparison is presented between the forms of the model derived for instantaneous and continuous infusion cases with other, more realistic injection functions, *e.g. ramped* injection models. We present results which show that the model can be fitted to regions that are enhancing significantly relative to their surroundings. These fitted models predict a malignant nature for lesions that are missed in an X-ray mammogram. CONCLUSION: A model-based analysis of pharmacokinetic breast MRI sequences can provide useful information to a clinician. Reliance on any model for lesion detection should consider the problem of patient movement and mis-registration.

1455
T_2 map MRI of the prostate with histological correlation: preliminary results

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PURPOSE: To assess the efficacy of using water T_2 relaxation time measurements as a method of improving discrimination of prostate pathologies. MATERIALS & METHODS: MRI images were acquired with a 1.5 T GE Signa using combined pelvic phased array and endorectal coils. Four patients with biopsy proven prostate carcinoma were examined prior to undergoing retropubic prostatectomy. Localizing MRI images were followed by a T_2 map protocol using two dual echo T_2W FSE sequences (TR = 4 s, TE = 30/60 and 90/120 ms), at four locations. After surgery, the entire gland was sectioned and stained with haematoxylin and eosin. Sections corresponding to slice locations used in the T_2 maps had transparent grids superimposed onto them and the tissue type was recorded by grid location by a pathologist. An identical grid was superimposed onto T_2 maps and a comparison made between values of T_2 and regions of identical benign pathology, similar tumour grade and normal tissue. RESULTS: Regions with more than 50% tumour infiltration demonstrated the lowest values of water T_2 and no overlap with other regions with a mean ($\pm$SD) of 68.9 ± 8.8 ms. This was significantly lower than values in normal PZ tissue (105.6 ± 3.6 ms) ($p<0.001$), and fibroglandular BPH (115.6 ± 24.3 ms) ($p=0.01$). CONCLUSIONS: These preliminary results demonstrate that high resolution T_2 measurement (reflecting citrate concentration) may improve the staging accuracy of MRI and discrimination between benign and malignant disease.

1400–1600
Scientific Session
Musculoskeletal Imaging 2
Hall 1

1400
Invited Review
MRI of synovial tumours and tumour-like lesions
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MRI has become the imaging method of choice in the evaluation of synovial tumours and tumour-like lesions. True synovial tumours are relatively uncommon and include synovial lipoma, lipoma arborescens, synovial haemangioma, synovial chondromatosis and synovial sarcoma. Tumour-like lesions are more common and include pigmented villonodular synovitis (PVNS), synovial and ganglion cysts, amyloidosis, granulomatous synovitis and rheumatoid arthritis. In addition to the standard sequences, further information may be obtained using Gd-DTPA, either iv, as a static or dynamic investigation, or as an intraarticular injection. Although MRI may be helpful in the diagnosis of some synovial tumours and tumour-like lesions, the main role of MRI is in lesion detection, staging and follow-up. MRI is the most sensitive technique for detecting early synovial disease and may also demonstrate other abnormalities, including synovial effusion, erosions and involvement of adjacent bony, soft tissue and neurovascular structures. Optimal treatment often depends on accurate staging and MRI is the best non-invasive technique for demonstrating the extent of synovial masses. MRI is also the imaging method of choice for evaluating response to treatment and detection of lesion recurrence.

1430
Patient outcome following normal knee MRI
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AIMS: To assess patient outcome following a normal knee MRI in the setting of a district general hospital. METHODS: The reports of all 299 knee MR studies performed for suspected internal derangement in an 8 month period were scrutinized. 79 of 299 knees (26.4%) were reported as normal. Notes were retrieved for 66 of the 79 (83.5%) and all these patients' MRI scans were reviewed in a blinded fashion. The follow-up interval following MRI was 6–12 months for all patients. RESULTS: The length of symptoms prior to MRI varied from 1 week to 4 years (median 12 months). 71% of the scans were requested at the first orthopaedic clinic attendance. Review of the scans confirmed them to be normal. Following normal MRI, 52/66 (79%) patients were discharged at the first or second clinic visit with conservative treatment only. Seven patients (11%) continued to be reviewed in clinic within the follow-up period. In six patients (9.1%) arthroscopy was performed—three for suspected plicae (confirmed), one because of a tender lump (bursa), one for suspected chondromalacia patellae (confirmed) and only one for continued suspicion of internal derangement (normal). CONCLUSION: In suspected internal derangement, a normal MRI allows early discharge of the majority of patients. Follow-up has not revealed any significant false negative scans in this group of patients.

1440
Does knee MRI improve the management of patients with internal knee derangement?
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The results of all knee arthroscopies performed during a 6 month period prior to the availability of MRI were compared with the results of all knee arthroscopies performed during a second 6 month period, 1 year after the introduction of an MRI service. There was no change in the number of arthroscopies performed during the two periods. In the first 6 month period there were 102 arthroscopies, of which 47 were diagnostic and 55 therapeutic. In the second period there were 101 arthroscopies, 43 were diagnostic and 58 therapeutic. 68 of these patients had an MRI scan prior to the arthroscopy. The reasons for lack of change in the ratio of diagnostic to therapeutic arthroscopy will be discussed. In those patients with internal knee disruption, the addition of MRI resulted in an increase of approximately 4 weeks from the time of initial attendance to therapeutic arthroscopy. Unless MRI scanning can be performed with minimum delay it may result in a deterioration in the overall management of these patients.

1450
MRI in the assessment of patellar tendonitis
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PURPOSE: MRI is often used to assess patients with patellar tendonitis. Although abnormalities on MRI have been shown to correlate with areas of pathological abnormality, there has been no study comparing MRI with histopathological severity. This study aims to correlate and quantify the abnormalities identified on MRI by direct comparison with the severity of histological changes seen in post-operative specimens and thus to produce an objective guide to the significance of observed MRI abnormalities. MATERIALS & METHODS: The trial included 29 patients with patella tendonitis, unresponsive to conservative treatment, having MRI prior to surgery. RESULTS: The MRI appearances of tendon thickening, high signal intensity on T_2^* gradient recall echo images, particularly involving more than 25% of the cross-section, and abnormality in the anterior or posterior fat pads, are indicators of the increased histopathological severity. CONCLUSION: MRI offers a sensitive method of imaging patella tendonitis. The degree of MRI abnormality correlates with histopathological severity.

1500
MRI or arthrography of the shoulder: which do patients prefer?
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PURPOSE: To determine whether patients with shoulder problems prefer MRI or arthrography. As there is considerable clinical debate regarding the optimal radiological method for demonstrating shoulder lesions, choices could ultimately be made on the basis of cost and the preference of the patient. METHOD: 110 consecutive patients (88 MRI, 42 arthrography, 19 both) were asked about their degree of anxiety (SAI scores), pain (VAS scores) and preferences at various stages, before and after imaging. RESULTS: Mean levels of anxiety were slightly (ns) higher for patients undergoing MRI than arthrography. There was a statistically significant ($p<0.03$) reduction in anxiety after arthrography, with only minimal reduction following MRI. Pain scores fell for both patient groups while at rest during the imaging procedure compared with their pre-imaging baseline measurement. After arthrography discomfort tended to rise again, but continued to fall after MRI. Of the 25 patients who expressed a preference, on the basis of past or current experience, 11 preferred MRI and 14 arthrography (ns). A significantly higher proportion ($p<0.001$) of patients found MRI unpleasant or extremely unpleasant (20/77) compared with arthrography (3/41). However, there was no difference in the proportion of patients who said that they would not have their tests repeated (29/73 for MRI, 15/39 for arthrography). CONCLUSIONS: Although there were minor differences in both the anxiety and pain of patients undergoing MRI and arthrography, this study did not reveal any overall preference for either investigation.

1510
MRI of the shoulder: is fast STIR worth it?
S J Wenham and C E Hutchinson
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PURPOSE: This study prospectively compares the performance of inversion recovery fast spin echo (IRFSE or fast STIR) imaging with conventional T_1W spin-echo (SE) and T_2 FSE imaging in the demonstration of shoulder anatomy and rotator cuff pathology. MATERIALS & METHODS: 20 patients (12 males and 8 females), with a mean age of 46 years were referred for the investigation of clinically-suspected rotator cuff pathology. All underwent coronal oblique imaging with standard T_1 (TR 600, TE 20) and T_2 FSE (TR 3500, TE 90) and IRFSE (3500/90) sequences. The adequacy of demonstration of four anatomical structures and seven primary or secondary features of rotator cuff pathology were evaluated for each patient and compared using the Wilcoxon signed rank test. RESULTS: 15% ($n=3$) of patients showed complete rotator cuff tears, 45% ($n=9$) showed partial tears and 40% ($n=8$) had a normal

rotator cuff. Of the anatomical structures, the subacromial/subdeltoid bursa was significantly better demonstrated by IRFSE than by T_1 SE imaging ($p=0.0028$), but the remaining structures were better demonstrated by T_1. Abnormal fluid in the subacromial/subdeltoid bursa and in the glenohumeral joint was better demonstrated by IRFSE imaging than T_2 SE imaging ($p=0.0039$ and $p=0.0026$, respectively) but otherwise the IRFSE image fared the same or worse. CONCLUSION: IRFSE sequences suppress signal from both fat and muscle, with the majority of the signal coming from free water. Some free-water-containing structures in the shoulder, both normal and abnormal, are better demonstrated by IRFSE than by conventional spin echo images. Although the IRFSE images were helpful in cases of uncertainty, they were not felt to be of sufficient benefit to advocate their routine use.

1520

Avascular necrosis of the femoral head: MRI for prognosis in 14 patients with 3 year follow-up

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MRI is the most reliable method for detecting early avascular necrosis (AVN) of the femoral head. We reported a 17% incidence of AVN in 90 patients treated with chemotherapy for lymphoma and have reassessed this group to determine when AVN develops and whether the changes are reversible. 25 patients were imaged on completion of chemotherapy, after 6 months, then at annual intervals for 3 years (longitudinal group). Of the 65 patients imaged 5 and 17 years post-treatment, nine with AVN were imaged after 6 months, then annually. All patients had standard chemotherapy (steroid dose 2800 mg–3380 mg). Coronal T_2W and STIR sequences were performed. The extent of disease was assessed. Improvement was determined by reduction in the abnormal signal, particularly on the STIR sequence. RESULTS: *Longitudinal group*. Of the eight hips with Stage I or II disease five improved, one remained static and one patient (bilateral Stage I) died with no follow-up. One Stage III showed no change. *Cross-sectional group*: one patient (bilateral Stage I) showed some improvement. 7 years post-treatment 10 Stage I or II and five Stage III or IV were unchanged. Three patients required further chemotherapy due to relapse, but no deterioration in AVN was seen. CONCLUSION: The longitudinal group developed AVN within 6 months of treatment. Patients with early disease are likely to show spontaneous improvement in MRI appearances. Stage I or II disease more than 5 years after treatment is unlikely to show any change. Further treatment with steroids did not result in deterioration of AVN appearances.

1530

Acetabular malalignment into retroversion: the plain X-ray findings of a newly-determined condition

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PURPOSE: To describe a new sign found on the plain anteroposterior hip X-ray in patients with the newly described condition of acetabular alignment into retroversion. We have termed this sign as the "cross-over sign" and are not aware of it having been previously reported. MATERIALS: A prospective review of 310 young adults with symptoms arising from the hip. Standard view plain X-rays were used and axial CT scanning was performed with the aim of clearly defining the presence or not of a dysplasia of the hip. METHODS: The CT scanning protocol is of axial 2 mm cuts through the pelvis to allow a contour map to be constructed. This allowed for the orientation of the acetabulum to be derived and compared with the plain X-ray findings. RESULTS: Amongst the 620 hips studied, 178 were normal, 399 were dysplastic and 43 hips had as their only abnormality orientation of the acetabulum into retroversion. All of these hips had a characteristic sign demonstrable on the plain anteroposterior hip X-ray that was not present on the corresponding X-ray of the normal hips, nor of the dysplastic hips. This sign was of a crossing-over of the shadow made by the anterior lip of the acetabulum over that made by the posterior lip. Acetabular retroversion is defined. CONCLUSION: We believe we have described a new plain X-ray sign of the hip. Appreciation of this change may alert the clinician to subtle malorientation of the acetabulum in an otherwise normal-looking hip which may explain symptoms arising from the hip.

1540

The "penumbra sign" on T_1 weighted MRI in subacute osteomyelitis: frequency, cause and significance

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PURPOSE: We studied the frequency and cause of a feature exhibited on T_1 weighted MRI, termed the "penumbra sign", in a series of patients presenting with osteomyelitis and correlated it with the double-line sign described as a T_2W or STIR feature of both the Brodie's abscess and avascular necrosis. METHODS & MATERIALS: The clinical, radiographical, MRI, microbiological and histological findings in 32 patients referred to an orthopaedic oncology service, but subsequently proven to have osteomyelitis, were reviewed. The presence or absence of a rim of tissue lining an abscess cavity, typified by minor signal hyperintensity relative to the main abscess contents on T_1W MRI (the "penumbra sign"), was identified. The sign was correlated with the radiographical and other findings. RESULTS: The penumbra sign was identified in 24 cases (75%), while the corresponding double-line sign was evident in only 28% of these on T_2W or STIR images. The lesions were unilocular in 11 cases (46%) and multilocular in 13 (54%). The thickness of the penumbra ranged from 2–5 mm. Histology identified the tissue comprising the penumbra sign as granulation tissue containing thick-walled arterioles. CONCLUSION: The penumbra sign is characteristically seen on T_1W MRI in subacute osteomyelitis and is due to a thick layer of highly vascularized granulation tissue which may not be visible as the double-line sign on T_2W or STIR sequences. This characteristic, but not pathognomonic, MRI finding supports the diagnosis of bone infection and helps to exclude the presence of a tumour.

1550

"Spotty feet" in children—a normal MRI variant?

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PURPOSE: To determine the occurrence, pattern and clinical significance of unexplained signal changes within the bone marrow of children referred with foot symptoms. MATERIALS & METHODS: We reviewed 33 children (age range 6–15 years) referred to the Nuffield Orthopaedic Centre for MRI of the foot. T_1 SE and T_2 FSE or STIR sequences were performed on all children in the sagittal, axial and/or coronal plane. The reasons for referral for MRI included foot pain ($n=25$), assessment of a mass ($n=4$), possible osteomyelitis ($n=2$), and unexplained swelling ($n=2$). RESULTS: A total of 47 feet were imaged. 19 feet had normal uniform fatty marrow signal; 28 feet showed bone marrow heterogeneity ("spotty feet"). The appearances of the bone marrow ranged from multiple pin-point foci ($n=15$) to more confluent areas ($n=13$). All lesions were seen as low signal on T_1 weighted images and high signal on T_2 weighted and STIR images. Of the 14 children in whom both feet were imaged eight had similar appearances on the contralateral, asymptomatic side. CONCLUSION: Bone marrow heterogeneity is commonly seen in children's feet occurring in 60% (28/47). We postulate that this represents a normal MRI variant in children.

1400–1500
State of the Art Symposium
Radiation Protection — an Update
Hall 10b

1400

Invited Review

Update on radiation protection issues—negotiation of proposed Council Directive on Medical Exposure

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On 26 September 1996, the European Commission submitted a proposal for a Council Directive on Health Protection of Individuals Against the Dangers of Ionizing Radiation in Relation to Medical Exposures, replacing Directive 84/466/Euratom. The main changes proposed are: the extension of the scope of the Directive;

strengthening of the provisions of justification and optimization of medical exposures; an expansion of existing requirements on the quality control of installations, with requirements for quality assurance programmes and written guidelines for all equipment and procedures; a more prescriptive approach to continuing education and training; an extension of requirements for inspections by competent authorities; an increased role for the person requesting the medical exposure; the delegation of practical aspects of the exposure to individuals other than the medical practitioner; and a requirement for the introduction of procedures for audit. This paper reviews the negotiating process and progress to date.

1430
Invited Review
An update on the latest radiation protection issues—implementation of the revised Basic Safety Standards Directive
M K Williams
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PURPOSE: The current Ionizing Radiations Regulations 1985 (IRR85) largely implemented the 1980 Euratom Basic Safety (BSS) Directive. On 13 May this year a revised BSS Directive was adopted; Member States have 4 years to implement it. The Health and Safety Executive (HSE) has lead responsibility for developing proposals to implement the Directive, through a revision of the 1985 regulations. This paper will describe the key features of the Directive which are relevant to the medical sector, explain arrangements for the consultation and indicate possible changes to the Ionizing Radiations Regulations 1985. MATERIALS: The revised Directive is intended to reflect the 1990 recommendations of the International Commission on Radiological Protection. It provides revised dose limits, introduces a number of new requirements (*e.g.* mandatory authorization of certain practices and the use of dose constraints) and in certain cases gives more flexibility to Member States (*e.g.* with the designation of controlled areas). METHODS: At the end of May HSE issued an informal consultation paper on general issues relating to the revision of the regulations and supporting Approved Code of Practice. Subsequently, a series of Topic Groups were established to give HSE informal advice on specific aspects of the Directive and the need to retain some of the existing provisions in IRR85. We will draw on this advice to provide instructions to HSE solicitor and seek the Health and Safety Commission's agreement to the publication of a formal Consultative Document containing draft regulations, draft Approved Code of Practice and draft non-statutory guidance. CONCLUSION: We expect the Health and Safety Commission to publish their Consultative Document on the revision of IRR85 by the end of the year.

1400–1540
Scientific Session
Hepatobiliary Imaging
Hall 11a

1400
Invited Review
Non-vascular interventional radiology: hepatobiliary intervention
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This lecture will discuss the recent advances in hepatobiliary intervention in non-vascular (visceral) interventional radiology. The history of hepatobiliary intervention is one where technical advances in imaging and mechanical devices have gone hand-in-hand. From the earliest days of development of a simple catheter with side-holes, which enabled the radiologist to drain the biliary system externally, to the wide variety of metallic stents now available, there has been a considerable change in interventional radiology of the biliary tree. Several areas will be covered. (1) The current state-of-the-art and use of the interventional radiologist in patients with unresectable malignant biliary disease. This will include the indications for percutaneous biliary drainage of malignant disease *vs* surgical or endoscopic drainage. The lecture will also outline the current indications, uses, innovations, complications, and long-term results for metallic biliary stents. (2) The lecture will review the role of the radiologist in the diagnosis and treatment of laparoscopic injuries to the liver and biliary system. The role of the interventional radiologist in both detection and treatment of fluid collections, including bilomas and abscesses, etc., as well as the role in transhepatic biliary interventions, both diagnostic and therapeutic, for laparoscopic injuries will be detailed. The current indications for percutaneous biliary drainage and balloon dilatation of benign strictures, particularly after laparoscopic injury, will be outlined. (3) Percutaneous aspiration and drainage of hepatic abscesses have evolved to a level where they are the definitive choice of treatment for hepatic abscesses. The approach to hepatic abscesses, in terms of simple needle aspiration *vs* catheter drainage and the current controversy that now exists will be discussed. Results, potential complications, and overall approach will be given. (4) Finally, the treatment of primary and secondary hepatic tumours by interventional methods will be discussed. The role of alcohol ablation, radio-frequency, and other methods of controlled treatment of these lesions will be given. This last area represents the newest evolution of the radiologist as therapeutic clinician. This area of interventional radiology represents the purest form for the radiologist as a therapeutic and clinical caretaker for patients with significant cancerous disease.

1430
Transarterial chemoembolization for primary liver cell cancer
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PURPOSE: Primary hepatocellular carcinoma (HCC) in British populations is usually unresectable at presentation. Transarterial chemotherapy and percutaneous alcohol injection have been reported to improve survival in Japanese patients with HCC. The results of such treatments in British populations are difficult to compare because of larger tumour volumes and differences in aetiology. MATERIALS & METHODS: 73 patients (mean age 62.5 years) referred to this hospital with unresectable HCC were reviewed. Patients were staged by Okuda's method and recorded as Stage I (good prognosis), II (intermediate) or III (poor). Treatment was with intraarterial chemotherapy alone (Lipiodol/Adriamycin) in 58 patients, Lipiodol/Adriamycin and percutaneous alcohol injection ($n=10$), Lipiodol/Adriamycin and gelfoam embolization ($n=5$). Patients with technical difficulties or extrahepatic disease had in addition, systemic chemotherapy/hormonal therapy ($n=12$). Treatments were repeated at 6–12 week intervals. RESULTS: Median survival in Stage I was 9 months (range 6–39), in Stage II 6 months (range 1–20) and in Stage III 2 months (range 1–11). Percutaneous alcohol injections extended median survival in Stage I disease from 7.5 to 13.8 months. Response (fall in AFP or reduction in tumour size) was seen in 22/54 evaluable patients. One death resulted from a large volume ("single shot") alcohol injection. CONCLUSION: Aggressive interventional treatment can only be recommended for Stage I and II tumours. The response rate is comparable with iv chemotherapy, but side effects are more acceptable with transarterial treatment and small volume alcohol injections.

1440
Sonographic signs leading to conversion of laparoscopic cholecystectomy to open cholecystectomy
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PURPOSE: To determine whether sonographic signs can predict the need for conversion of laparoscopic cholecystectomy (LC) to open cholecystectomy (OC). MATERIALS & METHODS: Out of 215 patients planned for LC, 50 were converted (23%) to OC. All patients had a sonographic examination performed within 6 months prior to surgery. The sonographic examinations were scored without knowledge of the surgical outcome (LC or OC). The parameters looked for were: gall-bladder size, wall thickness, number and size of stones, grid, echogenic bile, impaction of stones in the cystic duct and size of the common bile duct. RESULTS: The sonographic signs associated with a higher conversion rate were: gall-bladder hydrops, 65%; contracted gall-bladder, 27%; stone impaction, 41%; more than 10 stones, 27%. With a combination of two signs the results were: gall-bladder hydrops and more than 10 stones, 100%; more than 10 stones and stone impaction, 83%. CONCLUSION: Sonographic signs, such as gall-bladder hydrops, contracted

gall-bladder, more than 10 stones and stone impaction in the cystic duct, are more often found in LC patients who eventually need conversion to OC.

1450

Magnetic resonance cholangiography with a local coil: technique, results and implications for clinical practice

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The purpose of this study was to evaluate the accuracy of magnetic resonance cholangiography (MRC) in diagnosing bile duct abnormalities. A pilot study was performed comparing MRC with endoscopic cholangiopancreatography (ERCP) on 100 consecutive patients. MR images (1.5 T; GE) were obtained using a shoulder coil placed on the abdomen with a heavily T_2W fast spin echo (FSE) (TR/TE: 11,000/272, ETL: 32) sequence, matrix size 256 × 128, 1 NEX, FOV 20 × 20 and contiguous 3 mm slices. Imaging acquisition took 44 s, accomplished in two breath-holds or by quiet breathing in non-breath-holders. Images were reformatted and prospectively correlated with ERCP which was performed within 24 h. Diagnostic images were obtained in all patients. ERCP/DC showed CBD stones in 30 patients, stricture in 26, and was normal in 44. MRC showed stone disease in 29 patients, stricture/tumour in 27 and was normal in 44. MRC had two false negatives and one false positive for stone disease. The overall sensitivity of MRC was 96.5%, specificity 97.7%; positive predictive value 98.7% and accuracy 97%. MRC directly altered patient management in six patients with stone disease who failed ERCP. MRC is a highly accurate technique for evaluating the biliary tree and can be successfully performed with a local coil and breath-hold technique. Its routine use in imaging the biliary tree can now be advocated. (Supported in part by a grant from The Charitable Infirmary Charitable Trust.)

1500

A prospective evaluation of MRI of common bile duct stones

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The establishment of laparoscopic cholecystectomy for the management of gall stones has demanded a parallel increase in the service providing endoscopic retrograde cholangiopancreatography (ERCP). MRI of the biliary tree has been recently developed and can demonstrate stones in the common bile duct. ERCP is a technique with hazardous complications and not without considerable financial and manpower cost; MRI is relatively safe, significantly cheaper and quicker. We investigated the use of MRI, in routine clinical practice, for patients referred for ERCP, in whom biliary stones were thought to be the likely diagnosis. 52 consecutive patients referred for ERCP with a clinical diagnosis of gallstones were considered for MRI cholangiography prior to their ERCP. The patients were scanned on a Siemens 1.5 T scanner using 2D and 3D PSIF sequences. The ERCP and MRI films and reports were then blindly reported as to whether stones were demonstrated within the common bile duct. Assuming ERCP to be the present "gold standard", MRI has a sensitivity of 46%, a specificity of 84%, a positive predictive value of 75% and negative predictive value of 61%. With the sequences employed the results are a little disappointing from the aspect of the efficacy of MRI cholangiography. This has prompted the search for improvement in the technique using different sequences.

1510

The role of magnetic resonance cholangiopancreatography in the study of biliary diseases

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AIM: This study assesses the role of magnetic resonance cholangiopancreatography (MRCP) in predicting the presence of biliary dilatation and the level of biliary obstruction. In addition, we have assessed the diagnostic accuracy of MRCP in comparison with endoscopic retrograde cholangiopancreatography (ERCP) in evaluating the cause of biliary diseases encountered in routine practice. MATERIALS & METHODS: The results of MRCP and ERCP were analysed in 166 consecutive patients with various proved biliary diseases (choledocholithiasis 71, malignant stricture 58, benign stricture 31, choledochal cyst one, normal five). MRCP was performed in a 1.5 T magnet, using a 3D turbo inversion recovery (3D-IRTSE) sequence, superficial coil and respiratory triggered technique. RESULTS: Diagnostic quality examinations were achieved in 154 patients with MRCP (92.7%) and in 152 with ERCP (91.5%). The sensitivity of MRCP in predicting biliary dilatation and the site of obstruction was equal to ERCP (94.2% and 95.4%, respectively). The sensitivity of MRCP in predicting the cause of the various biliary diseases was 83.1% and 85.5% for ERCP. CONCLUSION: MRCP shows a comparable sensitivity and specificity to ERCP in assessing diseases of the biliary system.

1520

Superparamagnetic ion oxide enhanced MRI in hepatic lesion detection: a sequence comparison

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PURPOSE: To determine the most sensitive sequence for the detection of focal liver lesions following superparamagnetic iron oxide (SPIO) contrast enhancement at a field strength of 1.0 T. METHODS: All imaging was performed on a Siemens Magnetom 42 SP system. 16 potential hepatic resection candidates, with known colorectal metastases, underwent MRI. FSE (TR 4000, TE 91, ETL 8), conventional SE (TR 2000, TE 45/90) and T_2* FLASH (TR 150, TE 10, FA 15°) sequences were obtained after SPIO enhancement and compared with unenhanced FSE. All five sequences were viewed independently by three blinded observers who recorded the number and location of lesions, assigning each one a confidence rating using a four point scale. The results were correlated with either surgery, intra-operative US and histology ($n=9$) or a four panel consensus review, together with all other imaging ($n=7$). Alternative free response receiver operating characteristic (AFROC) methodology was used to analyse the results. RESULTS: 65 true positive lesions were present in 16 patients. 34 confirmed at surgery. The mean area under the AFROC curve was 0.57, 0.73, 0.76, 0.74, 0.69, for TSE, SPIO enhanced TSE, SE 45, SE 90 and FLASH respectively. All SPIO enhanced sequences performed significantly better than unenhanced TSE. Of the post-contrast sequences, more lesions were identified on SE 45 images, but the difference was not statistically significant. CONCLUSION: SPIO-enhanced imaging significantly improves the detection of liver lesions compared with unenhanced T_2 weighted FSE. There was no statistically significant difference in performance for the post-contrast sequences.

1530

HASTE MR in evaluating the laparoscopic biliary patient

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PURPOSE: We hypothesized that the ultrafast, half-fourier acquisition spin echo (HASTE) MR sequence would be an accurate and noninvasive method of imaging patients undergoing laparoscopic biliary surgery. METHODS & MATERIALS: The MR images of 22 patients who underwent laparoscopic surgery for biliary disease were reviewed in a blinded fashion. Patients were imaged with a Siemens Magnetom body scanner (Siemens, Erlangen, Germany) utilizing a HASTE MR sequence. Images were assessed for pericholecystic fluid, biliary duct dilatation and common bile duct calculi. RESULTS: 18 patients had acute cholecystitis, three had chronic cholecystitis and one patient had acalculus cholecystitis. HASTE MR demonstrated pericholecystic high signal in all patients (100%) with acute cholecystitis. Sonography showed pericholecystic fluid in 14/18 (78%) of these patients. HASTE MR correctly demonstrated CBD stones in two patients. The presence of a complex pericholecystic fluid collection on MR correctly predicted the need for conversion to an open cholecystectomy in one patient with gangrenous cholecystitis. HASTE MR accurately excluded retained stones in two post-operative patients. CONCLUSION: HASTE MR can noninvasively and accurately evaluate patients undergoing laparoscopic biliary surgery. The technique has a role in excluding retained stones in the post-operative patient and may predict the need for open cholecystectomy.

1400–1520
Scientific Session
Chest CT
Olympian Suite

1400

Detection of small airways disease: a comparison of inspiratory and expiratory thin-section CT

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PURPOSE: Areas of decreased attenuation (DA) containing pulmonary vessels of reduced calibre are a cardinal feature of small airways disease. The aim of this study was to determine whether expiratory CT (eCT) enhanced the detection of DA compared with inspiratory CT (iCT), and to quantify interobserver variation. MATERIALS & METHODS: Inspiratory and expiratory HRCT images of 125 patients were scored independently by four observers for the percentage of DA (1) quantitatively to the nearest 5% and (2) semi-quantitatively on a five-point scale (0%, <25%, 25–50%, 50–75%, >75%). Confidence levels were assigned for each observation ("low"=one "high"=two). Cases selected were those in which a component of small airways disease is recognized [bronchiectasis ($n=26$), asthma ($n=26$), obliterative bronchiolitis ($n=23$), sarcoidosis ($n=18$), hypersensitivity pneumonitis ($n=13$)] and 19 normal volunteers. RESULTS: The extent of DA identified on eCT (median=6.7%: range=0–76.7%) was greater than that on iCT (median=3.8%; range=0–81.7% $p<0.0001$), and observer confidence was higher ($p<0.0001$). Single determination standard deviations on quantitative scoring for iCT and eCT were 10.5% [coefficient of variation (CoV)=101%] and 10.8% (CoV=82%), respectively. For semi-quantitative scoring, the mean-weighted κ values for scale of decreased attenuation on iCT and eCT were 0.59 and 0.66, respectively. CONCLUSIONS: DA is more extensive and observer confidence is higher on eCT than on iCT. Interobserver agreement is good when a coarse semi-quantitative scoring system is employed.

1410

Air-trapping in sarcoidosis: correlation with lung function

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PURPOSE: To determine the presence and extent of air-trapping in patients with sarcoidosis and correlate the CT appearance with lung function tests. MATERIALS & METHODS: 26 patients with proven sarcoidosis were evaluated. All patients had pulmonary function tests and high-resolution CT scans performed on inspiration and expiration. The presence and extent of air-trapping in HRCT was scored using a semi-quantitative system. CT scores were correlated with functional parameters. RESULTS: Areas of air-trapping were present in 25 out of 26 patients. The percentage distribution of air trapping was greatest in the lower lobes. There was a correlation between the extent of air-trapping and RV/TLC, $r=0.74$; and between FEV and air-trapping $r=0.51$. CONCLUSION: Air-trapping is a common finding in sarcoidosis and correlates with physiological parameters of small airways disease.

1420

The functional significance of HRCT abnormalities in survivors of adult respiratory distress syndrome

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PURPOSE: The long-term physiological consequences of adult respiratory distress syndrome (ARDS) are variable and there are few reports about the CT appearances of the lungs in ARDS survivors. The aim of this study was to evaluate the CT sequelae of ARDS and their functional significance. MATERIALS: HRCT images of 19 post-ARDS survivors (12 male, seven female; mean age=40.7 ± 19 years) were evaluated by two observers. METHODS: Scans were scored for the extent of decreased attenuation, coarse reticular pattern, ground-glass opacification, emphysema and bronchial abnormalities. Morphological—functional relationships were examined. RESULTS: A reticular pattern was the most common single abnormality ($n=17$); this was sited anteriorly in 13/17 cases (76%), and was more extensive in the middle lobe and lingula than in either upper or lower lobes ($p<0.005$, $p<0.007$ respectively). A reticular pattern was positively related to the ratio of residual volume to total lung capacity (RV/TLC) ($p=0.001$) but negatively correlated with gas transfer ($p=0.05$) and forced vital capacity ($p=0.03$). A ground-glass pattern ($n=9$) was also positively correlated with RV/TLC ($p=0.005$). Decreased attenuation ($n=14$), emphysema ($n=5$), and bronchial abnormalities ($n=26$) were not functionally significant on multivariate analysis. CONCLUSION: In ARDS survivors, a reticular pattern is the most common CT feature. A reticular pattern is associated with air-trapping with functional characteristics usually associated with emphysema. The anterior distribution and the functional behaviour of this pattern may reflect the more pronounced effects of barotrauma to the non-dependent lung in acute ARDS.

1430

High resolution CT evaluation of bronchopulmonary dysplasia in long term survivors: correlation with pulmonary function testing

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OBJECTIVE: To assess the value of high resolution pulmonary CT (HRCT) in identifying the sequelae of bronchopulmonary dysplasia (BPD) in long-term survivors and to correlate this with pulmonary function testing (PFTH). MATERIALS & METHODS: 21 children (age range 8–21 years, mean age 12.5 years) with previous BPD were assessed with HRCT of the chest. Scans were independently assessed by three blinded observers for the presence and extent of reticular densities, areas of increased lucency, subpleural linear strands, bronchiectasis and air space disease. The percentage of abnormal lung was calculated for each patient and a consensus opinion was drawn and correlated with PFTH and Jones stage I exercise test. RESULTS: 20 of 21 scans were abnormal, 16 of 21 showed multifocal areas of increased transradiancy, 12 of 21 patients showed reticular densities, six out of 21 subpleural linear strands, and four out of 21 patients showed bronchiectasis involving the lower lobes. Air space disease was not observed in any patient. The mean percentage of abnormal lung was 31% (range 0–95%). Significant findings were found when correlating each FVC, FEVs, FEVI/FVC, MMEFR, REC, RV, RV/TLC with percent of lucency and percent of total abnormal lung. CONCLUSION: HRCT can show significant abnormalities in survivors of BPD. The total extent of lung involvement and extent of areas of emphysema/small airways disease correlate well with PFTs.

1440

A CT sign of pulmonary hypertension: the ratio of main pulmonary artery to aortic diameter

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PURPOSE: To determine if the ratio of pulmonary artery diameter to aortic diameter (Rpa), as assessed on CT, is predictive of pulmonary artery hypertension. MATERIALS & METHODS: 57 patients who had undergone both chest CT (ultra-fast Imatron scanner) and catheter measurement of their pulmonary artery pressure were evaluated. The main pulmonary artery and ascending aortic diameters were measured on the CT work-station, at a single predefined level (where the right main pulmonary artery was best visualized). Mean pulmonary arterial pressures (MPAP) were obtained from measurements at cardiac catheterization ($n=47$, predominantly in those undergoing heart–lung transplant assessments), or Swan–Ganz catheterization ($n=10$). Paediatric patients or patients with complex congenital heart disease were not included in this study. RESULTS: There was a positive correlation between MPAP and Rpa ($r=0.69$). There was a weaker correlation between MPAP and pulmonary artery diameter alone ($r=0.62$). In 93% of patients in whom the MPAP was greater than 20 mmHg (commonly accepted as indicative of pulmonary artery hypertension) the ratio of pulmonary artery to aortic diameter was >1.0 (positive predictive value=93%). Overall, when a ratio (Rpa) of one is taken as the upper limit of normal, the sensitivity, specificity and negative predictive value for detecting pulmonary arterial hypertension were 65%, 86% and 44%, respectively. CONCLUSION: The ratio of pulmonary artery to aortic diameter is a useful CT sign of pulmonary artery pressure. In particular, there is a very high probability of pulmonary hypertension if the pulmonary artery diameter exceeds that of the aorta on CT.

1450
Invited Review
Clinical indications of 3D reconstructions in chest diseases
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Since its introduction, spiral CT has enlarged the usual frontal and/or transversal analysis of chest disorders routinely provided with conventional imaging modalities. As often emphasized, spiral CT data offer greater flexibility for image reconstruction and are uniquely suited for multiplanar reformation and 3D rendering. The purpose of this lecture is to review the clinical applications of 3D reconstructions in chest disorders, with an emphasis on practical considerations to maximize diagnostic information. Applied to central airways, a combination of multiplanar and 3D rendering of thin-section airway data can be useful to evaluate regions of stenosis and the extent of bronchial lesions before planning endoscopic procedures and/or surgery. Among the numerous applications of spiral CT, imaging of the thoracic vasculature and chest wall has been introduced in routine clinical practice. Instead of analysing hundreds of axial images, an appropriate selection of shaded surface displays and volume rendering techniques enables the radiologist to provide the referring clinician with a simpler view of complex anatomical relationships. A new insight into peripheral pulmonary vasculature and lung parenchyma is currently available, with the use of sliding thin slab maximum (or minimum) intensity projections which allow the depiction of lesions from transverse CT scans considered as normal or inconclusive. Whereas 3D reformations have the potential to replace more invasive imaging modalities, a precise knowledge of the benefits and limitations of these techniques is recommended prior to relying upon them for diagnosis.

1500–1700
State of the Art Symposium
Child Protection & Radiography
Hall 9

1500
Invited Review
Child protection in radiography: examples from professional practice
P Hogg, C Eaton and J Sudbery
Department of Radiography and Social Work, University of Salford, Salford M6 6PU, UK
Radiographers are continually presented with challenges which result in them having to adapt to manage new clinical situations. Child protection problems arising from radiographic practice are exemplar of what might contribute to such challenging situations. recent evidence has suggested that many radiographers may not be fully prepared to cope with the wide range of responsibilities and skills necessary to manage adequately with the professional and personal demands which may arise. This presentation will explore relevant evidence from several empirical studies conducted by, or in association with, the Departments of Radiography and Social Work at The University of Salford. This evidence will demonstrate typical and atypical cases of child protection problems (with possible solutions), which radiographers have encountered in their practice. The empirical stage of data collection for this presentation spanned 3 years and was concentrated mainly in the North West of England, though data has been generated from several other areas within the UK. During this time, 38 professionals from 13 professional groups with an "interest" in child protection were interviewed, 386 healthcare professionals returned completed survey questionnaires and two "data-gathering", multiprofessional, child protection symposia were conducted. The data demonstrates various child protection quandaries which radiographers have encountered during professional practice. Many of the radiographers indicated they were inadequately prepared for managing situations involving child protection and several radiographers admitted they actively avoided "getting involved" with such cases. Conversely, a limited number of radiographers indicated they had adequate knowledge and skills in specific areas of child protection and felt able to cope within these areas.

1530
Invited Review
Child abuse and child protection: current issues
J Sudbery, P Hogg and C Eaton
Departments of Social Work and Radiography, University of Salford, Salford M6 6PU, UK
This presentation will provide an overview of the current understanding of child abuse, with the concerns of the medical imaging department in mind. Relevant findings from social work, child development, law, public administration and psychology will be combined with those from radiology and radiography to outline the classification, extent, treatment and causes of abuse. The social problem of child abuse requires interdisciplinary collaboration; specific attention is paid to the role of the radiographer in this context. Current issues are examined in relation to: the social and emotional factors in abuse; the prevention of abuse; work that is carried out to remedy its effects; identification of abuse; and action to protect children who have suffered abuse. Child abuse is a subject which arouses strong emotions and a concise account is given of the dilemmas and controversies which can sometimes make it difficult to be sure of the correct course of action which protects the child, whilst respecting parents' rights and supporting the family. This session will highlight key provisions of the Children Act 1989 which is the source of the principles and procedures used to protect children from abuse. Keeping the child as the focus of attention, the paper identifies some of the issues which arise for radiographers in responding sensitively to children and parents in this context.

1600
Invited Review
Child protection: education and training for radiographers
C Eaton, P Hogg and J Sudbery
Department of Radiography, University of Salford, Salford M6 6PU, UK
This review concludes the session by proposing a model of good practice for the imaging of children which ensures that radiographers are working within the current legislative framework and associated guidance. In collaboration with several professional groups and charitable organizations, the model has been developed from the findings of several studies conducted by the Departments of Social Work and Radiography at the University of Salford. The model may be used to inform a programme of study, which matches the needs of the radiographers and the demands of managing children in the context of diagnostic imaging. The presentation will discuss the areas for consideration when planning a programme of study, with specific reference to undergraduate curricula, new job induction programmes and general continuing professional updating.

1630
Open forum

1515–1635
State of the Art Symposium
Radiation Protection — Communication
Hall 10b

1515
Invited Review
Communicating radiation risk to the patient
R H Corbett
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It is normal practice for radiologists to explain radiological procedures to patients although this should be done by the referring doctor. However, radiologists often spend time personally explaining a procedure. A consent form is often signed by patients in advance, without proper explanation as such forms are usually proffered by junior ward doctors. Many patients attend for an X-ray and are horrified to discover exactly what they are in for. Also, some patients now expect to be told details of the radiation risk. To enable a proper assessment of the radiation risk, there has to be a two-way discussion of the risks with the patient. The radiologist must realize that most patients are not scientists, are apprehensive, and often will not understand what they are being told. Some radiologists use the concept of background radiation as the comparative example for radiation risk. Some just say that without this test, we will not be able to find out what is wrong, so you might as well just have the test. This is unacceptable nowadays. It must also be realized that many patients will not have heard of background radiation and so not understand the comparison. Some ideas to get round this problem will be given.

1535
Invited Review
Communicating the risks to the patient's relatives in nuclear medicine
L K Harding
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Risks regarding radiation are difficult to explain and, although the nuclear power industry has spent much money on public relations, radioactivity is still perceived as a major hazard. Attempts to explain such risks all have limitations but this approach favours comparison with equivalent risks in everyday life. Simple explanatory leaflets sent to every patient overcome many of the difficulties. Relatives are members of the general public and will be subject to an annual dose limit of 1 mSv (5 mSv over 5 years). However, those "knowingly and willingly helping in the support and comfort of a patient undergoing medical diagnosis or treatment" will be subject to a constraint, probably 5 mSv. In a nuclear medicine department questions arise about travel with the patient, published data show that dose levels are low. Radiation doses in waiting rooms are occasionally questioned by relatives, but indications are that such exposures are also low and that the second waiting room is of little benefit. Once at home there are several areas of concern and the current British guidance notes are rather restrictive. The relevant chapter is being rewritten. Particular problems arise with children of patients who have had nuclear medicine investigations or therapy, or mothers looking after children who are themselves radioactive. Generally, the risks have been over-estimated and actual measurements are now available, these will be reviewed. It is important that any future legislation or guidance is based on measurement and that any restrictions are justified.

1555
Invited Review
The genetic revolution—consequences on risk and its perception
C Sharp
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The expanding horizons for the application of genetics to medicine has been accompanied by an unprecedented discussion, both in the media and scientific community, of the impact of this revolutionary science on individuals and their genetic family. Central to this issue is the fact that natural genetic variation in the human population has implications for the susceptibility of individuals to a range of diseases, including cancer. The important question for patients who are exposed to ionizing radiations is whether such genetic susceptibility to spontaneously arising cancer is accompanied by an increased cancer risk after radiation; available information suggests that such individuals do have an enhanced risk. Consequently, two important questions arise: what is likely to be the incidence of such genetic disorders in the population; and can such individuals be identified, either by family history or genetic testing or a combination of both? Practitioners and some patients will want to know if risks of stochastic (and in some cases deterministic) effects are enhanced in the individual for a procedure. However, it can be argued that genetic information gathered from an individual is not solely the property of that individual, as with most clinical investigations, but the joint property of all his/her genetic family. Communicating risk in this context has wider social and ethical considerations, not least in the way in which information is provided and to whom.

1615
Discussion

1515–1615
Scientific Session
*info*RAD™ 2
Hall 11b

1515
Invited Review
IT in radiological and radiographic education
M P Tatlow
Division of Imaging and Radiotherapy, South Bank University, London SE1 0AA, UK
The use of information technology (IT) in education has increased dramatically. High performance personal computers, which are relatively cheap to buy, have brought the potential of quality education material being delivered to the learner in a controlled and timely manner. The topic of this presentation—"IT in radiological and radiographic education" is broad. The content will address the considerations that need to be made when looking at the introduction of any IT-based education material (courseware) into a traditionally-delivered course. Introducing any courseware requires significant discussion with all educators concerned. Many factors have an affect on the acceptance and effectiveness of the intended courseware, great care has to be taken to prevent any resentment and the feeling of "not invented here" towards the application. There are primarily two approaches that can be taken, proprietary ready-made courseware and courseware which is created at the home site. The decision for development of courseware may initially seem an economic solution to an applications development, unfortunately this is rarely the case. Equally, the choice of ready-made applications have their own costs. These expenses lie in several areas and will be discussed. As the growth of the World Wide Web continues, educators must examine the evolving technology and review where it lies within the education arena. It is something that must be realistically considered as it will ultimately impact on application development.

1535
Invited Review
Using the World Wide Web to teach radiology: how and why
A C Downie
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PURPOSE: The aim of this discussion is to explain how the Internet and its derivative, the World Wide Web, may be used in the teaching of radiology. Examples include the use of e-mail, Usenet newsgroups electronic journals and radiology web sites. As an example, the workings of the UMDS radiology teaching file, to be found at http://www-ipg.umds.ac.uk/~acd/ will be explained and some of the difficulties encountered will be discussed. Future developments include web resources as an integral part of the medical curriculum, feedback and self-assessment and the provision of CME credits online. CONCLUSION: The Internet and World Wide Web are rapidly developing resources for radiologists; they offer great opportunities for developing new materials and new approaches in radiology education.

1555
The impact of the interactive computer assisted learning package CALRAD
R A Lerski, J M Wilson and S Morrison
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A computer assisted learning program, CALRAD, has been produced by a consortium of universities established to work on a teaching and learning technology programme (TLTP) funded project. CALRAD teaches the core of knowledge identified in the Ionising Radiation (POPUMET) Regulations 1988 to a target audience of undergraduate medical students and junior doctors. The program consists of eight interactive "books" covering such topics as basic physics of radiation, biological effects of radiation and safe use of X-rays. The program also incorporates a "problem-based learning" approach, in the form of case studies, which have been designed to provide students with an opportunity to apply the knowledge they have gained in the interactive books in the context of a realistic situation. The effectiveness and usability of the program has been evaluated and the results of these evaluations will be presented. The place of CALRAD in POPUMET teaching in the future will also be discussed.

1605
Discussion

1545–1655
Scientific Session
Radiotherapy & Oncology 3
Hall 10a

1545
The matching of linear accelerators to facilitate patient transfer for gap management in radiotherapy departments
A Anderson, G M Ford and H Porter
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The recent Royal College of Radiologists *Guidelines on the Management of Gaps in Radical Courses of Radiotherapy Treatment* has renewed interest in the technical problems of "matching" linear

accelerators to make them as similar as possible. In this paper we will report on the matching of three linear accelerators of different ages: a Clinac 2100C, a Clinac 600CD and a Clinac 600C. We will show how a combination of energy matching the common 6 MeV mode, wedge-matching with a software-controlled wedge (the enhanced dynamic wedge) and geometrical matching of accessory tray and other mounts has produced three accelerators with radiation and geometrical properties which are similar enough to permit the transfer of patients between accelerators with no requirement to replan or recalculate outputs. The acceptance testing and quality control of these matched systems will be discussed and the implications for departmental "gap management" protocols developed. As these three accelerators were installed in our department over a 5 year period we will also discuss some of the problems (and their solutions) relating to the commissioning of new control software on accelerators, while continuing normal day-to-day operations with older versions of the software. Finally, we will present some practical comparisons of two versions of the software-controlled dynamic wedge (the standard dynamic wedge and the enhanced dynamic wedge).

1555

Computers *vs* hand-written data in radiotherapy treatment

S McWilliam

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This presentation considers the possible benefits of using computerized systems to minimize the need for hand-written records. It considers the advantages and disadvantages in terms of accuracy, effective records and efficient use of radiographers time. If a significant proportion of a typical clinical radiographers working day is spent writing information which can be transferred through a network, then with a computerized system, not only is the risk of errors reduced but either staffing levels can be reduced, or radiographers can spend more time concentrating on patients.

1605

Cost efficiency of radiation therapy

R Allison

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PURPOSE: The costs of radiation therapy in a single state have been assessed and related to the survival-benefit experienced by a cohort of patients treated in a single year. METHODS: This study has paralleled that of Glazebrook's Alberta Study. The costs of radiation therapy were obtained from the Queensland Radium Institute *Annual Report*. These include interest and redemption on capital equipment. The patient cohort was that of 1982, which presented with a major (*i.e.* not minor skin) cancer and received radiotherapy, either alone or in combination with intent to cure. Palliative benefits have not been assessed. Actuarial survival rates have been plotted. The area under the curve has been calculated to provide survivor years. These have been costed. RESULTS: The Queensland population in 1982 was 2 419 600. In 1982 1295 patients were treated with curative intent by radiation therapy. Actuarial survival at 2 years was 73%, at 3 years 64%, at 5 years 55% and at 10 years 45%. Intercurrent deaths were censored. In 1982 costs at the Queensland Radium Institute were $6 238 410 or $2.58 per head of population. From the area under the curve, there were 6859 survivor years at 10 years resulting from the 1982 cohort of radiation treatments for cure. The cost per treatment for that year was $481.39 per patient. The cost per survivor year was $909.52 or $2.49 per day. In 1982 there were four linear accelerators and one cobalt machine. These produced an average of 1372 person years of life per machine for those treated with radical intent. One treatment machine operating for 10 years is therefore capable of producing 13720 years of life. Assuming the cost of a machine at that time to be $1 million, one year of life would cost $72.88 or $1.40 per week. CONCLUSION: Radiation therapy is still considered by some to be an expensive treatment modality, due largely to the high cost of machinery. It is forgotten that labour costs represent 80% of any oncology facility. The average linear accelerator costs in the region of $1 million and a bunker has been estimated to cost in the region of $200 000 additional to the cost of a cancer centre. Accepting a conservative amortization, *i.e.* 10 years, this still translates into $120 000 per year for machinery. When other costs are considered, the treatment of malignant disease for cure by radiation therapy appears to be a bargain. No account has been taken in this study of the enormous individual patient benefits gained from palliative treatment. In 1982 717 patients, or 35% of the total, were treated with palliative intent and 8% of these survived 10 years. Patients treated palliatively have been included in the total cost, but not in the survivor years.

1615

Morbidity and patient satisfaction following radical retropubic prostatectomy

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PURPOSE: To assess morbidity and patient satisfaction following radical retropubic prostatectomy (RRP) for organ-confined prostatic carcinoma. MATERIALS & METHODS: 56 consecutive men with clinical stage T1 or T2 prostate cancer, who underwent nerve-sparing RRP were prospectively evaluated. A questionnaire was also sent to all patients to ascertain their views on the treatment they had received. RESULTS: Complete records were available in 50 cases. There were no perioperative deaths. Mean blood loss was 720 ml. One patient sustained a pulmonary embolism and there was one anastomotic stricture. Only two patients (4%) have persistent mild stress incontinence. Erectile dysfunction occurred in 26 previously potent men but satisfactory erections were achieved with intracavemosal alprostadil in all patients who wished to be treated. No patients have developed clinical evidence of disease progression and 43 (86%) have undetectable serum levels of prostate-specific antigen. 48/50 (96%) patients returned the postal questionnaire, all of whom would still have RRP if faced with the same clinical scenario again and would recommend the procedure to other men. CONCLUSION: Radical retropubic prostatectomy is a safe and effective treatment for localized prostate cancer and is associated with high levels of patient satisfaction.

1625

Investigation of automated TLD techniques for tumour dose estimation in external beam radiotherapy

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AIM: To investigate the use of an automated TLD facility for estimating delivered tumour doses from exit-dose measurements in external beam radiotherapy and to test its practicability in a clinical study of several radical treatments. MATERIALS: Lithium fluoride LiF:Mg, Ti(TLD-700) extremity monitors were used in conjunction with a Harshaw 6600 TLD reader. METHODS: The characteristics of these dosimeters were investigated, in particular the lack of full electronic equilibrium when used at megavoltage qualities. This necessitated a correction to be applied for the obliquity of the patients' exit surfaces. A formalism was developed to allow the estimation of the delivered tumour dose from the exit dose measurement and data from a HELAX treatment planning system. A clinical trial was carried out on 58 patients receiving pelvic treatments, 25 receiving head and neck radiotherapy and 14 receiving radiotherapy of the breast. For each group, estimated tumour doses were compared with the prescribed doses. RESULTS: TLD measurements were subject to an inherent uncertainty of $\pm 2\%$ (± 1 SD). The clinical trial showed that 91% of the estimated tumour doses lay within $\pm 5\%$ of the prescribed tumour dose. The maximum measured deviation was 8.5%. Under conditions of partial electronic equilibrium, surface obliquity requires exit dose corrections of up to 15%. Deviations which exceed HSE action levels for "exposures much greater than intended" may be identified. In addition, it is possible to identify gross errors in dose delivery at the onset of treatment, enabling corrective action to be taken during the remainder of the treatment.

1635

An assessment of image registration in the treatment planning of tumours of the brain

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Patients with malignant glioma, who undergo surgical excision of the tumour, may receive a course of radical radiotherapy. At Leicester, treatment-planning is based on a post-operative CT scan, with evidence of tumour size and position obtained from pre-operative MRI or CT data. The target volume is transferred to the CT scan by manual tracing. The purpose of this project was to investigate the feasibility of improving the accuracy of target definition by using image registration. The registration algorithm was based on chamfer-matching implemented as part of the Analyze™ image processing software. Initially a novel geometric phantom was used to assess both the performance of the algorithm and accuracy of registration under different conditions. Using this information, registration was then applied to patient data. It was found that the measurement of accuracy using the phantom agreed well with the values calculated within Analyze™. Registration was improved with

greater sampling of the object, with slice separation less than 8 mm and with the base volume completely overlapping the registered volume. With patient data, an MR image could be aligned with a CT image to within 2 mm. Image registration was found to be a reliable, quick and accurate method of identifying the target volume for radiotherapy treatment planning.

1645

Measurements of scattered doses to the testes in abdominal radiotherapy

G J Budgell, R A Cowan and A R Hounsell
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PURPOSE: Increasing numbers of men are receiving radical doses of radiotherapy to the pelvis as treatment for prostatic, rectal and bladder cancer. A percentage of these patients may wish to maintain their fertility. It is documented that spermatogenesis can be impaired temporarily or permanently by absorbed testicular doses of 50 cGy and above, corresponding to 1–2% of the prescribed dose of radical radiotherapy. The purpose of this study was to determine testicular doses for a variety of radical treatments. METHODS: Measurements have been made of testicular dose using standard geometries for bladder, prostate and rectal treatments using an anthropomorphic phantom at energies of 4, 8 and 20 MV. Variation in field size and distance from field-edge was studied. The results were compared with *in vivo* measurements performed using thermoluminescence dosimetry. RESULTS: *In vivo* and phantom measurements show good agreement, with a tendency for *in vivo* measurements to be slightly higher than predicted. Measured testicular doses ranged between 0.3% and 3% of the prescribed dose, increasing with field size, decreasing with distance from field-edge and decreasing with increasing energy. CONCLUSION: The measured dose levels are sufficient to lead to testicular damage. These results allow an estimate of testicular dose for individual patients to be made and provide guidelines on how best to minimize the dose in such cases: for example, by treating at higher energies or employing a testicular shield.

1550–1700
Scientific Session
Stents & the Gastrointestinal Tract
Hall 11a

1550

The use of Wallstent endoprostheses for the palliation of malignant tracheobronchial obstruction and fistulae

M Cowling, R Morgan, E Denton, P Scott-Mackie, J Dussek and A Adam
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PURPOSE: To assess the role of metallic stents in the palliation of patients with tracheobronchial malignancy. MATERIALS & METHODS: 18 patients with irresectable malignancy involving the trachea and bronchi were palliated by insertion of Wallstent endoprostheses. Patients were assessed before and after the procedure clinically, radiographically and using a dyspnoea score. 14 patients had obstruction of the large airways (trachea—one patient, main bronchus—seven patients, trachea and bronchus—seven patients, trachea and both bronchi—one patient) and were treated by uncovered stents. Seven patients had Grade 3 and seven patients had Grade 4 dyspnoea. Four patients had tracheoesophageal fistulae (three patients) or bronchoesophageal fistulae (one patient) resistant to treatment by oesophageal stenting and were treated by covered stents. All endoprostheses were inserted using combined fluoroscopic and endoscopic guidance under general anaesthesia. RESULTS: Metallic stent insertion was technically successful in all patients. Dyspnoea was improved by two grades in five patients, and a single grade in five patients. All three patients with tracheoesophageal fistulae had their fistulae completely closed by stenting. One very ill patient died 2 h following stent placement. At a mean follow-up of 5.6 months, eight patients were alive. Tumour overgrowth in one patient was effectively treated by two additional stents. Further pulmonary collapse was prevented in patients. CONCLUSIONS: Wallstents effectively palliate malignant obstruction of the major airways. Useful improvement in dyspnoea is achieved in the majority of patients. Oesophagorespiratory fistulae resistant to treatment by covered metallic stents in the oesophagus may be closed by insertion of covered stents in the major airways.

1600

Metallic stents for the palliation of malignant dysphagia: experience with 130 patients

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Department of Radiology, Guy's and St Thomas' Hospital, London SE1 9RT, UK

PURPOSE: To assess the efficacy of metallic stents in the palliation of oesophageal carcinoma. MATERIALS & METHODS: 130 patients with malignant dysphagia due to inoperable oesophageal carcinoma were palliated by the insertion of metallic stents. The stent types used were: covered Wallstent endoprosthesis in 92 patients, nitinol Strecker stent in 32 patients, and the covered Gianturco stent in six patients. Tumour types were 59 squamous carcinomas, 62 adenocarcinomas, six undifferentiated carcinomas, three metastatic carcinomas. All stents were placed under fluoroscopic guidance using light sedation. Patients were evaluated before and after stenting by a dysphagia score (0 = normal diet, 1 = some solid food, 2 = semi-solid food, 3 = liquids only, 4 = complete dysphagia) and were followed up until death. Patients with recurrent dysphagia were treated by endoscopic laser therapy by additional stents. RESULTS: The mean dysphagia score significantly improved from 3.14 to 1.15 following stenting. Delayed oesophageal haemorrhage occurred in nine patients. Endoprosthesis migration occurred in 19 patients (three Gianturco, 16 Wallstents). 18 of the migrated stents were initially placed across the gastroesophageal junction. Recurrent dysphagia was due to tumour ingrowth (eight Strecker stents), overgrowth (seven Wallstents, three Strecker stents) and food bolus obstruction (two Wallstents, two Strecker). Multiple balloon dilatation was required in 32% of the six Strecker stents. CONCLUSION: Metal stents are effective palliation for oesophageal carcinoma. Gianturco stents and covered Wallstents placed across the gastroesophageal junction tend to migrate. Strecker stents are prone to tumour ingrowth and incomplete expansion.

1610

Radiological placement of self-expanding metal oesophageal endoprostheses for palliation of carcinoma—our first 50

H G Thomas
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PURPOSE: To assess the cost-effectiveness and complications of our first 50 metal oesophageal stent placements in the palliation of oesophageal carcinoma. MATERIALS & METHODS: 50 stents were placed in 44 patients with oesophageal carcinoma from July 1994 to April 1996. 28 male:16 female. Mean age 75 years, range 46–92 years. Stents used were 12 uncovered Strecker, 22 uncovered Wallstents and 15 covered Wallstents. RESULTS: Stent insertion was successful in all patients. Mean hospital stay post-stenting was 4.5 days (range 1–25). By May 1996 26 patients had died (survival range 2–225 days). Mean survival was 73 days, median survival 50 days and 30 day mortality 12/44 (27%). Of the 18 alive, the mean follow-up is 166 days and median 127 days. The longest survivor is 67 weeks. Major complications include five complete migrations, one haematemesis leading to death, one perforation (0.5%) and 10 with recurrent dysphagia, including four tumour ingrowth and one tumour overgrowth, one benign stricture and two bolus obstructions requiring re-intervention. Minor complications included five minor migrations, three recurrent dysphagia/bolus obstructions treated conservatively, four chest infections, three with pain, two with aspiration and two with coffee-ground vomit. Of the 10 migrations, 20% of all stents, five were complete and five minor. These included six of the 15 covered Wallstents (40% migration rate) and half of these were complete. These were stents *not* placed across the oesophago-gastric junction. CONCLUSION: The procedure is relatively safe and atraumatic, with a low perforation rate (0.5%) and short hospital stay (4.5 days). There is a high migration rate, particularly with covered Wallstents. The findings justify the additional costs of the metal stents.

1620

Expandable metal stents in obstructing colorectal carcinoma

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PURPOSE: The aim of the study is to evaluate the technical feasibility and clinical application of placement of expanding metal stents (EMS) for the acute management and palliation of colorectal

carcinoma. MATERIALS & METHODS: Six patients with newly diagnosed colorectal carcinoma had expandable metal stents (EMS) placed over an 8 month period. Four patients had inoperable hepatic metastasis in association with distal colorectal tumours. Two patients presented with acute imminent obstruction and had significant medical contraindications to emergency surgery. Five of the tumours were in the rectosigmoid region, with one being in the proximal transverse colon. All had a 22 mm × 10 cm Wallstent (Sneider Europe AG) placed across the neoplastic lesion using fluoroscopy and standard guidewire manipulation. RESULTS: All stents were successfully placed and expanded adequately within 24 h. There were no significant complications related to the insertion. There was one stent migration 5 weeks after placement. Two patients had their surgery as elective procedures. The other four patients continue to have palliative chemotherapy. CONCLUSION: Self-expanding metal stents can be safely placed within the colon. They are successful in decompressing obstructing lesions and converting from emergency to elective surgery.

1630
Invited Review
Interventional radiology in oesophageal strictures and fistulae
A Adam
Department of Radiology, Guy's and St Thomas' Hospital, London SE1 9RT, UK
PURPOSE: To outline the role of interventional radiology in the management of oesophageal strictures and fistulae. MATERIALS & METHODS: We have carried out a prospective randomized study involving 60 patients with inoperable oesophageal carcinoma: 18 treated with laser, 23 with plastic-covered Wallstent endoprostheses and 19 with uncovered Strecker stents. In addition, we have treated a large number of patients with benign oesophageal strictures, mostly with balloon dilatation but occasionally with uncovered metallic endoprostheses. We have also used plastic-covered stents in patients with malignant oesophageal perforation and fistulae. RESULTS: The prospective study showed that both plastic-covered and uncovered stents improved dysphagia significantly better than endoscopic laser therapy. Uncovered stents are prone to tumour in-growth and plastic-covered stents are prone to migration, especially when the lower end of the endoprosthesis projects into the fundus of the stomach. New designs of plastic-covered metallic endoprostheses are less prone to migration. Benign strictures are best treated with balloon dilatation under fluoroscopic guidance. In selected cases, in which no realistic alternative method of treatment is available, uncovered metallic stents may be useful. Malignant oesophageal perforations and fistulae are treated effectively by the use of plastic-covered metallic stents. A retrospective comparison with conventional therapy for oesophageal perforation has shown that the use of stents is associated with a lower mortality rate. In patients with fistulae in the upper oesophagus the use of covered tracheal stents has been successful. CONCLUSION: Interventional radiological methods are very effective in treating both malignant and benign oesophageal strictures and fistulae.

1615–1700
Categorical Course
Vascular Interventional Radiology 2
Olympian Suite

1615
Invited Review
Aortic and iliac stent grafts
J F Dyet
X-Ray Department, Hull Royal Infirmary, Hull HU3 2JZ, UK
PURPOSE: To review the current status of stent grafts (covered stents) as used to exclude (or repair) aneurysms in the thoracic and abdominal aorta and in the iliac arteries. MATERIALS: Straight tube and bifurcated stent grafts were used, consisting of a self-expanding nitinol or stainless steel stent, covered with thin Dacron or polycarbonate. METHODS: At the moment all aortic stent grafts have to be inserted by femoral arteriotomy, but iliac devices can be inserted percutaneously. Only 5% of aortic aneurysms are suitable for a straight tube graft, with 15% suitable for presently available bifurcated grafts and 50% suitable for an aorto-uni-iliac graft with fem–fem cross-over. RESULTS: The early results of Parodi showed 20% technical failure, 10% mortality and 10% conversion to open operation. Blum, using a bifurcated system, reported recently 4% technical failure, with 4% mortality and no conversion to open procedure. So far, about 500 such procedures have been performed world-wide. CONCLUSION: A number of questions regarding the longevity of implanted stent grafts remain to be answered, but nevertheless this looks a viable technique which will eventually be by percutaneous approach and will markedly reduce mortality and morbidity in aneurysm repair.

1625–1715
Categorical Course
Musculoskeletal Ultrasound 2
Hall 11b

1625
Invited Review
Ultrasound of the knee
S G Davies
Department of Radiology, East Glamorgan NHS Trust, Pontypridd CF38 1AB, UK
US is an established modality in the investigation of musculoskeletal disorders of the knee. It is of particular value in assessing the extensor mechanism of the knee. Patellar tendonitis is an increasingly recognized sporting injury; US contributes significantly to the management of this condition. Apart from its use in superficial ligamentous injury, US helps to define and characterize cystic and solid lesions around the knee joint. This presentation will focus on the assessment of the extensor mechanism of the knee, with a description of the pathophysiology of the patellar ligament and technical aspects of the examination. Examples of other pathological processes around the knee will be presented.

1650
Invited Review
US of foot and ankle
W W Gibbon
Department of Radiology, The General Infirmary at Leeds, Leeds LS1 3EX, UK
The aim of the current presentation is to demonstrate the clinical value of US in a wide range of conditions involving the foot and ankle, as well as showing how to optimize demonstration of the abnormalities sonographically. The presentation outlines the examination technique, normal sonographic anatomy and common pathologies of the foot and ankle region. The pathomechanical processes involved in the production of various forms of heel pain will be discussed in terms of their US appearances. In sports-related over-use injuries to the ankle juxtaarticular tendons, US will often demonstrate, not only the "cause", but also the "cause of the cause" of the injury. Acute ligamentous and capsular injuries to the ankle and hindfoot are also readily demonstrated sonographically and examples will be provided of such injuries. Soft tissue masses, particularly benign neuronal tumours, are not uncommon in the forefoot and, to lesser extent, hindfoot. Illustration of a selection of such soft tissue masses will also be provided.

1645–1715
Scientific Session
Radiation Protection — Dose
Hall 10b

1645
Effective dose, conversion factors and risk during common paediatric examinations
D A Broadhead and K Faulkner
Regional Medical Physics Department, Newcastle General Hospital, Newcastle-upon-Tyne NE4 6BE, UK
PURPOSE: To obtain conversion factors which could be applied to easily-measured dose quantities from paediatric examinations to convert them into effective doses. This enables the risk from the examination to be calculated using age-related risk factors. MATERIALS: Five anthropomorphic paediatric phantoms, representing 0–15 year olds, were used. These phantoms are made up

of slices with holes where lithium fluoride thermoluminescent dosemeters are placed. METHOD: Mean technique factors for typical paediatric examinations were established. Micturating cystograms, barium meal and swallow, chest PA and abdomen AP were simulated on each of the phantoms. The results were averaged according to the loading scheme to give the individual organ doses. Effective doses were calculated. During the simulation of each examination the entrance surface dose and dose–area product were also recorded. Conversion factors were calculated to convert the entrance surface dose and dose–area products to effective dose. RESULTS: Effective doses ranged between 4–8 μSv for chest PA examinations and 25–174 μSv for abdomen AP examinations. For abdomen AP examination there was a large difference between the effective dose for male and female patients. The factors differed from the ones listed in the NRPB report. CONCLUSION: Conversion factors have been established which allow the effective dose from common X-ray examinations to be obtained from easily measurable quantities. Differences in effective dose occurred between the age ranges and the sexes. The conversion factors differed from those published elsewhere, highlighting the effect of field size on the effective dose.

1655

Dose–area product in the assessment of effectiveness of staff protection in interventional radiology

J R Williams

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PURPOSE: To investigate dose area product (DAP) as a measure of the work-load of interventional radiologists. In particular, to normalize film badge dose to DAP to identify those procedures which result in high staff doses and to identify individuals whose working practices lead to them receiving an unnecessarily high dose. MATERIALS: Dose studies have been made for cardiac angiography, lower limb arteriography and interventional procedures involving patients with liver disease. The period of each study has been 6–19 months. METHODS: In addition to the normal body badge worn under the lead apron, interventionalists also wore a dose monitor outside the lead apron at the neck and ring monitors on each hand. The monthly doses were normalized to the patient DAP for which each interventionalist was responsible. RESULTS: For lower limb angiography, the average doses to the body, neck and hands of four interventionalists was equal to 0.05, 0.89 and 2.45 μSv $(\text{Gy cm}^2)^{-1}$ respectively. For biliary drainage procedures much higher doses were observed, 6.6 and 29.0 μSv $(\text{Gy cm}^2)^{-1}$ to the neck and hands respectively. Initial studies have shown that whole body doses to cardiologists were 0.15 μSv $(\text{Gy cm}^2)^{-1}$. The range of normalized dose for this group of staff varied between 0.02 and 0.63 μSv $(\text{Gy cm}^2)^{-1}$. CONCLUSIONS: Normalization of doses received by staff to work-load, expressed as DAP, has proved to be a useful tool in the assessment of the dose implications of interventional procedures and of the working practices of individual members of staff.

1705

Film processing at general dental practitioner clinics: how does it affect patient dose and film contrast?

[1]D G Sutton, [2]C J Martin, [1]A Watt, [3]C Darragh and [3]I Simpson

Department of Medical Physics, [1]Dundee, [2]Glasgow, [3]Aberdeen, UK

PURPOSE: To determine the role of processing conditions on the radiation dose delivered during dental X-ray examinations. METHOD: A test phantom comprising a copper step wedge, a 1 mm lead filter and an open window was constructed and used in routine surveys of general dental practitioner (GDP) clinics (over 100 X-ray sets). At each practice the air kerma for a bite-wing exposure was determined and two exposures of the test phantom were made. One film was processed using the dentist's own facilities and the other at a dental hospital, using a processor which was subject to regular quality assurance checks. Log values of relative exposure were calculated using data derived from theoretical X-ray spectra and a "characteristic curve" was generated for each film. These data, together with the measured air kerma, were used to derive the apparent speed and contrast of each film. RESULTS: Measured speeds of films processed at GDP clinics were up to 80% less than for similar films processed at the dental hospital and generally had lower contrasts. Recommendations that processing should be improved at the GDP practice were made when speed differences and doses exceeded a set threshold. There was no significant correlation between measured speed and dose delivered for a bite-wing examination. Reductions in exposure factor changes were made when the densities lay above an agreed acceptable range. CONCLUSION: Attention to processing conditions will result in considerable dose-saving and improvement in image quality in GDP practices.

1715–1800
Royal College of Radiologists **George Simon Memorial Lecture**
Hall 1

1715

Eponymous Lecture

CT of the lungs: above and beyond the diagnosis

D M Hansell

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At the turn of the century, chest radiography was enthusiastically adopted by physicians as a means of improving their diagnostic skills. The concept that much pathophysiological information could be gleaned from the chest radiograph came much later. Initially, many regarded the chest radiograph as providing only "a pale reflection of physiological reality." More than 50 years after its introduction, a report by Morris Simon (no relation to George Simon), appeared in the radiological literature, describing the haemodynamic significance of upper lobe blood diversion in patients with mitral stenosis. As the first centenary of chest radiography passes, the first 10 years of high resolution CT (HRCT) comes to an end. The superiority of HRCT over chest radiography—in purely diagnostic terms—has now been established. However, the accumulation of pathophysiological insights into lung disease is only now beginning to catch up with the rapid diagnostic ascendancy of HRCT. In many ways HRCT effectively bridges the gap between the *gestalt* impression of a chest radiograph and the detailed, but very local, information provided by lung biopsy specimens. In this lecture the new pathophysiological light that HRCT has shed on lung disease will be explored, using fibrosing alveolitis and obliterative bronchiolitis as examples of interstitial and airways diseases respectively; this will be followed by a foray into conditions characterized by a more complex pathophysiological picture. Undoubtedly, more signs of disease and functional correlates remain to be identified. In the future these will be revealed as HRCT continues to sharpen our pathophysiological image of the lungs.

Notes

Tuesday 20 May

0800–0850
Refresher Course
Breast Biopsy
Hall 9

0800
Invited Review
Image-guided breast biopsy
A R M Wilson
Breast Services, Nottingham City Hospital, Nottingham NG5 1PB, UK
It is now firmly established that both screen-detected and symptomatic breast problems are best assessed using the triple approach [clinical examination, imaging and fine needle aspiration cytology (FNAC) and/or needle core biopsy]. It is now routine to obtain a definitive diagnosis without resort to open surgical biopsy. An increasing proportion of breast lesions are impalpable and radiologists have had to develop skills in image-guided breast biopsy. A vogue for FNAC has more recently been replaced by a preference for core biopsy, stimulated by the introduction of spring-loaded core biopsy devices. Core biopsy is preferred as it provides histological detail. Core biopsy requires a 14 gauge needle with at least a 20 mm "throw"; the Manan and BIP guns have been shown to provide the best samples and are easiest to use. FNAC should be performed using needles no larger than 22 gauge, with a clear hub. Use of local anaesthetic is recommended for both sampling methods. Contrary to expectations patients find core biopsy more acceptable and less painful than FNAC. US is the ideal and preferred method for image-guiding both FNAC and core biopsy; approximately 80% of impalpable breast lesions are visible on US. This method causes the least patient discomfort and lesions are sampled both quickly and accurately. Two to three FNAC or core separate samples are sufficient for US-guided biopsy. The remaining 20% of lesions (mainly microcalcifications and some architectural distortions) require X-ray guided biopsy; stereotaxis is consistently more successful than other X-ray guided techniques. Five samplings should be attempted using this method. Core biopsy with specimen radiography should be performed for microcalcifications. Image-guided breast biopsy is the most successful means of sampling suspicious breast lesions and US is the preferred method.

0825
Invited Review
Fine needle aspiration and core biopsy: a review
P D Britton
Cambridge & Huntingdon Breast Screening Centre, Rosie Maternity Hospital, Robinson Way, Cambridge CB2 2SW, UK
It has long been recognized that needle biopsy is a useful adjunct to imaging in the diagnosis of breast cancer. With the advent of screening the utility of fine needle aspiration cytology (FNAC) was advocated in the UK training centres and has subsequently been widely practised throughout the NHS Breast Screening Programme (NHSBSP). Recent work has been published, particularly from the USA, advocating the use of wide-bore needle core biopsy for breast diagnosis. Debate continues as to the relative merits and roles of FNAC and wide-bore needle core (WBNC) biopsy. Core biopsy is more expensive in terms of needle cost. FNAC results may be available almost immediately after biopsy and some clinics operate a same-session reporting system. One major advantage of core biopsy is in pathological interpretation. The skills of an expert breast cytopathologist are not widely available and this may, in part, explain the wide variation of results of the NHSBSP Cytology Survey (data to be shown). Core biopsy, with its larger sample of tissue, offers advantages in providing additional information, such as tumour grade and whether an invasive cancer is present. Overall, the precise roles of WBNC and FNAC biopsies are still to be established. It is likely that it will ultimately be determined by such diverse factors as lesion type, the logistics of running a particular clinic and the availability of local expertise. The relative merits and disadvantages of the two procedures will be discussed.

0800–0845
Categorical Course
Vascular Interventional Radiology 3
Hall 10a

0800
Invited Review
Peripheral angioplasty and thrombolysis
M R E Dean
Department of Radiology, Royal Shrewsbury Hospital, Shrewsbury SY3 8XQ, UK
Peripheral angioplasty has an established role in the treatment of peripheral vascular disease. Femoral angioplasty is mainly used at the opposite ends of the disease spectrum; it is used in the treatment of relatively simple lesion in patients with intermittent claudication, whose symptoms do not justify a surgical operation, and it is used for more complicated lesions in patients with chronic critical ischaemia. In this situation infragenicular angioplasty is also undertaken as an alternative to a femorodistal by-pass graft. Aortoiliac angioplasty has, in the last 5 years, developed an expanded role following the introduction of arterial stents. Long iliac occlusions, complicated stenoses and extensive aortoiliac disease, which previously would have been treated surgically, are now regularly treated by endovascular methods. Thrombolysis now forms an increasingly large part of the vascular radiologists work. There is no absolute consensus on the optimium technique. Low dose infusion, high dose accelerated thrombolysis, mechanical thrombolysis and aspiration embolectomy all have their advocates. The techniques, indications, results and complications of peripheral angioplasty and thrombolysis will be presented.

0800–0845
Refresher Course
Nuclear Medicine in Oncology
Hall 10b

0800
Invited Review
The role of positron emission tomography (PET) in cancer management
M N Maisey
Radiological Sciences, UMDS, Guy's and St Thomas' Hospital, London SE1 9RT, UK
In the past 5 years positron emission tomography (PET) has moved from an almost exclusively research role in patho-physiology, to take an increasingly important place in the diagnostic applications of nuclear medicine. A number of technical advances have enabled this to occur which include: having reliable cyclotrons with relatively low running costs and a larger field of view; using high resolution cameras with a whole body capability; and an increasing appreciation of the potential role of ^{18}F-fluorodeoxyglucose (FDG) in cancer diagnosis and management. Clinical PET is used in cardiology, neuropsychiatric applications and oncology. Its use in oncology has shown the most rapid growth, now accounting for over 75% of most clinical PET studies world-wide. The principle applications of PET in oncology currently utilize ^{18}F-FDG; but there is potential growth in the use of many other positron-emitting tracers, some of which will find a role after being more fully evaluated. Using FDG and whole body or localized imaging, PET can be considered under five broad categories: (1) in the diagnosis of malignancy, (2) as a single investigation staging procedure, (3) in the detection of recurrent disease, (4) in monitoring treatment response, (5) in directing biopsy and treatment. The predominant malignancies for which PET now has an established role and where it has been well-evaluated include squamous cell carcinoma of the head and neck, non-small cell lung cancer, Hodgkin's and non-Hodgkin's lymphoma, breast cancer, colorectal cancer, malignant melanoma and recurrent brain tumour, with many other tumours being actively reviewed. The current clinical role of PET imaging in the management of patients with cancer and the relationship with other tracer and radiological nuclear medicine and radiological investigations will be summarized.

0800–0845
Refresher Course
Percutaneous Gastrostomy
Hall 11a

0800
Invited Review
Percutaneous gastrostomy and jejunostomy
P R Mueller and S L Dawson
Department of Abdominal Imaging and Interventional Radiology, Massachusetts General Hospital, Boston, MA 02114, USA

We have performed over 320 gastrostomies or jejunostomies over the last 10 years, using percutaneous gastropexy and placement of a large calibre gastrostomy tube during the initial sitting. Percutaneous gastrostomy is generally performed, either for feeding or gastric draining, in patients who have prolonged nasogastric nutritional needs, CNS injury or stroke, or who are victims of major trauma. A secondary group of patients is that population which has gastric outlet obstruction due to retroperitoneal or mesenteric malignancy, which obstructs the duodenum or antrum. In patients who have a history of chronic aspiration or reflux and in whom nasogastric feeding is intolerable, primary transgastric jejunostomy can be performed to place a tube beyond the ligament of Treitz and avoid the risk of aspiration of gastric contents. Under fluoroscopic guidance, a point midway between the superior and inferior margins of the inflated stomach is chosen, just distal to the incisura, in the proximal half of the gastric atrium. Local anesthesia is given at the four corners of a 2.5 cm square and a specially designed slotted needle which contains a T-tack fastener is plunged into the stomach. Gentle traction is applied to the tack and the crimp fittings on the outside portion of the suture which is attached to the T-tack will fix the stomach to the anterior abdominal wall at four points. Over the course of approximately 2 weeks (in patients without ascites) this gastropexy will form a fibrous adhesion to the anterior abdominal wall, sealing the tract for any potential leakage of gastric content into the peritoneum. After the gastropexy has been performed (this usually takes 10–20 min), the centre of the square is anesthetized and a 3–4 mm nick is made in the skin, which is then dissected deeply. The 18 gauge needle is once again thrust into the stomach and a guide-wire placed through it to allow placement of the gastrostomy tube through the centre of the gastropexy. With the guide-wire in the gastric lumen, progressive dilation is performed to allow placement of a suitable sized, peel-away introducer sheath. The introducer is used to allow placement of a 12, 14, 15 or 16 F gastrostomy tube, which is usually coiled in the antrum. The guide-wire is removed and contrast injected to confirm intragastric position. *Transgastric jejunostomy*: Transgastric jejunostomy is performed for the same reasons as percutaneous gastrostomy, but is especially indicated in patients with a history of aspiration or chronic gastro–oesophageal reflux. Our complication rate for over 320 gastrostomies is lower than reported surgical and endoscopic rates. We have approximately 5% minor complications and 1% major complications. This compares favorably with surgical reports of 7–12% minor complications and 5–10% major complications. The advantage of radiological gastrostomies over either of the other techniques is that it can be performed without general anesthesia and without the development of post-operative ileus. It can be easily converted into a jejunostomy. In addition, the technique can be performed despite the presence of tight esophageal strictures and, at least in our institution, is cheaper than either a surgical or endoscopic gastrostomy.

0800–0845
Refresher Course
Investigation of Neonatal Vomiting
Hall 11b

0800
Invited Review
Investigation of neonatal vomiting
A Sprigg
X-ray and Imaging Department, Sheffield Children's Hospital, Sheffield S10 2TH, UK

Vomiting in a child aged under 6 weeks can be a symptom of many diseases, including infection in any part of the body, or structural disease in the gastrointestinal tract. The commonest cause is gastro-oesophageal reflux. Bile-stained vomiting is always significant and malrotation must be excluded as a cause. Proximal intestinal atresias tend to present earlier than distal, but not all congenital abnormalities present before the child leaves hospital. US is a very useful technique to use on a vomiting neonate and is the diagnostic imaging modality of choice in confirming pyloric stenosis. Plain radiographs are fundamental to the diagnosis of other abnormalities, supplemented with appropriate GI contrast examination. An understanding of neonatal patho-physiology and close cooperation with surgical colleagues is essential in providing a useful imaging service.

0800–0850
Categorical Course
Musculoskeletal Ultrasound 3
Olympian Suite

0800
Invited Review
US of the infant hip
R Arthur
Department of Diagnostic Radiology, The General Infirmary at Leeds, Leeds LS2 9NS, UK

Since its introduction in the early 1980s US has been increasingly used in the diagnosis and management of congenital dislocation of the hip, now often referred to as developmental dysplasia of the hip. A number of approaches to the US examination have been proposed, accompanied by an even greater array of measurements, angles and indices. In general two basic approaches have been adopted: (1) the static evaluation, as described by Graf, based on a description of acetabular morphology; and (2) the dynamic method described by Harcke et al, based on an assessment of hip instability. This paper will review the merits of these two approaches and highlight their limitations. In addition, the arguments supporting the introduction of US as a primary screening tool will be discussed.

0825
Invited Review
Paediatric skeletal US
G Long
Department of Radiology, Sheffield Children's Hospital, Western Bank, Sheffield S10 2TH, UK

This is an overview of the use of musculoskeletal US in children (excluding developmental hip dysplasia). The potential role for musculoskeletal US is being increasingly recognized in adults, yet remains relatively under-used in paediatric practice. The incomplete ossification of skeletal structures confers an additional advantage for US in neonates and children. This combines with the non-ionizing and non-threatening nature of US to make it an extremely valuable modality for musculoskeletal imaging in children. Aspects which will be presented include the role of US in the investigation and differential diagnosis of hip pain in children, including irritable hip, septic arthritis, Perthes and slipped capital femoral epiphyses. The value of US in paediatric practice will be discussed under the following headings: *Trauma/inflammation*: including Osgood–Schlatter's disease, avulsion injuries, chronic traction injuries, occult fractures, foreign bodies and sesamoiditis. *Infection*: including septic arthritis, osteomyelitis, infected metal-ware and pyomyositis. *Lumps/bumps/swellings*: including vascular malformations, lymphangiomata, popliteal cysts, neurofibromata and lymphoedema. With wider recognition of its value, the use of musculoskeletal US in paediatric practice will hopefully expand; continuing improvements in US technology promise yet further advances.

0850–1000
Scientific Session
Spiral CT
Hall 1

0850
Invited Review
CT angiography
S C Rankin
Department of Radiology, Guy's and St Thomas' Hospital, London SE1 9RT, UK
In spiral CT the rapid acquisition of a volume of data obtained during high levels of circulating contrast, with no respiratory misregistration, has allowed the development of CT angiography. The ability to produce multiple overlapping slices with no increase in the radiation dose to the patient enables superb 2D and 3D reconstructions to be obtained from commercially available software. To produce optimal vascular images the following decisions must be made: (1) maximum duration of the breath-hold, (2) slice width, (3) distance to be covered, (4) the pitch and table speed, (5) volume of contrast and scan delay, (6) reconstruction index, (7) the field of view and (8) what post-processing of data should be undertaken. The rationale for these decisions will be discussed. The limitations of CT angiography and results of studies comparing it with angiography will be presented.

0920
Spiral CT measurement of blood flow and perfusion changes after liver tumour ablation
A D B Waldman, J Richenberg, M Baque and W R Lees
Department of Radiology, Middlesex Hospital, London W1N 8AK, UK
PURPOSE: Thermal ablation using interstitial laser therapy (ILT) has been shown to be effective in the treatment of liver metastases from colonic carcinoma, both in experimental animal models and clinical practice. We describe the use of dynamic CT to measure tissue perfusion in defined regions of the liver for assessment of lesion ablation and changes in local blood flow following ILT. METHODS & MATERIALS: Rapid sequential single-slice CT acquisition, following bolus injection of iv contrast, is used to measure the kinetics of hepatic arterial and portal phases of contrast enhancement from which quantitative tissue perfusion parameters are derived. These are compared in the metastases and adjacent liver parenchyma prior to, and at different times after treatment in a series of more than 15 patients. RESULTS: No significant arterial or portal phase enhancement is seen in completely ablated metastases. Up to a four-fold increase in hepatic arterial perfusion is observed immediately surrounding the metastases post-treatment, and more diffusely in the treated liver segment. This preferential enhancement is apparent within minutes of treatment and may persist for months. CONCLUSIONS: Loss of perfusion reliably monitors lesion ablation. Possible mechanisms for the surrounding hyperaemia and implications for growth of partially treated lesions and delivery of adjuvant chemotherapy are discussed.

0930
Biliary imaging by spiral CT cholangiography (CTC): a non-invasive alternative when endoscopic cholangiopancreatography fails
Z Sajjad, M Deakin, D J West, M Vaughan, J McCaig and J W Oxtoby
Department of Radiology and Surgery, North Staffordshire Hospitals (NHS) Trust, Princes Road, Hartshill, Stoke-on-Trent, Staffordshire ST4 7JL, UK
Following iv infusion of biliary contrast medium, meglumine iotroxate, spiral acquisition CT was carried out in 60 patients (21 male and 39 female patients, age range 19–78 years). Of these, 27 had undergone failed endoscopic cholangiopancreatography (ERCP). Diagnostic images were obtained in 59/60 patients. Biliary tract pathology was identified in 43 patients. Of these, 25/43 had gall bladder stones which had been identified on previous US scans but, more significantly, 18/43 had common bile duct (CBD) pathology which had not been definitively diagnosed on other imaging. Of these 18, 12 had CBD stones, five had primary duct/ampullary stenosis and one patient had a post-operative stricture. In two patients other significant intraabdominal pathology was picked up on the source images (one CA oesophagus, one pancreatitis). Of particular interest was the group of patients which had failed ERCPs. Diagnostic images were obtained in all of these 27 patients. Significant abnormalities requiring further intervention were found in 13 patients. None of the patients had significant complications. We conclude that CT is a valuable, additional, non-invasive, biliary imaging technique and is of particular value when ERCP has failed.

0940
Peripheral cholangiocarcinoma: three phase helical CT appearances
J H Lim, K T Yoh and W J Lee
Department of Radiology, Samsung Medical Center, Seoul 135-230, Korea
PURPOSE: To describe the morphological characteristics of peripheral cholangiocarcinoma on three-phase helical CT. MATERIALS & METHODS: Three-phase helical CT scans of 22 tumours in 21 patients (18 men and 3 women, aged 39–77 years) with pathologically-proven cholangiocarcinomas were reviewed by three radiologists. All CT scans were obtained at 30 s, 70 s, and 180 s after starting bolus injection of 100 ml nonionic contrast media at a speed of 3 ml s^{-1} for hepatic arterial, portal venous, and equilibrium phases, respectively. RESULTS: 19 tumours (86%) showed low attenuation masses with stippled or septated central enhancement in portal and equilibrium phases. A linear, dense, marginal enhancement was seen in 13 cases (59%) in arterial phase. A thick, bandlike peripheral enhancement was seen in 17 cases (77%) on either portal phase or equilibrium phase. Associated findings were wedge-shape transient parenchymal enhancement at the periphery of the masses (72%), satellite nodules (68%), focal bile duct dilatation (54%), umbilication of the hepatic surface (45%) and diffuse peripheral bile duct dilatation (45%), representing evidence of clonorchiasis. CONCLUSION: Three phase helical CT is helpful in the diagnosis of peripheral cholangiocarcinoma by analysing the morphological characteristics of the masses and associated findings.

0950
Dual-phase helical CT in the evaluation of hepatic and extrahepatic tumours
H Schwarzenberg, F Wesner, J C Steffens and M Heller
Department of Radiology, University of Kiel, Kiel 24105, Germany
PURPOSE: To evaluate dual-phase helical liver CT (DP-CT) in the imaging of hepatic and extrahepatic tumours. METHODS & MATERIALS: DP-CT (120 kV, 210 mA, collimation: 10 mm, table speed: 10 mm s^{-1}) was performed in 114 patients with carcinomas of pancreas ($n=54$), bile ducts ($n=16$), colon ($n=10$), hepatocellular carcinoma ($n=10$) and other tumours ($n=24$). After unenhanced CT scanning, 120 ml of contrast material (300 mg %, 4 ml s^{-1}) were injected. Scan delay of the hepatic arterial phase (DP-CT/1) was 20 s and for the portal venous phase 60 s (DP-CT/2). Regions of interest were obtained from the three phases in 40 cases. CT findings were correlated with the operative results in 25 cases. RESULTS: Mean attenuation of the liver was $54 \pm 13/71 \pm 15/95 \pm 21$ HU (unenhanced CT/DP-CT/1/DP-CT/2). 53 hepatic lesions were detected in DP-CT/1 compared with 36 in DP-CT/2 ($p<0.05$). Good quality imaging of extrahepatic structures was achieved. CONCLUSION: DP-CT/1 is superior in the detection of hypervascular lesions compared with DP-CT/2. The proposed scan parameters are suitable for the detection of liver lesions, as well as for imaging extrahepatic structures and tumours.

0900–1020
State of the Art Symposium
Environmental Radiation
Hall 9

0900
Studies of radiation dose to NHS staff from radon: the benefits of air-conditioning and the effectiveness of remedial work
A R Denman, S P Barker, F Marley and P Phillips
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On average 50% of radiation dose received by the general public is caused by radon gas or, to be more precise, the deposition of radon daughters in the lung. In Northamptonshire radon gas levels are sufficiently high that the county has been declared a "Radon Affected Area". Studies of the temporal variation of radon gas and the occupancy of buildings have shown that NHS staff can receive doses of up to 21 mSv per annum. Studies in operating theatres have shown that the radon gas level is around 30% that of adjoining rooms without air-conditioning and that the gas levels are dependent on the air-conditioning cycle, rather than occupancy. Radon

daughters show a similar variation, but are lower than expected. As a consequence, radiation dose to operating theatre staff is around 15% of that to staff in adjoining rooms. (The authors acknowledge the loan of equipment and the encouragement of Tracey Gooding at the NRPB for this aspect of our work.) The same techniques have been applied to locations where remedial work, such as an underfloor sump and extraction fan, has been necessary to reduce radon levels. The staff-dose reductions achieved can be up to a factor of 10, but are less substantial than the reduction in average radon levels where staff work normal office hours. The cost-effectiveness of the remedial work will be considered.

0920
Invited Paper
Personal dosimetry measurements of the radon-related dose to the basal layer of the skin
J P Eatough
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Radon is a naturally-occurring, radioactive, noble gas which is ubiquitous in both indoor and outdoor air. It decays to a series of short-lived radioactive decay products, which include the α-particle emitters ^{218}Po and ^{214}Po. These decay products can attach to surfaces in the environment, including human skin. α-particles emitted from these radionuclides on the skin surface may irradiate the skin's outer layers, including the basal layer from which radiation-induced stochastic effects in the skin are assumed to originate. Personal dosimetry measurements have been undertaken to improve estimates of the radon-related dose to the basal layer of the skin for normal environmental conditions. These measurements have utilized novel personal dosemeters incorporated into wrist-watches. 40 volunteers selected through hospital medical physics departments wore both a wrist-watch dosemeter and a personal radon dosemeter continuously for a period of around 1 month. Each wrist-watch records the total number of α-particle events on the detector surface and allows events arising from ^{214}Po and ^{218}Po to be identified specifically. With this information the α-particle radiation dose to the basal layer can be determined at a given radon exposure. The basal layer dose varies with anatomical location, due to epidermal thickness and because many areas of skin are protected by clothing. The highest dose is received by the face and initial results suggest a dose rate of 10 mSv per year at the average UK radon exposure of 20 Bq m^{-3}. This is in good agreement with previous theoretical predictions and corresponds to a lifetime dose of the order of 0.5 to 1 Sievert. Correspondingly higher doses are received at elevated radon concentrations. Acknowledgements: This work is supported by the Department of Health under the "Radiation and Public Health Research Programme".

0945
Invited Review
Childhood thyroid cancer after Chernobyl
O V Epchtein and M A Zymovets
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Over the last 10 years, we have followed-up children who have been exposed to radiation and found no increase in hypothyroidism and autoimmune thyroiditis. But since 1990 the incidence of thyroid cancer in children has dramatically increased in the Ukraine. During 1981–1985, only 25 cases were registered in paediatric patients. During the 10 years after the Chernobyl accident, 239 cases in the 0–14 age group have been registered. The incidence of childhood thyroid cancer was 0.04–0.05 per 100 000 children before the accident, 0.43 per 100 000 in 1992, and 0.39 per 100 000 in 1993. It should be stressed that 63.3% of children with thyroid cancer live in the six most contaminated regions of the Ukraine. In our opinion, thyroid cancer treatment has to include surgery (thyroidectomy and monolateral or bilateral cervical nodal dissection, if necessary) as the primary method of treatment. Further diagnostic scanning using orally administered ^{131}I is necessary for detecting any post-surgical remnant. Whole body scintigraphy is used for the detection of regional and distant metastases. Radioactive iodine is the best isotope for supplementary ablation therapy and for definitive therapy in differentiated tumours of papillary or follicular cell type. All children have to receive thyroid-stimulating hormone suppressive therapy after surgery.

1010
Cellular immunity of individuals accidentally exposed in the 1986 radiological accident in Chernobyl
E Bayeva, V Sokolenko, S Melnik and S Khomenko
Department of Physiology, Cherkassy State University, Cherkassy 257000, Ukraine
PURPOSE: To determine the effects of low dose radiation on cellular immunity. MATERIALS: The patients were divided into three groups. Group one consisted of people who lived within 30 km of Chernobyl power nuclear station (CPNS) and who, after the radiological accident, had been evacuated to the city of Cherkassy. Group two comprised people who dwelt in central Ukranian cities (1986–1996) where radioactive contamination is 1 mCi km^{-1}. Group three were residents from radiation-free areas in the Ukraine. METHODS: Total leucococyte counts and proportion of lymphocytes were measured. The study was carried out by immunofluorescence staining with anti-CD3, CD4, CD5, CD8 antibodies and FITS-conjugated human anti-mouse antibodies. RESULTS: CD3+ lymphocyte studies were not statistically different in the participants who had been injured in the radiological accident from control subjects. The present study showed that people who were evacuated from areas within 30 km of CPNS have a decreased proportion of CD4+ cells, although numbers of T-helper lymphocytes were stable. On average, they received 0.14 (range 0.04–0.25) Gy external irradiation before being evacuated to Cherkassy. In contrast, patients who have been exposed to low doses of irradiation over 10 years, show decreases in both the proportion and absolute number of CD4+ lymphocytes. All measures of CD8+ lymphocytes were similar in both groups injured by radiation and were basically normal. A rare T-cell subpopulation, CD4− CD8− T-cells, may be differentiated through a pathway different from the pathway of conventional CD4+ or CD8+ T-cells. A significant increase in the frequency of these cells was found in people who had been injured in the radiological accident in Chernobyl.

0900–1000
Scientific Session
*info*RAD™ 3
Hall 10a

0900
Invited Review
IT issues in the Calman recommendations on the reorganization of cancer services
J Milan
Department of Computing and Information, The Royal Marsden NHS Trust, Sutton SM2 5PT, UK
The Calman recommendations are that cancer services should be provided by cancer units specializing in the commoner types of cancer, working with cancer centres which deal with a wide variety of diseases and treatments. Within the NHS internal market purchasers will progressively seek to purchase cancer services from designated units and centres, and seek to ensure that they get value for money with respect to both the costs and quality of care. Purchasers and providers will need to use standardized "currencies" associated with specific types and stages of cancer for quantifiable units of surgery, radiotherapy, chemotherapy and other types of cancer care. The effective capture of cancer currencies, their proper classification and the robust communication of them between units, centres and purchasers presents formidable IT problems, some of which are common to general acute care and some specific to cancer. This paper discusses the initiatives which are being taken by the NHS Management Executive with respect to data classification and communication, considers the significance of these to the reorganization of cancer services and discusses what further needs to be done to fully realize the benefits of the Calman recommendations. It will also discuss the work which has been done at the Royal Marsden NHS Trust on cancer currencies and the information systems which have been developed to routinely capture and monitor them.

0940
Clinical oncology MAISY: an integrated, computerized audit and administrative system
A Benghiat, W V Steele and V Saunders
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Clinical oncology MAISY is a custom-designed, paradox-based clinical and administrative system devised by the Clinical Oncology Department at Derbyshire Royal Infirmary and commercially available through the software writers, Compucorp. Designed in accordance with NHS IMT strategy principles, with consideration for the overlapping needs of clinics, secretarial and other staff, information need only be input once, to be shared among all appropriate members of the clinical team. With network access from 17 terminals sited in radiotherapy treatment units, examination rooms, wards and offices, key elements of the patients' history, diagnosis, treatment and follow-up can be captured and made immediately available on-line for action and analysis. Key features of the system

include: interface with hospital PAS via "Reflections" software for direct down-load of patient demographic and GP data; integral interface with MS "Word" for production of notes annotations, discharge summaries etc.; comprehensive, user-defined "response" dataset (including ICD10 diagnostic codes) enabling double-click data entry; integral Paradox report-writer, facilitating production of routine and *ad hoc* management, contracting and audit reports; and integral security features restricting read/write access to appropriate personnel. MAISY has now been used successfully for over 2 years by clinicians, radiographers, managers, nursing, pharmacy, secretarial and audit staff to input, view, report and analyse history, diagnostic, treatment and outcome data, accumulating a valuable dataset of over 2000 patient treatments and outcomes.

0950
Developing your own radiological management system
H K Chow
Department of Radiology, Kings Mill Centre, Sutton-in-Ashfield NG17 4JL, UK
PURPOSE: To show it is possible for a non-computer expert to develop and implement a successful radiological information system (RIS). MATERIALS: IBM compatible personal computer and Access 1.1. METHOD: Newark Hospital X-ray Department perform approximately 18 000 examinations per annum. In 1995 the X-ray Department did not have an RIS but used a local area computer network linking various computers within the Central Nottinghamshire NHS Trust. A decision was made in 1995 to design and implement our own RIS based on Microsoft database Access 1.1. No programming language was necessary in writing the RIS software. Staff training was given during a pilot trial of the RIS. RESULTS: Design and implementation of a successful and low cost RIS system which has been running successfully for over a year. CONCLUSION: It is worth considering developing your own RIS for a small X-ray department which may not be able to afford a commercial system.

0900–1045
State of the Art Symposium
Nuclear Medicine / Breast Imaging
Hall 10b

0900
Invited Review
Unsealed source therapy for solid tumours
V R McCready
Department of Nuclear Medicine, The Royal Marsden Hospital, Sutton, Surrey SM2 5PT, UK
Successful therapy depends upon a high radiation dose being delivered to the tumour. Experience with thyroid carcinoma has shown that doses of the order of 300 Gy are required for total ablation. This dose is difficult or impossible to deliver with external beam therapy and it is possible that when other tumours recur they do so as a result of sub-optimal irradiation. Unsealed radioactive sources provide an alternative method of delivering radiation to solid tumours. A variety of novel labelled compounds are becoming available for clinical use. These include precursors, such as MIBG; receptor-based compounds, such as Octreotide; or antibodies. However, due to problems in delivery of the labelled compound from the circulation to the tumour, sub-optimal uptake may take place. An alternative method is to inject the labelled compound directly into the tumour. The combination of a suitable radionuclide and carrier provides new exciting methods of delivering high radiation dose with minimal radiation outside the tumour. This method may provide a means of total ablation of primary tumours, enabling chemotherapy to be given for any early secondary spread.

0930
Invited Review
Nuclear medicine in the detection of primary and secondary carcinomas of the breast
P J Ell
Department of Nuclear Medicine, The Middlesex Hospital, London W1N 8AA, UK
Despite all recent advances with imaging technology, in general the management of a patient presenting with a suspected carcinoma of the breast continues along traditional lines: physical examination, mammography and, when deemed necessary, biopsy. As a consequence of the progress achieved in imaging in general, a number of newer imaging modalities are attempting to alter the above described, conventional approach. Amongst these, US, MRI and nuclear medicine tracer techniques have all expanded considerably in this field. It is the purpose of this presentation to review the contribution made by nuclear medicine in breast imaging and the management of a patient with suspected disease. The presentation will review the role of PET and glucose-scanning, the role of SPET with isonitrile, methylene diphosphonate, thallium chloride, receptor and monoclonal scintigraphy. Data from a European multicentre trial, involving 246 patients, comparing MIBI scintigraphy with mammography and biopsy, will be reviewed. The significance of the findings will be discussed in the light of the merits and difficulties encountered. Brief mention will be made of efforts to develop specific radiation detectors for breast imaging and radionuclide tracer methods.

0950
Invited Review
Detection and diagnosis of small breast cancers
M J Michell
Breast Screening Assessment Unit, King's Healthcare NHS Trust, Denmark Hill SE5 9RS, UK
The main benefit to the population from X-ray mammography is a reduction in mortality from breast cancer due to treatment of small (less than 15 mm diameter) tumours detected by systematic mammography screening. Audit of small cancer detection rates, together with analysis of interval cancers and incident screen cancers, has suggested that the sensitivity for detection of small cancers can be improved both by improving the screening test (optimal target film density 1.4–1.8; two-view mammography for prevalent screens) and by improving the standard of radiological interpretation of screening mammograms. "Minimal sign" breast cancers may be perceived on screening mammograms if particular attention is paid to asymmetrical opacities occurring in the forbidden zones and to secondary signs of malignancy, such as parenchymal deformity. These signs are illustrated and their imaging work-up is discussed. Modern techniques of imaging-guided needle biopsy of small, mammographically detected abnormalities allow a positive pre-operative diagnosis of malignancy to be made in up to 90% of cases, thereby reducing benign surgical biopsy rates and allowing therapeutic surgery for malignant cases to be planned for the first operation. Imaging guidance is either by stereotaxis or US; needle biopsies are either fine needle aspiration for cytology or core biopsy for histological examination. In deciding which techniques to use the facilities available must be considered, together with the likely underlying pathology of the lesion. The advantages and disadvantages of the different biopsy techniques available are discussed.

1010
Invited Review
US in breast imaging
E Moskovic
Department of Diagnostic Imaging, Royal Marsden Hospital, Downs Road, Sutton, Surrey SM2 5PT, UK
High resolution breast US plays an invaluable role in the assessment of both benign and malignant breast disease and is now frequently found in breast diagnostic units, surgical out-patient departments and assessment clinics, as well as in the general radiology department. The advantages of breast US in experienced hands include economy, safety and speed, as well as the obvious usefulness of on-the-spot aspiration cytology. Patient preference over mammography is commonly commented on. Whilst traditionally US has been used for differentiating solid from cystic lesions, particularly if mammographically detected, large numbers of younger "breast-aware" symptomatic women are now referred for diagnostic scans, which can provide rapid, safe and reliable reassurance. Young women at high risk of developing breast cancer can also be reviewed in this way and US is the diagnostic method of choice for evaluating lumps in pregnancy. An increasing number of breast localizations are now undertaken using US guidance under "direct vision", which avoids the discomfort of breast compression, waiting for films to be processed and re-positioning of wires. At this institution (Royal Marsden Hospital) breast US constitutes the single most commonly requested US scan, constituting up to 40% of the overall work-load, and we are now performing over 600 US-guided breast procedures (cyst aspirations, fine needle aspiration cytology and localizations) per year. US is the most accurate method of measuring the size of breast carcinomas and is subsequently easy to use in monitoring response to chemotherapy. Information about tumour vascularity can be obtained using Doppler facility and, if needed, US can be used to aspirate axillary nodes. Breast implants are readily imaged safely and rapidly with US, which can detect implant rupture and can be safely used to aspirate lesions around a prosthesis.

1030
Discussion

0900–1000
Invited Review Lecture
Assessment Procedures for Radiologists
Hall 11b

0900
Invited Review
General Medical Council—assessment procedures for poor performance of radiologists
B Ayers, P Armstrong, A Chalmers, G Roberts and D Slimmon
General Medical Council, London, UK
The General Medical Council has the responsibility through Parliament to protect the public by ensuring that good standards of medical practice are maintained. Until recently, the procedures for qualified doctors have been limited to Health and Conduct issues, but from September 1997 the GMC will extend its activities to cover poor performance by doctors. In preparation, the GMC has set up working groups to identify the procedures to be used for the assessment of doctors referred for practising poor standards. The overall aim is to define areas of poor performance and to encourage correction whenever possible but to limit practice if necessary. The ultimate sanction is to remove registration. The principles underlying performance assessment need to be made common across all medical practice while being sufficiently flexible to encompass all specialties. In this session, the GMC Working Group for clinical radiology will present its work to date and explain how it is intended to collect evidence in a variety of ways, including interviews with medical and non-medical colleagues, in order to make such a judgement. This assessment cannot be a simple examination but has to be designed to test the actual practice of the doctor involved. The common misconceptions and apprehensions about the nature and intention of this process will be addressed. The session will consist of a presentation followed by a prolonged period for questions and debate and should be of interest not only to radiologists but to radiographers and other non-medical colleagues who may be asked to give evidence. The GMC's booklet *Good Medical Practice* is the starting point and could be usefully read in advance.

0945
Discussion

0900–1100
State of the Art Symposium
MRI in Paediatrics
Olympian Suite

0900
Invited Review
The role of MRI in children with epilepsy
L Abernethy
Department of Radiology, Royal Liverpool Childrens Hospital, Alder Hey, Liverpool L12 2AP, UK
Imaging of the brain in childhood epilepsy has a role which is different from that in adult patients. Congenital and developmental abnormalities are of considerable importance. Tumours and vascular disease are uncommon. In children, brain tumours are the cause of only 1–2% of all seizures and 4–6% of partial seizures. The diagnosis of epilepsy is clinical and a brain scan cannot confirm—or refute—a diagnosis of epilepsy. Classification of epilepsy syndromes is based upon the clinical and EEG findings, but brain imaging may help to define some specific epilepsy syndromes. The role of imaging is the identification of structural brain abnormalities. If a focal lesion is found, surgery may be curative. The identification of structural abnormalities may be important in predicting long-term outcome and in genetic counselling. Not every child with epilepsy needs a brain scan. Specific indications include: intractable seizures or relapse of seizures following a period of good control, neurological deficit, clinical signs of a neurocutaneous syndrome, developmental regression, simple or complex partial seizures, infantile spasms, myoclonic seizures, or "febrile" seizures in the first year of life. MRI is the preferred imaging technique as it has a unique capability to detect subtle structural abnormalities, such as disorders of neuronal migration and organization, hippocampal atrophy and sclerosis, and foreign tissue lesions (haematomas, neuroepithelial tumours, low grade gliomas). Imaging protocols must be tailored to the clinical and EEG features of the individual child, with thin-section volume imaging of areas of likely abnormality.

0925
Invited Review
Sedation or anaesthesia for paediatric MRI
S Chapman
Radiology Department, Birmingham Children's Hospital NHS Trust, Birmingham B16 8ET, UK
The ever-increasing demand for MRI is harder to sustain in paediatrics because of the uncooperative nature of a significant percentage of the patients. Diagnostic images may only be possible when the child is sedated or anaesthetized, but the major question is: which should be used? The Royal College of Radiologists and College of Anaesthetists recommend general anaesthesia as the safest way of inducing "deep sedation", but the lack of adequate numbers of trained paediatric anaesthetists prevents the running of a responsive service if these guidelines are followed. There is no doubt that, for the unit or radiologist with limited experience in managing children, the involvement of a skilled anaesthetist is essential. However, for many other MRI installations safe sedation is possible provided a number of prerequisites are fulfilled and each member of staff recognizes the role they play in providing a safe service. The lecture will cover the following points: the definition of sedation; responsibilities; facilities; patient preparation; high risk patients and conditions; sedation regimes; post-sedation care; published guidelines; and cost and throughput.

0950
Invited Review
MRI of the chest, abdomen and pelvis in children
K McHugh
Radiology Department, John Radcliffe Hospital, Headington, Oxford OX3 9DU, UK
This presentation gives an overview of the applications of MRI in the chest, abdomen and pelvis in children, with relevant examples and illustrations. MRI has a significant role to play in paediatric oncology, with most malignancies now imaged by a combination of US followed by MRI when feasible. Although CT continues to have superior spatial resolution in the lung parenchyma, MRI is the preferred modality for imaging the mediastinum, thymus and major airways. Cardiac MRI tends, unfortunately, to be underutilized. After plain radiology and sometimes US, MRI can have a useful role in a number of musculoskeletal conditions other than neoplasms. Similarly, there is an increasing role for MRI in paediatric gynaecological problems, including intersex states. Paediatric radiology tends to be a problem-oriented exercise on many occasions and MRI can often be very useful as a means to problem-solving, particularly in the paediatric abdomen. Faster sequences and perhaps oral contrast medium, not currently licensed in children, will expand the use of MR in children even further. Finally, it must be emphasized, however, that MRI should be integrated sensibly with other imaging modalities in children; clinical problems can frequently be solved by other imaging modalities at a fraction of the cost of MR without the need for sedation or anaesthesia.

1015
Invited Review
MRI in paediatrics
G H Sebag
Department of Pediatric Radiology, Robert Debre 48bd, Serurier, Paris 75019, France
During the last 10 years, MRI has developed into a major tool for imaging children because of its ability to study both anatomy and function (including blood flow, CSF flow, perfusion, spectroscopy and brain function) non-invasively and without making use of ionizing radiation. Furthermore, powerful post-processing workstations have enhanced image presentation and play a vital role in the effective display of MR information for clinical applications (3D, curved plane, surgery simulation and planning). Most recent developments have been towards more rapid imaging techniques in part to reduce problems of motion, the need for sedation and to study dynamic events. Common disorders and those in which MRI can play a major role in clinical care will receive the greatest emphasis, especially disorders of the central nervous system, musculoskeletal and cardiovascular systems. Finally, the issue of MR clinical efficacy and cost-effectiveness, in comparison with other imaging modalities, will be discussed.

1040
Discussion

0940–1020
Scientific Session
MRI of the Lower Gastrointestinal Tract
Hall 11a

0940
MRI with a dedicated intrarectal coil in the staging of rectal tumours
J M Curtis, L Miller, M J Hershman and C J Garvey
Academic Department of Radiology and the Anorectal Specialty Group, Royal Liverpool University Hospitals, Liverpool L7 8XP, UK
PURPOSE: To determine the accuracy of pre-treatment staging of rectal tumours using intraanal MRI (IAMRI). METHODS: IAMRI was performed in 20 patients using a dedicated intraanal coil on a Philips 0.5 T magnet. Axial T_1, T_2 and STIR sequences were obtained. Technical factors will be discussed. Histology, either from biopsy or resected specimen, was available in all cases. Intraanal US, using a 10 MHz probe, was performed on 10 of these patients and the limitations of this technique will be mentioned. TNM classification was routinely used for staging. RESULTS: T-staging was accurately determined in 18 of 20 patients. One patient was overstaged because of prior pre-operative radiotherapy giving a streaked appearance in the peri-rectal fat. One patient, showing vaginal invasion on MRI, was understaged on biopsy as T3 because a resected specimen was not obtained. Biopsy pathology can understage T4 tumours, IAMRI may yield more information. Nodal staging was only possible in seven of 20 patients. Five of seven patients were accurately staged. There was one false-positive and one false-negative. CONCLUSION: MRI with a dedicated intraanal coil is valuable for staging rectal tumours. Nodal staging was less reliable than tumour staging, but the number of cases of nodal sampling were small. Further work is needed to improve the accuracy of nodal staging.

0950
A comparison of endoanal MRI with surgical findings in perianal sepsis
N M deSouza, A Zbar, G J Gilderdale, R Puni and R E Steiner
Robert Steiner MR Unit, Hammersmith Hospital, London W12 0HS, UK
PURPOSE: To assess the value of endoanal MRI in perianal sepsis. METHODS: A prospective study using a specially designed internal receiver coil 12 mm in diameter and 9 cm in length. MRI was carried out in 10 patients (seven males, three females, 25–63 years old, mean 38 years) with simple cryptogenic perianal sepsis and in 11 patients (seven males, four females, 18–56 years old, mean 32 years) with complex recurrent disease. RESULTS: In those patients with simple perianal infection, abscess collections were intersphincteric (six), ischiorectal (two) and mixed (two). Endoanal MRI accurately detected 100% of abscesses and 80% of fistulae. In complicated cases, (multiple recurrences, sepsis secondary to inflammatory bowel disease or where the fistula track(s) traversed the main sphincter complex), endoanal MRI identified 85.8% of abscesses with 100% confirmation of abscess site and horseshoeing. Surgical and radiological concordance was present in 85.8% of fistulae with identification by MRI of the internal opening in 78.5%. CONCLUSION: Endoanal MRI provides high resolution images of perianal abscesses and tracks and their relationship to the levator plate. It is therefore recommended in the pre-surgical evaluation of perianal sepsis.

1000
MRI of perianal fistulae: STIR or SPIR?
S Halligan, J C Healy and C I Bartram
Intestinal Imaging Centre, St Mark's Hospital, Northwick Park HA1 3UJ, UK
PURPOSE: Correct treatment of fistula *in ano* depends upon accurate pre-operative assessment of fistula anatomy. MRI using STIR sequences has been shown to diagnose tracks which would otherwise be missed, but is time consuming. It has been suggested that T_2 imaging with fat-suppression (SPIR) is more sensitive to inflammatory change, a hypothesis tested by this prospective study. METHODS: 21 consecutive adult patients (15 male) undergoing MRI for suspected perianal sepsis were studied prospectively using a 1.0 T whole body system (Philips Gyroscan), and body coil. Initially, axial and coronal T_1 weighted turbo spin echo sequences were obtained (TR/TE 571/20, 256 × 256 matrix, FOV 375 mm, 6 mm slice thickness, 2 mm interslice gap, 3 NEX), followed by STIR (TR/TE 1500/15, 4 NEX) and SPIR (TR/TE 2588/70, 6 NEX) sequences using identical matrix, FOV and slice thickness. T_1 and STIR sequences were assessed on a workstation (Philips Easyvision) for the presence and location of sepsis and were subsequently compared with SPIR imaging. RESULTS: Active disease was diagnosed in 15 patients; three extrasphincteric fistulae, eight trans-sphincteric, one intersphincteric, and three superficial. Internal openings were identified in 12; anal in nine, rectal in two, and both in one. Six patients had supralevator involvement. In no case did STIR sequences fail to resolve inflammation seen subsequently on SPIR, despite reduced track intensity. In contrast, the anal sphincters and pelvic floor musculature were better resolved by STIR, leading to easier and more confident determination of fistula anatomy in eight of the 12 (67%). T_1 sequences were only helpful in one case, diagnosing ischiorectal fibrosis not apparent on other sequences. CONCLUSIONS: Although track intensity is greatest with SPIR imaging, the superior ability of STIR to resolve pelvic floor anatomy facilitates diagnosis of fistula geography.

1010
Criteria for local tumour staging in rectal cancer using high resolution fast spin echo (FSE) MRI: preliminary results
[1]G Brown, [2]C J Richards, [2]G T Williams and [1]M W Bourne
Departments of [1]Radiology and [2]Histopathology, University Hospital of Wales, Heath Park, Cardiff CF4 4XN, UK
PURPOSE: To establish reporting criteria by detailed comparison of thin slice MRI with histology. METHODS: 14 patients with rectal cancer underwent T_1 and T_2 weighted scans of the pelvis and thin slice MRI. Axial T_2 FSE scans through the rectal tumour were obtained using a pelvic coil, 3 mm slices and a 16 cm field of view. Following surgery, MRI of the rectal specimen was performed using the same technique. Each *in vivo* and specimen image slice was staged prospectively (TNM staging) and compared with the corresponding histopathological slice stage. The 14 specimen MRI scans provided 133 slices for analysis. RESULTS: All 14 patients were correctly staged pre-operatively by MRI. Low signal within the submucosa with preservation of the muscularis propria layer corresponded to T1 tumours on histology (positive predictive value, PPV of 84%). Low signal obliterating the submucosa/muscle interface with preservation of the outer muscle layer corresponded to histological stage T2 tumour, (PPV of 86%). Spiculation represented benign fibrous stranding rather than T3 tumour. The PPV for T3 as breach or loss of continuity of the rectal wall was 100%. The agreement for T stage between MRI slices and the corresponding histopathological slices was 88% ($\kappa = 0.84$). In three patients, tumour was incompletely resected; at laparotomy there was extensive spread of tumour with adjacent organ invasion. These were correctly staged by *in vivo* MRI scans as T4 tumours. CONCLUSION: Current pre-operative adjuvant therapy strategies require an accurate non-invasive method of tumour staging. These preliminary results suggest that thin slice MRI may achieve this.

1015–1145
Scientific Session
Breast Imaging
Hall 1

1015
Invited Review
NHS Breast screening programme
J Patnick
NHS Breast and Cervical Screening Programmes, The Manor House, Sheffield S11 9PS, UK
The NHS Breast Screening Programme is now approaching the end of its first decade of operation. Considerable progress has been made in delivering a high quality screening programme to the women of the UK but a number of exciting and important challenges remain for the future.

1045
Do disappearing calcifications matter?
H R Seymour, N A Sellars and R G Given-Wilson
Department of Radiology, St George's Hospital, London SW17 0QT, UK
PURPOSE: Spontaneously-resolving breast microcalcification is rarely reported and has not been documented in association with malignancy. We present 25 cases of disappearing microcalcification.

METHODS: A retrospective review of 95 806 screening mammograms in assymptomatic women revealed 25 with resolution of foci of microcalcification. Some were women with benign-appearing calcifications, which diminished on routine 3-yearly screening. The remainder had calcification considered indeterminate and were on more frequent review following full assessment (including fine needle aspiration cytology, FNAC). RESULTS: 12 women were identified with clearly benign microcalcification, which had either disappeared (six cases), or diminished in volume (six cases), at 3 year follow-up with no other interval changes. 13 women had indeterminate calcification and were assessed. 12 of these had benign cytology and were placed on early recall. Microcalcification diminished in all cases, but two subsequently developed histologically-proven malignancies which were then excised. One woman refused FNAC and underwent surgical excision biopsy which identified benign breast disease. CONCLUSION: We conclude that the majority of resolving microcalcifications are associated with benign processes. However, some indeterminate disappearing microcalcifications progress to malignancy. Any changes, including resolution, of indeterminate microcalcification should prompt full investigation.

TUESDAY

1055

Does incident-round screening work? A comparison of prognostic factors of prevalent and incident carcinomas

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PURPOSE: If incident-round mammographic screening is to save lives it must detect breast cancer when the time-dependent variables of size and lymph node stage are favourable. METHODS: The size, grade and lymph node stage of 252 prevalent-round and 116 incident-round invasive cancers were compared. RESULTS: Incident-round invasive cancers were of higher grade than prevalent tumours (24% *vs* 40% Grade 1, 36% *vs* 43% Grade 2 and 40% *vs* 16% Grade 3, $p < 0.000005$). Overall lymph node involvement (26% *vs* 25%), invasive size distribution and nodal stage for each grade of incident and prevalent tumours were not significantly different. Grade 1 tumours detected at incident screening were significantly smaller than Grade 1 tumours detected at prevalent screening ($p = 0.022$). CONCLUSION: Incident screening detects higher grade cancers at the same size and lymph node stage as prevalent invasive cancers. Given the similar cancer detection rates of prevalent- and incident-round screening, incident-round screening should have a greater impact on mortality than prevalent-round screening, by finding more Grade 2 and 3 tumours at small sizes. The smaller size of incident Grade 1 tumours indicates that the lead time of Grade 1 tumours is longer than the 3 year screening interval. If the screening interval was reduced to below the lead time for Grade 2 tumours, this may allow the detection of Grade 2 tumours at smaller sizes than in the prevalent-round, with a consequent impact on mortality.

1105

How reliable is modern breast imaging in predicting histological diagnosis in the symptomatic population?

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During the study period of January 1993 to July 1996, 6910 symptomatic patients were assessed in the Breast Unit of Addenbrooke's Hospital, Cambridge. Mammography was performed on 5650 patients and US on 2933 patients. In 1673 patients (24%) both mammography and US were performed. Mammographic and US appearances were prospectively classified between one and four (one—no significant lesion, two—benign lesion, three—possibly malignant, four—probably malignant). Histological confirmation following surgical excision was available in 569 patients, of which 309 were benign and 260 malignant. The imaging classification was correlated with histology in these 569 lesions. In predicting histology, the sensitivity and specificity of mammography alone was 78.6% and 83.1%, respectively, US was 88.7% and 78.3%, respectively, and mammography and US in combination was 94.1% and 67.3%, respectively. Only one patient had both a mammogram and US reported as normal (category 1 for both tests) in whom subsequent histology revealed a carcinoma. We will discuss the role and reliability of standard breast imaging and, in particular, the use of intensive US in this group of patients with symptomatic breast disease.

1115

Radiological features of breast cancer in young women

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PURPOSE: To review the presenting diagnostic features of young women with breast cancer. METHODS: Retrospective review of radiological and clinical features of consecutive breast cancers occuring in young women (below the age of 40 years) over a period of 3 years. Mammography and US scans were reviewed (double-read) by two breast-screening radiologists. Radiological features were correlated with cytological and histological findings, either from image-guided core or surgical open biopsy. RESULTS: 32 women under 40 years out of a total of 580 cancers (5.5%) formed the study group. Approximately 62% presented with either radiologically or clinically benign features. The most common feature was a vague asymmetrical density, but another common finding was a well-defined mass. The presence of a well-defined lump was found in all grades of tumour. In only 12 (38%) were the radiological features suspicious or diagnostic for malignancy. The diagnosis was commonly first indicated by cytology. Image-guided core biopsy was therefore obtained for confirmation, due to the disconcordance between clinical, radiological and cytological findings. CONCLUSION: Cancers in young women commonly present with benign clinical and radiological features and therefore demonstrate the importance of the triple assessment, with the addition of cytology and core biopsy.

1125

US findings in pure lobular carcinoma: comparison with matched cases of ductal carcinoma of the breast

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OBJECTIVE: To examine the US manifestations of pure lobular carcinoma of the breast and compare these with the US findings of matched patients with ductal carcinoma. MATERIALS AND METHODS: Patients attending St Mary's Breast Unit with a proven histological diagnosis of lobular and ductal carcinoma, in whom US was performed pre-operatively, either for diagnosis or to guide biopsy, were studied. 23 patients with histologically-proven pure lobular carcinoma were matched for age and clinical presentation with similar patients with histological ductal carcinoma. The US findings and certainty of diagnosis based on US findings were compared. The mammographic findings in these patients will also be presented. Image findings were graded as follows: U1/M1, diagnosis uncertain. U2/M2, benign findings. U3/M3, probable benign findings. U4/M4, probable malignant findings. U5/M5, malignant. RESULTS:

Lobular				Ductal			
U1	1	M1	7	U1	—	M1	4
U2	—	M2	—	U2	—	M2	—
U3	—	M3	1	U3	2	M3	—
U4	9	M4	6	U4	5	M4	7
U5	13	M5	7	U5	16	M5	11
Total	23		21		23		22

Three patients did not have mammography at the same time as US. CONCLUSION: Clinical and mammographic findings are sometimes confusing or inconclusive in lobular carcinoma. US is usually diagnostic and, although the numbers in each category are too small for statistical analysis, it seems that high frequency US is at least as accurate in the diagnosis of lobular carcinoma as it is in ductal carcinoma and is more specific than mammography.

1135

Interventional methods in breast diagnostics: ultrasonic guided high-speed core-cut biopsy

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PURPOSE: Evaluation of the clinical reliability of ultrasonic-guided, high-speed, core-cut biopsies ($n = 1498$) (1991–1995). MATERIALS & METHODS: From May 1, 1992 to April 30, 1993 we performed ultrasonic-guided, high-speed, core-cut biopsies in 307 patients after mammography and breast US examination. In 119 cases if the tentative diagnosis from breast imaging procedures

did not reveal any pathological findings and corresponded well with the histological findings of the core-cut biopsy we dispensed with further surgical or diagnostic procedures. In 188 women the biopsy was followed by surgery and the histology of the core-cut biopsy and of the specimen from surgery were compared. RESULTS: In the group of core-cut biopsies followed by operation, the histology of the core-cut biopsy showed a sensitivity of 98%, a specificity and positive predictive value of 100% and a negative predictive value of 91%. If we combine the results of all breast imaging procedures, including core-cut biopsy, then specificity, sensitivity, positive and negative predictive values reach 100%. CONCLUSION: In trained hands, after the experience of "$n=1498$" (1991–1995), the ultrasonic-guided, high-speed, core-cut biopsy is a reliable method for the histological diagnosis of breast lesions visible in US scans. This technique can avoid unnecessary operations under defined conditions.

1015–1135
Scientific Session
Radiotherapy & Oncology 4
Hall 10a

1015
Invited Review
Missing tissue compensation

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Dose inhomogeneity across the target volume (PTV) can be caused by the changing patient contour within the treatment field area (the amount of "missing tissue"). Compensation for missing tissue is usually by a fixed wedge or individually-made compensator. Construction (or selection) of this device requires multiple external contours of the patient throughout the area of the proposed treatment fields, which can be obtained from a variety of devices, some devices have computer software which automatically interprets and converts the amount of missing tissue into a compensator "map" and, via a compensator cutter, into a physical compensator. Bolus or wax can be used on the skin surface as a missing tissue compensator, especially when using mixed modality (electron and photon) beams, but increased skin dose will be a consequence. The use of traditional fixed wedges is common. Usually the wedge only compensates in one direction and two treatment fields irradiating the same area with the wedges in different orientations can be used. With the technological advance of "dynamic wedges", one of the beam-defining collimators moves across the radiation field during dose delivery, according to a pre-determined schedule, to produce a wedge-shaped treatment field. It is possible to produce a customizable beam shape, at least in one dimension. The dynamic use of multileaf collimators, where each individual leaf can be moved in conjunction with dynamic gantry rotation, will soon allow compensation in all dimensions. Treatment planning and quality assurance of such a system is another problem entirely! A further extension of dynamic beam production is "intensity beam modulation" (IBM) where the profile across the target volume from the BEV is extracted from CT information and converted into accelerator beam modulation instructions to compensate for variations in profile before it enters the patient. Faster CT scanners for radiotherapy scanning mean 3D CT information is often available for treatment planning. More non-coplanar radiation fields can be used which, with careful selection of beam direction and entry point, can reduce the requirement for missing tissue compensation. The increased complexity of treatments requires verification of dose delivery on the treatment machine. At present, positional information is obtained from EPIDs and studies are currently in progress to extract dosimetry profiles from these megavoltage images, both for the verification of the position of external compensators and the extraction of raw data required (using radiological thicknesses), to construct accurate compensators.

1045
MRI of the brain: applications in radiotherapy treatment planning

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PURPOSE: To demonstrate the practicality of using MRI alone as the basis for radiotherapy treatment planning. MATERIALS: All MRI scans were performed using a 1.5 T GE Signa. The therapy treatment position was replicated using a slotted flat bed insert and individually designed plastic head masks. Water filled 2 mm diameter tubes affixed to the mask provided appropriate reference points for planning treatments. METHODS: After acquisition of a localizer, a 3D gradient echo data set was acquired for clinical evaluation. A 2D FSE scan was then used as the basis for radiotherapy planning. An FSE scan was employed to minimize susceptibility effects and a bandwidth of ± 32 kHz was used to reduce chemical shift effects to a minimum. Data was then transferred to the planning computer. RESULTS: A total of 15 patients have been scanned. The target volumes defined by the MRI scans were compared with those obtained using orthogonal plain radiographs. No significant change to the position of the isocentre of the target volume was noted. There was a reduction in the length of the treated volume, undoubtedly due to better visualization of the tumour with respect to the surrounding anatomy. CONCLUSION: Previous workers have employed CT scans, in combination with MRI data, to plan radiotherapy treatments because of concerns over geometric distortions in MRI. Geometric distortions in our MRI scans were minimal, we utilized the most homogeneous part of the main magnetic and gradient fields. Water tube separation and target skin distance measurements revealed no evidence of distortions and were accurate to ± 2 mm. This work demonstrates that MRI can be used for radiotherapy planning in the brain without recourse to CT acquisition and subsequent image registration.

1055
Accelerator output fluctuation: the effect on megavoltage CT and portal image quality

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PURPOSE: The effects of linear accelerator output beam fluctuations on megavoltage imaging systems are analysed. MATERIALS & METHODS: For the purpose of this paper, experimentally observed variations are grouped into four classes: (1) initial stabilization of the accelerator output over the first few seconds; (2) low frequency spatial variation in output with the accelerator gantry stationary; (3) beam asymmetry as a function of gantry rotation; and (4) radiation isocentre movement as a function of gantry rotation. Experimental measurements are presented, obtained using custom-built imaging systems mounted on a Philips SL25 linear accelerator. RESULTS & CONCLUSIONS: Beam asymmetry and isocentre movement are found to be repeatable functions of gantry angle. The low frequency spatial output variations, however, appear to be sufficiently random that they cannot be corrected for in any systematic way, but are shown to be of low enough magnitude ($\pm 0.5\%$ total signal), and of a nature which means that they should not give rise to serious defects in output image quality. Sample CT reconstructions and portal images are presented from measurements showing the systematic fluctuations described.

1105
The role of the radiographer in electronic portal imaging

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Online imaging has been introduced as a result of technological advances in radiotherapy. Monitoring of patient position and field placement during treatment is possible, enabling differentiation between systematic and random error. Electronic portal imaging (EPI) has been in routine clinical use at The Royal Marsden NHS Trust (London) since September 1994. Treatment set-up time is not significantly increased using EPI, but time must be allowed for image assessment. In our centre, site specific imaging protocols have been established, defining guidelines for image assessment. EPI images are taken daily for the first week of a patient's treatment and "matched" to the simulator reference image by the radiographers, using the tools of the EPI software. Hard copies are reviewed by the clinician at weekly audit meetings. If a consistent field displacement is seen in the initial treatments, the clinician is notified immediately and appropriate action taken. EPI enables the radiographers to initially assess images and thus monitor reproducibility of treatment. Intervention is also possible if discrepancies are identified. Appropriate training for image assessment is essential but, once the skill is acquired, it is beneficial for routine daily treatment. We believe that the initial assessment of EPI images should be an extension of the radiographers role. As well as heightening job satisfaction, it also enables accuracy of treatment delivery to be effectively monitored.

1115

What to do with living, breathing, moving patients? The importance of patient positioning in radiotherapy

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A frequent problem with radiotherapy planning is that of patient movement during treatment. As methods in cancer treatment become more advanced and sophisticated, and treatment fields become better defined, there still exists the living, breathing, moving patient! For certain treatments a small movement may not be a problem, but for others even the slightest movement may be critical. Patient movement and inaccuracies in treatment may be greatly reduced by careful positioning and by the implementation of patient positioning and immobilization devices. With the progress of accurate planning computers, the use of CT scanners and highly sophisticated treatment units, the weakest link in the treatment accuracy chain is the patient. Accurate devices which can reproduce patient position from day-to-day and from unit-to-unit are vital. One example of a patient positioning device, which has improved patient set-ups at Plymouth, will be presented. Angled couch-top tilt-boards are often used for the positioning of patients undergoing radiotherapy for breast carcinoma. The reproducibility of set-up on a "home-made" and commercial board was assessed on 42 patients, using an optical outlining system installed on a treatment unit and simulator. The results indicate an improvement in set-up errors for 2° from 35% on the home-made board to 12% on the commercial board. This was thought to be due to improved stability and detailed graduated settings available for head and arm localization. From the study it would appear imperative that any positioning device affords individual reproducible daily set-up, quickly and efficiently on a treatment unit.

1125

Prostate cancer: endorectal coil MRI before and after external beam radiation

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PURPOSE: To determine the value of endorectal surface coil MR (Endo-MR) in the monitoring of patients with prostate cancer, before and after external beam radiation (EBR). MATERIALS AND METHODS: A prospective study was performed on 21 patients (57–74 years) with biopsy-proven prostate cancer. All patients underwent Endo-MR imaging prior to EBR (pre-EBR). The time interval between biopsy and MR examination was more than 3 weeks. EBR was delivered by high energy photons with a total dose of 70 Gy/35–38 fx/5 days a week. 6 months after EBR another Endo-MR examination was performed in 12 patients (post-EBR). We used a 1.5 T unit (Gyroscan ACS, Philips) performing T_1 and T_2 spin echo sequences in axial and coronal planes (slide thickness of 3 mm, FOC 210 mm). Imaging analysis of both pre- and post-EBR scans included the assessment of tumour size, prostate capsule involvement, infiltration of the neurovascular bundle and the seminal vesicles. RESULTS: Pre-EBR scans revealed eight patients with tumour Stage A and B, in whom surgery was not performed for cardiovascular or other medical reasons, and 13 patients with tumour Stage C. We obtained a variable pattern of changes following irradiation. Post-EBR scans showed residual tumours of decreased size in five patients and no residual tumour in two patients, one of them showed diffuse signal loss of the entire gland. No change in tumour size and signal intensity was found in five patients, two of them had concurrent hormonal therapy. PSA levels were decreased in all patients. CONCLUSION: Endo-MR provides important information for radiotherapy planning by accurate tumour staging and seems to be capable of demonstrating post-radiation changes in patients with localized prostate cancer.

Space resulting from late withdrawal of abstract.

1030–1200
Scientific Session
Gastrointestinal Tract
Hall 11a

1030

Invited Review

An update on imaging of the small intestine

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Plain radiographs and barium studies are the techniques most often used in the diagnosis of disorders of the small intestine. Plain radiographs remain the initial procedure in patients who present with suspected perforation or obstruction of the intestine. Barium examination is used to investigate the small intestine when symptoms present less acutely. The barium follow-through is the most widely used barium technique, although enterocylsis (small bowel enema) is replacing it in many centres. Enteroclysis gives excellent visualization of the jejunum and ileum and is ideal for demonstrating Crohn's disease, neoplasms and other intestinal disorders. It is useful in patients with suspected small intestinal obstruction when plain radiographs are normal. CT is playing an increasing role in the evaluation of the small intestine, particularly in patients with obstruction and in suspected intestinal infarction. Angiography and radionucleide studies continue to play an important role in certain selected cases. US has a limited role in the small intestine. However, unexpected intestinal disorders may be detected during US examinations of the abdomen.

1100

Staging oesophageal cancer: initial experience with MH-908 blind endoscopic US probe

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PURPOSE: Endoscopic US is the most accurate way of T and N staging oesophageal cancer. Unfortunately, the technique is often limited by the inability to cross a stenotic lesion with the Olympus UM-20 echoendoscope. Dilating the stricture, with its inherent risks, does not necessarily guarantee the echoendoscope will cross the lesion. Miniprobes, which are passed down the biopsy channel of an endoscope, are of limited use because of the high (20 MHz) frequency used. It is also difficult to accurately steer the miniprobe to obtain good images of the oesophageal wall. We present our initial experience with the Olympus MH-908 blind probe. MATERIALS & METHODS: 18 patients with oesophageal cancer, who on endoscopy were thought to have a lesion that could not be crossed by the large UM-20 echoendoscope without prior dilatation, were staged with the MH-908 probe. The probe is introduced over a guide wire and, as there are no fibreoptics, has a diameter of only 8 mm. It is fully steerable, like an ordinary endoscope, and operates at 7.5 MHz allowing good tissue penetration. RESULTS: In all 18 patients, T and N staging of the tumour was possible. Coeliac nodes were also assessed in 15 patients. We describe the technique used, illustrated by examples of local and nodal staging of the disease, before and after radiochemotherapy. CONCLUSION: With the

more widespread use of pre-operative radiochemotherapy, accurate staging of oesophageal cancer is becoming increasingly important. The Olympus MH-908 probe allows reliable staging of stenotic lesions without the risks of oesophageal dilatation.

1110
^{18}F-FDG PET scanning in gastrooesophageal adenocarcinoma: evaluation and quantitation

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PURPOSE: To evaluate ^{18}F-FDG PET in gastrooesophageal adenocarcinoma and to quantify tumour activity pre- and post-chemotherapy. MATERIALS & METHODS: 14 patients with gastrooesophageal adenocarcinoma had conventional imaging. 10 patients were randomized to immediate surgery or neoadjuvant chemotherapy. In the latter group CT and PET scans were repeated pre-operatively. The remaining four patients went on to receive palliative treatment. Quantitation of tumour activity in pre- and post-chemotherapy scans was performed using tumour : liver ratios (TLR). RESULTS: Primary tumour was detected in the 19 scans. Regional node activity could not be visualized separately. Increased focal hepatic uptake of isotope was confirmed in two of the four cases of liver metastases identified on CT. Bone metastases were detected in one patient. TLRs ranged from 1.8 to 4.7 pre-chemotherapy. Post-chemotherapy TLRs fell in two cases but there was no subjective decrease in the area of distribution of activity. Three showed no change in TLR but decreased area of activity. CONCLUSION: PET is effective in detecting the primary tumour. Tumour activity can be quantified using TLRs. More patients and longer clinical follow-up is required to assess the value of PET imaging parameters in monitoring tumour response.

1120
Comparison of FDG PET and CT in the staging of oesophageal carcinoma

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PURPOSE: To evaluate the accuracy of FDG PET and CT in the staging of oesophageal carcinoma. METHODS: This study involved a group of 20 patients with oesophageal carcinoma. Half-body PET images were obtained 30 min following iv injection of 350 Mbq of ^{18}F-FDG. Attenuation-corrected local views of the oesophagus were also acquired. The images were evaluated semi-quantitatively, using standardized uptake values and visual analysis. 10 mm axial CT images of the thorax and abdomen were obtained with oral and iv contrast and were interpreted independently of the PET scans. In 15 operable patients PET and CT data were correlated with surgical and histological findings for the primary tumour, perioesophageal and left gastric lymphadenopathy, and liver metastases. In five inoperable patients CT and PET findings were compared. RESULTS: PET identified all primary tumours, one was missed by CT. In the operable group perioesophageal nodes were demonstrated by PET in three patients and by CT in four patients. Left gastric nodes were identified by PET in one patient and by CT in six. One patient had liver metastases detected by PET but not CT. In the inoperable group CT and PET demonstrated liver metastases in one patient. Omental disease was identified by PET and CT in one patient, with visualization of ascites by CT. CONCLUSION: PET offers no advantage over CT in staging local disease. PET is worse than CT for identifying perioesophageal and left gastric nodes due to poorer anatomical resolution of PET. CT and PET are complementary for distant metastases with CT providing anatomical localization.

1130
The non-ionic water-soluble contrast small bowel meal: clinical relevance and surgical correlation

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AIMS: The use of non-ionic water soluble contrast (NIC) to examine the small bowel is described infrequently. The aim of our study was to determine the influence of NIC small bowel meal (SBM) on clinical management and to correlate the results with surgical findings. METHODS: NIC SBM examinations were performed on patients with a diagnosis of suspected small bowel obstruction, following clinicoradiological discussion. 100–150 ml of NIC was administered orally or by nasogastric tube, with abdominal radiographs as appropriate. Subsequent course was determined from review of hospital records. RESULTS: 20 patients (age 35–95 years, median 74 years) were examined, 10 of whom subsequently underwent laparotomy and 10 of whom were managed conservatively. In each group, five showed definite radiological small bowel obstruction on plain film. Indications for NIC SBM included possible obstruction (14 cases, eight with known malignancy), post-operative obstruction/ileus (five cases) and faeculent wound discharge and distension in a patient with known Crohn's disease (one case). Of patients undergoing laparotomy, on NIC SBM six showed complete obstruction, three partial obstruction and one normal findings. Patients managed conservatively showed one retroperitoneal perforation, confirmed at post-mortem, and one complete obstruction. Findings at laparotomy included metastatic involvement (three), adhesions (two), primary pelvic malignancy (two), caecal carcinoma (one), gall stone ileus (one) and mesocolic hernia (one). In 18 of the 20 cases NIC SBM was helpful to the surgeons in deciding whether laparotomy was required. CONCLUSIONS: NIC SBM is a useful investigation when considering surgical intervention in patients with a difficult diagnosis of small bowel obstruction.

1140
Small bowel volvulus: value of CT in the pre-operative diagnosis

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PURPOSE: To determine the value of CT in the detection of small bowel volvulus and related strangulation, in patients with intestinal obstruction. METHODS & MATERIALS: The study group included 20 patients with a surgically documented small bowel volvulus and a pre-operative CT examination of the abdomen. Cases were collected consecutively over a 40 month period. CT results were prospectively analysed and readers were asked to check the presence of small bowel obstruction, small bowel volvulus, incarcerated obstruction, and strangulated obstruction. CT findings were thereafter correlated with the surgical findings. RESULTS: CT enabled the preoperative diagnosis of small bowel occlusion in all cases and the specific diagnosis of small bowel volvulus was achieved in 13 patients (65%), without a significant difference in frequency in patients with or without irreversible ischemia at operation. The final diagnosis of incarcerated small bowel was achieved in 95% of the cases. Severe strangulation was established on CT in 13 patients on the basis of a delayed enhancement of the bowel wall ($n=2$) and/or mesenteric haziness ($n=13$). 10 of these patients underwent bowel resection for irreversible ischemia ($n=5$) or bowel necrosis ($n=5$) and three had a still viable intestine after derotation and adhesiolysis. No single CT sign of strangulation was observed in seven patients; none of them underwent bowel resection. The final diagnosis of small bowel volvulus and/or severe strangulation was pre-operatively achieved in 18/20 patients (90%). CONCLUSION: With improved technology and increased confidence in image interpretation, high resolution CT of the abdomen allows sensitive detection of small bowel volvulus and related strangulation.

1150
Contrast herniography, a useful investigation for groin pain?

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PURPOSE: To assess whether contrast herniography was of value in the diagnosis and management of clinically occult groin pain. MATERIALS: The study comprised a retrospective audit of 82 consecutive examinations performed over 3 years from 1994 to 1996. METHODS: The results of contrast herniography were reviewed and compared with clinical outcome. A satisfactory clinical outcome was defined as discharge from the outpatient clinic, with resolution of symptoms, following either surgical exploration or conservative management. RESULTS: 82 herniograms were performed. 79 had notes available for review. 25 examinations were positive. All had surgical exploration which confirmed the radiological findings. Outcome was satisfactory in all cases. The remaining patients had conservative treatment. 80% of these were discharged within two subsequent outpatient visits. Of 11 patients with persistent symptoms, six had surgical exploration, despite negative herniography. Three had hernias demonstrated. In all these cases, the time interval between the herniogram and surgery was greater than 6 months. CONCLUSION: Herniography is a useful examination in the diagnosis of clinically occult groin pain. It has a pivotal role in deciding which patients should undergo surgery and which should be managed conservatively. Patients with persistent symptoms despite conservative treatment might benefit from a repeat herniogram to assess interval change prior to any surgery.

1035–1200
Scientific Session
Radiography—Diagnostic Imaging & Radiotherapy
Hall 9

1035
Radiography reporting in a community hospital
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South Tees Acute Hospitals NHS Trust is a large acute Trust sited mainly in three acute hospitals in Middlesbrough, UK. The Radiology Division also provides a radiographic service to three community hospitals in East Cleveland, using single-room Departments. This paper describes the Department's approach to initiating radiographer reporting at one of the community hospitals, Stead Memorial Hospital in Redcar. The paper will contrast the approach of academic certification for radiographer reporting currently being pursued in one of the acute hospitals, Middlesbrough General, where there is a large Accident and Emergency Centre. In the community setting, radiographer reporting has been on a very practical basis, with training from radiologists within the Department and auditing of performance. In a study of 1000 examinations used to assess accuracy of reporting and using the radiologists as the "gold standard", the community radiographer demonstrated specificity and sensitivity rates in excess of levels expected of successful academic candidates. The paper will also consider how these two approaches, *i.e.* academic and practical, may be used in tandem for the future.

1045
The design and testing of an instrument to measure the effectiveness of continuing professional development
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This research was funded by the Kodak Radiography Management Travel Award 1996. Continuing professional development (CPD) is currently being promoted as a high priority issue within imaging departments. The impetus for this has come from the review of the Professions Supplementary to Medicine Act and the College of Radiographers response to this. CPD is seen as; "...continuous and systematic maintenance, improvement and broadening of knowledge and skills along with the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner's working life..." (College of Radiographers 1996). However, no research has been undertaken to assess the effectiveness of CPD or its impact in the clinical situation. Consequently, managers are not being guided in the most cost-effective way to maintain and enhance standards in their departments. At best the "Happiness Index" (Diamond et al, 1975) is used to evaluate formal study events and no tool has been created to measure informal CPD. This study conducted 25 in-depth interviews with managers, radiographers, educationalists and representatives from the College of Radiographers. The interviews were performed around the South East of England, Scotland, Cambridge and the USA (where CPD has been mandatory for 2 years and, in Orlando, for 12 years). The taped interviews were fully transcribed and analysed using thematic analysis. The interviews centered on the components of "effectiveness", clinical impact and how CPD activity should be measured and assessed. The preliminary findings have been used to create a "model of effectiveness" and an objective tool to measure impact. This can be used by individuals and managers to assess cost-effectiveness of formal CPD events and informal CPD activities.

1055
Radiographer led treatment review: a work-based education programme for professional development
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This paper evaluates a 6 month, work-based programme of professional development for therapeutic radiographers wishing to develop further their competence in reviewing the process of radiotherapy treatment. By the end of the programme they should be capable of working independently and accountably, in accordance with the protocols of the Mid-Kent Oncology Centre for Radiotherapy Treatment Review, across a full range of treatment sites. A group of 10 radiographers are following the work-based programme, engaging in an average of 4 h per week direct treatment review activity. They are receiving supervision and tutorial support from clinical oncologists and academic staff, together with expert inputs of knowledge and other directed learning activities. Over the study period the radiographers' knowledge and skills in the process and recording of radiotherapy treatment reviews is developed and made explicit. The learning tool is a portfolio in which radiographers produce and reflect on their records of learning. A formalized learning agreement exists between all parties to ensure progressive learning, tailored to the working context. The portfolio contains all relevant learning activity and includes items for specific summative assessment, both objective and reflective. The proferred paper will analyse the process and outcomes of this innovative pilot development from academic, clinical and professional perspectives. Problems with this approach will be identified and discussed; the benefits to patients, departments and radiographers will be elaborated. Implications for future practice will be evaluated.

1105
Is sufficient exposure information available to clinical users of US?
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PURPOSE: Trends towards higher intensity diagnostic US equipment and overlaps between diagnostic and therapeutic exposures, motivated this study to investigate biological safety from the perspective of the ultrasonographer. METHOD: A sample of 100 radiographers, randomly selected from the BMUS membership list, were posted a questionnaire to obtain information on: equipment currently in use, testing of this equipment and induction programmes on the introduction of new equipment. The sample group were also asked for their opinions on the potential of diagnostic US to cause adverse bioeffects and where responsibility for biological safety lies. Concurrently, semi-structured interviews were carried out with experts from relevant fields, including physicists, ethicists and manufacturers. The topics discussed included risks, benefits, safeguards and responsibilities in diagnostic ultrasonography. RESULTS: The high intensity equipment presently in use is a cause for concern among physicists and some of the ultrasonographers questioned during this study. Only 65% of respondent's departments carry out quality assurance testing of US beam parameters. The issue of biological safety is not addressed in up to 65% of induction sessions following the purchase of new technology. Exposure information displayed during clinical sessions, does appear to be practically useful. In conclusion, investigation of safety from the ultrasonographer's perspective raises some important issues, highlighting the need for their contribution to the development of research-based solutions to the problems identified.

1115
Survey of current practice in special care baby units and its relationship to patient dose
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PURPOSE: The CEC draft working document *Quality Criteria for Diagnostic Radiographic Images in Paediatrics* provides guidelines on good radiographic practice for use in paediatric radiography, with the aim of minimizing patient dose. It was the aim of a joint MRC and North Thames Health Authority funded project, to assess current radiation doses over a number of sites for neonates undergoing mobile chest radiography. The purpose of presenting the results of the radiation dose survey in the context of the CEC guidelines on good radiographic technique, is to provide essential information on current practice and recommendations for potential dose reductions. MATERIALS & METHOD: Six sites were used to record dose-area products of actual mobile neonatal chest X-ray examinations, using a meter of increased sensitivity. Entrance skin and effective doses were calculated based on NRPB tabulated data for paediatric patients. All site's radiographic equipment were extensively audited and tested. RESULTS: Results will be presented on the relative doses from all sites in the context of each site's relative congruency with the CEC guidelines for radiographic technique. Initial results show significant fluctuations in recorded doses between sites which are directly traceable to the implementation of the CEC guidelines, such as exposure factors, X-ray generator and speed of the imaging system. CONCLUSION: Conclusions and recommendations will be made on current practice in neonatal radiography and the applicability of the CEC guidelines.

1125
MRI of the pelvic floor and perineum
S M Todd and R J Johnson
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Pelvic floor anatomy is complex and difficult to image by conventional radiography, US or CT. MRI, with its greater tissue contrast and multiplanar facility, allows a clearer definition of normal anatomy and involvement with disease processes. The technique provides information that can affect surgical or radiotherapy treatment planning. An imaging protocol for the pelvic floor has been developed which provides high definition of normal and abnormal anatomy. This is now being used to establish an educational package for surgeons, radiotherapists, radiologists and radiographers. Normal anatomy of the pelvic floor and perineum is demonstrated, together with the relationship of the pelvic floor to adjacent viscera. Selected cases are shown to illustrate involvement of the pelvic floor and perineum in malignant disease processes. The images have been produced on a Siemens Magnetom Impact Expert 1.0 T scanner using protocols that included spin echo T_1 weighted and turbo spin echo (fast spin echo) T_2 weighted sequences. The objectives of establishing an educational package are discussed.

1135
The Royal London Hospital experience of the Docklands bombing: radiographic experience of a major incident
M Viner, J Schweiso, R Hadley-Rowe, J Fisher and O Chan
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PURPOSE: Every radiological department has a major incident plan, fortunately most departments have never had to implement their policy. In the aftermath of the IRA bomb blast in London Docklands, the Royal London Hospital Major Incident Plan was put into operation. The aim of this presentation is to show how our major incident plan performed and, in particular, the role of the radiography staff. METHODS & RESULTS: Following a press release and warning of the possibility of an IRA bomb in the City/Docklands a blast was heard at The Royal London Hospital. All communications to the Hospital were disrupted and therefore a police motorbike dispatch rider was sent from the scene to the Royal London Hospital. The Major Incident Plan was implemented within minutes of the bomb blast. The two consultants and senior registrars on call for radiology were at the time in the hospital. The Trauma Room and Accident and Emergency X-ray Department were isolated for the first patients triaged by the team leader with acute injuries for acute plain X-ray imaging and for acute CT services. The general Radiology Department and the vascular suite were opened up for all less acute general radiographic services and for all emergency interventional procedures. A total of 34 patients were admitted to the Accident and Emergency Department. Of these, 32 were referred to the X-ray Department. Patients referred for imaging were triaged by the two consultants and dealt with appropriately by the radiographers and senior registrar in radiology. Only three patients needed CT scans, one with an acute head injury, and two for detection of foreign bodies. CONCLUSION: Our experience of this major incident highlights the importance of all radiology departments having a major incident plan, which includes triaging of patients, in order to provide an effective and rapid service in extremely difficult circumstances.

1100–1200
Scientific Session
MR Angiography
Hall 10b

1100
Comparison of MRI varicography of the calf using turboSTIR imaging with conventional varicography
D F Sallomi, J M Jarosz, H Taylor, R Lund, P Summers, J Kearns, A Irvine and J Bingham
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PURPOSE: Imaging of varicose veins is undertaken before surgery to localize communications with the deep venous system. Varicography will only demonstrate the injected varix and a separate venogram is required to show the deep veins. Doppler US is time-consuming and operator dependent. The STIR sequence is very sensitive to fluid and a rapid imaging method of calf veins using the turboSTIR sequence was compared with contrast varicography and venography. METHOD: A protocol was established on four normal subjects. 10 patients with symptomatic varices underwent contrast varicography and MR varicography on the same day. Imaging was obtained on a Siemens Magnetom Impact 1T system using a general body coil. Contiguous 2 mm thin slices were obtained with a turboSTIR sequence (TI 120 ms, TE 60 ms and TR 5900 ms) and reconstructed with a MIP algorithm. Total imaging time was 10 min. Images were directly compared with varicograms/venograms for visualization of the varices, communications with the deep veins and the deep venous system. RESULTS: TurboSTIR images demonstrated all superficial varices and showed the communications with the deep venous system. All six pairs of deep veins in the calf were shown in the majority of patients. Comparative images are presented. CONCLUSION: MR varicography using a turboSTIR sequence provides more information than contrast studies in the calf quickly and non-invasively, although with lower spatial resolution. The method is limited to the calf as fast-flowing blood results in signal loss.

1110
A comparison of DSA and MRA in the assessment of peripheral vascular disease
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PURPOSE: The aim of this research project was to directly compare DSA and MRA images of the peripheral arteries to discover if MRA could be shown to have a diagnostic capacity comparable to DSA. MRA could offer a low risk, lower cost alternative to angiography. MATERIALS: A Siemens 1.0 T Magnetom Impact was used to acquire the MRA images and a Phillips Integris 3000 fluoroscopic unit acquired the DSA images. METHODS: 25 patients (50 limbs) with suspected peripheral arterial disease were randomly selected and the superficial femoral artery (SFA), popliteal artery and run-off arteries were imaged using DSA and MRA. 250 separate arterial segments were then graded on a patency scale and the two imaging techniques compared. Significantly different results were reassessed to discover which technique provided the most accurate patency score. RESULTS: 72.8% of arterial segments had similar patency scores with both techniques. The 27.2% of discrepant results were reassessed and half were correctly determined using DSA and half using MRA. DSA was more accurate in larger peripheral vessels, such as the SFA, and MRA was more accurate for smaller, distal vessels. CONCLUSIONS: DSA and MRA are comparable imaging techniques in the assessment of peripheral vascular disease. DSA, however, is more accurate for the detection of disease in larger vessels, such as the SFA, and MRA is more accurate for the depiction of smaller, distal, run-off vessels.

1120
MR angiography in the diabetic foot with gadolinium enhancement; comparison with angiography and Doppler US
[1]D I Sarma, [1]S Evans, [1]V Ayton, [2]M Morgan, [3]S Fraser, [3]M Edmonds and [1]H L Walters
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PURPOSE: The role of MRA in the surgical management of the ischaemic diabetic foot has yet to be defined. The aim of the study is to assess ankle and pedal arteries using MR angiography (MRA) with iv gadolinium. Comparison is made with digital subtraction angiography (DSA) and Doppler US with pulse-generated run-off (PGR). METHODS: 2D time-of-flight (TOF) MRA sequences were performed, pre- and post-gadolinium enhancement on symptomatic limbs of 18 insulin-dependent diabetics. (Siemens Magnetom 1.0 T, TR 31 ms, TE 9.8 ms, flip angle 45°, matrix 113 × 256; inferior saturation band, rectangular FOV) 3D-TOF MRA and phase contrast MRA was performed depending on patient compliance. Correlation of MIP images with angiography and Doppler studies was made with respect to vessel conspicuity and patency. RESULTS: Gadolinium enhancement significantly increases signal-to-noise ratio. This gives increased vessel conspicuity and confidence in determining patency. Vessel depiction by this means is shown to be more sensitive than Doppler US/PGR and may demonstrate surgically significant vessels not seen with DSA. Phase contrast angiography did not produce images of diagnostic quality. 3D-TOF MRA is valuable in demonstrating problem areas where in-plane or retrograde flow may show a pseudo-occlusion. The above findings including technical artifacts are illustrated. CONCLUSION: In diabetic patients in whom DSA fails to show adequate run-off, gadolinium

enhancement significantly improves 2D-TOF MRA and may help to prevent unnecessary intraoperative angiography and exploration.

1130
Implementation of a rapid acquisition, ultrashort TR dynamic gadolinium enhanced 3D technique for body MR angiography

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Intravascular contrast in dynamic gadolinium enhanced MR angiography (MRA) relies primarily on T_1 shortening effects, mitigating many of the saturation and flow-related phenomena characteristic of time-of-flight MRA. Radical reductions in repetition times (TR) are now feasible using high performance gradient subsystems, making very rapid acquisition times possible. Shortening the TR interval diminishes background signal, enhancing the effect of intravascular contrast. 3D-volume acquisitions create inherently high signal-to-noise data sets amenable to multiplanar post-processing. Optimization of intravascular signal intensity requires careful bolus timing to ensure that the peak concentration of Gd is correctly positioned within the data acquisition. METHODS: We acquired 3D-FISP sequences (TR 5 ms, TE 2 ms, acquisition times 15–20 s), during administration of iv Gd-DTPA, using a 1.5 T system. We imaged the peripheral vasculature (eight subjects), abdominal aorta (nine), renal (six) and pulmonary arteries (three), and compared the results with conventional imaging techniques. RESULTS: We visualized the peripheral vasculature distal to the level of the trifurcation. We delineated native and graft vessels and defined accurately both stenotic and occlusive lesions. The abdominal aorta and the proximal mesenteric branches were clearly demonstrated and we identified aortic aneurysms in four patients. The main renal arteries were well visualized and we demonstrated renal artery stenosis in three patients. We anticipate modifications in bolus timing and breath-hold techniques will enable discrimination of higher order renal vessels. Using breath-held pulmonary imaging we demonstrated fourth order arteries and images were diagnostic of pulmonary embolic disease in one patient. CONCLUSIONS: Dynamic gadolinium enhanced MRA using extremely short TR intervals can be used to produce high quality, diagnostic, vascular images in very rapid imaging times.

1140
Sequential projection angiography using contrast enhancement (SPACE): first clinical experiences with a new MR angiography technique

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PURPOSE: The clinical evaluation of a new sequential 2D projection MR angiography technique, sequential projection angiography using contrast enhancement (SPACE). METHODS: Examinations were performed on a 1.5 T scanner (Magnetom Vision, Siemens) using a phased array body coil. We used a snapshot-FLASH sequence (TE = 1.4 ms, TR = 3.4 ms), the flip angle was adjusted before injection of the contrast medium in order to reduce background signal (fat). Images were either acquired without any slice selection or as projections through thick slabs. The experiment was run continuously, yielding one image per 950 ms; about 50 images were acquired consecutively. The sequence was started immediately before the injection of the contrast medium with an automatic injector (Gd-DTPA, 0.1 mmol kg^{-1}, 3 ml s^{-1}). We performed MR angiography of thoracic vessels in 10 patients suffering from bronchial carcinoma, in one patient who had undergone aortic surgery and in 10 patients who had undergone cardiac bypass surgery. RESULTS: SPACE reliably provides high resolution anatomical images of the heart, pulmonary arteries, thoracic aorta and supraaortic vessels. Image quality corresponds well with the quality of images acquired using conventional catheter X-ray angiography. Patent cardiac bypasses (venous and arterial) could be demonstrated in all patients. In several patients, however, the signal was rather faint due to the small diameter of the bypass vessels. CONCLUSION: SPACE produces high resolution anatomical images of the vascular system, avoiding the necessity of exact timing of the contrast bolus. It provides information about haemodynamics and can also be performed in patients who are unable to hold their breath, due to an underlying medical condition.

1150
Inflammatory abdominal aortic aneurysms: appearances with gadolinium enhancement and the role of follow-up imaging

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INTRODUCTION: MRI can be used to stage abdominal aortic aneurysms (AAA) and has been shown to detect associated periaortic inflammatory change. The value of gadolinium contrast (Gd-DTPA) and the role of MRI in assessing response to steroid therapy has not been evaluated. We describe four patients with inflammatory IAAA who underwent enhanced MRI and CT pre- and post-steroid therapy prior to surgery. METHODS: MRI was performed at 1.0 T (Siemens Magnetom) using the body coil receiver with T_1 weighted spin-echo and gradient-echo pre and post Gd-DTPA. All patients also had CT pre- and post-contrast. Three of the four patients had repeat MRI and CT scans after a course of oral steroids and two of these patients have since undergone surgical repair. RESULTS: MRI displayed characteristics of an inflammatory cuff with significant enhancement after gadolinium contrast. The improved visualization of the cuff on enhanced MRI demonstrated its posterior extension in two cases and better delineated duodenal, ureteric and caval involvement compared with CT. However, CT better showed adjacent inflammatory "dirty fat" changes which improved with therapy. There was no difference in the degree of cuff enhancement in scans pre- and post-steroid therapy with either modality in the three treated patients, in one the thickness of the cuff reduced a little. CONCLUSION: Enhanced MRI can usefully demonstrate the nature and extent of periaortic inflammatory change in AAA. Findings compare favourably with CT, with better delineation of adjacent organ involvement. Imaging follow-up of steroid therapy provides little useful information.

1120–1150
Scientific Session
Management & Patient Care
Hall 11b

1120
Setting standards for plain film reporting: influence of observer variation

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PURPOSE: Skill mix and role extension initiatives have highlighted the difficulty of establishing quality standards for the accuracy of plain film reporting. A medico–legally acceptable performance might be one which is indistinguishable from that of a group of experienced consultant radiologists. The variation between experienced observers must be measured in order to assess the feasibility of setting such a standard. This study examines the variation found between three observers with the three major types of plain film examination. METHOD: 402 plain film examinations (205 skeletal, 100 chest and 97 abdominal) performed on accident/emergency patients were reported retrospectively and independently by three experienced consultant radiologists. The clinical data supplied on the request cards were available to the readers. Each examination was categorized by each reader as being normal, showing abnormality which was relevant to the current clinical problem, or as showing insignificant or irrelevant abnormality. Interobserver agreement for each type of examination was measured by the κ statistic. RESULTS: Concordance between all three readers was found in 51%, 61%, and 74% of abdominal, chest, and skeletal films, respectively. κ values confirmed that the level of interobserver agreement was higher with skeletal films ($\kappa_m = 0.68$) than with chest ($\kappa_m = 0.50$) or abdominal ($\kappa_m = 0.42$) films. However, the frequency of major disagreements (at least one reader reporting "normal" and one reporting "relevant abnormality") was similar for abdominal (11%), chest (12%) and skeletal (10%) films. CONCLUSION: The magnitude of interobserver variation must be taken into account when setting quality standards for plain film reporting.

1130
Informed consent: who should obtain it?
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PURPOSE: In current medical practice litigation is on the increase. For most radiological procedures informed consent is obtained by junior medical doctors. Our aim was to assess whether they possessed an adequate knowledge of complications of commonly performed radiological procedures. METHODS: 50 junior doctors seeking consent from patients for radiological procedures were asked to fill out a simple, closed questionnaire on the incidence of complications of the various procedures. RESULTS: Although the knowledge of general complications encountered was acceptable, that of specific complications involving interventional procedures was poor. DISCUSSION: When patients expect an in-depth explanation of their procedure, it may be of benefit if radiologists seek consent from their respective patients. The subject of consent for general surgical procedures has not been addressed. However, this study raises the question whether more inexperienced medical staff should be allowed to seek informed consent.

1140
Oral sedation in MRI
L J King, D P Peppercorn and P Armstrong
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INTRODUCTION: In published series, up to 10% of MRI examinations fail due to claustrophobia and other psychological problems. Our anaesthetics department does not recommend administration of iv sedation by radiologists in MRI. Claustrophobic patients are therefore given another appointment and advised to obtain prior oral sedation from their clinicians. This results in inefficient use of scanning time and leads to patient dissatisfaction. AIM: To determine whether offering oral sedation to all out-patients results in reduced numbers of failed scans due to claustrophobia. METHOD: All out-patients attending the MRI department received an appointment letter explaining the potential risk of claustrophobia and offering oral sedation. Patients accepting the offer of oral sedation attended the department 1 h before their scan and were given 10–20 mg of oral Temazepam. Failure rates were compared for the three months before and after the introduction of the policy. RESULTS: The failure rate before introduction of the policy was 28/738 patients (3.8%). The failure rate following the new policy was 21/700 patients (3.0%). The take-up rate for Temazepam was 28/796 patients (3.5%). Of the 28 patients who received sedation, one could not be scanned due to claustrophobia. CONCLUSION: The new sedation policy did not make a significant change to the failure rate due to claustrophobia. Our figures suggest that patients who elect to receive sedation are not the individuals who would be unable to tolerate MRI. However, the policy has reduced complaints regarding the MRI service.

1200–1245
British Institute of Radiology
Silvanus Thompson Memorial Lecture
Hall 1

1200
Eponymous Lecture
Heterogenicity of human response to ionizing radiation
D Scott
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In a few rare cancer-prone syndromes there is good evidence of elevated sensitivity to ionizing radiation, manifested as excess cancers (*e.g.* heritable retinoblastoma, Gorlin syndrome) or severe normal tissue damage [ataxia-telangiectasia (A-T)] after radiotherapy. Recent studies suggest that radiation sensitivity is not confined to these rare disorders and that it is possible to identify radiation-sensitive individuals amongst cancer patients and within the normal population. This could lead to the identification of individuals at risk of radiation-induced cancers and radiotherapy patients at risk of complications. Investigations of inter-individual differences in radiosensitivity have traditionally measured killing of cultured skin fibroblasts, which is time-consuming and could not be used on a large scale in a clinical setting. Recently, assays involving detection of radiation-induced chromosome damage in lymphocytes have given promising results that can be obtained in less than a week. 20 cancer-prone conditions have been found to exhibit chromosomal radiosensitivity of lymphocytes. We found that 40% of breast cancer patients were sensitive, suggesting a high level of genetic predisposition, much higher than can be accounted for by the breast cancer genes *BRCA1* and *BRCA2*, or by carriers of the *A–T* gene. The assay required cytogenetic expertize so we have now utilized a procedure involving detection of micronuclei in post-mitotic cells, a simpler technique with the potential for automation. A high proportion of breast cancer cases was also sensitive in this test and this proportion was higher amongst patients with radiotherapy complications. The heritability of chromosomal radiosensitivity is now being investigated with the ultimate aim of identifying the genes involved in radiation sensitization.

1300–1345
Royal College of Radiologists
Sir Peter Kerley Memorial Lecture
Hall 1

1300
Eponymous Lecture
Spiral CT of pulmonary vessels
M Remy-Jardin
Department of Radiology, Hospital Calmette Boulevard Jules Leclerc, Lille 59037, France
Any technique that eliminates the artifacts from respiratory motion and optimizes iv contrast requirements is capable of replacing more invasive angiographic procedures. Minimal experience in spiral CT angiography is necessary to obtain uniform and nearly constant opacification of intrathoracic vessels down to 2–3 mm in diameter with smaller volumes of contrast medium than are employed in conventional or digital routine angiography. This explains why spiral CT angiography of the pulmonary vessels is of optimal contrast in 95% of patients, as a consequence of which spiral CT angiography of the chest is gaining widespread acceptance. The purpose of this lecture is to review the current indications of spiral CT angiography of the pulmonary vessels in congenital and acquired disorders. The main technical aspects of spiral CT acquisition are presented with special attention to the injection parameters to provide optimal evaluation of the pulmonary circulation. The role of spiral CT in acquired diseases, *i.e.* staging of bronchial tumours, hemoptysis of pulmonary arterial origin and systemic supply to the lung, is discussed with special interest in the evaluation of pulmonary arterial and venous erosive processes. To date, spiral CT angiography is the diagnostic and pretherapeutic modality of choice for pulmonary arterio-venous malformations (PAVMs) and congenital anomalies of the pulmonary venous return. The clinical impact of spiral CT angiography is discussed with special emphasis on the current non-invasive alternatives provided with this technique.

1350–1600
State of the Art Symposium
Management & Procurement
Hall 11b

1350
Invited Review
Mysteries of management
J Roylance
United Bristol Healthcare Trust, Marlborough Street, Bristol BS1 3NU, UK
The successful application of the general management function in the National Health Service must be based on three fundamental characteristics of the service. (1) Modern healthcare is a complex matrix of individually unique interactions between individual patients and carers making individual professional judgements. It cannot be designed within a series of policies, protocols and procedures and is not amenable to simplistic monitoring. (2) The whole workforce is intrinsically highly motivated, and while it is possible

for management to demotivate as has regrettably been demonstrated from time to time, it is neither possible nor desirable to introduce artificial motivational initiatives. (3) The time has long passed when it was possible to offer everything medically possible to all who would benefit. Furthermore, the gap between the possible and the affordable has increased inexorably over the years, despite massive increase in funding, improved efficiency of provision and, more recently, emphasis on evidence based care. Management must therefore be based on empowerment of an informed workforce with genuine trust and support, to inculcate a success orientated culture based on universally held values.

1420
Invited Review
Hospital purchasing
J Pope
Central Middlesex Hospital, Acton Lane, Park Royal, London NW10 7NS, UK
Abstract not available.

1450
Invited Review
Managed services: MRI and CT
D A Haworth
Alliance Medical Ltd, Banbury OX15 6HU, UK
The provision of an MRI or CT Scanner via a managed service is a cost-effective way for a Trust Hospital to obtain the latest technology without the risks associated with access to future funding, competition, capital charges and technology obsolescence. A managed services company such as Alliance Medical Ltd can provide a high quality service supported by an extensive education and marketing programme. The units are operated by specialist radiographers trained to a high skill level utilizing state of the art technology which is frequently upgraded. The service, whether it is a static or a mobile scanner, is tailored to meet each individual customer's requirements.

1520
Invited Review
Technology—bringing through PFI
G R Lewis
Siemens Healthcare Services, Bracknell RG12 8FZ, UK
A service provider's view of using the Government's Private Finance Initiative to deliver clinical and financial benefit to imaging departments within the NHS. The purpose of the paper will be to discuss how the Private Finance Initiative can work for diagnostic imaging and to demonstrate some of the natural benefits it can bring. An analysis of traditional capital purchasing in the NHS and maintenance/refreshment programmes will be made, giving the positive and negative elements. How much is it really costing will be discussed. Are our hospitals benefiting from effective use of modern technology? The difference Private Finance Initiative could bring to an imaging department will be examined. The paper will provide a study of comparisons made between capital replacement programmes and revenue-based Private Finance Initiative options. It will look at the Private Finance Initiative process and how can we make it work. Reasons for imaging technology to be included at the design stage of new healthcare facilities with input from the clinical team as well as the service provider will be given.

1535
Invited Review
What price purchasing in radiology?
B G White
X-ray Systems, Siemens plc, Bracknell RG12 8FZ, UK
It is generally accepted that best "value for money" is obtained by the process of competitive tendering. This practice has been vigorously applied to procure all forms of radiological and therapeutic equipment supplied in the United Kingdom since the 1980s. As a result, purchasers have benefited from substantial price falls for all radiological equipment, while at the same time radiology departments have benefited from a considerable increase in the radiological and clinical efficiency of imaging systems. In the same period, however, there has on the one hand been a contraction of the UK radiological manufacturing base, a reduction of the number of manufacturers/suppliers, and an apparent reduction of UK investment in radiological development with the possibility of the stifling of imaging innovation. On the other hand, we have seen a progressive increase in the complexity of the procurement process, delays in projects caused by options appraisals covering contracts for capital purchase, operating lease and, more recently, PFI schemes abound. As a result there has been a marked increase in procurement administration incurred by many purchasers with a corresponding increase in contract administration by the supplier. It is possible, therefore, that the real cost of supply may have been partly increased by cost of administration. This paper takes a pragmatic look at the recent evolution of the radiological supply process and offers some possible solutions to benefit all those engaged in the process of the selection and supply of radiological equipment.

1550
Discussion

1400–1530
Special Focus Session
Film Viewing
Hall 1

1400–1510
Scientific Session
*info*RAD™ 4
Hall 10a

1400
Invited Review
IT standards in clinical practice
D J Harvey and N J G Brown
Department of Radiology, Singleton Hospital, Swansea SA2 8QA, UK
In the past, one of the major factors inhibiting the use of information technology for the dissemination of radiological data has been the lack of appropriate standards. Standards covering both image and descriptive data now exist and are being developed further, but can only be of use if those responsible for the purchase and installation of radiological equipment understand their roles, strengths and limitations. The main emphasis in radiological information technology is on the DICOM/MEDICOM standard, this is critically discussed. Radiological systems must also be able to share their information with other systems in the wider health-care world; some of the standards necessary for such communication are introduced. Advice is given on the practicalities and pitfalls of purchasing equipment to comply with the standards discussed. This includes the current NHS policies on standard's enforcement, security and data-ownership issues; changes that are likely to be necessary in the near feature are addressed.

1440
Practical DICOM image transfer from a range of CT scanners
G A Howard, M O'Brien and S Edyvean
ImPACT Department of Medical Physics and Bio-engineering, St George's Hospital, London SW17 0QT, UK
We have established practical procedures for obtaining CT image and header data from a wide range of current CT scanners. The procedures use public domain software which enables a Sun Workstation to operate as a DICOM 3.0 image server, to support technical evaluation of CT scanners. Each scanner evaluation requires the transfer of several hundred CT images from the system under test, to one of ImPACT's image analysis workstations. Traditionally, the image transfer was achieved by obtaining a tape or optical disk of images from the scanner and decoding the manufacturer specific image format for analysis on an ImPACT workstation. Such a technique required a custom-made reformatting program for each scanner model. An obvious solution to the format problem was to obtain a DICOM tape or optical disk each time. However, this requires a wide range of archive devices to accommodate all the manufacturers. In addition, DICOM conformant archive devices have developed more slowly, making DICOM transfer using ethernet connection the preferred option. The new procedure utilizes the software, "CTN" which is available free from several Internet sites. Once downloaded, the CTN source code, together with a relational database, required complex compilation. Initial hardware difficulties associated with the ethernet connection were overcome and DICOM image transfer was successfully tested on scanners from four different CT manufacturers. As all current CT scanner models have DICOM compatibility as an option or as standard, the same reformatting program can be used for all the manufacturers. A laptop SPARC workstation with the CTN software has made the ImPACT DICOM server fully portable.

1450
A computerized reporting system for US quality assurance measurement
S Perring
Department of Medical Physics, Poole Hospital, Poole, Dorset BH15 2JB, UK
A program has been developed to simplify and automate the reporting of quality assurance measurements made to test image quality of US B-mode scanners. The program was developed in Visual Basic to run on any PC running Windows 3.1 or above. US image quality measurements are made according to the protocol stated in the NHSBSP Publication No 27 for scanners used in the Breast Screening Programme, with additional measurements being made, particularly for low frequency probes not normally used for breast investigations. Data recording is simplified by use of a pro-forma sheet with tick boxes. Data entry on the computer is largely achieved by mouse-clicking on tick boxes. A formal typewritten report is automatically generated and the data recorded for future comparison in a Microsoft Access compatible database. Reports can also be generated for comparison of quality parameters with values previously obtained. Action levels may be set for most quality parameters and reported values falling outside those action levels automatically highlighted in the typewritten report. Initial studies have indicated at least 20% of high frequency probes fail at least one of the criteria for quality stated in NHSBSP Publication No 27.

1500
Discussion

1400–1510
Scientific Session
Nuclear Medicine
Hall 10b

1400
Invited Review
The contribution of brain receptor imaging to understanding schizophrenia
[1,2]L S Pilowsky, [2]D C Costa, [1]G F Busatto, [2]R L Mulligan, [2]P D Acton, [2]S Gacinovic, [1]M J Travis, [1]V Bigliani, [3]C Stephenson, [2]P J Ell and [1]R W Kerwin
[1]*Institute of Psychiatry, De Crespigny Park, London SE5,* [2]*Institute of Nuclear Medicine, Middlesex Hospital, UCMSM, Mortimer St, London, W1,* [3]*Fulbourn Hospital, Cambridge, CB1, UK*
Schizophrenia is a devastating mental illness affecting 1% of the community. Medication for the disorder is effective, but is often associated with unpleasant, stigmatizing side effects. Nuclear medicine techniques for imaging brain receptors in living human subjects allow investigation of important neurochemical hypotheses in schizophrenia. The dopamine hypothesis of schizophrenia suggests that over-activity of mesolimbic dopamine systems is responsible for some of the symptoms of schizophrenia; and that antipsychotic drug efficacy is directly related to the degree of blockade of dopamine D_2 receptors. We have used the selective dopamine D_2 ligands ^{123}I IBZM, and ^{123}I epidepride with single photon emission tomography (SPET) to test these hypotheses *in vivo*. The serotonergic hypothesis of antipsychotic drug action proposes that blockade of 5-HT_{2a} receptors is a critical factor in the action of highly effective novel antipsychotic drugs. The 5-HT_{2a} SPET ligand ^{123}I R91150 has been used to address this question *in vivo*. Data from all these studies will be reported. These strategies are proving critical for understanding the neuropharmacology of schizophrenia and guiding the development of better antipsychotic drugs with fewer side effects.

1430
^{99}Tc^{m}-nanocolloid scintigraphy for assessing osteomyelitis in diabetic neuropathic feet
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PURPOSE: Distinguishing osteomyelitis from neuropathic osteoarthropathy in diabetic feet is a common and difficult clinical problem with no highly accurate descriminatory investigation. This study assesses the novel use of marrow scintigraphy and compares it with MRI for the diagnosis of osteomyelitis in neuropathic osteoarthropathic diabetic feet. METHODS: Nine diabetic patients with chronic foot ulcers were prospectively assessed using ^{99}Tc^{m}-nanocolloid scintigraphy and MRI independently. Those patients showing features of osteomyelitis underwent percutaneous bone biopsy or surgical ray excision for histological confirmation. Other patients were followed up clinically for a minimum of 6 months to exclude osteomyelitis. RESULTS: Marrow scintigraphy, in agreement with MRI, demonstrated all four cases of biopsy-proven osteomyelitis and excluded three cases with neuropathic osteoarthropathy alone. One case of suspected osteomyelitis of the ankle on marrow scintigraphy but not MRI was not confirmed clinically. One case of suspected osteomyelitis on both imaging modalities was shown on biopsy to demonstrate changes of avascular necrosis but not osteomyelitis. In this study ^{99}Tc^{m}-nanocolloid scintigraphy shows a sensitivity of 100% and specificity of 60%. An important false positive result is seen with avascular necrosis both on marrow scintigraphy and on MRI. CONCLUSION: Although larger studies are needed to validate this technique, ^{99}Tc^{m}-nanocolloid marrow scintigraphy appears to be a promising, cheap alternative to MRI for assessing diabetic feet for osteomyelitis.

1440
Positron emission tomographic imaging of extracranial head and neck tumours using a high density avalanche chamber camera
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PURPOSE: A positron emission tomography (PET) system based on high density avalanche chamber (HIDAC) detectors utilizes a different technology from traditional systems containing multiple rings of small bismuth germinate crystals. Advantageous characteristics of the HIDAC camera are high spatial resolution, spatially isotropic performance and comparatively low cost. The aim of this study is to evaluate the ability of the HIDAC PET camera to image extracranial head and neck tumours in patients undergoing radiotherapy. MATERIALS & METHODS: Each patient underwent a pre-treatment MRI scan and PET scan with repeat examinations at 4 months and 8 months post-treatment. MRI scans in three orthogonal planes using T_1 weighted and T_2 weighted sequences were performed using a 1.0 T magnet (Siemens Magnetom). PET scans were performed following injection of 100 MBq of 2-[^{18}F]-2-Deoxy-D-glucose (FDG). Image acquisition commenced 40 min later, followed by 3D reconstruction. Quantitative assessment was made by delineating the tumour margin and comparing it with uptake within cerebellum. Both examinations were reported independently. RESULTS: To date, 26 studies have been performed on 14 patients. Images of diagnostic quality were obtained in 24 studies with both non-diagnostic studies occurring in the same patient. An underlying physiological cause is suspected. The primary tumour site was successfully identified in 13/14 patients. Discordance between PET and MRI findings was present in three studies. Nodal metastases were identified in six patients on PET and these corresponded with enlarged nodes on MRI. Tumour to cerebellar ratios ranged from 0.24 to 1.54 and nodal cerebellar ratios ranged from 0.45 to 0.86. CONCLUSION: HIDAC PET imaging is capable of identifying the primary tumour site and nodal metastases. Installation of extra-detectors will produce 20 fold increase in sensitivity giving rise to further improvement in image quality.

1450
Comparison of post-acute findings of SPET and MRI in traumatic brain injury
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Prediction of outcome in patients with traumatic brain injury (TBI) is required to plan appropriate and individual rehabilitation services. 46 young patients (age range 17–40, mean age 34 years) underwent single photon emission tomography (SPET) and MRI as part of a study to help predict outcome. Five patients were excluded due to lack of conclusive MRI data; two did not attend; two were claustrophobic; and one patient moved during the study. All patients had moderate or severe TBI (mild TBI excluded) and the tests were conducted at least 6 months or more after the trauma (optimum time for measuring outcome). Interpretation of SPET and MRI was conducted by two blinded experts (for each test) with disagreements decided by a third expert ($n=2$). In addition, semiquantification (SQ) of the SPET data was undertaken. The frontal (FL) and temporal lobes (TL) for each patient were scored as abnormal, normal

or equivocal for each modality. The FL were abnormal in 39/82 (48%) by SPET; 29/82 (35%) by SQ and 27/82 (33%) by MRI. The TL were abnormal in 27/82 (33%) by SPET; 14/82 (17%) by SQ and 25/82 (30%) by MRI. We conclude that (1) SPET detects more abnormalities than MRI (especially in the frontal lobes) in post-acute TBI; (2) SQ does not appear to improve the quality of SPET reporting; (3) the higher sensitivity of SPET and a possible role for SQ in TBI needs further assessment with psychological parameters of outcome measurement.

1500
Work in Progress
See p. 121.

1400–1530
Scientific Session
Genitourinary Tract Imaging
Hall 11a

1400
Invited Review
The role of Doppler in renal disease
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Duplex Doppler US has been used in abdominal diagnosis for more than 15 years. Extravagant claims have been made with respect to the diagnostic utility of the technique for a number of applications, in both the native and transplant kidney. Many of the potential applications have, however, shown insufficient sensitivity and specificity when subjected to critical evaluation. Newer advances in colour-flow imaging, including colour power Doppler, convergent colour and 3D display, together with the advent of newer generation US contrast agents, require careful review of the current status of colour-flow Doppler applications in renal diagnosis. The questions that remain unanswered by existing imaging and other investigative techniques, and how new US technology may address these questions, will be presented.

1430
Diffuse non-metastatic enlargement of the adrenal glands on CT: correlation with endocrine status
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PURPOSE: We have previously shown that patients with lymphoma and other malignancies frequently have non-metastatic enlargement of the adrenal glands on CT. We have now compared the radiological and endocrinological investigations in patients with a variety of malignancies. METHOD: In 14 patients, seven with lymphoma and seven with a variety of other solid tumours, CT scans were obtained as part of their clinical staging. The maximum width of the body, medial and lateral limbs of each adrenal gland was recorded in a blinded manner. Each patient underwent a dexamethasone suppression test (0.5 mg po every 6 h for 48 h followed by a 09:00 serum cortisol). Normal dexamethasone suppressability was accepted if the serum cortisol was <50 nmol l^{-1}. RESULTS: Patients who failed to suppress after dexamethasone (*i.e.* cortisol level >50 nmol l^{-1}, mean $=294$ nmol l^{-1}, range 67–1147) had significantly more enlarged adrenal glands than those who did suppress; mean combined width, mm ($\pm$SEM) (1) body: 19.3 (1.4) *vs* 13.0 (1.8), $p<0.02$; (2) medial limb 13.4 (1.0) *vs* 9.5 (0.6), $p<0.03$; (3) lateral limb: 14.3 (0.7) *vs* 8.8 (0.6), $p<0.005$. Of the 14 patients, 10 had enlarged adrenals and, of these, eight failed to suppress with dexamethasone. Only one of the four patients with normal size adrenal glands failed to suppress. CONCLUSION: Significant adrenal enlargement seen in a variety of malignancies is associated with serum cortisol levels which fail to suppress in the low dose dexamethasone suppression test in 80% of cases. The mechanisms responsible and the clinical significance remain to be determined.

1440
Quantitative CT evaluation of adrenal gland masses: a step forward in the differentiation between adenomas and non-adenomas?
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PURPOSE: To determine if adrenal adenomas can be distinguished from non-adenomas based on the CT attenuation values obtained at various times after iv administration of contrast material (CM). MATERIALS & METHODS: 72 patients with 78 adrenal masses (41 adenomas, 37 non-adenomas) were examined with helical CT before and after administration of 120 ml non-ionic CM. Patients were assigned into two different groups according to the length of time following scan delays: 30 s and 90 s delay, and 60 s and 180 s delay. 40 normal subjects served as controls. Helical CT scans 30 min after administration of CM were obtained in both controls and patients. The scattergrams and mean values of the size and attenuation values of unenhanced and enhanced scans were correlated with the final diagnoses. RESULTS: The 41 adenomas had a mean unenhanced attenuation value of 4 ± 16 HU compared with 37 ± 12 HU for the 37 non-adenomas ($p<.001$). The sensitivity: specificity ratio for the diagnosis of adrenal adenoma was 61:100% at a threshold of 11 HU. Although average non-adenoma attenuation was significantly greater than average adenoma attenuation on the 60 s and 90 s scans ($p<.001$), there was much greater overlap in the attenuation values of the adenomas and non-adenomas than with the unenhanced images. At 180 s after injection of CM, non-adenomas (73 ± 17 HU) had higher attenuation values than adenomas (41 ± 18 HU) ($p<.001$), and the sensitivity: specificity ratio for the diagnosis of adrenal adenoma was 91:100% at a threshold of 64 HU. 30 min after administration of CM, all adenomas exhibited attenuation values less than 37 HU (mean, 20 ± 10 HU), whereas all non-adenomas had values above 41 HU (mean, 59 ± 19 HU). With a threshold level of 40 HU 30 min after administration of CM, the sensitivity: specificity ratio for the diagnosis of adrenal adenoma was 100%:100%. CONCLUSION: These clinical data provide strong support for an important role for delayed enhanced CT scans obtained 30 min after administration of CM, in accurately distinguishing between adenomas and non-adenomas. CT attenuation values before enhancement and those obtained 180 s after injection of CM can characterize an adrenal mass with high specificity and acceptable sensitivity. CT scans obtained during an earlier phase of contrast enhancement (<90 s) are not helpful in characterizing adrenal masses.

1450
Characterization of adrenal masses by contrast-enhanced CT: value of the 15 min delayed scan
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PURPOSE: Non-contrast CT permits characterization of adrenal masses by region of interest (ROI) density measurements, but many adrenal masses are detected only after iv contrast has been administered for other reasons. This study was performed to determine whether characterization is still possible by contrast-enhanced CT using a 15 min delayed study. MATERIALS & METHODS: 48 adrenal masses in 42 patients (25 male: 17 female, age range 28–91, mean age 66), underwent contrast-enhanced CT. 15 min delayed scans were performed through the adrenals using similar scan parameters. ROI measurements were made on both the immediate and delayed scan. Proof of diagnosis was based on histology (18 patients) or follow-up (24 patients) from 6 months to 1 year. RESULTS: Mean ROI measurements for benign lesions was 14 HU (range 1–18) and 42 HU for malignant lesions (range 26–74). Using a threshold of 20 HU, a 15 min delayed CT correctly characterized all adrenal masses. CONCLUSION: Characterization of adrenal masses using contrast-enhanced CT is possible using a 15 min delayed scan. Incidentally discovered adrenal masses can therefore be characterized without the need for a further unenhanced study.

1500
Use of PSA assay and Gleason score for predicting the stage of newly diagnosed prostate cancer?
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PURPOSE: to determine the value of Gleason score and prostate specific antigen (PSA) assay for prediction of disease stage in men with newly diagnosed prostate cancer. MATERIALS & METHODS: 96 consecutive men, newly diagnosed with prostate cancer and candidates for radical therapy, underwent contrast-enhanced pelvic CT and skeletal scintigraphy. Staging

examinations were reported blinded to the Gleason score and level of PSA and used the TNM classification. RESULTS: There were significant differences between the mean PSA of 15 men with (M1) and 81 men without skeletal metastases ($p=0.01$) and between men with locally confined and non-confined disease ($p=0.02$). There was no difference between the PSA values of 12 men with (N^{+ve}) and 84 men without (N^0) lymph node metastasis ($p=0.9$). However, only one man with CT evidence of N^{+ve} disease had a PSA value below 20 ng ml^{-1}. Only two men with Gleason scores below six had N^{+ve} disease and both had PSA values over 50 ng ml^{-1}. A single man with M1 disease had a PSA value below 20 ng ml^{-1}. CONCLUSION: PSA values and Gleason score estimation may be used to predict those men with newly diagnosed prostate cancer unlikely to have lymph node or skeletal metastasis. In this study, if only those with PSA values over 20 ng ml^{-1} had been examined, one in three men would have been spared CT examination with a 90% sensitivity for lymphatic metastasis.

1510
Characterization of focal testicular lesions using quantitative analysis by dynamic MRI

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PURPOSE: Benign testicular lesions can be locally excised, but US cannot reliably distinguish these from malignant lesions. The current management of such patients is therefore orchidectomy. This study aims to determine whether malignant tissue can be distinguished from focal benign lesions by measuring the relative changes in signal intensity during dynamic contrast injection. METHODS: Five patients with US detected focal testicular lesions were scanned on a 1.5 T GE Signa. Following T_2 weighted FSE and T_1 weighted scans, dynamic contrast enhanced fast spoiled gradient recalled echo scans (FSPGR) were performed. Five 4 mm axial slices were obtained through each focal testicular lesion and the contralateral testicle during and after bolus administration of Gd DTPA (0.1 mmol kg^{-1}). Multiple regions of interest (ROIs) were then selected in each slice to obtain values of relative mean pixel intensities (SI^{ave}), relative peak signal intensities (SI^{peak}) and time taken to achieve SI^{peak}. Following orchidectomy, axial slices of the specimen were performed and correlated with the corresponding MRI slices and ROIs, allowing correlation of 60 ROIs with histology. RESULTS: Areas of malignant and benign stroma were present in all histological specimens. Benign areas, such as cysts, fibrosis, haemorrhage and necrosis, showed no change in relative signal intensity during dynamic contrast enhancement. The SI^{ave} and SI^{peak} in each area of tumour involvement were greater than that of normal testicular stroma (range 130–180%). CONCLUSION: Dynamic MRI may be a potentially useful means of distinguishing benign from malignant lesions in patients with equivocal focal lesions identified by US.

1520
Assessment of irradiated bladder carcinoma with dynamic contrast-enhanced MRI

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PURPOSE: To assess the feasibility of using dynamic contrast-enhanced MRI to distinguish residual or recurrent tumour from benign post-irradiation changes in treated bladder carcinoma. PATIENTS & METHOD: 40 patients with bladder carcinoma had pre-radiotherapy staging MRI. MRI was repeated 4 and 12 months after completing radiotherapy. In addition to conventional spin echo sequences, dynamic imaging was obtained using a T_1 weighted gradient echo sequence through the tumour (pre-therapy) or tumour bed (post-therapy). Following injection of 0.1 mmol kg^{-1} of dimeglumine gadopentate, images were acquired every 6–8 s for at least 150 s. Enhancement profiles were obtained for tumour, tumour bed, fat, skeletal muscle and the bladder wall distant to the tumour. Bladder carcinoma is known to demonstrate rapid, early, strong enhancement. By reference to this pattern, enhancement profiles were scored as: tumour, equivocal, or no tumour. The morphological appearance of the bladder on spin echo sequences was scored in the same way. The enhancement profiles were then compared with bladder morphology; both the morphology and profiles were compared with the results of cystoscopic biopsy and patient follow-up. RESULTS: Regarding the presence of tumour, the enhancement profile had a specificity of 94% and a negative predictive value of 100% 4 months post-radiotherapy, falling to 89 and 73% at 12 months. Bladder morphology was less specific (71% at 4 months and 78% at 12 months). Both the morphology and enhancement profiles were relatively insensitive—especially at 12 months, where neither technique had a sensitivity of over 40%. CONCLUSION: Dynamic contrast enhancement profiles may prove useful in refuting the presence of residual bladder cancer, especially within the first 6 months after radiotherapy. Further statistical analysis is ongoing.

1400–1520
Scientific Session
Paediatric Imaging
Olympian Suite

1400
Invited Review
MRI of the paediatric spine

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MRI has revolutionized the diagnostic evaluation of paediatric spinal disorders, becoming the modality of choice in many indications. The paediatric spine is ideally suited for investigation by MRI since it is the only technique which can clearly differentiate individual components of the spine from one another (including spinal cord, roots, CSF, vertebra, disc, bone marrow). Furthermore, MR flow studies have brought new insights in cerebrospinal hydrodynamics and cord motions (syrinx, tethered cord). Recent advances in post-processing software have enhanced the effective display of complex anatomy and are valuable in the management of complex spinal malformation. Spinal dysraphisms, intraaxial and extraaxial tumours, trauma and infection, in which MRI play a major role in clinical care, will receive the greatest emphasis. Finally, for each disease, the specific role of MRI and its comparison with other imaging modalities will be discussed in order to maximize the cost-effectiveness of spinal MRI.

1430
Administration of contrast media to children: current practice in the UK

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The Royal College of Radiologists (RCR) recently published a document, *Advice on the Management of Reactions to Intravenous Contrast Media*. This contained several recommendations regarding the administration of contrast media (CM) to children, namely that those radiologists administering CM to children should be trained in paediatric resuscitation; that the adrenaline dose for the child should be calculated by its weight and clearly displayed prior to administration of CM; and that paediatric drugs should be stored separately. In order to assess compliance with these recommendations a questionnaire was sent to 200 Fellows of the RCR (clinical radiology) in the UK. 132/200 (66%) replied. Of these, 80 (60.6%) are involved in administering CM to children. However, only 26/80 (32.5%) have had training in paediatric resuscitation. The majority of those radiologists had received their training prior to the start of their careers in radiology, with only 10/80 (12.5%) having received training in paediatric resuscitation as a radiologist. Only 13/80 (16.3%) calculate the adrenaline dose by weight prior to CM administration. In 27 of 80 radiologists' departments (33.8%) paediatric drugs are correctly stored separately from adult drugs. The RCR document does appear to have had some effect as 22/80 (27.5%) claim to have changed or plan to change their practice. However, that change may not always be to improve training as, in six of these 22, the result has been the radiologist abdicating responsibility for administering CM to children to his or her paediatrician colleagues.

1440
Assessment of dysphagia by the modified barium swallow in children. Is the extra effort worthwhile?

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PURPOSE: To assess the value of the modified barium swallow to feeding management in the swallowing-impaired child. MATERIALS & METHODS: 60 patients of less than 14 years of age were assessed using both liquid barium and barium-impregnated foodstuffs and videofluoroscopy. The patients were assessed by radiologists, speech and language therapy and dietician together. RESULTS: In 30 cases (50%) additional information, which was gained from the modified technique but was not apparent with liquid barium alone, led to significant management changes.

CONCLUSION: The modified barium swallow should be considered as a useful investigation in determining changes in managing severe swallowing disorders. Involvement of the speech and language therapist and dietician at the time of the study enhances the information gained.

1450
US assessment of colonic wall thickening in cystic fibrosis
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Colonic fibrosis causing stricture is a recently described complication in children with cystic fibrosis (CF). Studies suggest that US evidence of bowel thickening predicts this complication and is prevalent among children receiving large doses of high strength pancreatin preparations. We have performed detailed colonic US in 33 children with cystic fibrosis, including 25 receiving high strength pancreatin (Creon 25,000). The combined thickness of mucosa, sub-mucosa and muscularis propria was measured in ascending, transverse and descending colon. In nine healthy controls the mean thickness measured was 0.91 mm (SD=0.136) with a range of 0.7–1.3 mm. Mean measurements in ascending, transverse and descending colon in CF children were 1.33 mm (SD=0.20), 1.29 mm (SD=0.24) and 1.27 mm (SD=0.21). Maximum measurements were 1.8 mm, 2.1 mm and 1.8 mm, respectively. Simple regression identified a significant relationship ($p<0.001$) between age and maximum colon thickness in all three areas. The colon of CF children was up to 50% thicker than controls. Thickening of the order described elsewhere did not occur among any of the children studied. The results suggest that the most important factor determining the thickness of the CF colon is age.

1500
The role of cranial CT in the management of acute febrile encephalopathy
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AIM: To evaluate the role of emergency cranial CT in the acute management of children with fever, acute depression of conscious level, with or without seizure (acute febrile encephalopathy). MATERIALS & METHODS: 26 consecutive children (age range 2 months–11 years 11 months, median—1 year 2 months) admitted to the Paediatric Intensive Care Unit over a period of 24 months with the clinical diagnosis of febrile encephalopathy underwent cranial CT within the first 12 h of admission. Scans were independently assessed by two observers for evidence of cerebral oedema (compression of cerebral sulci/ventricles and basal cistern effacement with or without abnormal grey/white matter differentiation), the presence of extraaxial collections, abnormal meningeal enhancement, central venous sinus thrombosis, and parenchymal abnormalities, abnormal basal ganglia attenuation. CT findings were correlated with clinical outcome. RESULTS: A minority of scans 7/26 (27%) were abnormal. No CT showed features of raised ICP where this was not suspected clinically. Lesions requiring neurosurgical referral—extraaxial (subdural) collections in 3/26 (12%) and parenchymal abscesses or bleeds in one case (4%)—were all accompanied by suggestive focal neurosurgical signs, and no intervention resulted. Central sinus thrombosis was not diagnosed in our patient population. CONCLUSION: In children with acute febrile encephalopathy, cranial CT was a poor indicator of raised intracranial pressure and emergency cranial CT did not provide any additional information which altered clinical management.

1510
Neonatal MRI on dedicated 1.0 T scanner
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BACKGROUND: In our neonatal intensive care unit we have installed a prototype MRI system designed and designated solely for neonatal use. The system is used to investigate sick preterm infants. METHODS: The magnet bore is 500 mm long, providing excellent access to the infant. Infants are transferred from bedside to scanner room in a semi-cylindrical cot on a custom-built cart. Mechanical ventilation can be continued using an SLE ventilator and infusion of iv drugs maintained by iv pump. Monitoring is performed using a Hewlett Packard Merlin life-support system with heart rate, oxygen saturation and temperature channels. A typical scanning protocol is a T_1 (TE 20, TR 600) and T_2 (TE 120, TR 2700) weighted spin echo, and a T_2 weighted FSE. The following parameters have been used for FSE images: TR 3000, TE 128, but improved contrast was achieved with TR 3500, TE 208. Diffusion, inversion recovery and angiography sequences are obtained depending on pathology. RESULTS: 54 examinations have been performed on 40 infants, median (range) gestational age at birth 30 (24–42) weeks and at scan 38 (27–52) weeks. Sequential images have been obtained which demonstrate maturational changes in the brain, including the gyral pattern. Other studies include diffusion-weighted imaging, demonstrating infarcts and delineation of nerve tracts. DISCUSSION: Examination of sick preterm infants with MRI can be performed safely using this system. This prototype Picker 1.0 T Neonate scanner allows diagnosis of cerebral abnormalities and serial imaging in a population that previously had limited MR investigation.

1415–1515
College of Radiographers
Student Conference
Hall 9

1415
Presidential Address
J Henderson
President, College of Radiographers

1430
Invited Review
War surgery with the International Committee of the Red Cross
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Since World War II most major conflicts have occurred in under developed countries. The ICRC is mandated to provide care and attention to the victims of war. One of the ways this is achieved is by the provision of surgical care to war wounded. The clinical management principles in the care of war wounded will be described and reference made to some of the additional activities which result from this surgical work.

1515–1605
Scientific Session
MRI of the Breast
Hall 10b

1515
Dynamic MR guidance of laser therapy to breast cancer
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PURPOSE: Interstitial laser therapy (ILP) is a minimally invasive therapy that potentially may be used to treat small cancers. This study aimed to evaluate dynamic MRI as a method of monitoring ILP during treatment and to correlate imaging changes with histopathological assessment of laser damage. MATERIALS & METHODS: 14 women with cytologically-proven breast cancers were studied prior to surgery. Between one and four 18 G MR compatible needles were passed into the tumour under US guidance. Patients were moved to a 1 T MR scanner and positioned in a side access breast coil. Optical fibres connected to a diode laser source were passed through the needles and ILP performed using 2 W per fibre for 500 s. Therapy was monitored using a 2D FLASH sequence (TR 111 s, TE 10 ms, FA 50°). Images were acquired every 30 s during, and for 3 min after, ILP. Contrast-enhanced images were acquired in three patients immediately after the treatment was finished. RESULTS: An expanding area of signal loss appeared around the fibre tip after a delay of 30–60 s, which stabilized in size and reduced after treatment ended. The maximum diameter of signal loss correlated closely with the histological measurements of laser necrosis ($r^2=0.80$). Contrast-enhanced images acquired immedi-

ately after treatment were not predictive for the extent of laser necrosis. Complications included a skin burn in one patient and damage to the pectoralis muscle in three. CONCLUSION: Dynamic MR may be used to monitor the effects of thermal ablation of breast tumours during ILP.

1525
Prediction of axillary lymph node status in breast cancer by use of dynamic contrast enhanced MRI
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PURPOSE: To test the hypothesis that dynamic breast MRI can be used to predict axillary lymph node status in patients with breast cancer. MATERIALS & METHODS: 51 women with primary invasive breast cancer underwent dynamic contrast-enhanced MRI of the breast. Region of interest (ROI) analysis was performed on parametric images obtained by kinetic modelling of the dynamic data. Large, operator-defined ROIs, and automated, computer-defined, 9 pixel ROIs were selected. Typical enhancement ratios representing the relative increase in mean pixel signal intensity were calculated for each ROI. Stepwise logistic regression analysis was applied to identify prognostic factors of axillary node status. Receiver operating characteristic (ROC) curve analysis was performed to assess the accuracy of the logistic regression model. RESULTS: A predictive model was developed that calculates the risk of axillary node involvement based on patient age and two MR variables, namely, large ROI size and the maximum enhancement ratio of the automated ROI ($ER_{max(A)}$). Stepwise regression analysis revealed $ER_{max(A)}$ to be the most important predictor of node status ($p<0.001$). Patient age ($p=0.007$) and ROI size ($p=0.045$) were also found to be independent, statistically significant predictor variables. The model had good accuracy (area under the ROC curve, $A_z=0.89$). Almost 25% of the patients were correctly identified having either a less than 5% or greater than 95% probability of being node-positive. CONCLUSION: Axillary node status is related to readily identifiable MR parameters. The suggested predictive model may decrease the need for surgical staging of the axilla in breast cancer patients.

1535
MRI of invasive lobular carcinoma of the breast
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PURPOSE: Invasive lobular carcinoma (ILC) may present with only subtle changes on mammography and it has been proposed that patients with this tumour would benefit from MRI. The purpose of this study was to compare mammography with MRI for the detection of ILC. METHOD: 10 patients with surgically resected ILC of the breast were retrospectively reviewed with their MRI and mammographic imaging. The MRI was performed on a 1.0 T scanner using a 3D FLASH T_1 weighted sequence before and after contrast enhancement. Image registration and subtraction was performed to identify areas of abnormal enhancement. RESULTS: MRI accurately depicted local tumour stage in seven out of nine patients. In one patient the tumour size was over-estimated by 1 cm and in another a 5 mm secondary focus of ILC was missed. The tenth patient showed multiple areas of diffuse enhancement, which corresponded to multicentric ILC and *in situ* lobular carcinoma (LCIS). Mammography was suspicious for tumour in all patients but accurately staged tumour size in one patient only. In two patients with microcalcification only, mammography grossly underestimated tumour size. CONCLUSION: This study confirms that MRI is more accurate than mammography in defining the size of ILC. Two patients who underwent operations based on clinical and mammographic examination alone may have been saved from re-operation for positive surgical margins if the MRI results had been taken into account. MRI was unable to differentiate between non-invasive and locally invasive LCIS and therefore suspicious areas found on MRI should be biopsied.

1545
Surface coil MRI of brachial plexopathy in breast cancer
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PURPOSE: To investigate the role of MRI in determining the cause of brachial plexopathy in patients with breast cancer using surface coil imaging of the neck and brachial plexus supplemented with body coil imaging. MATERIALS & METHODS: 36 patients with symptoms of brachial plexopathy following treatment with surgery, chemotherapy and or radiotherapy for breast cancer, were examined on a 1.5 T MRI scanner (Siemens Medical Systems). Surface coil images of the cervical spine and brachial plexus were obtained using turbo spin echo sequences (T_1 and T_2W). These were supplemented with body coil imaging, of the neck and mediastinum. iv contrast medium was given in selected patients. Results were interpreted as brachial plexus related tumour, fibrosis, normal or tumour at other sites. RESULTS: MRI detected tumour recurrence in 47% (brachial plexus 26%, other sites 21%). Fibrosis was diagnosed in 16% and normal appearances were found in 37%. The results were verified by clinical follow-up for a period of at least 12 months following MRI. The sensitivity on MRI for detecting tumour recurrence was 88%, specificity 90%, positive predictive value 88% and negative predictive value 90%. CONCLUSIONS: MRI has a useful role in the investigation of patients with brachial plexopathy in breast cancer.

1555
The role of MR-mammography in the diagnosis of multicentricity in breast cancer
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PURPOSE: The pre-operative diagnosis of multicentricity in breast cancer is of crucial importance because multicentricity is an absolute contraindication for breast conserving therapy. MR mammography (MRM) is the most sensitive technique for the diagnosis of malignant lesions of the breast. MATERIALS & METHODS: Between 1st July 1994 and 31st December 1995, MRM was performed in patients with invasive breast cancer, which were clinically and/or mammographically and sonographically multifocal or multicentric non-diffuse tumours. These patients were treated by modified radical mastectomy. The results of clinical and radiological methods were compared with results of the histological large slice technique for the diagnosis of multicenticity. RESULTS: In 46 patients multicentricity was diagnosed pre-operatively; multicentric breast cancer was confirmed histologically in 38 patients. The sensitivities for the diagnosis of multicentricity were: palpation 47%, mammography 66%, sonography 79% and MRM 89%. In eight patients MRM showed false positive contrast enhancement (CDIS, fibroadenoma and fibrocystic disease). CONCLUSION: MR mammography is the method with the highest sensitivity in the diagnosis of multicentricity in breast cancer. Preoperatively, additional suspect focal lesions have to be histologically clarified to avoid unnecessary mastectomy.

TUESDAY

1530–1700
College of Radiographers
Students' Scientific Session
Hall 9

1530
Student presentations
Please see pp. 133–134 for abstracts.

1640
Open Forum

1530–1700
State of the Art Symposium
Controversies in Functional MR Imaging
Olympian Suite

1530
Invited Review
Functional MRI provides real physiological insight
D G Gadian
Department of Radiology and Physics, Institute of Child Health, University College London Medical School, London WC1N 1EH, UK
There are several ways in which MRI can contribute to the investigation of brain function. One approach involves the use of structural MRI techniques to define focal pathology, which can then be related to specific abnormalities in brain function. A second approach,

which forms the basis of this presentation, takes advantage of the fact that MRI can now be used to map activated regions of the brain. Widely known as functional MRI, this latter approach provides the opportunity to learn a great deal about the functional anatomy of the brain. There are also a number of potential clinical applications of the technique. Functional MRI relies on the detection of focal changes in the water signal resulting from the haemodynamic changes associated with brain activation. Numerous studies of several domains of brain function, for example vision, sensorimotor skills, speech and language, illustrate the power of the technique and alleviate concerns about the problems generated by artefactual signals, such as those associated with stimulus-correlated motion. Applications from a number of centres will be presented.

1545
Invited Review
Functional MRI as presented is generally much contaminated by artefact
I R Young and J V Hajnal
Robert Steiner MR Unit, Hammersmith Hospital, London W12 0HS, UK
Functional MRI relies on detection of differences in signal intensity that correlate with an imposed task protocol. Several authors have shown that such signals can come from sources other than direct brain activation and that the presence of erroneous signals may be very common. Perhaps the most important source of artefactual stimulus-correlated signals is subject motion. The statistical tests used to extract putative MRI signals, extract all stimulus-correlated signals and thus do not provide a means of discrimination between them. The final activation images tend to show amorphous blobs and spots, which may then be overlayed on anatomical images acquired by quite different sequences. Recognition of true activation in the face of undifferentiated false positives thus relies on signals appearing in expected locations. This greatly diminishes the power of fMRI to find unexpected results and can lead to unconscious bias in which expected results are preferentially retained. Hitherto, almost all fMRI data has been acquired using multislice techniques, often with only a single slice obtained or with slice gaps. These kinds of data, which fail to provide continuous 3D coverage, are vulnerable to uncontrolled signal changes, due to changes in subject position and result in processing errors when re-aligned. Interpretation of fMRI results is currently based on blood flow and oxygenation models, which themselves have proved difficult to validate in humans under physiologically relevant conditions. It is to be hoped that the obvious importance of, and widespread interest in fMRI will lead to technique developments that appropriately marry data acquisition with subsequent processing and analysis to produce robust techniques which can provide clear differentiation between true and false positive signals.

1600
Discussion

1615
Invited Review
Image guided therapy through interventional MRI: will it be economic and effective?
N M deSouza
Robert Steiner MRI Unit, RPMS, Hammersmith Hospital, DuCane Road, London W12 0HS, UK
The excellent anatomical detail and high level of soft tissue contrast provided by MR are of enormous potential value in providing guidance for both diagnostic and therapeutic procedures. However, use of MRI has been limited by the poor access provided by most magnets and the practical difficulties of working within a magnetic field. Newer, more open-plan magnet configurations now provide improved access to the patient and manufacturers are producing a range of MR-compatible equipment. MR-guided diagnostic procedures are performed with MR-compatible needles (*e.g.* biopsy) or via endoscopes and are facilitated by the use of specially designed insertable coils. Intracavitary coils placed endovaginally, endorectally or during endoscopy with an MR-compatible gastroscope provide high resolution images of tissue of interest. MR-guided therapeutic procedures are largely performed through flexible fibreoptic endoscopes and embrace a wide spectrum of clinical applications, including treatment of common conditions, such as benign prostatic hypertrophy and prolapsed intervertebral discs. In endoscopic laser ablation of the prostate it is possible to use MR to monitor the extent of deep tissue ablation during the procedure. Further areas of development of MRI-guided intervention are during focussed US ablation of breast and prostatic lesions, cryotherapy to the prostate, laser surgery to the cervix, chemical or mechanical ablation of oesophageal varices and chemical or laser discectomy. In these conditions it will be possible to tailor surgery to the precise extent of the tissue response, in order to achieve the optimum clinical result.

1630
Invited Review
Frameless stereotaxy offers a better solution than in machine approaches—the case for frameless stereotaxy
D R Sandeman
Neurosurgery Department, Frenchay Healthcare Trust, Frenchay Park Road, Bristol BS16 1LE, UK
All minimally invasive surgery requires some form of image guidance. This debate is about the relative merits of real time imaging compared with image guidance using pre-operative images. The ideal imaging modality for image guidance would have the following characteristics; it would be non-invasive, supplying undistorted image data in real time, characterizing all the anatomical and functional information about the tissue of interest in sufficient detail to monitor the progress of a procedure. It must be user friendly and its routine use must not be prohibited by cost. Such an ideal is impossible to achieve. Real time imaging modalities available at the present time include X-rays and ultrasound. In conventional form both have applications for image guidance, *e.g.* in spinal fixation or ultrasound localization of spinal cord tumours. Digitization and road mapping techniques in conjunction with advances in catheter technology have opened up the field of endovascular occlusion of cerebral aneurysms. However, poor image quality and restriction to a single imaging modality limits the range of applications of real time imaging in conventional neurosurgery. The use of pre-operative images overcomes some of these difficulties. The appropriate image data can be acquired ahead of time and different imaging modalities fused together. This allows sophisticated pre-planning to take place. An order of magnitude greater accuracy in the peroperative execution of a minimally invasive procedure is now routine. Illustrative examples include functional image guided epilepsy surgery and complex spinal fixation. The main limitation is the inability to track soft tissue movements and there is a need for real time imaging modalities that will do this. Intraoperative MRI is one theoretical solution if the hardware development problems can be overcome. The ideal is for all invasive procedures to involve image guidance using pre-operative images combined with "in machine" real time image update.

1645
Discussion

1540–1700
Scientific Session
Genitourinary Tract Interventional Techniques
Hall 11a

1540
Permanent metal stents in the treatment of ureteric strictures
G T Rottenberg and D Rickards
Department of Imaging, The Middlesex Hospital, Mortimer Street, London, UK
AIM: Ureteric strictures can be treated by surgery or dilatation. Surgery is definitive, but dilatation proves to be temporary and usually requires insertion of a double J stent. We have examined the use and patency rates of permanent metal stents in the ureter. METHOD: A retrospective examination of patients who have been stented in our department was performed. 21 ureters in 16 individuals were stented (five patients had bilateral stents). Indications for stenting were: post-radiotherapy strictures ($n=5$), disseminated malignancy ($n=6$), unknown aetiology ($n=2$). The mean number of stents inserted per ureter was 1.5. RESULTS: Follow-up was difficult in this group of patients with a 13% 6 month mortality and 13% lost to follow-up. Five of 16 patients (31%) demonstrated stent occlusion within 6 months of insertion and four out of 16 (31%) demonstrated significant intimal hyperplasia. Only two patients had widely patent stents at 6 months. CONCLUSION: Metal stents are of little use in ureteric strictures due to the development of intimal hyperplasia. There may be an indication for their use in patients with advanced malignancy who are unable to tolerate percutaneous drainage or conventional double J stents. A further use may be for patients in whom it is difficult to change their double J stents.

1550
Flexible cystoscopy combined with digital fluoroscopy for outpatient ureteropyelography and retrograde ureteric stent placement
[1]N C Cowan, [1]J E Greenland, [1]M J Cowan, [2]J G Noble, [2]D W Cranston
Departments of [1]Radiology and [2]Urology, The Churchill Hospital, Oxford OX3 7LJ, UK
PURPOSE: To evaluate the combined use of flexible cystoscopy with digital fluoroscopy for outpatient ureteropyelography and retrograde ureteric stent placement. METHOD: Flexible cystoscopy and digital fluoroscopy were used in the interventional radiology suite for ureteropyelography and retrograde ureteric stent placement, removal or exchange. Procedures were performed following iv sedation and analgesia and oral antibiotic prophylaxis on an outpatient basis. RESULTS: A consecutive series of 52 adult patients (30 males and 22 females) are reviewed. 30 retrograde ureteropyelograms, 23 retrograde stent removals and 24 retrograde stent placements were performed. There were five failures of stent placement (5/29). The ureteric orifice could not be located in four cases (4/34). Complications included one case of ureteric perforation and one case of high placement of a ureteric stent above the ureteric orifice. CONCLUSION: Retrograde ureteropyelography and retrograde ureteric stent placement and exchange may be performed under local anaesthesia in the interventional radiology suite. With this technique a general anaesthetic is avoided and the problem of ureteric catheter displacement during patient transfer from theatre to the radiology department eliminated. Antegrade, retrograde and rendezvous procedures are possible at the same sitting for the management of ureteric obstruction.

1600
Are radiological parameters associated with successful antegrade ureteric stent placement in malignant ureteric obstruction?
T R Goodman, N C C Cowan, J R D Tuson, F V Gleeson and S J Golding
Department of Radiology, The Churchill Hospital, Oxford OX3 7LJ, UK
PURPOSE: To determine the predictive value of radiological parameters for the outcome of antegrade ureteric stent (AUS) placement in malignant obstruction. MATERIALS & METHODS: AUS was attempted in 88 consecutive patients for malignant obstruction over a 3 year 7 month period. Patients were assessed for: (1) Tumour type. (2) Site of calyceal access. (3) Site of stricture. (4) Length of stricture from the UVJ. (5) Percutaneous nephrostomy-AUS interval (PCN-AUSI). (6) Bidimensional measurement of primary tumour. (7) Presence of nodal disease. (8) Site of nodal disease. (9) Mean diameter of periureteric nodes. RESULTS: 127 stents were satisfactorily placed in 137 ureters, giving a success rate of 93%. The only parameter of predictive value was the PCN-AUSI which was longer in the successful group. CONCLUSION: Nephrostograms and CT examinations are of no value in predicting the outcome of AUS placement in malignant ureteric obstruction. With recent technical developments the site of calyceal access is also irrelevant. A long PCN-AUSI is associated with an increased likelihood of successful AUS placement.

1610
An audit of an ambulatory outpatient transrectal US guided prostate biopsy service: cost savings and relative diagnostic yield
A K Dheer, M Joyce and P McCarthy
Department of Diagnostic Radiology, University College Hospital, Galway, Ireland
INTRODUCTION: This Department introduced transrectal US (TRUS) guided prostate biopsy in March 1995. Some patients are still admitted by the urology services for transperineal (TP) prostate biopsy in theatre under general anaesthesia. AIM: To evaluate cost-savings to be gleaned by performing TRUS-guided biopsy in an outpatient setting *vs* inpatient evaluation by TP prostate biopsy (by the urological services). The study also compares our relative diagnostic yields. MATERIALS & METHOD: A retrospective review of 50 consecutive recent patients evaluated by each diagnostic pathway (100 in all) in early 1996. RESULTS: The average cost per diagnosis of malignancy in our group was Ir£110, while for those evaluated by the TP route, the average cost was Ir£3723; most of the staggering difference in cost being explained by prolonged hospital inpatient stay (average 5.61 days). No patient in the TRUS group required inpatient admission for a complication arising from the procedure. The pick-up rate of malignancy in the TRUS group was 46% as opposed to 73% in the TP group. However, there are differences in the two group which may explain this: the patients in the TP group had a higher average PSA level, median PSA level and were more likely to have abnormality on digital rectal examination and to have metastatic bone disease at presentation. CONCLUSION: TRUS-guided prostate biopsy in an outpatient setting is cost-effective, quick, safe and offers a high diagnostic yield.

1620
Painful varicoceles managed by embolization of the spermatic vein
[1]P A Spencer, [2]B T Parys and [2]J Levekis
Departments of [1]Radiology and [2]Urology, Rotherham General Hospital Trust, Rotherham S60 2UD, UK
PURPOSE: To evaluate the success of managing symptomatic varicoceles by the endovascular technique of spermatic vein embolization. The technique is established in the management of infertility, where a varicocele is associated with a low sperm count. MATERIALS & METHOD: 30 patients with scrotal pain/discomfort associated with a varicocele were treated (age 14–74 years, mean 32 years). 27 of the varicoceles were left-sided. The spermatic vein was catheterized via the inferior vena cava following a puncture into the right common femoral vein. Venography was performed and embolization undertaken using spring coils, either 0.25 inch steel (COOK) or 0.35 inch "SPIRALE" tungsten coils (MERCK). Three coils were positioned in the distal, mid and proximal portions of the spermatic vein. RESULT: Technical success was achieved in 20 cases (66%). All patients were followed up at 3 months. Relief of symptoms and disappearance of the varicocele was achieved in 18 patients (90%). In two patients a technically successful embolization had no effect. The procedure was incomplete in 10 patients, due to either unsuitable anatomy, demonstrated by the venogram (five patients), or failure to catheterize the spermatic vein (five patients). CONCLUSION: This technique has an important role to play in the management of the symptomatic varicocele.

1630
Invited Review
Renal masses: imaging armamentarium 1997
H Hricak
Department of Radiology, University of California, 505 Parnassus Avenue, San Francisco CA 94143, USA
Significant improvement in the detection and diagnosis of kidney pathology has been made possible with the technological advances in the areas of US, CT and MRI. Although the iv urogram (IVU) is still often considered to be the best initial study in the search for renal masses, it has been shown that in the presence of a CT-confirmed renal mass, detection by IVU is only 21% when the lesion is smaller than 2 cm, 52% when the lesion is 2–3 cm and 85% when the lesion is 3 cm or more in diameter. A normal IVU, therefore, does not exclude the presence of a renal mass; when a mass is detected, further lesion characterization by US, CT, or MRI is necessary. If a cystic mass is suggested based on the IVU findings, US is the next imaging examination of choice. While US is an excellent modality for the detection and characterization of renal cysts, in the detection of solid lesions US accuracy decreases considerably. When compared with CT, US demonstrates detection of 60% of lesions smaller than 2 cm and 83% of lesions between 2 and 3 cm in size. Lesion detection or characterization on contrast-enhanced MRI (90%–97%) equals that of CT (89%–99%). CT is less expensive and more widely available and thus remains the preferred cross-sectional imaging procedure for the diagnosis, characterization and staging of renal lesions. MRI is reserved for those cases where CT staging is inconclusive, especially with respect to vascular extension and direct tumour invasion of neighboring tissue, or in patients with renal failure, or other contraindications for the use of iodinated contrast media.

1545–1705
Special Focus Session
Digital Imaging—an Historical Overview
Hall 1

1545
Invited Review
Electronic computing 1940–1965
M Campbell-Kelly
Department of Computer Science, University of Warwick, Coventry CV4 7AL, UK
This paper traces the significant milestones in the first quarter-century of the electronic computer's existence. Electronic calculators were first developed during World War II for mathematical

applications, such as ballistics calculations and code-breaking. The modern "stored-program" computer was invented by John von Neumann and others in June 1945 at the Moore School of Electrical Engineering at the University of Pennsylvania. The stored-program design—which established the blueprint on which almost all subsequent computers have been based—proved extremely flexible, enabling the computer to evolve from its mathematical origins to become first a business machine and then a full-scale information-processing system. This evolution was largely made possible by the decreasing size and cost of electronics and the improving capabilities of software developers. Finally, the integration of communications and real-time computers enabled computer systems to respond instantaneously to real-world events, allowing them to control systems as diverse as airlines reservations and medical informatics.

1600
Invited Review
Computing in medicine, especially radiology from 1965
R E Bentley
Formerly: Department of Physics, Institute of Cancer Research, Sutton SM2 5NT, UK
In 1965, a computer really was a computer, in the sense that it was nearly always used to do arithmetic. Familiar non-numeric uses came later. It was natural that, in medicine, the first successful applications would be in areas which were highly numerate. The first was in radiotherapy, the second was in nuclear medicine, where data was available in a digital form. Up to 1965, computers had been used only in "batch mode", with a sequence of jobs queued up and run as and when the machine became free. The user had to prepare his data "off-line" on paper-tape or punch-cards and results of calculations had to be collected later. This was clearly not a viable way of dealing with data from diagnostic devices. In 1965 the first affordable mini-computer was announced, with a directly-connected cathode ray tube so that results could be viewed immediately and in a graphical form. It was now possible to connect computers directly to devices, such as γ cameras to provide quantitative information, to enhance the appearance of images and to allow a wide range of opportunities for combining, comparing and manipulating results. The greatest triumph for the digital computer came in the 1970s when it was applied to X-ray tomography. The principle had been known for many years, but only the rapidly increasing ratio of performance over price allowed it to become a viable tool for clinical work. MRI is even more dependent on the availability of affordable computers.

1615
Invited Review
The introduction of computing into diagnostic imaging
G R Higson
Medical Technology Consultants-BRI International Ltd, Staines TW18 4RH, UK
Until 1968 the possibility of introducing computers into diagnostic radiology had been limited to automating some of the settings on the control desk. It took someone totally freed from a background in radiology to recognize the revolution that computers could make possible. Godfrey Hounsfield was a computer expert in EMI, looking for applications for his devices. Probably only such a person could have had the idea of using narrow beams and reconstruction techniques to produce cross-sectional views of a kind that, until then, had been seen only in the pages of anatomy text books. It took 3 years to progress from Hounsfield's idea to a working scanner installation. Despite the limitations of the first unit—4-min scan time, off-line processing often taking 24 h—dramatic results were obtained. Ambrose and Hounsfield described the new scanner and their novel images at the 1972 Annual Congress of the BIR and founded a new diagnostic imaging speciality. The immediate success of the CT scanner opened the eyes of physicists and engineers to the possibilities offered by computer processing of radiological information. The numerous applications of these techniques will be described by other speakers, but it is good to remember that features regarded as commonplace today, such as windowing, subtraction, magnification etc. were introduced into radiology by a non-radiologist who won the Nobel Prize for Medicine.

1630
Invited Review
The digital hospital
D J Allison
Imaging Department, Hammersmith Hospital, London W12 0HS, UK
Hammersmith Hospital is now filmless. All wards, operating theatres, clinics and seminar rooms in the institution are linked by a picture archiving and communication system (PACS), at the heart of which is an all-digital imaging department. The presentation describes the brief history of this development, outlines the principal features of its architecture and discusses some of the clinical, logistic, economic and managerial implications of PACS.

1645
Discussion

1600–1645
Categorical Course
Vascular Interventional Radiology 4
Hall 10a

1600
Invited Review
Vascular interventional radiology of the liver
S Olliff
Radiology Department, Queen Elizabeth Hospital, Birmingham B15 2TH, UK
This presentation will cover the following areas. Hepatic artery embolization for iatrogenic and traumatic bleeding. Hepatic artery aneurysm. Embolization and chemoembolization of liver tumours. TIPSS and related procedures for bleeding varices and uncontrolled ascites. Hepatic vein dilatation and re-canalization for Budd–Chiari syndrome. Hepatic vein stents, thrombolysis and TIPSS. Vascular interventions in liver transplant patients. Hepatic artery, portal vein and hepatic vein/IVC.

1610–1700
Refresher Course
Management
Hall 11b

1610
Invited Review
Re-engineering ones own department
P Davies
Department of Radiology, City Hospital NHS Trust, Nottingham NG5 1PB, UK
The author has re-engineered his own department on four occasions. Firstly, when a radiology management system was installed, second when moving into a new department, third when incorporating another department and fourthly because of cash shortages. As a result of the first re-organization he was asked to keep a watching brief on the City Hospital HISS project and, as a result of this, has studied project management. Project failure has been well-studied and can be mapped onto more general failure models. Failure is due to systems running out of control and the response to increasing demand of a system under control can be modelled, resulting in a curve of the same form as Starling's law of the heart curve. Re-engineering aims to bring systems back into control and it does this by simplification, but it must be remembered that it is important to do all those things that are necessary, and none of the things which are not necessary, to obtain the desired result. These major changes must be managed correctly.

1635
Invited Review
Process re-engineering at the Leicester Royal Infirmary NHS Trust
J Penny
Centre of Best Practice, Leicester Royal Infirmary NHS Trust, Leicester LE15 8DW, UK
Leicester Royal Infirmary NHS Trust is a pilot site for the NHS re-engineering initiative which aims to produce dramatic improvements in patient care, teaching and research. Re-engineering in the health care environment looks to improve the fit of one sub-process with another, ensuring that the process experienced by the patient is under control, values their time and meet their wants and needs. Re-engineering has to be experienced to be studied and this presentation concentrates on the work, reflections and lessons learnt

during the programme at the Leicester Royal Infirmary. Discussion will include the reasons for undertaking such a major change programme, achievements, where radiology fits into a patient process and what re-engineering can and cannot achieve.

1615–1705
Refresher Course
Imaging of the Pharynx & Oesophagus
Hall 10b

1615
Invited Review
Contrast evaluation of dysphagia
D F Martin
Department of Radiology, Withington Hospital, Manchester M20 2LR, UK
Evaluation of the oral, pharyngeal and oesophageal phases of swallowing, which when disordered can give rise to dysphagia, creates increasing radiological work-load. Adequate evaluation can have important therapeutic consequences, with appropriate treatment ranging from speech and language therapy to oesophageal stenting. This presentation will concentrate on the technical aspects of contrast evaluation of swallowing, describing a technique which is safe and effective. The range of normality is wide and varies considerably with age and this, together with common pathologies, will be described and illustrated.

1640
Invited Review
New methods of oesophageal imaging
C L Kay
Radiology Department, Medical University of South Carolina, Charleston, SC 29425, USA
In addition to the conventional barium examination of the oesophagus, there are now numerous other modalities available for imaging the oesophagus, particularly in relation to the staging of oesophageal cancer. This review will address the relative advantages and disadvantages of current "state of the art" imaging methods, including spiral CT, MRI and endoscopic ultrasound. In addition, there will be an introduction to exciting "cutting edge" research into oesophageal imaging, namely endoscopic MR (in which an MR receiver coil is incorporated into the tip of an endoscope) and virtual oesophagoscopy (in which the manipulation of data acquired during a spiral CT scan reproduces the endoluminal view obtained at fibreoptic endoscopy).

1715–1800
Institute of Physics and Engineering in Medicine
Douglas Lea Memorial Lecture
Hall 1

1715
Eponymous Lecture
Radiation, hypoxia and genetic stimulation: implications for future therapies
G E Adams
The Gray Laboratory Cancer Research Trust, Northwood HA6 2JR, UK
Cellular stress responses, whereby very low doses of cytotoxic agents induce resistance to much higher doses, represent evolutionary defence mechanisms against cellular injury. They appear to be stimulated by a variety of chemical, biological and physical agents, including radiation, drugs, heat and hypoxia. There is much homology in the range of effects of these agents, which are marked by the up-regulation of various genetic pathways. Low-dose radiation stress influences processes involved in cell-cycle control, signal transduction pathways, radiation sensitivity, changes in cell adhesion and cell growth. There is also homology between radiation and other cellular stress agents, particularly hypoxia. Whereas, traditionally, hypoxia was regarded mainly as an agent conferring resistance to radiation, there is now much evidence illustrating the cytokine-like properties of hypoxia, as well as radiation. Stress phenomena are important in risks arising from low doses of radiation, as well as other toxic agents. Conversely, exploitation of the stress response in settings appropriate to therapy can be particularly beneficial, not only in regard to radiation alone, but also in treatment with combinations of radiation and drugs. Similarly, tissue hypoxia can be exploited in novel ways to enhance therapeutic efficacy. Bioreductive drugs, which are cytotoxically-activated in hypoxic regions of tissue, can be rendered even more effective by hypoxia-induced, increased expression of enzyme reductases. Nitric oxide pathways are influenced by hypoxia, offering possibilities for novel vascular-based therapies. Other approaches will be discussed.

Notes

Wednesday 21 May

0800–0845
British Institute of Radiology
Annual General Meeting & Awards Ceremony
Hall 9

0800–0845
Categorical Course
Vascular Interventional Radiology 5
Hall 10a

0800
Invited Review
Renal angioplasty and embolization
A-M Belli
Department of Diagnostic Radiology, St George's Hospital, London SW17 0QT, UK
The main indications for renal angioplasty are in the management of hypertension, renal failure and pulmonary oedema. The only undoubted area of clinical success is when the hypertension is secondary to fibromuscular dysplasia, where a cure is achievable. The technical success of PTA in atherosclerotic renal artery stenosis has undoubtedly been increased since the advent of stents, particularly for ostial disease, but this does not necessarily reflect an improvement in clinical success. The poor clinical results in the treatment of hypertension reflect the fact that a reliable diagnostic test for identifying renovascular hypertension is lacking and so many patients with essential hypertension are also treated. The results of PTA for renal impairment are also difficult to predict. However, good results have been achieved in the management of non-cardiogenic pulmonary oedema, where the problem is usually due to either bilateral renal artery stenosis (RAS) or RAS in a single kidney. This is, however, a small group of patients. Renal embolization, on the other hand, is extremely successful in the management of haemorrhage due to trauma or tumour and often makes surgery unnecessary, whilst preserving as much renal tissue as possible. Renal embolization also has a place in ablating the native kidneys of renal transplant patients with hypertension.

0800–0845
Refresher Course
Lasers in Medicine
Hall 10b

0800
Invited Review
Review of lasers in medicine
W M Davies
Department of Medical Physics and Clinical Engineering, Swansea NHS Trust, Swansea SA2 8QA, UK
The unique properties of light produced by an ever-widening range of lasers has been exploited to assist with the solution of a range of diagnostic and therapeutic problems. This review will examine how changes in laser technology, coupled with a better understanding of the mechanisms of the interaction of laser light in tissue, are fostering significant new opportunities for lasers in the medical field. The various mechanisms utilized to effect treatment will be briefly discussed to illustrate how laser energy is able to sometimes offer unique solutions to medical problems. With the majority of medical specialities, from cardiology to plastic surgery, using lasers routinely we will examine how some of these applications have arisen and where they may be going in the future. The prospects of new high power laser diodes, with a wider range of wavelength than currently available, is going to significantly improve the affordability of laser technology and will generate considerable new interest in its use. Outside of the surgical arena lasers are being used as optical probes to aid diagnosis. Their specific wavelengths may be tuned to aid differentiation of a range of medical problems. Finally, the review will consider the role of low power lasers where the evidence of treatment is running ahead of the understanding of the mechanism.

0800–0850
Refresher Course
Bariums in the '90s
Hall 11a

0800
Invited Review
The role of the barium examination
[2]P J Shorvon and [1]A H Chapman
[1]*St James's Hospital, Leeds and* [2]*Central Middlesex Hospital, London, UK*
In these days of increasing use of upper GI endoscopy, the barium meal has been relegated in some departments to a very minor role. The purpose of this refresher course is to illustrate the continuing importance of the technique, indicate the areas where it has a distinct advantage over endoscopy and discuss how the technique needs to be adapted to make full use of its potential. The place of the barium meal will also be discussed in relation to non-invasive testing of *Helicobacter pylori*.

0825
Invited Review
Beyond the duodenum
A H Chapman
Department of Radiology, St James's University Hospital, Leeds LS9 7TF, UK
The radiologist still plays a vital role in the investigation of the small bowel as enteroscopy is only available at specialized centres and rarely provides a complete examination. Clinicians should be discouraged from referring patients with vague abdominal symptoms and minimal abdominal signs for small bowel radiology, as the yield of pathology in this group is particularly low (< 5%). Patients find enteroclysis unpleasant compared with the small bowel meal but, for gastrointestinal bleeding, subacute obstruction and malabsorption and the assessment of strictures, enteroclysis is the preferred examination. The advent of the video-endoscope has been responsible for the detection of increasing numbers of early colonic cancers, undetectable with barium radiology. Despite this, approximately 250 000 barium enema examinations are still performed in the UK each year and numbers show no sign of decreasing. No doubt this is because there are insufficient numbers of skilled colonoscopists to take on this work-load, but also because the barium enema consistently demonstrates the right half of the colon and has a low complication rate. The barium enema may miss pathology in a difficult sigmoid colon, but this segment of bowel can be viewed by flexible sigmoidoscopy which has a lower complication rate than diagnostic colonoscopy. Clinicians should be encouraged to refer patients for both barium enema and flexible sigmoidoscopy.

0800–0845
Refresher Course
Transrectal US & Prostate Biopsy
Hall 11b

0800
Invited Review
Transrectal US and prostate biopsy
D Rickards
University College Hospitals, London, UK
Over the past year probe technology has not altered much, but the modern trend towards using tight catheter ray probes produces some problems for various intraprostatic interventional techniques. The appearance of carcinoma by US criteria, colour Doppler and par Doppler applications to US and prostatic cancer are becoming slightly more defined. However, biopsy remains the only definitive way of diagnosing malignancy at present. Biopsy techniques vary, but it seems that the modern trend is for Sexton biopsies, although an argument can be made for more biopsies to include the seminal vesicles angles to try and accurately diagnose and stage the disease at one sitting. Antibiotic protocols have been the subject of a lot of debate over the last year. Prophylactic antibiotics should probably

be used as all biopsies should be an elective procedure and therefore can be covered with antibiotic treatment 2 days beforehand. Male factor infertility and its investigation with lower tract genital US continues to provoke some interest. It is not widely used, but should be. Indications for US in male factor infertility will be explored and the implications discussed. Interventional techniques within the prostate include laser oblation and cryotherapy. Both are trying to create a niche in the market for the treatment of both benign and malignant disease, but have yet to receive world-wide recognition. The use of laser oblation in both primary disease and disease that has escaped hormonal control will be discussed. Transrectal US can largely replace fluoroscopy in lower urinary tract urodynamics. More information will be gained by pre-study US than by spot films during micturition. The implications of lower tract and transrectal US in the investigation of outflow obstruction will be discussed.

0800–0845
Refresher Course
MRI & Intracranial Infection
Olympian Suite

0800
Invited Review
MRI and intracranial infection
I Moseley
Lysholm Radiological Department, National Hospital for Neurology and Neurosurgery, London WC1N 3BG, UK
Infections are classified according to the tissues or spaces involved. Inflammation of the brain is *encephalitis*, but the term is reserved for diffuse infections, often viral. MRI is particularly sensitive to the cytotoxic oedema seen in this condition when acute and may give positive results when CT is normal. In patients with AIDS, parenchymal loss and diffuse signal change can be seen as effects of chronic HIV infection. *Cerebritis* refers to pyogenic infection of the brain, which may proceed to formation of an abscess. It may be difficult to make a diagnosis in the initial stages. Although brain abscesses are usually shown clearly by CT, the appearances are strictly nonspecific; a low-density rim on T_2 weighted images may, however, suggest the diagnosis. Contrast enhancement around abscesses may be less prominent in patients with impaired immunity. Both CT and MRI give valuable data in cerebral granulomata due to chronic infections and conditions which mimic them. *Meningitis* can involve the dura mater (pachymeningitis) or the arachnoid (leptomeningitis). The former is more likely to result in neurological complications such as hydrocephalus, and contrast-enhanced MRI is more sensitive than CT in this group of patients, although the findings are nonspecific. Many patients with uncomplicated acute leptomeningitis do not need imaging, which is often noncontributory. An empyema is an infection, usually pyogenic, in a pre-existing or potential space. Extradural and subdural-empyemas are commonly associated with sinus or middle ear disease; they may complicate acute meningitis. Early changes are often subtle and MRI with contrast medium is the examination of choice.

0845–1045
State of the Art Symposium
European Radiology—Opportunities for Collaboration
Hall 1

0845
Invited Review
Radiology in Europe—radiological education
L Dalla Palma
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In 1992, through the Working Group on Education, the EAR conducted a survey among its members to obtain an overview of the current pattern of radiological education in Europe. Results showed that the organization and content of radiological training programmes, and the training facilities in which such programmes are offered, vary widely throughout Europe. It was considered appropriate that the EAR should offer guidelines to supplement existing regulations usually designed to ensure safe and ethical practice. *Guidelines for general radiology*: In principle, a general radiologist should have acquired the clinical radiological skills necessary to investigate all body systems at a level appropriate to a community hospital and should be capable of providing a sound clinical radiological opinion. The duration of specialist training in radiology should be 5 years, the first 4 years serving as a common trunk and the 5th year concerned with a subspecialty, or an extension of training in general diagnostic radiology. The 5 year programme has been suggested. *Guidelines for subspecialized radiology*: The guidelines for training in subspecialized radiology are based on the recommendations given in the UEMS Radiology Section and the UEMS European Board of Radiology *Guidelines on Training in General Radiology*. The recommendations have been suggested by the EAR Committee for Subspecialties and the specific recommendations for each subspecialty have been proposed and approved by the respective European society for the subspecialty. The training programme has been prepared for the following subspecialties: cardiovascular; gastrointestinal and abdominal; head and neck; interventional; musculoskeletal; neuro; paediatric; thoracic; and uroradiology. The duration of subspecialty training is 2 years. In the fifth year, general radiology training should be totally devoted to one subspecialty and is counted as the first year of subspecialty training.

0900
Invited Review
European ultrasound
H B Meire
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The practice of clinical US varies widely throughout Europe. Differences derive mainly from the different healthcare structures, especially the contrast between the UK hospital-based NHS system and the private poly-clinics and mono-specialty clinics common in many European countries. There are major differences in who actually performs the US scans. In the UK the use of sonographers is now quite well-established, especially for obstetric, cardiac and vascular studies. Throughout Europe very few countries allow any non-medical personnel to perform US scans. In the UK many hospital radiology departments offer a comprehensive diagnostic US service, often including both obstetrics and vascular studies. Throughout most of Europe US tends to be specialty-based, especially in obstetrics, gastroenterology and urology. These different approaches raise questions concerning equipment utilization, technical competence and training in diagnostic US. In those radiology departments offering a wide ranging service, the operators gain great skill at equipment use, but are at risk of becoming a "Jack-of-all-trades, master of none". Where US is offered by a clinician, he or she may become quite experienced in their own specialty but, as their practice is primarily clinical, they may never become fully competent in US and the equipment may be under utilized. Clearly, the different ways in which the diagnostic US service is offered has an impact on the training requirements for medical and non-medical staff involved. There are now initiatives to move towards a more uniform training standard in the different specialties across Europe and to try to establish some form of certification of competence in the practice of US.

0915
Invited Review
Nuclear medicine
P J Ell
Department of Nuclear Medicine, The Middlesex Hospital, London W1N 8AA, UK
The European Association of Nuclear Medicine (EANM) resulted from the merger of two previously existing European Societies of Nuclear Medicine. The first meeting of the EANM Executive took place in Budapest in August 1987. In these 10 years the EANM has grown into an Association with over 3000 members from some 40 countries world-wide. An annual Congress rotates through Europe, the last being held in Copenhagen in September 1996, with the 1997 Congress taking place in Glasgow in August. These Congresses attract a large number of participants (3500) with a significant industrial participation (2500 m^2). The Congress runs over 5 days (inclusive of pre- and post-Congress events) with between five and seven parallel sessions and an average of 600 oral and 500 poster presentations. The European School of Nuclear Medicine, as part of the EANM Committee for Education, is actively promoting postgraduate education in nuclear medicine across Europe. There are significant opportunities for collaboration with radiology in Europe. As an example, in one year, a multicentre trial of *ca* breast imaging was carried out, with data collection from eight European Centres and 246 patients. A comparative study looked at the relative

accuracies of mammography and scintimammography with isonitrile imaging in comparison with biopsy data. This trial will be discussed in greater detail in the mini-symposium on breast imaging at this Conference. The need, and indeed the desirability, of collaboration between radiology and nuclear medicine is paramount today and the opportunities are significant. With goodwill immense progress could be achieved.

0930
Invited Review
The European Congress
H Ringertz
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The formal corner-stones for collaboration in radiology within Europe, including the EU countries, are the European Association of Radiology (EAR), individual membership of the European Congress (ECR) and the journal *European Radiology*. The new type of European radiology congresses was initiated by European industry with interests in radiology equipment, X-ray film, contrast media, etc. They identified a need for a European platform, a view which was accepted by EAR. The first new type congress was held in 1991 and the choice of a "permanent" site in Vienna was successful in stimulating east–west collaboration within European radiology. The ECR consists, as most large congresses do, of three main components: the scientific program (presentations and posters), an educational programme, and a technical exhibition. There is a close connection between these different components and opportunities for collaboration exist both between and within them. The development of the programme is a good example of this collaboration, with formal collaboration both with industry and the subspecialized European radiology societies. ECR has not yet matured to a final form, and maybe never should, but it is already a useful matrix, catalyst and enzyme for collaboration between all different aspects of radiology in Europe.

0945
Invited Review
Obtaining European support for your research
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The European Union supports research within member states. Research and development within Europe is brought together within Framework programmes. We are currently three-quarters through Framework IV (1994–1998) and preparations for Framework V are well-advanced. The Framework programme is managed in Brussels, under the direct responsibility of a Commissioner. In total Framework IV is budgeted at US$16 billion. Two programmes within Framework IV are most likely to be of interest to those interested in medical imaging, these are the Telematics and Biomed programmes. The Biomed programme included topics related to brain and cardiovascular imaging, as well as the techniques and technology of imaging systems. The Telematics programme contains several further programmes involving medical imaging. This presentation will review opportunities still available under Framework IV, speculate about Framework V and provide some practical advice about succeeding in obtaining European funding for your research. A database of projects sponsored and supported by the EU can be found courtesy of CORDIS (Community Research and Development Information Services) on the World Wide Web (WWW) at http://www2.cordis.lu/.

1000
Invited Review
The EAR database
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Computer technology is revolutionizing medical imaging and communication. The aim of the EAR database is to offer to the European radiological community a tool for communication and education using the Internet resources. The construction of a European database, under the authority of the EAR, was approved by the Executive Bureau of the Association. Possible applications are: teaching, building reference image databases, supplying classified services and scientific applications such as multicentric trials, etc. Access to the Database will be open to the entire radiological community free of charge. The structure of the Database is based on the principle of a distributed database with a central server acting as browser to other servers, as well as a local database fed by submitted educational files and imaging files. An editorial committee mainly comprising European radiologists will review the submitted new clinical cases or educational files.

1015
Discussion

0900–0945
British Institute of Radiology
Presidential Address
Hall 9

0900
The cancer patient in the radiology department; do we live up to our responsibilities?
S J Golding
Department of Radiology, University of Oxford, UK
Cancer patients present the X-ray department with additional challenges beyond the normal requirement of competent and conscientious imaging service. Increasingly, radiology comes to play a greater role at key points of oncological management. Few solid tumours are detected without recourse to diagnostic imaging. Disease staging, treatment planning, monitoring therapy, detecting recurrence and interventional onco-radiology all have significant but differing imaging needs. The radiologists may, through the course of an individual patient's disease, have the opportunity to develop a closer clinical relationship—with the responsibility which this implies—than is possible in many other disease states. A diagnosis, or suspicion, of malignant disease prompts severe fear in patients and they require particularly sympathetic handling. However, patients have different fears at different points of their management and may move rapidly between these phases. The radiologist, intent on responding to the patient's need, must therefore understand the psychological phases appropriate to the particular point of investigation. However, no training in this is generally available and learning proceeds on the basis of experience and individual insight, the level of which may not be high in this specialty. How then is the need to be met? Should the radiologist communicate results of investigation to patients direct? Many clinicians feel that this an infringement of their clinical responsibility, but patients consistently report dissatisfaction with leaving the imaging department in ignorance of their results; this practice can be said to imply an unfeeling lack of involvement with their care and anxiety. However, if radiologists are to rise to the challenge of clinical consultation they need a clear perception of the clinician's management if they are not to send out messages which are in conflict with this. They also need to be adept at the proper verbal and non-verbal communication skills, as well as having the knowledge of how far such a conversation can be taken within the constraints of the X-ray department and how to disengage at an appropriate point without generating additional anxiety. Again, such skills are currently likely to be obtained only at the prompting of personal interest and insight and there appears to be a significant training need. Imaging departments are necessarily busy places and facilities for calm and secluded consultation are rarely available. Providing such conditions, together with the radiologist's time to deal with this matter satisfactorily, raises additional costs, although within the context of an X-ray department business plan these are unlikely to be large enough to explain the current lack. Moreover, hospitals rarely appear to take advantage of design philosophies which re-enforce psychological support to the patient. All too often, new departments are designed to a programme only of cost-containment and workload efficiency. The result is that X-ray departments frequently provide an unsympathetic atmosphere and a technical environment in which frightening events may occur to patients with an already high level of anxiety. This is in spite of the fact that small changes in design can produce major changes in psychological effect. Rising to the needs of the cancer patient can be simply met by small changes in training and in policies for provision of hospital care. Whether such conditions are provided by the cost-consciousness and short term expediency currently characterizing the post-reform NHS is questionable.

0900–1100
State of the Art Symposium
Imaging Technology 1
Hall 10b

0900
Invited Review
Developments in MRI
M Smith
Leeds General Infirmary, Great George Street, Leeds LS1 3EX, UK
Abstract not available.

0925
Invited Review
Developments in radionuclide imaging
T D Beynon
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The development of a binary Gabor plate has allowed the development of 3D holographic imaging from incoherent sources. Of particular interest is the work on γ-ray holography applied to medical imaging. Examples will be given using a standard gamma camera, without collimators, of 3D imaging using $^{99}Tc^{m}$ and ^{18}F sources. Future developments of the technique will also be outlined.

0950
Invited Review
Developments in ultrasonic imaging
P N T Wells
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Developments in transducers and digital electronics have been largely responsible for recent advances in ultrasonic imaging capability. Transducer materials which match more closely to the patient and the fabrication of arrays with smaller elements, have made it possible to operate at higher frequencies, with shorter pulses and better beam formation. They have also led to the development of novel intraluminal probes. At the same time, faster and cheaper integrated circuits, including application specific devices, and the plummeting cost and escalating performance of computers, mean that ultrasonic signals can be digitized closer to the transducer and that subsequent signal processing schemes can be implemented by software. The impact of these developments can be seen across the whole range of ultrasonic scanners, from inexpensive linear array systems to powerful and versatile machines optimized for 2D real-time imaging and approaching the theoretical limits of resolution, tissue discrimination and flow detection. Contrast agents have the potential greatly to extend the clinical utility of ultrasonic investigations, both anatomical and functional. Instruments will be needed that can display and quantitate contrast agent distributions and exploit harmonic scattering. 3 and 4D imaging systems have already been demonstrated. Advances are now needed in display technology. Image fusion research is another promising area. The gap that exists in contemporary imaging, for structures in the 10 μm range, needs to be filled: will the instruments be scanners or microscopes? Ultrasonic imaging is also likely to have an increasingly important role in guiding interventional procedures.

1015
Clinical PET with a low-cost 3D PET scanner, the ECAT ART
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PURPOSE: Evaluation of a 3D, partial ring, rotating PET scanner, the ECAT ART (Siemens/CTI PET systems) for clinical imaging. MATERIALS: The ECAT ART is a commercially viable 3D PET scanner with 46% of the detectors of the equivalent 2D scanner. Tomographic sampling is achieved by rotating two opposed banks of detectors. System resolution is 6 mm on axis, with an absolute sensitivity of 11 400 cps MBq^{-1}. METHODS: Due to the open geometry of 3D PET systems, the increase in sensitivity is to some degree offset by increased detection of random and scattered coincidence events. The noise equivalent count (NEC) rates were measured for phantom arrangements simulating imaging conditions in the head and body. Injected activity and imaging protocols were optimized using the results. A segmented attenuation correction (SAC), suitable for deriving attenuation correction factors from short, noisy transmission scans appropriate to whole body imaging, was evaluated using a NEMA phantom with inserts of differing attenuation coefficient. The accuracy of data correction methodology, including scatter correction, was evaluated using a Utah phantom. RESULTS: NEC rates from phantom experiments indicated an injected activity of 370 MBq and 185 MBq was appropriate to brain and whole body studies with ^{18}F-fluorodeoxyglucose (FDG). SAC provided accurate attenuation correction with short (3–5 min) scans appropriate for oncology FDG whole body studies. Image activity ratios within 10% of the real values were obtained for Utah phantom experiments and ^{18}F-DOPA scans are analysed quantitatively on this basis. CONCLUSION: The ECAT ART scanner is a useful instrument for both qualitative and quantitative PET imaging.

1025
Combined US and MRI system for MR interventions
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PURPOSE: To develop an MRI-compatible US system to expedite MRI interventions. MATERIALS AND METHODS: A standard 2D greyscale US scanner was adapted for use within the MRI suite itself by means of a probe cable extension and remote video output. Image quality assessment was performed with standard phantoms both within and without the ambient magnetic field. US scanning and guided interventions were carried out on the MRI table prior to MRI confirmation of needle positions. RESULTS: Diagnostic quality images were achieved within the magnetic field independent of probe angle to the Bo axis. Using this system tissue biopsy and thermoablative MRI-monitored procedures were successfully carried out on the MRI scanner bed itself and we present our results in phantoms and *in vivo*. CONCLUSION: As MRI becomes the modality of choice in an increasing number of clinical situations, so does the demand for MRI-guided intervention. Using closed-bore scanners, interventions are difficult, time-consuming and costly. By increasing the speed of needle placement and removing the need for patient transfer, this new US combination system makes MRI intervention more feasible and a safer proposition. In the period before open-access scanners become widely available, this system permits MRI-interventions to be performed using existing generation, closed-bore MRI scanners.

1035
High precision ^{1}H MRS metabolite peak area ratios and concentrations using automated acquisition and post-processing
E Moore, M Smail, S C R Williams and A Simmons
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PURPOSE: Precision of proton spectroscopy measurements is critical for research and clinical applications. It is considered here for normal volunteers and a phantom containing *in vivo* levels of metabolites. MATERIALS & METHODS: Metabolite and corresponding unsuppressed water spectra were acquired from an 8 ml voxel using PRESS localization (TR = 2000 ms, TE = 136 ms, 256 averages) on a 1.5 T GE Signa. Automated shimming and water suppression techniques were used, providing maximum water line-widths of 3 Hz and water suppression >99%. *In vitro* spectra were collected twice-weekly for 18 months. *In vivo* spectra were acquired on five occasions over a 3 month period from the occipital lobe of each of the seven volunteers. Peak areas were determined for NAA, Cho, Cr + PCr and unsuppressed water using Levenberg–Marquardt fitting. Metabolite concentrations were determined by using the unsuppressed water signal as an internal standard. RESULTS: A coefficient of variation (CV) was calculated for metabolite ratios and concentrations for the phantom and each volunteer. Volunteer results were then summarized by a mean CV. *In vitro* CVs of NAA/Cho, NAA/Cr and Cho/Cr ratios were 4.49%, 1.57% and 4.28%. Equivalent *in vivo* mean CV values were 5.29%, 4.61% and 7.12%. CVs for *in vitro* NAA, Cho and Cr concentrations were 2.79%, 4.02% and 2.82% compared with *in vivo* mean CV values of 2.74%, 5.48% and 4.05%. CONCLUSION: Levels of precision for both metabolite ratios and concentrations are extremely encouraging and superior to those reported in the literature. We attribute this to highly automated techniques for shimming, water suppression and peak area measurement.

1045
Work in Progress
See p. 124.

1055
Discussion

0900–1010
Scientific Session
CT of the Colon
Hall 11a

0900

Is minimal preparation CT comparable with barium enema in elderly patients with colonic symptoms?

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PURPOSE: Recent papers comparing CT with barium enema (BE) have used a variety of preparation techniques prior to the CT study (bowel preparation, rectal air, tap water enemas and iv contrast). We wished to compare a minimal preparation, minimal supervision CT technique, that could realistically be performed on an outpatient or overnight stay basis, with the standard BE. METHOD: 100 elderly patients with symptoms referable to the colon had an unenhanced CT, following oral contrast commenced the previous evening. This was followed at an interval by a standard technique BE. These investigations are reported independently. RESULTS: Six tumours have been confidently diagnosed and 48 patients have had negative reports from both CT and BE. Three small polyps and one sigmoid colon annular tumour were diagnosed on BE only. CT raised the possibility of lesions in 15 cases where the BE was negative. Four significant aneurisms, one pancreatic and two ovarian masses were seen on CT. 10 BE examinations were abandoned or severely limited. CONCLUSION: Minimal preparation, minimal supervision CT is a practical first-line investigation alternative to BE in frail elderly patients. A good quality BE remains the "gold standard" for investigating the colon, as CT will miss a number of small polyps and occasionally larger lesions, particularly in difficult areas such as the sigmoid colon. CT will also prompt further investigation due to suspicious bowel wall thickening, *i.e.* false positives, in some patients. In a small number of cases CT will identify other serious pathology.

0910

Spiral CT pneumocolon in the pre-operative staging of colonic carcinoma

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PURPOSE: Double contrast barium enema and colonoscopy will both detect over 90% of colonic carcinomas but they cannot assess local, regional or distant spread. Previous studies, mainly using conventional CT, have shown variable accuracy in CT staging of colonic cancers and its role remains controversial. This pilot study was performed to determine the accuracy of spiral CT pneumocolon for staging colonic carcinoma. MATERIALS & METHODS: 20 patients with colonic carcinoma, diagnosed by colonoscopy, underwent pre-operative spiral CT. The CT was performed after colonic preparation. Oral contrast was given at least 3 h before the scan to ensure colonic opacification. With the patient on the CT table, a pneumocolon was performed and a volume scan was then undertaken with 100 ml iv contrast. Images were prospectively analysed and the tumour staged by radiologists blinded to the colonoscopy results. Surgical and pathological correlation was obtained in all cases. RESULTS: The carcinoma was identified correctly in all cases. 18 out of 20 (90%) patients were correctly staged. Of those incorrectly staged, both were over-staged by CT due to errors in predicting lymph node involvement. These cases had small nodules in the pericolonic fat that were not found to contain tumour. CONCLUSION: Spiral CT pneumocolon accurately locates and stages colonic carcinoma. The weakness of the technique is the evaluation of lymph node metastases but, despite this, these results are comparable with the best previously documented CT staging figures.

0920

Virtual endoscopy: comparison with colonoscopy in the detection of space-occupying lesions of the colon

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PURPOSE: A new technique known as virtual colonoscopy (VC) has recently been described which combines abdominal helical CT scanning and virtual reality computer technology. The reconstructed images provide a simulation of the interior of the colon, as viewed by endoscopy. The purpose of our study was to compare VC with conventional colonoscopy (CC) in patients with suspected or known space-occupying lesions of the colon. METHODS: 33 patients underwent a non-contrast helical CT scan (Picker PQ 5000) of the abdomen and pelvis following regular colonoscopy bowel preparation. The colon was distended by rectal air insufflation via an enema tube and iv glucagon was administered to paralyse the bowel. A continuous volume CT dataset of the abdomen was reconstructed and reformatted into the VC presentation (epi-Scope™) by one of the investigators blinded to the results of other imaging. A CC was performed on the same day and documented with standardized videotape recording. RESULTS: A total of 28 polyps ≥ 3 mm in diameter were identified at CC. Of 10 polyps 3–5 mm in diameter at CC, one was seen at VC (10%); of 13 polyps 6–10 mm in diameter at CC, five were identified at VC (38%); of three polyps 11–20 mm in size at CC, two were noted at VC (67%); and of two polyps >20 mm at CC, both were seen at VC (100%). There were four false positive diagnoses at VC, including stool incorrectly identified as polyps and colonic spasm mistaken for a colonic stricture. CONCLUSION: Our initial results show that VC is technically feasible and capable of detecting the majority of lesions >1 cm in size. Current technology may miss smaller polyps but, with further developments in computer software, VC may prove a useful tool in the detection of space-occupying lesions of the colon.

0930

Spiral CT pneumocolon to assess colonic tumours: radiological–pathological correlation

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AIM: To determine the accuracy of spiral CT pneumocolon in the radiological staging of colonic tumours. METHOD: 30 colonic tumours were identified on dynamic, contrast-enhanced spiral CT pneumocolon after bowel cleansing, iv smooth muscle relaxant and rectal air insufflation. Barium enemas were performed in 18 of these patients; eight were incomplete and a confident diagnosis of tumour was made in 13 cases. Colonoscopy was performed in 18 cases, 13 were incomplete and 15 tumours were diagnosed. All patients had surgical resection and CT *vs* pathological correlation was performed. Spiral CT pneumocolon showed all 30 cancers as strongly enhancing masses. The radiologists were blinded to the barium enema, colonoscopic and pathology results. CT pericolic fat soft-tissue infiltration was specific for tumour involvement. RESULTS: All 28 patients with irregular outer colon walls on CT had full thickness wall infiltration histologically (stages B2 and C2) and two patients with smooth outer colon walls were stage A. All 30 tumours were correctly staged by CT, with respect to local tumour invasion, but six were under-staged because of under-diagnosis of nodal involvement, for which the sensitivity was 63% and specificity 100%. CONCLUSIONS: We conclude that spiral CT pneumocolon is simple, quick and well-tolerated compared with colonoscopy and barium enema. It gives detailed information on local and distant spread of colonic tumours.

0940

Invited Review

Spiral CT of the bowel

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The latest generation of spiral CT scanners allow for examination of the entire abdominal contents within a single breath-hold. A collimation of 5 mm or less, with reconstruction at 2 mm or 2.5 mm increments, will then allow for acquisition of a near isotropic dataset for 3D analysis. After bowel cleansing and paralysis, air or carbon dioxide is insufflated into the colon to the point of discomfort. 100–150 ml of iodinated contrast (depending upon body weight) is infused, matching the infusion rate to the duration of the scan. The scan data are acquired during the arterial phase. We have examined over 50 patients with full surgical and histological correlation using this technique. All of the 38 primary tumours were detected. Differentiation of benign or malignant lesions was possible in 49/51 cases. All benign processes were also detected, although patients with IBD were specifically excluded from this study. T-staging and M-staging were over 95% accurate, but the standard size criteria for lymph node status was only 65% accurate. Small lymph nodes (*i.e.* less than 1 cm) were seen in all patients, irrespective of the primary pathology. CONCLUSION: Spiral CT of the bowel with 3D analysis is highly sensitive for the detection of disease. It is also accurate in diagnosis and T-staging, but is not sufficiently accurate in determining the node status. It is an economic and practical alternative to colonoscopy and barium enema in patients with a high likelihood of significant large bowel disease.

0900–1010
Scientific Session
Cardiac Imaging 1
Hall 11b

0900

Right ventricular wall motion assessment by MRI

M Veiga, D J Beacock, T N Bloomer, J P Ridgway, J Cullingworth and U M Sivananthan
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PURPOSE: The "centre-line" method is the most reliable for quantitative assessment of ventricular wall motion. We evaluated this method for the right ventricle (RV). METHODS: Eight volunteers were examined using a 1.5 T Philips ACS NT MRI system. Axial cine breath-hold views were obtained from the diaphragm to the pulmonary bifurcation. We used the modified centre-line method (mass version 1 of a Unix workstation). A reference point in the apical epicardial contour was chosen for both end-diastolic and end-systolic images, before applying the centre-line method. RESULTS: Results were displayed as a graph with wall motion in ordinate (mm) and the 100 chords in abscissa. All showed a similar pattern of RV wall motion: (1) first part of the curve corresponding to the septum, mostly negative (range from −5 to +5 mm: mean −1.3 mm); (2) second part corresponding to the tricuspid valvular plan, positive (range from 0 to +20 mm: mean +14.3 mm); (3) third part corresponding to the free wall with the widest amplitude of movement (range from +10 to +40 mm: mean +11.8 mm); and (4) fourth part of the curve corresponding to the apical region, slightly positive with a narrow range of movement (range from −5 to +5 mm: mean +1.1 mm). CONCLUSION: Regional RV wall motion can be assessed accurately using axial views of the RV obtained by MRI and applying the centre-line method. Reliability is dependent on good image definition and the accuracy of wall motion analysis by a computer program.

0910

Assessment of right ventricular volumes by breath-hold cine MRI in normal adults

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Magnetic Resonance Imaging Unit, Leeds General Infirmary, Leeds LS1 3EX, UK

PURPOSE: Assessment of the right ventricle (RV) is complicated by the fact that the anatomy cannot be modelled by simple geometry. Neither echocardiography nor right ventricular angiography give a 3D or volumetric assessment. Radioisotope scanning provides volumetric information only. MRI defines the anatomy accurately in 3D. Breath-hold methods speed up the acquisition and reduce respiratory artefact. MATERIALS & METHODS: Right ventricular studies were performed in 10 normal adults. A Phillips 1.5 T MR scanner was used with a 20 cm diameter surface coil to obtain breath-hold cine fast gradient echo sequences in expiration. 1 cm axial slices were scanned from the RV apex to the pulmonary bifurcation. Each sequence was acquired in about 20 s. Cine sequences were analysed on a Unix workstation with MASS software (University Hospital Leiden). The RV endocardial border was manually traced frame-by-frame to allow calculation of systolic and diastolic volumes and ejection fraction. RESULTS: RV diastolic volume 122.9 ± 30.2 ml, RV systolic volume 52.5 ± 15.9 ml, RV stroke volume 69.6 ± 18.3 ml, RV ejection fraction 57.5 ± 4.6%. Inter- and intra-observer agreement is acceptable. There is good correlation between the volumes and body surface area (RV diastolic volume $r = 0.97$, RV systolic volume $r = 0.92$, RV stroke volume $r = 0.91$). RV ejection fraction is independent of body surface area. CONCLUSION: MRI is a straightforward method of assessing RV volumes and systolic function.

0920

Mechanical left ventricular assist devices in the treatment of left ventricular failure

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Cardiac transplantation may be limited by several factors, including availability of donor organs and the post-transplant problems of immunosuppression and allograft coronary artery disease. Against this background, the concept of a mechanical artificial heart is appealing and there is now increasing interest in the use of implantable pump devices to aid cardiac output. Following the successful use of mechanical pumps as a bridge to cardiac transplantation, implantable devices are now being used to treat heart failure in patients who are not candidates for transplantation. Further technical developments will allow the use of left ventricular assist devices (LVAD) in patients with poor cardiac output to prevent the onset of multi-organ failure. Removal of these devices will be possible should the left ventricular myocardium recover. This poster illustrates the use of the Thermo Cardiosystems Heartmate vented ventricular LVAD in the treatment of two patients with intractable left ventricular failure. The mechanism of action and radiographic appearances of the mechanical LVAD are described. To date, LVAD have been used mainly in cardiac transplant centres in patients awaiting transplantation. The increasing use of implantable pumps outside these centres, in patients who are not candidates for transplantation, will make an understanding of these devices and their radiographic recognition increasingly important.

0930

Imaging of cardiac and paracardiac masses: the complementary role of MRI to echocardiography

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PURPOSE: Echocardiography is the first choice imaging method for intracardiac and paracardiac masses. However, in some cases imaging can be suboptimal, due to a suboptimal acoustic window, or limited lateral resolution in the far field. We present a series in which further diagnostic information was obtained by MRI. MATERIALS & METHOD: 14 patients, in whom intracardiac or paracardiac masses were suspected on echocardiography, were referred for MRI. 2D and Doppler transthoracic echocardiography were performed with a Hewlett-Packard Sonos 2000 system in all 14 and seven had transoesophageal studies with a multiplane transducer. MRI was performed with a 1.5 T Sigma GEMS scanner, using ECG gating and a Torso surface coil. Spin echo T_1 and gradient echo images were taken in coronal, transaxial and oblique planes. RESULTS: On echocardiography there were six paracardiac masses and eight intracardiac masses. MRI demonstrated mediastinal spread of a lung tumour in four and a hiatal hernia in two. Of the intracardiac masses MRI demonstrated, three were due to a calcified mitral annulus, two were lipomatous hypertrophy of the interatrial septum and one was an atrial myxoma. In one case two separate lesions were demonstrated in the right ventricle, suggesting metastatic spread from a distant tumour (an ovarian tumour was found subsequently at abdominal US). In one case, no lesion was seen on MRI. CONCLUSION: MRI is a useful complementary method of imaging suspected cardiac masses when echocardiography examinations are suboptimal.

0940

Invited Review

Stressing the myocardium

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When investigating abnormal cardiac physiology there is a need to induce conditions of stress to the heart. Imaging and physiological data from the resting heart can then be compared with those from the heart under stress. Stress conditions have been traditionally induced to acquire catheter-based data, *i.e.* to maximize gradients across the mitral valve or in the standard exercise test, using various treadmill or bicycle regimes. Where the patient is able to undergo physical exercise these regimes have been adapted to other imaging tests of the heart, particularly myocardial perfusion scanning and ultra-fast CT. Many patients, however, are unable to perform maximal exercise and require a pharmacological regime to stress the heart. Four main agents have been used. (1) Dipyridamole is an indirect coronary vasodilator which inhibits the transport of the primary vasodilator, adenosine, into cells. It also inhibits the enzyme responsible for the inactivation of adenosine and can either be given orally or, more commonly, in an iv dose of 0.56 mg kg^{-1} over a 4 min period. (2) Adenosine is also administered iv and interacts with cell surface receptors to induce maximal hyperaemia at doses of 140 μg kg^{-1} min^{-1}. This drug has an extremely short half-life and must be given as a continuous iv injection. (3) Dobutamine is an adrenergic β-agonist which has direct chronotropic and inotropic effects and is usually administered in increasing stepped doses up to 40 μg kg^{-1} min^{-1}. (4) Arbutamine is a similarly acting drug which is infused by a pump governed by a feedback loop which allows the doctor to set target heart rate and blood pressure

response. β-adrenergic agents are most often used for stress echocardiography and will in future be used for stress MRI. Adenosine and dipyridamole have been used most frequently as the stressing agents for myocardial perfusion imaging.

0900–1030
Scientific Session
Neuroradiology 1
Olympian Suite

0900
Invited Review
Interventional neuroradiology of intracranial aneurysms
A J Molyneux
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PURPOSE: To provide an overview of current status and future prospects for endovascular treatment of ruptured and unruptured intracranial aneurysms. The combination of development of high quality digital imaging systems for angiographic examination and interventions, and technological developments in catheter and device materials, have led to dramatic developments in interventional radiology in general and neuroradiology in particular. The introduction of the Guglielmi detachable coil device for treatment of intracranial aneurysms represents a dramatic advance. This device has now been in clinical use in the UK for 5 years and has been shown to be effective in preventing bleeding, or re-bleeding from previously ruptured intracranial aneurysms. During its initial evaluation period it was used in surgically-unsuitable aneurysms, or in patients who had failed surgical treatment. The indications have gradually widened as confidence has grown in the technique. It is now applied in many patients with ruptured intracranial aneurysms. This has led to a pilot phase randomized trial and funding by the Medical Research Council of the UK of a multicentre international study comparing conventional neurosurgical treatment with endovascular treatment in ruptured intracranial aneurysms. The problems and difficulties with the development of such a study will be discussed and the consequences for neuroradiology and neurosurgery, if the trial demonstrates that endovascular treatment is the procedure of choice, will be summarized.

0930
Evaluation of the role of MR myelography in lumbar spine imaging
J Thornton, S Pender, M J Lee, J Varghese, P Brennan and F McGrath
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We examined the role of MR myelography (MRM) in routine lumbar spine MRI by comparing it with conventional MR techniques. 100 consecutive patients had standard (T_2 sag + T_1 axial) lumbar spine MRI and coronal myelographic sequences (TR9000, TE 272, slice thickness 3 mm, FOV 24 × 18 matrix 256 × 256, 3 NEX) with MIP reconstruction. The MRI sequences were read separately by three radiologists in consensus. Thecal sac and nerve root abnormalities were recorded and image quality and diagnostic confidence assessed. 146 lesions were diagnosed by conventional MRI (the "gold standard"). Myelographic and standard imaging agreed in 19, MRM under-estimated 74 lesions and over-estimated 53. MR myelography image quality scored out of three was as follows: single slices—thecal sac 2.95, nerve roots 1.93; reformat images—thecal sac 2.93, nerve roots 1.73. The average diagnostic confidence for MRM (scored out of five) was 4.5. MRM is a new imaging technique which produces pleasing images. However, initial experience suggests that the information obtained is inaccurate. The reasons for and significance of this will be discussed, along with the pitfalls in analysing MRM images. Further evaluation of the technique is needed.

0940
MRI appearances of the cervical cord in multiple sclerosis
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PURPOSE: To document the appearance and distribution of cervical cord plaques in relapsing–remitting (RR), secondary progressive (SP) and primary progressive (PP) multiple sclerosis (MS). METHOD: Cervical MRI scans of 130 patients with clinical MS were reviewed. The site, number and length of plaques on sagittal T_2 weighted images were recorded. The epicentre of the plaque was recorded (either central or one of eight peripheral sectors) on axial T_2 weighted gradient echo sequences. RESULTS: 130 patients (87 female, 43 male, mean age 41.6 years) were studied (91 RR; 31 SP; eight PP). 79/130 (61%) had cervical cord plaques [51/91 RR (56%); 20/31 SP (65%); 8/8 PP (100%)]. Mean number of plaques was 1.4 (range 1–4) and mean plaque length was 13.5 mm (range 5–80 mm). 28% of plaques were at C2; 24% C3; 24% C4; 14% C5; 5% C6; 3% C7; 2% T1. All plaques had a peripheral component; 52% encroached on the central region of the cord. Plaques were centred as follows: anterior 0%, anterolateral 6%, lateral 18%, posterolateral 34%, posterior 30% and central 2%. 10% of plaques involved more than 50% of the cord. CONCLUSION: 76% of cervical cord plaques are sited at C4 or above. Most plaques are peripheral: 82% are sited posteriorly and laterally. Distribution of plaques within the cord is similar in different clinical subtypes of MS. All patients with primary progressive disease had cervical plaques.

0950
Does saturation of clivus fat signal improve visualization of the pituitary?
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PURPOSE: To assess whether T_1 weighted sagittal-enhanced MRI scans of the pituitary obtained with saturation of the clivus fat signal, offer the radiologist any diagnostic advantage over images obtained without fat saturation. METHODS: 23 patients (mean age 40 years, 7 male and 16 female) referred for pituitary MRI were imaged in a 1 T scanner. The standard pituitary protocol of unenhanced coronal and enhanced coronal and sagittal T_1 weighted 3 mm scans was followed by a sagittal T_1 weighted fat-saturated sequence. A consultant MRI radiologist retrospectively analysed the enhanced fat-saturated and non-fat-saturated T_1 weighted sagittal scans of each patient. RESULTS: Using the fat saturation protocol, saturation of clivus fat signal was achieved in 100% of scans. In 21/23 (91%) of patients, visualization of the posterior and inferior margins of the pituitary was improved in scans obtained with saturation of clivus fat signal compared with those without. In 2/23 (9%) of patients there was no change in visualization of the posterior and inferior aspects of the pituitary. The fat-saturated acquisition was 2 s faster than the non-fat-saturated sequence. CONCLUSION: In most cases, visualization of the posterior and inferior margins of the pituitary on enhanced sagittal T_1 weighted scans is considerably improved by saturation of the clivus fat signal. For optimal visualization of the pituitary, it is suggested that standard pituitary MRI protocols should feature a fat-saturated acquisition.

1000
Abnormalities on proton magnetic resonance spectroscopy in asymptomatic HIV-positive individuals
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MRI Unit, The Middlesex Hospital, UCL Hospitals Trust, London W1N 8AA, UK
PURPOSE: Cerebral proton MR spectroscopy (H-MRS) can demonstrate biochemical abnormalities in patients with AIDS, particularly in patients with HIV-associated dementia. Whether individuals develop HIV-related cerebral abnormalities during the early asymptomatic stage of HIV-infection (Centre for Disease Control group II) remains unclear, although it is known that HIV can enter the brain shortly after seroconversion. The purpose of this study was to determine whether abnormalities on H-MRS occur during this early, asymptomatic stage of HIV infection. METHODS: 84 HIV^{+ve} asymptomatic (CDC group II) homosexual/bisexual males and 78 seronegative controls were studied. The control group consisted of 49 seronegative men at low risk and 29 seronegative homosexual men at high risk of HIV infection. Single voxel, gradient localized H-MRS was performed at 1.5 T (TE = 135 ms, TR = 1600 ms) in an 8 ml volume of parieto–occipital white matter. Results are expressed as ratios of the areas under the three main peaks corresponding to N-acetyl (NA), choline (Cho) and creatine (Cr). RESULTS: There were no statistically significant differences between controls at high and at low risk for HIV infection. There were statistically significant differences in NA/Cho, NA/Cr (both $p < 0.05$) and NA/(NA + Cho + Cr) ($p < 0.001$) between the combined control groups ($n = 78$) and the asymptomatic seropositives ($n = 84$). CONCLUSIONS: Abnormalities in cerebral biochemistry are demonstrated by H-MRS during the "asymptomatic" phase of HIV infection. This may have important implications for assessing the efficacy of therapies administered during early, asymptomatic HIV infection.

1010
Expert–novice differences in the interpretation of MRI of the brain
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[1]*School of Cognitive and Computing Sciences, University of Sussex,* [2]*Medical Systems Research, De Montfort University, Leicester and* [3]*Institute of Neurology, London, UK.*
A collaborative study between the Medical Systems Group, De Montfort University, Leicester, the School of Cognitive and Computing Sciences, University of Sussex and the Institute of Neurology, London is developing prototype tutoring systems (MEDIATE) to assist radiologists in interpretation and diagnosis from neurological MRI scans. PURPOSE: This study investigated differences between novice, intermediate and expert radiologist assessments of similarity in MRI neuro-scans and their interactions with an image archive, via a computer-based browsing system. MATERIALS & METHODS: 17 subjects assessed similarities of lesions visible in neurological MRI scans. The subjects placed new cases within a conceptual map using the browsing system. Placement of these cases was based on similarities with other archived cases, already identified as points in the conceptual map. All of the subjects' interactions with the system were logged. RESULTS: The study has shown that: (1) Novices and less experienced radiologists repeatedly explore the image archive looking for similarities between cases. (2) More experienced subjects immediately identify cases similar in appearance and location and retrieve cases in the vicinity to refine their initial hypothesis. (3) Experts undertake the task more quickly, novices devoting a smaller proportion of time to identifying the initial problem. CONCLUSIONS: Previous studies on chest X-rays examined expert–novice differences in interpretation. A major issue is whether these X-ray findings translate to MRI interpretation. This study was designed to assess expert–novice differences in MRI similarity judgement. The findings reported correlate favourably with the findings of the previous studies. An outline of the evaluation and results will be presented and discussed.

1020
Whole brain functional MRI using an auditory stimulus and echo planar imaging
J Galliers, G Rees, A Houseman, O Josephs, A Brennan, G Lewington, K Friston and R Turner
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An experiment was devised to determine the extent of cortical activation during a simple auditory stimulus, using an EPI sequence fMRI technique. This was a developmental step in the optimization of protocol design for our 2 T Siemens Vision MRI scanner and enabled comparison with previous results obtained using other functional brain-mapping techniques. It also validated our technique for auditory presentation in the noisy environment of the MRI scanner. This type of fMRI is based on blood oxygenation level dependent (BOLD) contrast, where the subtle magnetic susceptibility differences between oxy and de-oxyhaemoglobin are measured, providing a strong indicator of local cerebral blood flow and hence neuronal activity. An alternating series of auditory stimuli (words spoken at 60 words per minute and rest conditions) was presented to a subject via specially designed earphones. The image acquisition consisted of 100, 64 slice EPI scans, each volume taking 6 s, with 3 mm isotropic voxels. Statistically-significant activated areas were extracted by comparing auditory presentation and rest images, in the framework of statistical parametric mapping (SPM). These results were compared with those of similarly designed positron emission tomography (PET) experiments. The MRI experiment demonstrated highly significant activations in the area of the auditory cortex. Comparison of data showed there was little difference between the fMRI activated areas and those found with PET (within the spatial resolution of PET, 6 mm).

1000–1030
College of Radiographers
50th Annual Conference
Hall 9

1000
Presidential Address
J Henderson
President, College of Radiographers

1030–1145
State of the Art Symposium
Coronary Arteriography
Hall 11b

1030
Invited Review
Imaging equipment
C M Turnbull
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Coronary angiography remains the commonest selective angiographic technique performed world-wide. Advances in computer processing and storage technology have led to digital acquisition and processing of angiographic images obtained during cardiac catheterization. International standardization of digital archival storage has been introduced, creating "cineless" systems. The equipment currently available from the main manufacturers is reviewed. Advice is offered to those radiologists, unfamiliar with coronary angiography, who may be involved in the installation and running of a cardiac catheterization laboratory.

1050
Invited Review
Safe technique
C Reek
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Coronary arteriography is a commonly performed investigation which involves a relatively high radiation dose and significant morbidity, with a mortality of 0.12%.[1] It should be performed in an environment with appropriate monitoring equipment and back-up, such as cardiological advice and a cardiac arrest team. During cardiac catheterization attention should be paid, not only to minimization of radiation dose and avoidance of complications, but also to the production of high quality angiograms to enable accurate interpretation and, therefore, increased likelihood of appropriate treatment. To achieve these aims one of the first requirements is a sound understanding of the principles of image production, familiarity with the radiographic equipment and its optimal use, along with well-trained radiographic staff. Knowledge of coronary anatomy—variations and common anomalies—is essential, together with the ability to apply this to the choice of suitable catheter sizes and shapes. Sensitive catheter handling and an awareness of patient comfort and safety will then allow optimal catheter positioning for angiography. Since coronary artery anatomy is so variable, angiographic views cannot be chosen effectively by "recipe", but should be modified to the individual patient. This requires the operator to think and interpret as the investigation proceeds, but will lead to the best results with the lowest patient risk. The performance of high quality coronary angiography as safely and effectively as possible means having well-trained, knowledgeable staff with appropriate experience. I will discuss these requirements and their achievement.

Reference
1. The Joint Audit Committee of the British Cardiac Society and Royal College of Physicians of London. Br Heart J 1993 Sep; 70:297–300.

1110
Invited Review
Interpretation of angiograms
M S T Ruttley
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Coronary arteriography (CAG) must be performed by an operator with the knowledge and skill to safely obtain images of all the coronary arteries and their named branches, be they normal, variant or diseased at origin or in their distribution. Each segment of these arteries and any lesion found must be imaged by optimal equipment in at least two planes, preferably orthogonal, and there should be no foreshortening, overlap by branch or parent vessel, or obscuration by spine or diaphragm in at least one of the planes. The operator must continually interpret during performance of the CAG in order that the examination is tailored, within broad guidelines, to an individual patient's anatomy and pathology. Intraobserver and interobserver error is acknowledged in CAG interpretation and can be minimized during the procedure by the presence of an expert assistant and after the procedure by review of the completed CAG

by the operator and expert colleagues. A formal double-reporting system is ideal, but in practice multiple readings are usually achieved during interdisciplinary (cardiology, radiology, cardiac surgery) case conferences. The essential radiographical, anatomical and pathological knowledge required for CAG interpretation will be summarized in the presentation. The value and limitations of "eyeball" and computerized quantitative analysis of the CAG and the use of different reporting systems will be examined.

1130
Discussion

1045–1215
State of the Art Symposium
The Future of Radiography
Hall 9

1045
Invited Review
The responsibilities of a professional into the 21st century
R I Johnson
Osborne Clarke, Bristol BS1 4HE, UK
PURPOSE: The first task is to identify who is a professional and what duties arise from that status. Will society at large extend the class of professionals? If so, why? Will it relate to control of standards alone? Is everyone capable of being a professional person? Are rules of professional misconduct a guide towards what society does or does not find acceptable? Is the world, including the world of scientific applications, changing too fast for adequate continuous training? Indeed, what lessons are to be learned from the need for continuous training? How shall society value the service of a professional? Is there a difference of attitude to a caring professional compared with a business professional? How does the speed of communication, the speed of recording data and the speed and ability to withdraw and compare data affect a professional? How does a professional relate to other countries and other standards? MATERIALS: Law reports and 33 years experience as a solicitor acting for professionals with problems. METHODS: Comparative analysis between professions. Analysis of regulatory body activities. Analysis of complaints and evidence of attitudes. CONCLUSION: Responsibilities derive from duties in the context of the demands of society. Professional honesty and objectivity will not change, but the subject matter with which professionals have to deal will change. Flexibility and common sense is the British way of coping with change. Are vocations out of date? Who will people trust and why? What are the responsibilities of universities? Who trains whom to be a professional?

1115
Invited Review
Continuing professional development
J Adams
NHS Executive, Department of Health, Quarry House, Quarry Hill, Leeds LS2 7UE
The recent review of the current Professions Supplementary to Medicine (PSM) Act, the Department of Health initiative to explore and enhance career development opportunities for a range of professions allied to medicine, together with discussions on role extension and development, have served to take the requirement of the Code of Professional Conduct for radiographers to "*...take every reasonable opportunity to sustain and improve their knowledge and professional competence*" from the level of professional idealism to an issue which must be taken seriously by all stake-holders. Who are these stake-holders? Who benefits from the continuing professional development (CPD) of radiographers? The report on the review of the PSM Act suggests that the professional body should have responsibility for drawing up and implementing a CPD scheme, but who decides the priorities when the "professional development" of an individual does not appear to align with priorities of employers, or the developing agenda of the Education Consortia? The report on the review of the PSM Act suggests that annual registration is likely to depend on demonstration of CPD of the individual registrant. So this professional idealism must be translated into a practical, continuing process that not only promotes and builds on existing skills, but also enhances the radiographer's contribution to health care provision in a range of settings and a variety of roles.

1145
Invited Review
Delegation of radiological procedures to radiographers
A H Chapman
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Non-interventional US, IVPs, barium meals and enemas are some of the examinations currently being delegated to radiographers. The advantages to the radiologist are obvious but delegation has to be proper, agreed, planned and audited. Management approval should be sought and a scheme of work devised. The radiologist must be satisfied that the delegatee has been adequately trained and has the skills to perform the task. Training takes time and there needs to be a sufficient volume of work to ensure that the time spent is justified and that the delegation does not interfere with the training of junior radiology staff. When delegation occurs, the patient should be aware and be informed of the name of the responsible doctor and the status of the person undertaking the task. Once trained it is likely that radiographers will then train their colleagues, but the radiologist must retain control of the service, be available when supervising and audit the service to identify any problems and ensure that quality is maintained.

1045–1155
Scientific Session
Gynaecological Imaging
Hall 11a

1045
Invited Review
Gynecological oncology: imaging in times of cost constraints
H Hricak
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For cancer patients, "the first treatment should be the best possible, since it has the greatest chance for curing the patient". Although a number of prognostic factors influencing patient outcome have been identified, the stage of the disease remains the main determinant in guiding therapy decisions. There are inherent inaccuracies in clinical staging and recognized drawbacks to surgical staging, therefore cross-sectional imaging can play an important role in the pretreatment evaluation of gynecological cancer patients. Imaging does not allow a specific tissue diagnosis and the histological diagnosis of cancer remains essential. In cancer of the uterus, however, cross-sectional imaging offers an assessment of morphological prognostic factors, such as tumour size, depth of penetration, stage of disease and lymph node status. In the evaluation of uterine cancer, MRI is proven to be the optimal and most cost-effective approach. CT is reserved for advanced disease and lymph node biopsy. In patients with ovarian cancer, pre-treatment imaging contributes valuable information to surgical and management planning. The proper surgical approach can be selected, the need for pre-operative chemotherapeutic debulking can be assessed and the surgeon forewarned of the need for assistance from respective subspecialities if a complicated procedure, or bowel resection, is indicated. CT is established as the primary imaging modality for characterization of ovarian tumours and ovarian cancer staging; MRI is emerging as a problem-solving modality. Regardless of the modality chosen, awareness of specific clinical questions and the most efficient approach to answer them is essential. Imaging should be looked upon as a complementary tool, rather than competitive with the other methods of tumour evaluation (*e.g.* clinical or surgical assessment).

1115
Image capture: a mechanism to reduce patient radiation dose in hysterosalpingography
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PURPOSE: Hysterosalpingography (HSG) is an established procedure in the investigation of infertility. A disadvantage of the technique is the use of ionizing radiation in women of child-bearing age. The use of fluoroscopic image capture (frame-grabbing), rather than conventional or digital exposure, would reduce the dose. The potential disadvantage is poor diagnostic image quality. METHOD: To assess whether image capture provided adequate diagnostic information 50 HSGs were performed using standard digital exposures.

Immediately prior to exposure the screening image was stored. These were compared by two observers. RESULTS: All exposure digital images were deemed adequate. An average of three films were taken per examination. Pathology was noted on 27 of the 50 examinations. This included tubal or spill abnormality in 16 and uterine or cervical pathology in 11 patients. On the image capture radiographs the Fallopian tubes were not clearly seen in 32% (18/50). This was predominantly poor proximal tubal detail. Pelvic spill of contrast, whether absent, normal or loculated was shown clearly in all cases. The uterus was inadequately seen in 2% (1/50) but pathology in this case was visible. CONCLUSION: Tubal detail is not always clearly seen on image capture, therefore it cannot be recommended as the sole method of imaging on our current equipment. However, dose reduction may be achieved by taking only the initial film by exposure and subsequent images by capture. In our study this combination would have shown all anatomy and pathology clearly, with a dose reduction of approximately 75%.

1125

Assessment of interobserver and intraobserver variability of endometrial measurements by MRI and a standardized TVS technique

R Tetlow, P Ballard, L W Turnbull, P Lesny, M Blizzard, S R Killick and A Horsman

Department of Obstetrics & Gynaecology, Princess Royal Hospital and the Centre for MRI, Hull HU8 9HE, UK

PURPOSE: A multicentre study of endometrial thinning secondary to Leuprorelin Acetate or Danazol, demonstrated variations in transvaginal (TVS) measurement techniques, highlighting the need for standardization. This study aims to develop a reproducible technique for measuring zonal anatomy, compare the results with magnetic resonance (MR) imaging and then reanalyse the multicentre data. MATERIALS & METHODS: To assess intraobserver and interobserver error of the standardized (ABC) technique, 42 postmenopausal (PM) and 40 subfertile women underwent TVS, each examination comprising two measurements of endometrial thickness by two observers. 14/42 PM women also underwent serial TVS and MRI at 0, 2 and 4 months. MR measurements of endometrial volume and thickness were calculated twice by two observers. The ABC technique was then applied to the multicentre data. RESULTS: The largest intraobserver difference was demonstrated in the PM group by TVS at 0.12 mm (95% CI, −1.37, 1.79). The mean interobserver difference for TVS was also greatest in this group at 0.69 mm (95% CI, −0.14, 1.24), which compared with 0.25 mm (95% CI, −0.08, 0.64) for MR thickness and 0.36 ml (95% CI, −0.02, 0.74) for MR volume. No longitudinal trends were demonstrated by either technique, but the CV for endometrial volume was smaller at 8% compared with endometrial thickness values of 24% for MR ($p=0.025$) and 34% for TVS ($p=0.0001$). No difference was demonstrated between the paired pre-treatment multicentre data, but a significant difference in endometrial thickness was demonstrated between the two techniques after Leuprorelin Acetate ($p=0.015$). CONCLUSIONS: The proposed ABC method has an acceptable reproducibility and seems more sensitive to treatment changes than conventional techniques. However, MR volume measurements resulted in less random variation and may be better for detecting subtle effects.

1135

The quantification of blood velocity and flow in the uterine vessels using echo planar imaging at 0.5 T

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PURPOSE: To quantify blood velocity and flow in the uterine artery and vein in both uncomplicated and compromised pregnancies. MATERIALS: Volunteers included 10 uncomplicated pregnancies and five pregnancies complicated by intrauterine growth retardation, with gestational age from 20 to 42 weeks. METHODS: Echo planar imaging was used to acquire single shot images comprising 128 × 128 pixels at 0.5 T. Flow-encoding was achieved through a spin echo gradient pulse sequence. RESULTS: Velocity and flow were measured at 7–12 different phases of the cardiac cycle using ECG triggering with no breath control. The imaging plane was at the base of the broad ligament, where the vessels run parallel to the body axis. Velocity profiles show in general a single peak within the cardiac cycle. Although mean velocity values are greater for the normal pregnancies (3.85 cm s^{-1} SD = 0.66 and $n=10$) than for the compromised pregnancies (2.89 cm s^{-1} SD = 0.77 and $n=5$), the two samples overlap. Similar observation exist for the flow, with mean values of 241. (SD = 71) and 218 (SD = 71) ml min^{-1}. CONCLUSION: This is the first report of non-invasive demonstration of uterine artery and vein blood flow measurement using MRI. Quantification analysis performed on uncomplicated and compromised pregnancies show that the former exhibit greater mean velocity and flow values. MRI offers the advantage of consistency and reproducibility over US Doppler measurements.

1145

Changes induced by Tamoxifen on the uterus of postmenopausal women with breast cancer: preliminary TVS, MRI and pathological findings

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AIM: Although Tamoxifen improves disease-free interval and overall survival rate from early breast cancer, it induces a spectrum of benign and malignant endometrial pathology. This study compares the results of transvaginal scanning (TVS) with MRI in the assessment of early uterine change, in an attempt to establish the uterotrophic action of this drug. METHODS & PATIENTS: 10 women with newly diagnosed Stage I/II breast cancer underwent TVS (5.0 MHz probe) and fat-suppressed T_2W FSE MRI (1.5 T) to assess AP thickness and volume of the myometrium, junctional zone and endometrium. Both imaging modalities were repeated at 1, 3 and 6 months following Tamoxifen (20 mg day^{-1}) and, where available, results were compared with resectoscopic biopsy. RESULTS: Changes in endometrial dimensions were most readily detected by assessment of MR volume. At 1 month endometrial growth was evident in all patients with a mean (±SD) increase 13.6 ± 6.0 mm^3 ($p=0.003$). These findings were unchanged at 3 months, but both modalities showed diminution of endometrial size in all patients at 6 months, with a reduction in MR volume of 9.9 ± 6.8 mm^3 compared with the first post-treatment scan. Morphologically, both techniques demonstrated an irregular endometrial/junctional zone (JZ) boundary at 1 month; only multiple small cysts in the compact JZ were visible at 3 months, but persisted thereafter. The latter changes were confirmed histologically. CONCLUSIONS: These results show an early, but transient, response of the superficial endometrium to Tamoxifen and delayed appearance of changes suggestive of cystic transformation of basal endometrium. These findings indicate variable presence/expression of oestrogen receptors, both with time and between anatomical regions.

1050–1200 Scientific Session **Neuroradiology 2** Olympian Suite

1050

Embolization of intracranial meningiomas prior to surgery

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Pre-operative embolization of intracranial meningiomas has been performed since the 1970s but its benefit has remained controversial. It has been stated that the only lesions for which embolization may be beneficial (skull base lesions) are the very ones where it is seldom possible. Meningiomas are readily treatable without endovascular techniques, such techniques must therefore be both safe and effective. With improvements in catheter technology and embolic materials, we believe that, in experienced hands, these criteria are fulfilled. We performed a retrospective study of embolizations performed between 1990 and 1996. During this period referrals steadily increased and about 25 cases per year are currently considered for embolization. Our cohort consisted of 80 patients, with 54 convexity/falcine and 16 skull base tumours. External carotid artery supply was present in 89% and internal carotid supply in 43%. The tumours were graded as highly–moderately vascular, or minimally–avascular, according to angiographic appearance. Embolization was performed in 63 cases (77%), failed in six and was deemed inappropriate in 11. The degree of angiographic devascularization was compared with a number of variables, including operation time, transfusions and in-patient stay, separately for different tumour sites. For convexity/falcine lesions, mean operation time was 5.2 h

with partial, and 3.8 h with complete or near complete, occlusion; blood transfusion requirements were about 1000 ml and 375 ml, respectively; and post-operative stay was 18.6 and 11.8 days respectively. Differences were less marked for skull base lesions. No permanent neurological complications occurred. Technical problems were encountered in three patients which will be discussed.

1100
Temporal horn dilatation; an indirect sign in CT negative subarachnoid haemorrhage

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PURPOSE: In patients presenting with subarachnoid haemorrhage, CT scan is negative in 5%. In this group of patients, isolated temporal horn dilatation is often noted and may be an indirect sign of subarachnoid blood. MATERIALS: 200 consecutive normal CT brain scans and 137 CT brain scans of patients presenting to a regional Neurological Institute with subarachnoid haemorrhage over a 9-month period were analysed. METHODS: From the normal CT brain scans, normal temporal horn size was established for each age decile. In patients with subarachnoid haemorrhage, diagnosed by CT or LP, and normal ventricular systems, mean temporal horn size was also determined by age decile. RESULTS: No statistically significant difference in temporal horn size was demonstrated between sex or decade. Of patients with subarachnoid haemorrhage, 72 scans were excluded from analysis because of haematoma and mass effect distorting the ventricular system (36) and acute hydrocephalus (36). 52 patients with CT-positive subarachnoid haemorrhage had normal ventricular systems, but significantly larger isolated temporal horn dilatation compared with normals (1.7 ± 0.5 *vs* 0.7 ± 0.4, $p < 0.001$: all data given as mean $\pm$ SD in cm, statistical comparison by Mann–Whitney test). 13 patients had a proven subarachnoid haemorrhage but, despite a negative CT, had a mean temporal horn size significantly greater than normals (1.3 ± 0.6 *vs* 0.7 ± 0.4, $p < 0.001$). CONCLUSION: In patients in whom subarachnoid haemorrhage is suspected, isolated temporal horn dilatation is an indirect sign of subarachnoid bleeding, despite the absence of visible blood on CT.

1110
Diagnostic studies in thrombotic cerebral venous disease

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AIM OF STUDY: Thrombotic cerebral venous disease is uncommon, but is associated with significant morbidity and mortality. Its effects can be altered by anticoagulant therapy if diagnosed early. A review of 23 patients with cerebral venous thrombosis presenting over a 4 year period has allowed an assessment of optimal imaging techniques in these patients and an objective assessment of a dynamic CT scan technique which is used to determine the presence or absence of venous thrombosis. METHODS: 23 patients presented with confirmed evidence of thrombotic cerebral venous disease over a 4 year period to the Institute of Neurological Sciences, Glasgow. Five had thrombosis limited to the cavernous sinus and underwent a total of 16 diagnostic tests to establish the diagnosis. 18 patients had evidence of thrombosis outside the cavernous sinus and underwent a total of 30 diagnostic tests. Six of these patients underwent CT scanning. 30 other patients in whom no venous thrombosis was to be excluded or where venous anatomy was required prior to surgery also underwent CT scanning. The observer variability in this new dynamic scanning technique was assessed using four observers, two consultant neuroradiologists and two second year registrars. RESULTS: Patients with cavernous sinus disease underwent on average a greater number of tests than those with other forms of cerebral venous thrombotic disease, reflecting the difficulty in establishing this diagnosis. The most sensitive technique was orbital phlebography. The dynamic CT scan technique on a "forced choice" technique had an excellent detection rate and compared favourably with published detection rates for MR venography and spiral CT. Venography was the diagnostic test in 14 of the 18 patients with cerebral venous thrombosis. Specific reference will be made to the value of non-enhanced CT scanning. All patients with involvement of the deep venous system had a reduced Glasgow Coma Score and all patients with deep venous thrombosis had evidence of more superficial sagittal sinus or transverse sinus thrombosis. Dual sinus phlebography is only necessary as a pre-thrombolysis examination. CONCLUSION: Thrombotic cerebral venous disease is an uncommon but important disease. CT scanning is the diagnostic examination of choice and patients with deep venous involvement have low Glasgow Coma Scores, but this does not occur without more superficial sinus thrombosis.

1120
Use of single slice thick slab phase contrast angiography as a screening technique for dural venous sinus thrombosis

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PURPOSE: To examine the reliability of single slice phase contrast angiography (PCA) in excluding dural venous sinus occlusion. MATERIALS: Images were obtained from 25 normal volunteers, 50 patients undergoing routine head scan and four patients with suspected dural venous sinus thrombosis. METHODS: Normal volunteers were imaged using sagittal and coronal single slice PCA (SSPCA, slice thickness 13 cm, TR 14 ms, TE 7 ms, flip angle 20°, velocity encodation rate 30 cm s^{-1}; sinus patency and flow rate were confirmed by measurement of flow in the superior sagittal and transverse sinuses, jugular bulb and upper jugular vein. SSPCA images in normal volunteers were examined to determine the optimal orientation of the thick slab and to assess variations in image quality. SSPCA findings in four patients with suspected venous occlusion were confirmed by contrast CT (two cases), formal MRA (one case) and/or angiography (three cases). RESULTS: Variations in dural sinus patency and flow in normal volunteers were accurately predicted by single slice PCA. Imaging time was 29 s per acquisition. Use of a single angulated slice (140 mm thick, cephalo–caudad angulation 30°, right–left angulation 30°) provided sufficient separation of right- and left-sided structures to allow use of a single projection. The presence and extent of sinus occlusions in four patients (one infection, two spontaneous, one traumatic) were accurately identified by SSPCA. CONCLUSIONS: The SSPCA technique takes less than 30 s and offers a very rapid screening process for dural venous sinus occlusion in patients undergoing MRI brain scans. The absence of signal in the transverse sinus may be a normal variant but loss of signal elsewhere is highly suggestive of sinus occlusion. This work was supported by Philips Medical Systems.

1130
Use of high resolution spoiled gradient-recalled acquisition in the steady state volume imaging of the optic nerve in Graves ophthalmopathy

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PURPOSE: To examine the potential diagnostic value of optic nerve measurements in assessing the risk of optic neuritis in patients with Graves ophthalmopathy (GO). MATERIALS: Images were obtained from 32 normal volunteers (Group 1) and 27 patients with Graves ophthalmopathy (Group 2). METHODS: All subjects were imaged using a spoiled gradient-recalled acquisition in the steady state (SPGR) acquisition using a 0.5 T GE Vectra scanner. Optic nerve images were reconstructed interactively in a curved axial oblique plane through the centre of each nerve. Measurements of nerve diameter were taken at seven standard points from the back of the globe to the pre-chiasmal optic nerve. The presence of neuritis was based on clinical assessment and measurement of visual evoked potentials. RESULTS: Measurements of optic nerve diameter in Group 1 followed a normal distribution, with variances of 14–22% at the seven standard measurement points. The diameter of the orbital optic nerve showed a gradual decrease towards the orbital apex and the nerve then increased in diameter within the optic canal. In Group 2 the diameter of the nerve showed no significant difference from that of Group 1 at any level. In orbits with neuropathy ($n = 6$) there was a significant decrease in nerve diameter in the posterior half of the orbit and in the intracranial pre-chiasmal region, compared with non-neuropathic patients and Group 1 ($p < 0.05$). Despite this, there remained considerable overlap between neuropathic nerve diameters and those of Group 1. CONCLUSIONS: High resolution SPGR volume acquisitions and subsequent curved reformation provide a reliable method for assessing variations in optic nerve diameter. The technique demonstrates significant decreases in nerve diameter, associated with optic neuropathy, supporting the hypothesis that this results from a compressive mechanism. However, the degree of compression is insufficient to allow use of optic nerve diameter measurements as a diagnostic test.

1140
MRI of optic neuritis: value of combined fat and water suppression
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PURPOSE: To examine the benefits of combined fat and water suppressed T_2 weighted images in the diagnosis of optic neuritis. MATERIALS: Imaging was performed on a Philips ACS NT 1.5 T instrument. Five normal volunteers and 10 patients were recruited. All patients had abnormalities of visual evoked potentials and fulfilled the clinical criteria for the diagnosis of optic neuritis. Imaging was performed within 4 weeks (six cases) or between 4 and 6 months (four cases) after diagnosis. METHODS: Coronal images were obtained throughout the course of the optic nerve using four sequences. (1) STIR (2) spectral inversion recovery prepared T_2 weighted FSE (SPIR). (3) Spectral inversion recovery prepared fluid attenuated inversion recovery with FSE acquisition (SPIR/FLAIR). (4) Dual attenuation inversion recovery with FSE acquisition (DAIR). RESULTS: Neuritic segments were demonstrated in all 11 symptomatic nerves. The extent of neuritic involvement (number of images showing abnormality) was significantly greater on SPIR/FLAIR images. The contrast ratio between neuritic optic nerve and orbital fat, normal nerve and CSF was considerably greater on SPIR/FLAIR sequences than on others. SPIR/FLAIR images also improved demonstration of optic nerve atrophy in chronic neuritis when compared with other sequences. CONCLUSIONS: The use of SPIR/FLAIR sequences offers significant advantages over current methods in the demonstration of optic neuritis. This work was supported by Philips Medical Systems and by the Association for Research into Multiple Sclerosis.

1150
Imaging features of leptomeningeal metastatic disease
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PURPOSE: To describe the range of appearances and identify the best method for demonstrating leptomeningeal metastasic disease. MATERIALS & METHODS: In a retrospective study, the notes and imaging of all patients with a radiological and/or CSF cytological diagnosis of leptomeningeal metastases (LM) were assessed for the following: patient and tumour demographics, radiological appearances, initial radiological and cytological diagnosis, patient treatment and outcome. Discordance between the CSF cytology and radiological diagnosis of LM was also noted. RESULTS: 44 cases (38 female) of LM were identified over a 2.7 year period (diagnosis based on: imaging only 21 cases, cytology only six cases, both 17 cases). The average patient age was 46 years, and breast carcinoma was the commonest primary tumour (27/44). Two-thirds of patients presented with at least one cranial or spinal nerve palsy. Contrast-enhanced CT was normal in 40% (10/25), with LM mistaken for parenchymal disease in a further 24% (6/25). Cytology was positive in 85% (23/27), but Gd-enhanced MRI was positive in all cases where it was performed (27/27). Pial enhancement and nodularity was the commonest finding (67%) but other manifestations included loculated nodular disease, neural enhancement and white matter changes. Prognosis was uniformly poor. CONCLUSION: Leptomeningeal metastatic disease occurs in young patients, has a poor prognosis, and treatment regimes and aims differ from those for parenchymal CNS metastases. CT is normal or misleading in two-thirds of patients and CSF cytology may also be negative. The investigation of choice is Gd-enhanced T_1 weighted MRI.

1100–1150
100th BIRthday Symposium
History
Hall 1

1100
Invited Review
J J Thomson and the discovery of the electron
G Squires
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Joseph John Thomson (1856–1940) was appointed to the Chair of Experimental Physics in the Cavendish Laboratory at Cambridge at the age of 28 and started research on the conduction of electricity through gases at low pressure. He studied the properties of the rays emanating from the cathode in a gas discharge by deflecting them with electric and magnetic fields, and in 1897 announced that they were negatively charged particles about 2000 times lighter than hydrogen atoms, the lightest particles then known. Further, the mass of the particles was the same, irrespective of the nature of the gas in the discharge tube and the material of the cathode. He concluded that he had found a new particle, a universal constituent of matter. The discovery of the particle, subsequently called the electron, was one of the most significant events in the history of science and led to the present model of the atom. The electron plays a fundamental role in all branches of science and technology.

1125
Invited Review
Marie Curie and Medicine
S Quinn
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Unlike many of her scientist colleagues, Marie Curie had an abiding interest in the medical applications of her discoveries. She was an early advocate for the treatment of cancer with radioactive substances and found the funds and the radium for the first institute for cancer research in Paris. During World War I, she taught herself the rudiments of radiology and proceeded to equip a fleet of X-ray-mobiles for the front and to train young women as X-ray technicians. After the war, her name became synonymous in some circles with finding a cure for cancer, even though her own work had nothing to do with cancer treatment. This paper will explore the roots of Marie Curie's medical interests in her early, tragic childhood and in the heroic view of the world she learned from her patriotic Polish parents. In addition, the author will discuss Marie Curie's own medical history, taking issue with some past assumptions about the ways in which exposure to toxic and radioactive substances affected her health.

1110–1210
State of the Art Symposium
Imaging Technology 2
Hall 10b

1110
Invited Review
Image-guided surgery
D Hawkes
Division of Radiological Sciences, Guy's and St Thomas' Hospital, London Bridge SE1 9RT, UK
In recent years there have been rapid advances in the use of medical images to guide surgical procedures and other interventions. Applications divide into two main categories: those in which pre-operative images are used to provide a 3D computer model of the patient's anatomy for navigation during surgery; and those in which real-time interventional imaging is used to guide the procedure. This paper describes how accurate 3D models are generated from pre-operative images and how a range of locator technology can now provide the means to register these models to the patient by intra-operative use. These methodologies are illustrated with reference to image-guided neurosurgery, skull base and spinal surgery. The means of combining pre-operative and interventional images for guidance are being developed, including methods of providing augmented reality as a guide to interventions. The main challenges for the operating room of the next century are discussed.

1135
Invited Review
Developments in electrical impedance tomography
D C Barber
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It is now well-established that the electrical characteristics of tissue, both electrical impedance and the variation of impedance with the frequency of the applied current, vary significantly from tissue to tissue. Electrical impedance tomography (EIT) is an imaging technique which is capable of reconstructing images of the distribution of impedance within a conducting object, such as the human body, from measurements of the voltage distributions developed across the surface of the body when various patterns of current are passed through. The measurement technology for EIT is now well-established. Current is applied and voltages measured through electrodes connected to the surface of the body. At least one system is

capable of collecting data in 3D at eight different frequencies. Image reconstruction is a difficult task. The relationship between the electrical impedance and the surface measurements is ill-conditioned and non-linear and sets significant limits to the accuracy which can be achieved with EIT systems. However, useful images of changes in conductivity with time and of derived electrical properties of tissue can be reconstructed and some clinical applications are emerging, which will be outlined. The technique is inexpensive, compared with other medical imaging modalities, harmless and can be used at the bedside. Recently, we have been developing a modification of EIT, magnetic impedance tomography (MIT), which uses measurements of the magnetic field developed around the patient when current is passed through the patient. As a non-contact system, apart from a pair of current drive electrodes, this offers the possibility of producing reproducible images of absolute impedance. Some preliminary results will be shown.

1200
Discussion

1200–1245
British Institute of Radiology
Imation Mayneord Memorial Lecture
Hall 1

1200
Eponymous Lecture
Diagnostic imaging and interventional therapy of the hepatocellular carcinoma
L Dalla Palma
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Hepatocellular carcinoma (HCC) accounts for 4% of all malignant tumours worldwide and represents the seventh most frequent tumour. It develops on a cirrhotic liver in more than 80% of cases. Therapy is based on careful staging and patient clinical pattern. Surgery, either resection or transplantation, remains the best treatment, results are influenced by tumour volume: single lesions < 5 cm have the best outcome with a 3 year survival rate of 50% and 47% respectively. The disease-free survival rate is higher for transplantation (27% *vs* 46%). Surgery is, however, unsuitable in some cases. Percutaneous ethanol injection (PEI) and transcatheter arterial chemoembolization (TACE) are alternative therapies. The reported PEI 3 year survival-rate for single lesions < 5 cm is 60%; the rate rises to 72–81% for a lesion < 3 cm. When PEI follows TACE the rate is 72%–85% for a lesion with diameter 3–9 cm. In a randomized study in patients with multifocal HCC (up to three nodules) we observed a 3 year survival rate almost identical for PEI (52%) and TACE (48%). In cases with more than three nodules TACE had a survival rate of 38%, in untreated patients this rate was 20%. As the outcome is so influenced by the stage, the role played by imaging is very important. In a multicentric trial on 291 patients we compared the sensitivity of US, CT, DSA and lipiodol CT: both US and CT under-staged the disease. LCT had the highest sensitivity, but was not able to image all nodules. Recently, laparoscopic US has been proposed for its high sensitivity (91% in a literature review of 500 cases). The possible role of an early diagnosis, obtained by screening is also discussed.

1300–1345
Royal Society of Medicine
Finzi Lecture
Hall 1

1300
Eponymous Lecture
Advanced MRI of the pelvis
J O Barentsz
Department of Radiology, University Hospital, Nijmegen 6500 HB, The Netherlands
Rapid improvements in hardware and software, innovations in contrast agents and the use of MR-guided biopsy make pelvic MRI an increasingly powerful tool. In this lecture recent advances in MRI of prostate and bladder cancer will be presented. High resolution images (matrix: 1024 × 1024) produced using new phased array surface and endorectal coils, will be shown. Advantages of fast 3D sequences in local and especially in nodal staging will be illustrated. A study of 134 patients with bladder or prostate cancer, showing an accuracy of 90%, specificity 98%, sensitivity 75%, and a positive predictive value of 94% in lymph node staging, will be presented. With neovascularization, the use of ultrafast dynamic contrast-enhanced sequences allow better recognition of prostate and bladder cancer. These tumours show earlier enhancement compared with benign tissues. This allows better staging and evaluation of (chemo)-therapy. Initial results and advantages of MR-guided biopsy will be shown. In the near future, fast, high resolution, dynamic contrast enhanced MRI of the pelvis will further improve the diagnosis, staging and follow-up of patients with prostate and bladder cancer. This technique will therefore be used with increasing frequency. MR-guided biopsy will contribute to a less invasive diagnosis, resulting in better treatment planning.

1300–1345
College of Radiographers
Stanley Melville Memorial Lecture
Hall 9

1300
Eponymous Lecture
Psychosocial support for cancer patients—the future
J Young
Cancer Support and Information Centre, Mount Vernon and Watford Hospitals NHS Trust, Northwood HA6 2RN, UK
During the past 50 years the diagnosis and treatment of cancer has changed beyond recognition. CT scanning, MRI and mammography have made earlier detection and improved diagnosis possible. Research into tumour markers, identification of genetic characteristics of some cancers and immunotherapy targetted against specific changes in tumour cells will facilitate treatment of individual cancers. Multimedia imaging of tumour and normal tissue, together with designer-fractionation for the delivery of radiation, is being developed alongside increasingly powerful cocktails of cytotoxic drugs aimed selectively at cancer cells. However, despite these revolutionary changes in diagnosis and treatment, the fundamental needs of cancer patients remain the same: information, advice, best treatment and, above all, supportive care with courtesy and dignity. In addition to this, rising expectations of cure, due to technological advances, have placed a heavy burden on over-stretched health services to fulfil these needs and have increased patient demand for better provision of information and better supportive care and counselling, particularly when, despite technology, cure may not be possible. In the face of a rapid decline in the social fabric of society, when caring for the sick will become an increasing problem, how can the apparent increase in need for psychosocial support of cancer patients be addressed? In 1995 the Calman/Hine report was published recommending the reorganization of cancer services, based on the philosophy of totally patient-centred cancer care. Perhaps a future strategy will evolve within the framework of the implementation of the recommendations of this report.

1350–1520
Scientific Session
Obstetric Imaging
Hall 11a

1350
Invited Review
Proximal tubal disease, diagnosis and treatment
J M McHugo
Ultrasound Department, Birmingham Women's Hospital, Birmingham B15 2TG, UK
Infertility or subfertility is a common problem, affecting at least one in 10 couples. Tubal disease is the aetiological factor in approximately 30% of cases. The diagnosis of tubular disease has been made historically with laparoscopy and/or hysterosalpingogram using

X-rays. Recently, imaging using US and sonographic contrast agents (echovist or saline) plus falloposcopy and hysteroscopy have become available. When a diagnosis of proximal tubal occlusion is made, the therapeutic options are tubular microsurgery or tubular intraluminal dilatation. This lecture will illustrate the approach taken in the diagnosis and classification of tubular disease using selective salpingography with manometry. The therapeutic options available using X-ray-controlled interventions and outcomes will be presented.

1410
Invited Review
Tubal catheterization
M E Crofton
Department of Radiology, St Mary's Hospital, London W2 1NY, UK
Fallopian tubal disease is a major cause of infertility, conventionally diagnosed by hysterosalpingography (HSG) and/or laparoscopy and dye insufflation, treated by either tubal surgery or IVF. However, false positive diagnoses of tubal occlusion occur with both HSG and laparoscopy, so patients may be referred inappropriately for tubal surgery. Indeed, a study by Sulak et al showed that approximately 50% of patients undergoing cornual resections for allegedly blocked tubes had no significant histological abnormality demonstrated in the resected specimens, the occlusions apparently being caused by fine adhesions or amorphous debris. There is therefore a need to improve the accuracy of the diagnosis of tubal disease. Transcervical fallopian tube catheterization is a relatively simple outpatient interventional procedure which allows more accurate diagnosis of tubal disease. Using specialized equipment—either balloon catheters or vacuum hysterograph cups—guidewires and catheters are advanced through the cervix to the uterine cornua. Injection of contrast directly into the cornua confirms or refutes the diagnosis of cornual occlusion. If the tubes are occluded proximally, an attempt is made to recanalize them by probing gently with a guide-wire. Tubal patency can thus be achieved in 76–95% patients, with subsequent pregnancy rates of 10–45%. Ectopic pregnancies occur in 5–10%, but other complications are rare. Fallopian tube catheterization therefore has an important role both diagnostically and therapeutically, and should be considered in all patients prior to surgery for proximal tubal disease.

1430
Is scanning in an early pregnancy clinic an effective screening method for ectopic pregnancy: a review of 500 cases
I Lyburn, M P Callaway, H Scott and H Andrews
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INTRODUCTION: Ectopic pregnancy remains a significant cause of maternal death in the UK. We present a review of 500 consecutive patients scanned in the early pregnancy clinic, reviewing the outcome in patients in whom an ectopic pregnancy had been suspected on transvaginal scanning (TVS), and correlating the findings with those of all patients operated on for ectopic pregnancy over the same time period. METHOD: 500 consecutive scans in the early pregnancy clinic were reviewed. Using the diagnostic coding system, the notes of all patients undergoing an operation for ectopic pregnancy over the same period were also reviewed and the findings correlated. RESULTS: 26 positive operations were performed over the period when 500 scans were performed, 22 patients (81%) had the diagnosis of ectopic pregnancy suggested by their initial scan, while four were diagnosed clinically and had normal scans. There were five cases in which the diagnosis of ectopic pregnancy was suggested on scanning, who subsequently did not have an ectopic pregnancy. Three laproscopies demonstrated bulky uterus, one scan had questioned an adenexal mass in the presence of a normal uterus, which was normal at laproscopy and one patient was treated conservatively. The major TVS finding in the positive cases was a bulky uterus in patients with thickened endometrium, free fluid and adenexal mass being reported with similar frequency. A gestational sac was noted in only one patient, but did not effect diagnostic accuracy. This may reflect that equipment in this clinic did not have Doppler facility. CONCLUSION: A direct referral early pregnancy clinic with radiological input is an effective way of identifying patients with ectopic pregnancy.

1440
Prenatal cranial MRI in assessment of US detected fetal anomalies
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PURPOSE: To determine the utility of prenatal cranial MRI in assessment of US detected fetal abnormality. MATERIALS & METHOD: Seven patients (gestational age 20–35 weeks) were studied who had been referred for MRI after abnormal or equivocal antenatal US examination. A combination of either T_1 weighted spin echo, FSE and gradient recalled sequences and T_2 weighted FSE sequences in planes axial, coronal and sagittal to the fetal head were obtained. No maternal sedation was given. MRI diagnosis was compared with final diagnosis. RESULTS: Diagnostic images were obtained in all seven cases. Some sequences were degraded by fetal movement. T_1 weighted FSE sequences in planes axial and coronal to the fetal head yielded most diagnostic information (acquisition times 60–90s). Five out of seven cases were suspected agenesis of the corpus callosum (ACC) on US. Of these two out of five were confirmed by MRI; one out of five was shown to be partial ACC and two out of five were normal. One out of seven cases suspicious of intracranial haemorrhage on US and one of seven Vein of Galen aneurysms were confirmed by MRI. MRI diagnoses were confirmed by either autopsy or post-natal US. CONCLUSION: MRI can be a useful adjunct to antenatal US in difficult or equivocal cases.

1450
Changes in fetal liver physiology demonstrated by echo planar imaging
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PURPOSE: To assess changes in hepatic red cell production in the fetus between 20 and 26 weeks of pregnancy, during the time that the spleen and bone marrow supercede the liver as the major sites of haemopoiesis. METHOD: Contiguous transverse axial echo planar imaging (EPI) scans of the fetus were carried out on 16 pregnant women on two successive occasions at 20 and 26 weeks on a 0.5 T purpose-built scanner. A T_2* MBEST sequence was employed with a slice thickness of 1 cm and matrix display of 128 × 128. (The study received local Ethical Committee approval). Mean pixel values were measured within regions of interest in the liver, amniotic fluid and background noise. By assuming the amniotic fluid signal is constant between each examination the ratio of the liver to amniotic fluid pixel values will be a measure of the liver signal, independent of any changes in scanner performance. RESULTS: The mean liver to amniotic fluid pixel values were 0.3 ± 0.02 at 20 weeks and 0.55 ± 0.02 at 26 weeks. The difference was highly significant ($p < 0.0001$). CONCLUSION: The T_2 weighted pulse sequence used is sensitive to alterations in tissue susceptibility caused by the presence of iron-containing moieties which result in signal attenuation. The observed signal changes can be explained by a progressive decrease in red cell production by the liver and a consequent reduction in liver iron as the spleen and bone marrow take over haemopoiesis.

1500
Volume estimation of fetal brain, liver, lungs and maternal uterus by MRI
[1,2]Q Y Gong, [1,2]N Roberts, [3]A S Garden and [1,2]G H Whitehouse
[1]Department of Medical Imaging, [2]Magnetic Resonance and Image Analysis Research Centre, [3]Department of Obstetrics and Gynaecology, University of Liverpool, Liverpool L69 3BX, UK
PURPOSE: To present the MRI-based volume estimation for fetal brain, liver, lung and maternal uterus in normal pregnancies and to explore their relationship with gestation age. METHODS & MATERIALS: 36 fetal MRI series were obtained at different maternal gestation age (range from 27–41 weeks) in 27 singleton uncomplicated pregnancies. MRI examinations were performed on a 1.5 T SIGNA (General Electric, Milwaukee) using a gradient-recalled acquisition in the steady state (GRASS) sequence within the guidelines laid down by the National Radiological Protection Board. Ethical permission was obtained. The series in which the organ of interest was measurable and fulfilled the requirement of Cavalieri principle of stereology were included in the study. The volume estimations were performed by one radiologist using a point-counting technique available within ANALYZE software (Mayo Foundation, USA). RESULTS: The volume estimates for fetal brain, liver, lung and maternal uterus ranged as 118.1–371.2,

73.41–189.80, 17.14–111.60 and 3351.00–6684.00 ml, respectively. Their predicted coefficient of error was (6.75 ± 2.29)%, (9.16 ± 1.95)%, (12.37 ± 4.54)% and (6.08 ± 2.05)% respectively. Their linear relationship with gestation age were highly significant ($p < 0.01$) with R^2 of 0.83, 0.70, 0.58 and 0.86, respectively. There were also linear relationships between gestation age and the volume estimates of the fetal brain, liver and lung, expressed as the percentage of the maternal uterus, with R^2 of 0.54($p < 0.01$), 0.37($p < 0.05$) and 0.28($p < 0.05$). CONCLUSION: MRI-based volume estimation of fetal brain, liver, lung and maternal uterus may be useful in assessing fetus intrauterine growth retardation, complementary to ultrasonography.

1510

Estimation of fetal developmental age by 3D MRI of brain

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PURPOSE: To achieve the 3D reconstruction of the fetal brain *in situ* by MRI and correlate its appearance with gestational age. MATERIALS & METHODS: Eight MRI 3D data sets of aborted fetuses of known ages were manipulated by image surgery using software developed at UCL to obtain surface and volume rendering reconstructions. These were displayed as moving images in two planes allowing examination of the entire external surface of the brain. Reconstructions were compared with existing pathology tables of brain development. RESULTS: Successful reconstructions were achieved in five out of eight cases. In four out of five cases accurate age estimation was achieved by the above method. CONCLUSIONS: Dorovini-Zis and Dolman (1977) demonstrated that the external convolutions of the fetal brain in the 2nd and 3rd trimesters relate closely to histological development. They examined preserved fetal brains, requiring 8 days delay before dissection, and established a standard pathological–photographic table of brain appearances and corresponding ages. In this study we have been able to achieve the same examination non-invasively, *in situ* and immediately. The information derived provides support both for the pathological and non-invasive MRI perinatal necropsy examinations when consent cannot be given.

1350–1530
Scientific Session
ENT Imaging
Olympian Suite

1350

Invited Review

Head and neck imaging

J E Gillespie
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This review will concentrate on three subjects which are representative of the types of challenge which face radiologists required to image this complex anatomical area. The first is imaging for sensorineural deafness. No one would disagree that MRI is the modality of choice and most people would agree that the "gold standard" sequence is thin slice contrast enhanced T_1 weighted imaging. The contentious question is whether the commonly-used, high resolution, T_2 weighted FSE sequences can be used as a definitive replacement for the screening of symptomatic patients. The second topic is the current state of imaging for patients with sinonasal malignancy. The radiologist is required to distinguish between inflammatory and neoplastic disease, map out areas of tumour extension and, in particular, determine intracranial and intraorbital extension. CT and MRI both have roles to play and will be discussed. The final topic is spiral CT acquisition. Spiral CT has useful head and neck applications and permits decreased examination times, better quality 2D and 3D image reformations and the development of the new technique of CT angiography (CTA). CTA images can be presented as maximum intensity projection (MIP) images or as 3D surface-rendered images, as with MRA.

1420

Is imaging for distant metastases justified in pre-operative staging of head and neck malignancy?

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PURPOSE: To define the role of thoracic CT and liver US in the pre-operative staging of patients with head and neck malignancy? MATERIALS & METHODS: Over a 2 year period 84 patients were studied, the majority of patients (80) had squamous carcinoma. Of these, 53 had primary carcinoma and 27 had recurrent primary carcinoma after treatment at another hospital. Seven of the patients with primary carcinoma had a recurrence during the study period and were restaged. Histology in the remaining four patients was lymphoma in two, plasmacytoma in one and paraganglioma in one. This gave a total of 91 staging episodes in 84 patients. All patients had a spiral CT of the thorax and mediastinum, viewed on lung and soft tissue windows. Liver imaging was performed in 78 episodes, using US in 69 and CT in nine patients. RESULTS: Thoracic CT showed pulmonary metastases in 10 patients, mediastinal nodal metastases in four, bony metastases in two and pleural metastases in one patient. Overall, metastases were shown in 15 of 91 staging episodes (16.5%) by CT. Liver imaging showed metastases in two of 78 staging episodes (2.5%) with liver metastases and adrenal metastases in two separate patients. CONCLUSION: Thoracic CT is needed in pre-operative staging of head and neck malignancy. The scan should include liver and adrenal glands. Using this scan regimen, routine liver US is not justified.

1430

MRI and CT in the assessment of recurrent head and neck cancer

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We present the imaging findings of 65 patients who were referred for either CT or MRI scanning, with clinical features suspicious of recurrent head and neck cancer. Of this group 42 were referred with either swelling or a palpable lump, accompanied by pain, and 23 were referred with symptoms of pain only. In the first group 33 cases demonstrated positive imaging features indicative of recurrent tumour. The most reliable features were: (1) the demonstration of enlarged and pathological lymph nodes on a STIR sequence at MRI, or enlarged nodes showing central cystic change on CT; (2) an abnormal soft tissue mass at the site of primary tumour resection, which again demonstrated abnormal high signal on STIR sequence MRI. CT was much less helpful in the assessment of local recurrence. Nine cases within this clinical group were negative for the assessment of recurrent tumour. The second group of 23 patients, referred with pain only, had a much reduced incidence of imaging evidence of recurrence. Only four were positive for the demonstration of recurrence, and 19 were negative. We present the MRI and CT features of recurrent tumour and of normal post-operative complication. Early follow-up of patients with no imaging evidence of recurrence has shown a high incidence (more than 30%) of subsequently clinically-proven recurrence. In conclusion, both MRI and CT can be very difficult to interpret in the post-operative situation. We discuss the value of post-operative scanning in providing a baseline for further imaging assessments.

1440

MR imaging of nasopharyngeal carcinoma

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PURPOSE: The purpose of the study was to determine the patterns of local spread on MR imaging in patients with nasopharyngeal carcinoma (NPC). MATERIALS & METHODS: 51 patients with newly diagnosed NPC underwent MR imaging at 1.5 T. Sequences included pre- and post-contrast T_1 weighted fast spin echo in all cases, enhanced dynamic images in 35, and T_2 weighted fat-suppressed images (SPIR) in 16 patients. RESULTS: Local invasion occurred into the following regions: levator palatini, tensor palatini, prevertebral muscles, pterygoid muscles, pharyngobasilar fascia, parapharyngeal fat space, nasal cavity, oropharynx, sphenoid sinus, maxillary sinus, ethmoid air cells, skull base, cavernous sinus and cranial fossa. The contrast enhanced T_1 weighted images were better than SPIR in the evaluation of invasion into the small muscles of the nasopharynx, posterior wall of maxillary antrum and genu of the pterygoid plates. The dynamic series provided no additional information. CONCLUSION: The patterns of local spread are described. The contrast enhanced T_1 weighted images are equal or better than SPIR in the evaluation of invasion of NPC into local structures.

1450

Prediction of the intraparotid portion of the facial nerve with MRI and CT

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PURPOSE: Visualization of the intraparotid portion of the facial nerve with current imaging techniques is not possible. Three separate radiological techniques, using different anatomical landmarks,

attempt to predict the course of the facial nerve. These are: (1) a plane extended posteriorly from the outer surface of the mandibular ramus; (2) Conn's arc; (3) soft tissue structures, including the posterior belly of digastric, retromandibular vein and lateral border of masseter. This study was undertaken to determine the reliability of these techniques in predicting the relationship of tumours to the facial nerve. MATERIALS & METHODS: 25 patients had pre-operative parotid imaging prior to the surgical removal of a parotid mass. 19 patients underwent MRI and six had CT scans. 14 malignant neoplasms, nine benign and two non-neoplastic lesions were removed. The relationship of the tumour to the facial nerve was assessed radiologically by each of the three techniques and compared with the findings at surgery. RESULTS: Radiological assessments yielded conflicting results in six cases. 16 patients had tumour involving the parotid gland deep to the facial nerve. This was predicted in 65%, 70% and 45% of cases respectively by the techniques outlined above. CONCLUSION: When planning parotid surgery, it is important for the surgeon to understand the advantages and limitations of the radiological assessment of the position of parotid tumours.

1500

Pendred syndrome: a clinical, imaging and genetic study

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This syndrome of severe familial deafness and goitre was first described exactly 100 years ago. PURPOSE: The most up-to-date information on the lesions which cause the hearing loss and goitre, and the genetic basis of the syndrome is reviewed. MATERIAL & METHODS: An on-going study of 50 patients with Pendred syndrome involves assessment of hearing loss and vestibular dysfunction, with detailed imaging of the petrous temporal bone and central connections by CT and MRI. Thyroid function is assessed by the perchlorate discharge test using radioactive iodide. RESULTS: A large vestibular aqueduct seems to be a constant feature of Pendred syndrome, with associated enlargement of the endolymphatic sac and duct. Mondini cochlear deformity with deficiency in the cochlear coils, as originally shown in the first description of a histological temporal bone study in 1968, later confirmed by imaging assessment, can be less confidently predicted as a constant feature. However, the clinical, genetic and radiological evidence in support of a distinctive, autosomal recessive entity, conforming to the condition described by Pendred, is overwhelming. An enlarged endolymphatic sac, best shown by thin section, FSE T_2 weighted MRI in the sagittal plane, was a constant feature in all 20 cases of Pendred syndrome which had this investigation. CONCLUSION: No single test is diagnostic, but taken in combination the audiovestibular, radiological and perchlorate studies appear robust enough to identify all such cases and linkage studies have recently confirmed the genetic basis.

1510

Salivary duct stenosis and calculi: is sialographic intervention effective?

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PURPOSE: Interventional techniques in the salivary ducts have been facilitated by increasingly sophisticated balloon catheter and guide-wire technology and the use of digital subtraction imaging. The aim of this study is to discuss these techniques and evaluate their efficacy. MATERIALS & METHODS: 40 sialographic interventional procedures have been carried out over the past 5 years at St George's Hospital, London and the Royal Bournemouth Hospital, Dorset. All patients had obstructive symptoms of the salivary gland, caused by either duct stenosis or calculi, demonstrated at sialography. Per oral balloon dilatation of salivary duct stenosis was performed in 30 cases. Removal of salivary duct calculi was attempted in 10 cases. Long-term clinical outcome was assessed by questionnaire. RESULTS: The technical and clinical results of parotid and submandibular gland interventions will be presented. The complications and problems encountered will be discussed. CONCLUSIONS: Obstructive symptoms of parotid duct stenosis can be safely and effectively relieved by per oral balloon dilatation. Sialographic intervention in submandibular duct stenosis and salivary duct calculi is less successful.

1520

Correlation of CT detection of skull base invasion with nm23 cDNA mutation in nasopharyngeal carcinoma

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PURPOSE: While CT evidence of skull base invasion is crucial to determine the prognosis of nasopharyngeal carcinoma (NPC), the mechanism of the invasiveness of this tumour is still unknown. This study aimed to clarify if skull base invasion of NPC is related to the cDNA mutational state of the nm23 gene, which has been shown to be relevant to the aggressiveness of several different tumours. MATERIAL & METHODS: RT/PCR (reverse transcriptase/polymerase chain reaction) was used to amplify the cDNA of nm23 in the NPC biopsy tissues; mutation of the PCR products was detected by the single strand conformational polymorphism (SSCP) method. The CT findings of patients were retrospectively reviewed. RESULTS: In 31 NPC biopsies, RT/PCR-SSCP detected the mutation of nm23 cDNA in five samples, four of the mutations were located at the nm23H1 region, while another one was at the nm23H2 region. Sequence analysis of these mutation sites revealed four point mutations and one insertional mutation. There were a total of five cases of skull base invasions demonstrated by CT. Of them, 40% (two out of five) revealed nm23 cDNA mutation. Only 12% (3/26) of cases without skull base invasion revealed nm23 cDNA mutation. CONCLUSION: Our results suggest that CT evidence of skull base invasion of NPC correlates with cDNA mutation of the nm23 gene.

1400–1500
100th BIRthday Symposium
Future
Hall 1

1400

Invited Review

The future of functional imaging

M N Maisey

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Abstract not available.

1430

Invited Review

Digital imaging

D J Allison

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The presentation will describe the current clinical applications of PACS (picture archiving and communications systems) and the advantages such systems offer in terms of the integration, analysis and presentation of digital imaging data. The implications of digital imaging systems for the future practice of hospital and community medicine, and for medical training and research will be discussed.

1400–1510
Scientific Session
Physics Mammography
Hall 10b

1400

Image quality variations in the NHS Breast Screening Programme

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A national survey of image quality and dose has been conducted across 265 mammography systems in the UK Breast Screening Programme (NHSBSP) with a view to identifying those systems which could be further optimized. Surveys were conducted by local physicists as part of routine quality control. The main parameters were the film density, film gradient using light sensitometry, mean

glandular dose to the standard breast (MGD) and image quality (IQ) measured with a TOR(MAM) test object. The films and data were processed centrally to minimize variations in the measurements. Each IQ score is the mean of readings by three observers with 95% confidence estimated as ±5. Film density ranged from 1.07 to 2.12 with a mean of 1.61 (SD=0.15). Film density has changed substantially since 1991 when in a similar survey film density had a mean of 1.33 (SD=0.29), showing the impact of national guidelines that film densities should be set to between 1.4 and 1.8. Over the same period the average MGD has increased only slightly from 1.29 (SD=0.35) to 1.36 (SD=0.34). Film gradient (from 0.25 to 2.00 above base and fog) ranged from 2.2 to 3.9 with a mean of 3.20 (SD=0.30). The IQ ranged from 48–86 with a mean of 69 (SD=8). Causes of reduced IQ were the use of low film densities, medium screens and older designs of mammography X-ray set. A correlation between MGD and IQ was observed. Although film density and MGD were generally satisfactory, film contrast and IQ were very variable, indicating scope for improvement.

1410

Pectoralis major muscle as a reference density in analysis of digitized mammograms—a practical assessment

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INTRODUCTION & AIMS: Quantitative evaluation of change in breast parenchymal density using digitized images would be a useful investigative tool. A method of normalization has been proposed to compensate for variable radiographic factors. Pectoralis major muscle is assessed as a reference density against which breast density may be normalized. Two digitization systems are evaluated for practical utility in the application of this method. MATERIALS & METHODS: 10 patients with bilateral lateral-oblique mammograms at a 2 year interval were selected randomly. The visual appearance of pectoralis muscle was assessed. The 40 mammograms were digitized using a charge-coupled device system (Cosimcar 1:1.4, 12.5 mm lens) and drum-scanning microdensitometer (Photoscan P-1000), at 8 bit intensity resolution, and then evaluated with ANALYZE™ software. The pectoralis muscle mean pixel value (mpv) was calculated from six regions of interest placed in a standardized pattern on the digital images. Similarly, pectoralis muscle mean optical density (mod) was measured using an optical densitometer. RESULTS & CONCLUSION: 26/40 films had adequate inclusion of pectoralis muscle but 7/40 had uneven muscle compression. Pectoralis muscle mod and mpv (CCD & DSMD) ranged from 0.61 to 1.68; 48 to 193 and 49 to 129, respectively. Correlation of pectoralis muscle mod with mpv was higher for DSMD ($r=0.94$) than CCD images ($r=0.67$) because many of the pectoralis muscle optical densities lie out with the logarithmic linear range of response of the CCD camera (1.32–3.15 OD). With meticulous radiographic technique the pectoralis muscle may be useful as a reference tissue density but a digitizer with sufficiently broad latitude is essential.

1420

Wavelet transform image enhancement and classification applied to digital mammography

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This paper presents an image processing and pattern recognition framework for mammographic image enhancement and classification using wavelet transforms. The enhancement procedure is based on the alteration of the multiscale wavelet transform coefficients by applying linear and non-linear functions and thresholding procedures. The pattern recognition approach incorporates feature extraction, selection and classification, and depends on statistical methods. A set of digitized normal and abnormal mammographic images (obtained from the MIAS database) was used to evaluate the performance of the wavelet-based processing. The processed images were then used as a training set in the statistical pattern recognition method. 20 statistical values were obtained from the images and five different classifiers were employed in this study. Our preliminary results suggest that the wavelet enhancement technique can be used as a potential discriminator for masses abnormalities and that the automated classification between normal and abnormal images gives high scores of accuracy.

1430

Shape analysis measures to differentiate between benign and malignant masses

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PURPOSE: Shape has often been used as a method for describing differences between benign and malignant masses. A typical, benign mass is approximately circular with a smooth, well-defined boundary. Conversely, a malignant mass is irregular in shape, often with spiculations and has an ill-defined boundary. The purpose of the study was to identify a set of shape analysis techniques which could exploit these definitions within a digital environment. This would enable computer classification of breast masses found in digital mammograms. MATERIALS: 10 shape measures were developed which would exploit the differences between benign and malignant masses. These were applied to a set of 45 masses obtained from digitized mammograms in the MIAS database for which histological information was available. METHODS: The shape analysis tools were applied to the set of masses (27 benign, 18 malignant). The shape of the masses were obtained by a radiologist tracing the perceived outline of a mass using a computer mouse. RESULTS: The results of the shape analysis tools were analysed using the ANOVA technique. It was found that three shape measures produced statistically significant differences ($p<0.004$ convex hull, $p<0.01$ shape number and $p<0.04$ shape number difference) between benign and malignant masses. CONCLUSIONS: The results suggest that shape may be used to differentiate between benign and malignant masses. Further studies are required using a larger image set to confirm this observation.

1440

Finding spicules in mammograms

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PURPOSE: Computer-based aids for screening mammography require the reliable automatic detection of a variety of signs of cancer. The detected signs are then used to prompt radiologists. We have developed methods which will form the basis for the detection of spiculated lesions and subtle architectual distortions. The emphasis of this work is the correct classification of linear structures in mammograms, especially those associated with spiculated lesions. METHODS: A principal component analysis (PCA) model was trained on linear structure information, extracted from mammograms, using a multiscale line detection technique and labelled by an expert radiologist into various anatomical types. The resulting model is able to classify the various linear structures (50% correct classification on a "leave one structure out" basis) and reduces the amount of data necessary to explain the major variations in profiles. RESULTS: The PCA model has been applied to a set of 19 MIAS mammograms, to determine the probability that a particular type of linear structure (*e.g.* spicule or vessel) is present at any given location in the image. The resulting spicule probability images can then be used to detect and classify the radiating patterns associated with spiculated lesions. CONCLUSION: A statistical model, based on principal component analysis, can describe the cross-sectional profiles of linear structures occurring in mammograms. The model has been applied to digitized mammograms to produce spicule probability images, *i.e* removing clutter from other types of linear structures. The same approach can be used to detect the specific linear structures associated with other mammographic abnormalities.

1450

Physical image quality evaluation of a charge coupled device based digital mammographic imaging system

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PURPOSE: To investigate the imaging performance provided by a charge coupled device (CCD) based detector used for small field mammographic imaging METHOD & MATERIALS: We have investigated the image quality of a Fischer Mammovision digital imaging system, a small field (5 cm × 5 cm) digital imaging system designed to allow visualization of legions in stereotactic needle biopsy. The image detection system is based on a high resolution intensifying screen optically coupled by a fibre optic taper to a high resolution CCD. An image matrix of 1024 × 1024 pixels is acquired, providing an image pixel dimension of approximately 50 μm and 12 bit grey scale resolution. Sensitometric characteristics, modulation transfer function (MTF) and noise power spectrum (NPS) were measured. RESULTS: The sensitometric characteristic, MTF

and NPS were used to determine the noise equivalent quanta (NEQ) which defines the quality of the images provided. The efficiency of the imaging system was determined by deriving the detective quantum efficiency (DQE). NEQ and DQE were determined as a function of exposure level throughout the dynamic range. Imaging performance of the system was compared with that of a mammographic film screen system and a computed radiography based digital mammographic system. CONCLUSION: The CCD-based system exhibits inferior signal-to-noise ratio compared with the other detectors. The system has a similar MTF to computed radiography, however this is inferior to that of the film–screen system.

1500
Work in Progress
See p. 125.

1400–1530 Scientific Session **Cardiac Imaging 2** Hall 11b

1400
Invited Review
Cardiac MR: adult congential heart disease
A J Jones
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Before the advent of open heart surgery 40 years ago, only patients with non-lethal heart disease survived into adulthood, many of them without a firm diagnosis. Operative treatment of such conditions has, however, become increasingly successful, both in the short and the long term. As the long-term success of operations on patients with complex congenital heart disease increases, so the cohort of adult patients with congenital heart disease has become an increasingly large group. This is a disparate group of people who have often had a series of different operations, with results varying from complete cure to palliation; many patients are under long-term follow-up. MRI is an ideal modality for such follow-up, being non-operator dependent, repeatable and making use of non-ionizing radiation. The current and potential roles of MRI in the assessment of adult congenital heart disease will be addressed, with particular reference to initial diagnosis and monitoring of complex disease, before, during and after surgical treatment. This will be done with reference to current and past cases and with a review of literature to predict where MR will help in the future. MRI may also be useful in the primary diagnosis of patients presenting late in life with congenital heart disease, or when considering for operation patients non-operable in early life and this will also be discussed.

1430
Activated guidewire angioplasty using soft wires: results from four treatment centres
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PURPOSE: To investigate the use of the activated guidewire technique in the treatment of chronic coronary occlusions using flexible wires. MATERIALS: The activated guidewire technique involves the use of a hand-held motorized unit which produces a complex vibratory motion in a flexible coronary guide-wire attached to an over-the-wire catheter. The device can produce different vibrational frequencies in the range of 30–100 Hz. In addition, the stroke length and wire protrusion from the catheter tip can be adjusted. METHODS: The mechanical device is used after a preliminary attempt to cross the occlusion with the wire alone had failed. 78 patients were included in the study (66 male, 12 female age 40–77 years) mean duration of occlusion 20 (7 ± 18) months. The location of the lesion was LAD 34, LCX 15, RCA 28 diagonal 1. There was an angiographic lead in 49/78. Average length of lesion was 28 ± 19 mm. Calcification was noted in 19/78 and bridging collaterals in 33/78. RESULTS: The overall success rate was 75.6%. The duration of the procedure was 30–150 min. In the 19 unsuccessful cases the wire failed to cross in 13, there were two cases of vessel rupture due to balloon over-sizing in the subsequent angioplasty as the only major complications of the procedure; there was no vessel perforation by the wire. CONCLUSION: Activated guidewire angioplasty is an effective approach in the angioplasty treatment of chronic total occlusion.

1440
Myocardial perfusion studies in patients with end-stage renal failure
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PURPOSE: Patients in end-stage renal failure may have diabetes mellitus, vasculitis, hypertension or other risk-factors for ischaemic heart disease. Before transplantation some assessment of cardiac health, at least in the more elderly patients, is desirable. This study was performed to determine the proportion of abnormal cardiac perfusion in patients over 35 in end-stage renal failure and being considered for transplantation. METHODS: 29 patients (19 male, mean age 58, range 39–76) underwent Dipyridamole or Dobutamine stress followed by 74MBq of ^{201}Tl. Tomographic images were performed immediately after stress and 3 h after rest. Images were reported as normal, showing ischaemia (defect at stress, normal rest) or infarct (fixed defect). RESULTS: 19 patients had an abnormal ^{201}Tl myocardial study, of these five showed an infarct, only one of these had complained of cardiac symptoms (central "angina-like" chest pain). Of the remaining 14 patients, 10 had no cardiac symptoms. All 10 patients with normal studies were asymptomatic. CONCLUSION: The high incidence of patients (76%) with abnormal myocardial perfusion studies, but no "angina-like" chest pain, among patients with end-stage renal failure, over the age of 35, make assessment of cardiac perfusion before major operative procedures, such as renal transplants, imperative.

1450
Myocardial perfusion imaging: a comparison of MRI and thallium-201 in patients with acute myocardial infarction
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86 patients underwent MRI and radionuclide (RN) perfusion imaging of the myocardium between 2 and 6 days after admission with an acute myocardial infarction (AMI). MRI was performed at 1.0 T in the short axis of the left ventricle (LV) using a fast gradient echo sequence. Normal myocardial signal was nulled. Serial acquisitions were performed, at a rate of approximately one every third second, through the base, middle and apex of the LV for a 2 min period beginning 10 s before the injection of 0.05 mmol kg^{-1} Gadobenate Dimeglumine (Bracco SpA, Milan). The myocardium was divided into 30 regions of interest (ROI) and each ROI qualitively scored for presence of signs of hypoperfusion. The same patients also underwent a standard non-stressed ^{201}Tl study (80 mbq) of myocardial perfusion. The radionuclide images were independently scored for myocardial hypoperfusion. There was no significant difference in the proportion of ROI classified as hypoperfused by the two tests (31% MRI, 33% RN, $\chi^2 = 2.460, = > 0.05$, McNemar test for correlated proportions). The observed agreement between the two tests was 66% (Cohen's $\kappa = 0.21$). We conclude myocardial perfusion MRI provides similar information to ^{201}Tl RN imaging in patients between 2 and 6 days after admission with AMI.

1500
Invited Review
The hidden treasures of the mediastinum
J B Partridge
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Vascular malformations of the great vessels were of passing interest to the radiologist until the advent of CT. Such abnormalities can produce quite confusing images in the chest and anyone performing CT of the chest should be reasonably familiar with the more frequent types. The formation of an azygos lobe is frequently associated with displacement of the azygos vein to the right, dragging mediastinal tissue with it and giving spurious mediastinal widening (the "flying azygos"). Absence of the infrahepatic section of the inferior vena cava requires that the azygos vein be of considerable size in order to assume venous drainage from most of the abdomen and below, to which end it may be as big as the aorta itself. Persistent left superior vena cava appears as a round or oval mass lesion immediately to the left of the aortic arch, where it may be mistaken for lymphadenopathy, particularly if contrast is given from the right arm. A right aortic arch is quite a substantial malformation that should be easy enough to spot on the plain film, but remember that the definition of a right-sided arch is that it passes to the right of the

trachea. The descending aorta therefore also starts on the right but may pass to the left at any point between the arch and the diaphragm, and associated branching abnormalities are common. These and other similar malformations will be reviewed. If time permits, we shall discuss the usefulness of non-contrasted CT in the evaluation of traumatic mediastinal haematoma and its relationship to aortic rupture.

1415–1515
College of Radiographers
Awards Ceremony
Hall 9

1520–1610
Scientific Session
Protection of the Patient
Hall 10b

1520
The effect of fluoroscopic kVp–mA curves on patient effective dose
D G Sutton and A Watt
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PURPOSE: Modern image intensification equipment permits the operator to select different modes of operation for the automatic brightness control (ABC). This work evaluates the way in which different ABC kVp–mA curves affect the effective dose to the patient. METHOD: The kVp–mA characteristics of five organ curves available on a Siemens Siremobil 2000 were plotted by introducing increasing thickness of copper into the beam. Back-scatter fraction was determined and hence the incident dose rate to the copper was derived. Typical field sizes for three examinations (stomach, hips, heart) were obtained from NRPB R262. Multiplication of incident dose rate and field-size yielded dose–area product per second (dap rate) for each kVp and investigation. Coefficients relating dap, kVp and effective dose were obtained from a fit to the data in NRPB R262. Previously published work was used to derive a 10 000 point look-up table relating kVp, thickness of copper and thickness of Perspex. Graphs of effective dose rate *vs* Perspex thickness were derived for each of the three examinations and five organ curves under consideration. RESULTS: To compensate for geometrical effects, the curves of effective dose *vs* Perspex thickness were normalized to the 5 mA standard (ant-isowatt) curve at each Perspex thickness. Lowest doses were obtained with the paediatric curve and the highest with the 8 mA high contrast curve. The relative contribution to effective dose will be discussed. CONCLUSION: The choice of ABC control mode can result in a variation of $\pm 50\%$ in the effective dose to the patient.

1530
Dose–area product results for a range of interventional procedures
A D Cotterill, J C Kyriou, A C Pettett and M C Fitzgerald
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Dose–area product (DAP) is now routinely measured in many establishments where general fluoroscopic and fluorographic examinations, such as barium meals and enemas, are carried out. Partly as a consequence of this, for the more general examinations, individual DAP readings can be assessed in relation to national or locally-derived reference values. In the case of more specialist examinations, such as vascular or cardiac interventional procedures, which often involve highly localized skin doses, the availability of national data and the derivation of local reference values is complicated by the range of procedures undertaken and variations in technique. This paper will report upon a classification system, based upon the area of the body irradiated, which has been designed to simplify the analysis and recording of data for a range of vascular and cardiac procedures. Results of DAP monitoring will be presented, along with suggested local reference values derived from them. Measured skin doses will be presented for procedures associated with highly localized skin exposures.

1540
Influence of technique on image quality and dose in paediatric imaging
J V Cook, J Kyriou, A Pettett, M Fitzgerald and S M Pablot
Department of Radiology, Queen Mary's Hospital for Children, St Helier Hospital Trust, Carshalton SM5 1AA, UK
PURPOSE: It is self-evident that dose measurements taken without assessment of image quality are of limited value. This study was undertaken to assess the differences in image quality and patient dose at two specialist and two general hospitals. MATERIALS & METHOD: Dosimetric data on 3000 examinations were obtained. 100 radiographs were selected at each hospital for patients who represented the average doses obtained in each of five age ranges. Two paediatric radiologists assessed the image quality according to established criteria published by the CEC. RESULTS: As expected, the image quality was higher in the specialist centres. However, only in fluoroscopy was there a significant reduction in corresponding dose. At the general hospitals image quality of the radiographs was lower, but they were still diagnostic. The use of faster screen–film combinations at the general hospitals and non-routine use of a grid, in selected age ranges for certain examinations, outweighed the benefit of superior radiographic technique at the specialist hospitals. CONCLUSIONS: There should be a core group of staff responsible for paediatric imaging (monitoring referral criteria, image quality and dose). Desired image quality of the radiographs should be tailored to the radiological request (high kV, added filtration, fast screen–film combinations, non-grid technique). Guidelines should be established outlining the techniques, radiation protection measures and expected dose ranges. Comprehensive guidelines have been prepared and will be discussed.

1550
Variations in the performance of automatic exposure controls in general radiography
J C Kyriou, A D Cotterill and M C Fitzgerald
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Automatic exposure controls (AEC) are widely used in general radiography and are important factors in determining the dose to the patient. They operate by terminating an exposure upon measuring a threshold of radiation, which should be set to give a film optical density within the suggested limits of 0.9 and 1.4 (HPA Topic Group Report Part IV). Usually, one of three ionization chambers placed behind the grid, but in front of the film, is used to control the exposure. This paper describes the results of our routine monitoring of AEC systems, including the analysis of 126 films taken on 48 AECs (32 horizontal, 16 upright), in 37 rooms and 10 X-ray departments. Various kVs and depths of a water equivalent phantom were used to simulate realistic spectra at the AEC. 14% of films had optical densities >1.4 and 32% had optical densities <0.9 (*i.e.* 46% of all films were outside the suggested acceptable range). Only two departments had no films outside the range and one had all films outside the range. The maximum density was 2.57 and the minimum 0.53. Given the implications on patient dose, these results were both surprising and alarming. In many cases the immediate intervention of the engineer was recommended and in one case the equipment was suspended. A time-efficient and focused method of routine assessment, which was developed through practical experience, will also be described.

1600
Work in Progress
See p. 127.

1530–1700
BIRthday Debate
This House Proposes that in View of Other Developments in Clinical Imaging, X-rays Are Obsolete
Hall 9
Chairman
I R Young *Robert Steiner MR Unit, Hammersmith Hospital, London W12 0HS, UK*
Introduction
S Golding *Oxford MRI Centre, John Radcliffe Hospital, Oxford, UK*

Speakers
For the motion:
P Robinson *St James's Hospital, Leeds, UK*
L D Hall *Herchel Smith Laboratory for Medical Chemistry, Cambridge, UK*
Against the motion:
P Goddard *Bristol Royal Infirmary, Bristol, UK*
G E Adams *MRC Radiobiology Unit, Didcot, UK*
Summing up
For the motion:
D Allison *RPMS, Hammersmith Hospital, London, UK*
Against the motion:
A Adam *UMDS, London, UK*

1545–1645 Scientific Session *info*RAD™ 5 Olympian Suite

1545
Invited Review
IT applications and recent developments
K Boddy
Edinburgh Healthcare Telematics Centre, 23 Chalmers Street, Edinburgh EH3 9EW, UK
Abstract not available.

1605
Remote reporting of emergency CT scans using teleradiology: a 2 year district general hospital based experience
R Evans, H Blake and C Hoskins
Department of Diagnostic Imaging, Mayday University Hospital, Croydon CR7 7YE, UK
PURPOSE: To evaluate clinical acceptance and efficacy of remote reporting of emergency CT scans using teleradiology. MATERIALS & METHODS: A retrospective study of emergency CT scans performed over a 2 year period in a district general hospital, with reference to those reported remotely by radiologists at home. Cases suitable for remote reporting were selected by a consultant radiologist and scanned according to an agreed protocol by a radiographer, with nursing and medical staff in attendance as appropriate. Images were captured from the CT scanner video output by an Oxford Imlink image transmission system and transmitted via modem to an Imlink transportable system in the radiologist's home. An immediate report was given to the clinician by telephone and a final report made from hard laser copy by the same radiologist the next working day. RESULTS: Over 100 scans were reported remotely, representing approximately 50% of the total on-call CT work-load. These were all head scans, the majority unenhanced. There were no alterations of the original CT report after subsequent review of the laser hard copy images. The protocol was well-accepted by medical, radiographic and nursing staff and no adverse events occurred. CONCLUSIONS: Remote reporting of emergency CT scans by radiologists is both effective and cost-efficient in a district general hospital and is well tolerated by hospital staff. A protocol for case selection and scanning procedure, such as that used in our centre, is essential.

1615
Reporting from PACS workstations: an assessment of the effect on reporting times
[1]S Bryan, [1]G Weatherburn, [1]J Watkins, [2]M Roddie and [1]M Buxton
[1]*HERG Brunel University, Uxbridge, Middlesex UB8 3PH and* [2]*Department of Radiology, Charing Cross Hospital, Fulham Palace Road, London W6 8RF, UK*
At Hammersmith Hospital the introduction of PACS was a two-stage process: initially conventional film was replaced by hard-copy computerized radiography (CR), secondly, CR films were replaced by PACS workstations. The purpose of this research was to assess the impact of these changes on the length of time which radiologists devote to the reporting process. Significant changes in reporting times will have important cost implications. A controlled "before and after" research design was adopted. Data were initially collected when conventional film was used in reporting: this was repeated twice—when hard-copy CR images were used and again when reporting was routinely from PACS workstations. All data were collected by independent health service researchers observing the reporting process. Data were collected on a variety of variables, including the time taken to produce the report, the number and nature of all images viewed, the experience of the radiologist and the number of disturbances that occurred. A total of 3605 conventional film observations, 1070 CR observations and 962 PACS observations were collected. Three comparisons of report time have been made: conventional film with CR; CR with PACS; and conventional film with PACS. In order to control for some of the potential biases in the before and after comparisons, such as different mixes of examinations being reported, multiple regression techniques have been used. The results of the comparisons of reporting times will be presented in the paper. This research is part of the economic evaluation of PACS funded by the Department of Health.

1625
Large screen image presentation integrated in a PACS: first experiences
E Kotter, C Merz, D Burger, A Einert and M Langer
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PURPOSE: Fast presentation of radiological images stored in a PACS on a large screen system. MATERIALS: We linked a department-wide DICOM-PACS (picture archiving and communication system, Prompt GmbH, Germany), archiving images from three CT and three MRI Systems (all Siemens Medical Systems), and one plain film scanner to a standard personal computer (PC). Specialized PC software allows presentation of images via a Barcographics 808 video projector. METHODS: We developed software for the presentation of radiological images which can access all images stored in our PACS in DICOM 3.0 format and query the PACS database. The software consists of two modules. Module one (preparation) allows (1) the query of the PACS database and the retrieval of images or series, (2) all standard image manipulations (brightness and center-window adjustment, image scaling and rotation, filter operations) and (3) storage of the manipulated images on the local hard-disk. Module two (presentation) is optimized for fast retrieval of the images stored locally and a simple and fast user interface. RESULTS: Since 1 October 1996, the radiological presentation for the daily surgical morning meeting (about 80 participating persons) has been performed with a large screen (5 × 4 m) video presentation system. While training for the use of the preparation module takes several hours, the use of the presentation module can be learned in less than 1 h. Preparation of the presentations now takes about 1 h instead of 20 min for conventional presentation with an alternator. The presentation is faster than with a film alternator because images are displayed faster. As the video projector is not as bright as a viewbox, the brightness of most images has to be corrected for presentation. Some MR images also need a slight centre-window adjustment. The images of the film scanner are adjusted with the help of a specialized grey-level histogram. Despite continuous software updates, we have had no failure during presentation. CONCLUSION: The overall quality of our radiological presentation was increased by better visibility of the images. This new presentation technique was readily accepted by our surgical colleagues. For large auditoriums, this technique allows better interdisciplinary case discussion.

1635
Interpretation time of CT scans with stacked-view PACS workstation *vs* film alternator in patients with small bowel obstruction
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PURPOSE: Interpretation time and detection rate of small bowel obstruction sites using a stack-view display in PACS workstation were compared with those obtained using a film alternator. MATERIALS & METHODS: The film stack-view displayed a "stack" of CT sections for each examination; users controlled the speed of change of each section. Two independent gastrointestinal radiologists reviewed the stack view and film of CT scans in 22 patients with small bowel obstruction in two sessions 2 weeks apart. The total time of interpretation and the detection rate of bowel obstruction site were recorded. RESULTS: The average time taken by two radiologists to examine a case using the film stack was 6 min 50 s and with film alternator 8 min 32 s. The detection rate of bowel obstruction site by stack view and film alterator was the same for each radiologist. CONCLUSION: Use of a stacked view by PACS workstation reduces the time taken for interpreting CT images in patients with small bowel obstruction.

Posters

National Indoor Arena Concourse Area

Paediatrics

POSTER 0101

Is the FLAIR sequence useful in imaging the paediatric brain?

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PURPOSE: Fluid-attenuated inversion recovery (FLAIR) sequences are now widely used in imaging the adult brain, particularly for demyelination and epilepsy. The aim of this study was to assess the technique's usefulness in a paediatric population. MATERIALS & METHODS: 57 patients (mean age 6.2 years, range 1 month to 17 years, 17 under 2 years, 31 male and 26 female) were imaged on a 1.5 T Philips Gyroscan ACS II scanner. Spin echo T_2W and fast FLAIR images were obtained, usually in the axial plane, together with other sequences as required. Indications for scanning were: seizure disorder, 21; developmental delay, 17; focal neurological signs, 17; movement disorder, nine; and dysmorphic features, three. T_2W and FLAIR images were independently assessed and directly compared by two experienced readers. The brain was divided into 62 areas, each of which was assessed for signal abnormality. RESULTS: 27 scans were normal on both sequences, six showed structural changes equally well seen on both sequences. 24 showed focal areas of signal change, better seen on T_2W in 11, better seen on FLAIR in six. 18 areas of abnormal signal in six patients were seen on FLAIR only (clinically significant in two patients aged 7 months and 7 years in whom the T_2W scans were thought normal), 26 on T_2W images only in six patients (clinically significant in five patients). Subcortical and thalamic lesions were better seen on FLAIR, cortical lesions on T_2W scans. CONCLUSION: FLAIR may show abnormalities not perceived on T_2W scans, but should not be interpreted in isolation. The high water content of the infant brain may render lesions inconspicuous on FLAIR images.

POSTER 0102

US imaging in infants and children undergoing transhepatic cardiac catheterization

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PURPOSE: Diagnostic and therapeutic cardiac catheterization can be carried out using transhepatic catheter techniques when conventional venous access is made difficult by congenital venous anomalies and venous occlusions. This paper describes our early experience using both transabdominal and transoesophageal sonography in guiding "free hand" transhepatic venous puncture and providing a "road-map" for intracardiac intervention. MATERIALS & METHOD: Four children have undergone transhepatic cardiac intervention at our hospital. Mean age was 5 years (age range 7 months–7 years). Conventional access was not possible due to previous Fontan operation (two cases), multiple venous occlusions (one case) and cavopulmonary shunt with baffling of the hepatic veins (one case). Under US a 4 F Teflon sheath needle was used to puncture and catheterize the middle hepatic vein. An 0.25/0.35 Amplatz guidewire was passed through the sheath into the atrium. Under fluoroscopy, contrast was injected into the sheath to confirm tip position within the atrium. The sheath was then exchanged over the wire for larger sheaths as required. Peroperative transoesophageal echography was used to monitor the cardiac intervention. Transabdominal US was used to guide coil deployment following removal of the sheath at the end of the procedure. RESULTS: Three patients underwent successful pacemaker insertion and one had a diagnostic cardiac catheterization. CONCLUSION: US proved invaluable in both guiding the procedure and in minimizing the fluoroscopic time to the children. We believe this is the first series to describe such sonographic freehand guidance combined with transoesophageal echography.

Neuroradiology

POSTER 0201

Neurological complications in sickle cell disease: a pictorial review

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INTRODUCTION: Sickle cell disease is the commonest haemoglobinopathy described. During deoxygenation abnormal HbS molecules form linear stacks, causing red cells to become deformed into a rigid, sickle shape. Sickle cells have difficulty passing through the micro-circulation, leading to blockage of small vessels. Neurological complications are common and have been reported in up to 26% of patients. MATERIALS & METHODS: We present a pictorial review of these complications. CT, digital subtraction angiography, MRI and magnetic resonance angiography (MRA) images are used from 10 patients. RESULTS: The following neurological complications are demonstrated: cerebral infarcts (CT and MRI); occlusion of the middle and anterior cerebral arteries (MRA); venous infarction and absence of flow in the transverse sinus (CT and MRA); diffuse white matter changes secondary to disease in deep penetrating arterioles (MRI); the moyamoya (puff-of-smoke) appearance of arterial collaterals (angiography and MRA); and intracranial haemorrhages with subarachnoid extension (MRI). CONCLUSION: CT and MRI can demonstrate both cerebral infarcts, which account for the majority of cerebrovascular accidents, and primary intracranial haemorrhage. MRI can also show deep white matter abnormalities in patients without a neurological deficit. A non-inflammatory intimal hyperplasia can cause chronic occlusion of the intracranial portion of the internal carotid artery and proximal segments of the middle and anterior cerebral arteries. The subsequent development of extensive collateral circulation results in the characteristic moyamoya appearance at the base of the brain. The posterior circulation is rarely involved. MRA imaging in these patients avoids the use of potentially hazardous cerebral angiography.

POSTER 0202

Patterns of pituitary haemorrhage: fluid–fluid levels and persistent high signal on T_1 weighted imaging

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PURPOSE: Fluid–fluid levels (FFL) are rarely described in T_1 weighted imaging following pituitary haemorrhage (PH). This study illustrates the occurrence and evolution of haemorrhage and FFLs at long-term follow-up. METHODS: T_1 weighted sequences were performed in multiple planes in 12 patients with PH scanned during the last 9 years (four male and eight female, mean age 34, age range 17–77). Six patients had pituitary FFLs and six cases with haemorrhage presenting with high intensity on unenhanced scan had repeat scans between 7 months and 4.5 years. RESULTS: FFLs were characteristically seen as dependent low signal with high signal supernatant. Careful scrutiny is necessary to detect the dependent low signal component as this may be subtle. One FFL follow-up scan showed uniform high signal at 4 months and in three cases, complete resolution of haemorrhage was seen at 7 months, 3 years and 7 years. Haemorrhage manifest as high signal alone persisted at 7 months, 1 year, 2 years and 4.5 years. In two patients the haemorrhage resolved between 3 and 6 years and between 6 and 18 months. CONCLUSION: FFLs are found more frequently than previous reports suggest. These data suggest that FFLs resolve more rapidly than high signal haemorrhage. Prolongation of high signal associated with methaemoglobin for several years may reflect different environments for haemoglobin degradation in pituitary and brain.

POSTER 0203

A more efficient screening protocol for the detection of acoustic neuroma using MRI

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PURPOSE: Screening for acoustic neuroma represents a significant workload for many radiology departments. However, in most patients a diagnosis of acoustic neuroma will be excluded, therefore

the ideal protocol is one which confirms normality by the most cost-effective method. Currently, most centres perform axial T_2 weighted (T_2W) FSE images of the internal auditory canals, followed by gadolinium-enhanced scans in equivocal cases. We present a new protocol comprising axial T_2W FSE images supplemented by coronal T_2W FSE scans where the VII and VIII nerves are not seen in their entire lengths on the axial images. Gadolinium is reserved for those cases which remain in doubt. MATERIALS & METHODS: We carried out a retrospective review of 427 cases scanned over a 1 year period using a 1.5 T system. All patients had unilateral audio-vestibular symptoms. Details of the sequences performed were collated by reviewing the scans. Films could not be retrieved for 38 patients and they were excluded from the study. No abnormalities were recorded in the written reports for these cases. In six patients abnormalities detected required a formal brain protocol to be carried out and these cases were also excluded. RESULTS: Acoustic neuroma was diagnosed in six of the 383 cases reviewed. In 316 patients (83%), axial T_2W images alone were performed. In 59 patients (15%) only additional coronal T_2W scans were necessary. Gadolinium was given in eight cases (2%). CONCLUSION: We conclude that in the majority of cases being screened for acoustic neuroma, axial T_2W images alone will be sufficient to reach a diagnosis. Where these are not diagnostic, an additional coronal T_2W sequence obviates the need for gadolinium-enhanced scans in a large proportion of patients, thereby reducing costs without increasing scan time. Gadolinium will still be required in equivocal cases.

POSTER 0204

Anatomy of the cerebellopontine angle and inner ear demonstrated by MRI: a clinico–pathological study

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PURPOSE: To achieve optimum display of structures in the cerebellopontine angle and inner ear by MRI, applying the results to the analysis of pathology. METHOD: 22 normal ears were imaged using both a transverse axial 2DFT FSE sequence and a 3DFT CISS (constructive interference in the steady state) sequence which provides heavily T_2 weighted images with gradient moment nulling reducing flow-artefact. Images with a matrix size of 512 × 512 were then reconstructed in standard and non-standard planes with a slice thickness of 0.7 mm. RESULTS: Although satisfactory delineation of the nerves within the cerebellopontine angle cistern and internal auditory canal was usually achieved on transverse axial scans, parasagittal images were helpful in narrow canals and in defining their relationship to mass lesions. In congenital abnormalities of the inner ear, targeted maximum intensity projection images from 3D data provide a global view which can be supplemented by appropriate planar images. In a review of 131 patients with sensorineuronal hearing loss, tinnitus and vertigo, no correlation was found between contact of the labyrinthine artery with the 8th nerve and symptoms (χ^2 test: $p=3.54$), thus refuting a suggested "nerve irritation" syndrome. CONCLUSION: Despite flow artefacts, transverse axial 2D FSE scans usually provide an adequate survey of the cerebellopontine angle: the limitations of slice thickness in analysis of inner ear structures can now be obviated by use of the 3D CISS technique.

POSTER 0205

Fluid attenuated inversion recovery sequence imaging in intractable epilepsy: a comparison with morphometry and T_2 relaxometry

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PURPOSE: To compare the detection of temporal lobe foci in patients with intractable epilepsy using a fluid attenuated inversion recovery (FLAIR) sequence and temporal lobe volumetric and T_2 relaxometry studies. METHODS: 22 patients with intractable epilepsy diagnosed on clinical, EEG and video criteria were studied by volumetric and T_2 relaxometry studies of the temporal lobe and the amygdala–hippocampal complex producing cross-sectional area and mean T_2 map profiles along the long axis of the temporal lobes. A non-proprietary FLAIR sequence implemented on a Siemens 42SPE imager (TR 6000, TE 150, TI 2100, nine slices, 5 mm thick, FOV 230 mm, MA 120 × 256 half-Fourier) was employed to image the temporal lobes parallel and normal to their long axes. RESULTS: In seven of the 22 patients there was agreement between the FLAIR images and the quantitative studies in identifying a unilateral focus. In one patient the quantitative studies showed evidence of a focus not supported by the FLAIR studies. In the remaining patients the studies were inconclusive. CONCLUSION: If high-signal abnormalities are shown on the FLAIR images consistent with the EEG and clinical findings, it may not be necessary to perform time-consuming quantitative studies to confirm the presence of a temporal lobe focus.

POSTER 0206

Complex partial seizures: a radiological–pathological study of the temporal lobe

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The aim of this study was to evaluate the accuracy of MRI in detecting temporal lobe abnormalities, associated with complex partial seizures, compared with a neuropathological examination. 45 patients underwent temporal lobe surgery for intractable epilepsy. MRI evaluation prior to surgery included FSE T_2 axial TR 4000, TE 86, slice thickness 5 mm with a 2 mm gap and FSE T_2 coronal, TR 4000, TE 105, 3 mm slice thickness and no gap, pulse sequences MRI scans were examined independently by three blinded neuroradiologists and the majority interpretation was taken as being definitive. 38 MRI scans were available for analysis. MRI diagnosed hippocampal sclerosis (HS) in 27, confirmed by pathology in 23, with insufficient tissue in three and one normal. MRI diagnosed tumour in five. Pathology confirmed four with severe gliosis in one. MRI was normal in six. Pathology demonstrated HS in four and insufficient tissue in two. MRI showed a cystic medial temporal lesion in one, but only a lateral neocortectomy was performed. Pathological evaluation also demonstrated subtle neocortical changes (cortical dysplasia, chronic inflammation and widening of perivascular spaces) not seen on MRI. MRI has an 87% sensitivity in the diagnosis of HS. This has a significant impact on the surgical management of temporal lobe epilepsy. Continued evaluation of clinical outcome, as well as the introduction of volumetric analysis on MRI is ongoing.

POSTER 0207

Errors in mathematical estimations of grey and white matter volumes from MRI

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PURPOSE: To examine the accuracy and reliability of grey and white matter volume estimations based on MRI images using a previously described technique. MATERIALS: Images of five normal volunteers were obtained using two inversion recovery sequences with TI of 300 ms and 490 ms. Imaging was performed on a Philips ACS NT 1.5 T instrument. Synthetic MR data was produced based on imaging parameters and known tissue T_1 and T_2 values. METHODS: The following assumptions of the original method were examined: (1) grey and white matter contribute minimally to signal intensity on late echo IR sequences (TI 490, TE 100); (2) measures of pure tissue intensity values for CSF and grey and white matter are reproducible; (3) mathematical estimation of tissue volumes based on these assumptions are sufficiently accurate for routine use; (4) estimations of grey and white matter volume are improved if assumption (1) is avoided by full mathematical solution of the segmentation equations. RESULTS: Measurements of grey and white matter intensity on late echo images showed tissue intensities in the range of 10–14% of the CSF signal. Reproducibility of pure tissue measurements was poor and this variability was particularly marked in estimation of grey matter intensity. Estimations of grey and white matter values from synthetic data demonstrated consistent underestimation of grey matter volumes by up to 40% and over-estimation of white matter volumes by approximately 15%. Segmentation using full mathematical solution of the segmentation produced accurate estimations of both grey and white matter volumes but became unreliable in the presence of random noise in the image. The susceptibility to noise was demonstrated in segmented images of normal volunteers. CONCLUSIONS: The mathematical segmentation technique has considerable theoretical advantages, but is systematically inaccurate. Inaccuracy can be reduced by use of the full mathematical solution of the segmentation problem, but the technique remains highly sensitive to image noise and variation in selection of pure tissue samples.

POSTER 0208

Utility of linear measurements in the differentiation of Alzheimer's disease and vascular dementia

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PURPOSE: To examine the reliability of simple linear measurements of grey and white matter in the differentiation of Alzheimer's disease (AD) and vascular dementia. MATERIALS: Images were

obtained in eight patients with AD and eight age- and sex-matched patients with vascular dementia. Imaging was performed on a 1.5 T Philips ACS NT scanner. Linear measurements of grey and white matter were made on an independent Philips Easy Vision workstation. METHODS: Measurements were made from coronal inversion recovery FSE images (TR 2562–4680 ms, TE 18–41 ms, TI 300 ms, slice thickness 3 mm). Images at four standard stereotaxic levels (Taliarach +32 mm, 0 mm, −4 mm and −20 mm) were selected. Measurements of substantial innominata, interuncal distance, intercaudate ratio (ICR) and interventricular distance (IVD) were made, as described by previous workers. Measurements of grey and white matter thickness were made at a total of 29 sites which were identified by anatomical description. Sites corresponded to Brodmann's areas 4, 6, 8, 11, 20, 28 and 47. Comparison of measurements between the patient groups was made using unpaired t tests with Bonferonni corrections where appropriate. RESULTS: There was no significant difference in the overall level of cerebral atrophy (ICR and IVD) or in the thickness of the substantial innominata between the two groups. The interuncal distance was significantly greater in the AD group ($p<0.05$) than in the vascular dementias. Linear measurements demonstrated significant loss of frontal and temporal grey matter and of temporal white matter in AD compared with vascular dementia. CONCLUSIONS: Linear measurements provide a simple method for assessment of regional grey matter loss in neurodegenerative diseases. They demonstrate predictable reduction in temporal and frontal grey matter thickness in patients with AD compared with patients with vascular dementia. This work was supported by Philips Medical Systems and by the Association for Research into Multiple Sclerosis.

ENT

POSTER 0301
Radiological features of ameloblastoma with histological correction

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PURPOSE: The aim of this study was to determine the radiological features of ameloblastomas and correlate these with the histological findings. MATERIALS & METHODS: A retrospective study was performed on 19 cases of histologically-proven ameloblastoma diagnosed between 1985 and 1995 in Kenyan patients. The average duration of symptoms was 1.5 years, with an age range of 15–52 years and a male to female ratio of 2:1. The orthopantomograms at presentation were analysed according to; site; size; degree of expansion; loculation; cortical thinning and cortical breadth; tooth loss; and root resorption. RESULTS: There were 10 cases of plexiform ameloblastoma and nine of follicular ameloblastoma. All the lesions occurred in the mandible, with a predilection for the molar and premolar regions. Expansion and cortical thinning were present in all lesions. All lesions are also associated with root resorption ranging from 1–13 teeth. Tooth loss was present in 17 out of 19 patients. Extension of tumour into the surrounding soft tissues was not seen. CONCLUSION: Ameloblastoma occurring in the mandible are very expansive lesions which result in cortical thinning and erosion. However, local invasion of soft tissues and cortical breach are atypical. Root resorption is a characteristic feature. We did not find a significant difference in the radiological features between plexiform and follicular ameloblastoma.

POSTER 0302
The MRI incidence of Thornwaldt's cysts

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PURPOSE: Thornwaldt's cysts are midline cysts in the superior nasopharyngeal recess which result from obstruction of the pharyngeal bursa, a potential space caused by a persistent connection between the notochord and pharyngeal ectoderm. A working classification of nasopharyngeal cysts is presented. A Thornwaldt's cyst incidence of 3.3% at autopsy has been reported in the literature. Such cysts are uncommon clinical entities and the authors' experience reporting MRI scans suggested this incidence to be too high. MATERIALS & METHODS: We retrospectively reviewed 2000 MRI scans of patients being scanned for various indications. Patients with nasopharyngeal cysts as a presenting complaint were excluded. RESULTS: Thornwaldt's cysts were identified in only three patients, an incidence of 0.15%. CONCLUSION: The incidence of Thornwaldt's cysts is much lower than some previous literature reports may have suggested.

POSTER 0303
Orbital rhabdomyosarcoma: radiological characteristics

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PURPOSE: To study the radiological characteristics of rhabdomyosarcoma, the most common primary orbital malignancy of childhood. No previous series has systematically addressed the radiological features. METHODS: We retrospectively reviewed the CT and MRI studies of patients with histologically confirmed rhabdomyosarcoma in the orbit. RESULTS: The CT studies of 30 patients were reviewed; five also had MRI. The 16 males and 14 females had a median age of 7 years (range 1 month to 51 years). The tumour occupied the intraconal and extraconal compartments in 14 cases (47%), was extraconal in 11 (37%) and intraconal in five (16%). The centre of the tumour was in the eyelids in two patients (6%) and in the paranasal sinuses in one (3%). Within the orbit, the upper inner quadrant was the most common site. Intracranial extension and invasion of the paranasal sinuses were each seen in two cases (6%) and there were changes in the adjacent bone in at least 13 cases (43%); one of these showed calcification within the tumour. The orbital soft-tissue structures, including the extraocular muscles, were displaced or encased by the tumour, but the eye was never invaded. On T_1 weighted images the tumour gave signal similar to that of muscle, but it gave a higher signal on T_2 weighting. Contrast enhancement was not usually striking. CONCLUSIONS: This series highlights the radiological features, which correlate well with the known pathological findings.

POSTER 0304
Role of pre-operative thin section CT in patients undergoing thyroplasty

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INTRODUCTION: Speech in patients with vocal cord malapposition due to non-malignant causes (*e.g.* recurrent nerve paralysis post-thyroid surgery) can be corrected by thyroplasty. This procedure involves inserting a silicon implant to effect medialization of the free edge of the paralysed vocal cord, improving vocalization. The proper size implant can be selected radiologically prior to surgery. AIMS: To assess the usefulness of pre-surgical measurements of vocal cord deficits, using thin section CT of the larynx, in constructing silicon implants of suitable size and shape. PATIENTS & METHODS: As part of an on-going study we performed thin section CT of the larynx on five patients referred from an ENT clinic with non-malignant caused vocal cord malapposition. The group consisted of three males and two females, mean age 64.4 years (range 24.2–77.5 years). All patients presented with unilateral recurrent laryngeal nerve paralysis. An obtuse-triangular intralaryngeal implant was constructed using measurements from thin section CT images taken at vocal cord level. The boundaries of this implant were the midline, an oblique line from the anterior commisure to the tip of the vocal process of the arytenoid cartilage and a horizontal line from the tip of the vocal process to the midline. RESULTS: Pre-operative CT scans in all five patients allowed estimation of the vocal cord deficit, enabling the surgeon to preoperatively construct a series of three implants of accurate AP length but variable width, avoiding time-consuming and potentially damaging intraoperative manipulation from fitting and refitting silicon implants. In addition, pre-operative CT allows accurate positioning of the surgical window in thyroid lamina at the exact midpoint of the vocal cord. Significant vocal improvement was noted by patients and surgeons, while functional improvement (*i.e.* glottic closure) was noted post-operatively on laryngeal examination. CONCLUSION: Pre-operative thin section CT of the larynx enables preselection of silicon implants of suitable size and shape, with accurate positioning of the surgical window in patients with unilateral vocal cord paralysis, significantly reducing preoperative manipulation and improving subjective and objective results.

Chest

POSTER 0401

CT, US, pleural fluid characteristics and clinical history in patients with thoracic empyema

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PURPOSE: To correlate CT and US appearances with clinical history and pleural fluid characteristics in patients with thoracic empyema. MATERIAL & METHODS: 20 patients with biochemically and bacteriologically-proven empyema were examined with contrast CT and US. The duration of history and laboratory markers of severity (pH, LDH, glucose) were recorded. Thickening and enhancement of both the extrapleural and pleural tissue were assessed on CT. Septations on CT and US were determined and pleural fluid echogenicity US was recorded. RESULTS: CT detected smooth pleural thickening with enhancement in all cases (mean thickness 2.8 mm, range 1.8–4.2 mm). Subcostal fat was thickened in seven out of 20 cases (mean = 2.94 mm, range 2–4.2 mm) and demonstrated increased attenuation in 17/20 cases. Statistical analysis showed that laboratory indicators of severity (pH, LDH and glucose) were positively correlated with each other ($p < 0.01$), but were not correlated with any of the CT or US features. Pleural thickening on CT correlated with length of clinical history, $r = 0.53$, $p = 0.01$. US demonstrated increased fluid echogenicity in 18/20 patients and appeared superior to CT in the detection of septations (13/20 cases *vs* 6/20). CONCLUSION: Both US and CT have effective and complementary roles in the assessment of empyema; however, this study has demonstrated that the imaging findings do not correlate with laboratory parameters of severity. Moreover, the positive correlation between CT pleural thickness and length of clinical history suggests that radiological features may have prognostic significance in thoracic empyema independent of established laboratory criteria.

POSTER 0402

The radiographical features of *mycobacterium malmoense* infection

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Pulmonary infections with non-tuberculous mycobacteria are still relatively rare and can be difficult to diagnose and manage. *Mycobacterium malmoense* was first reported in 1977 and is seen in parts of Northern Europe. The disease remains relatively rare and there are few reports of specific clinical or radiological patterns of this infection. We have reviewed our experience of this infection in the West Midlands region and present the radiological findings in 18 patients seen over a 3 year period. 18 patients (12 male, six female) age range 2–68 years, mean 53 years, were reviewed. All patients had a chest X-ray examination and four had a CT scan of the thorax. Underlying emphysematous changes were seen in six out of 18 patients (33%). Thick-walled cavities were seen in 10 (56%) patients, six having cavities in the right lung (five in the upper lobe) and four in the left lung. Upper lobe fibrosis was seen in 12 patients. Nodular consolidation was seen in four patients, with two having unilateral disease. Cystic changes were noted in five. Mediastinal glands were seen in one patient. No patients had pleural effusions. Two patients had a normal chest X-ray. Examples of radiographic abnormalities will be presented.

POSTER 0403

Mediastinal venous anomalies: potential pitfalls in cancer diagnosis

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PURPOSE: Mediastinal venous anomalies encountered during CT assessment of cancer patients are often unsuspected and may be misinterpreted, particularly in the presence of intrathoracic disease. We present an analysis of radiological interpretation and typical imaging findings of common venous anomalies in cancer patients. MATERIALS & METHODS: An analysis of 18 CT examinations and reports in 11 patients was performed. These were analysed for the typical features of venous anomalies, the presence of intrathoracic disease, the technique of examination and accuracy of the corresponding reports. RESULTS: Eight had anomalous pulmonary venous drainage, two patients had double superior vena cavae (SVC) and one had an isolated left SVC. A venous anomaly was noted on 15 reports with 11 (61%) having the correct anatomical diagnosis. Errors in diagnosis resulted from lack of iv contrast (seven examinations); concomitant mediastinal lymphadenopathy (seven patients); primary intrathoracic tumour (four patients) and radiation changes in mediastinum. The small calibre of vessels, previous mediastinal surgery and poor mediastinal fatty planes were other confounding factors. CONCLUSION: Coincidental venous anomalies in cancer patients, particularly those with intrathoracic disease, may be misinterpreted and misdiagnosed. An awareness of the anatomical features and optimal scanning technique are required to avoid misinterpretations.

Cardiac

POSTER 0501

Assessment of right ventricular volumes by breath-hold cine MRI in repaired Fallot's tetralogy

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PURPOSE: Objective imaging information in repaired Fallots tetralogy may be useful in patient follow-up and management. Assessment of the right ventricle (RV) is complicated by the anatomy, which cannot be modelled by simple geometry. Neither echocardiography nor RV angiography give a 3D or volumetric assessment. Radioisotope scanning provides volumetric information only. MRI is non-invasive and defines the anatomy accurately in 3D. Breath-hold methods speed up the acquisition and reduce respiratory artefact. MATERIALS & METHODS: RV studies were performed in five adult patients at least 12 years after surgical repair of Fallots tetralogy. A 1.5 T Phillips ACS NT MRI system was used with a 20 cm diameter circular surface coil to obtain breath-hold cine fast gradient echo sequences in expiration. 1 cm axial slices were scanned from the RV apex to the pulmonary bifurcation. Each sequence was acquired in about 20 s. Cine sequences were analysed on a Unix workstation with MASS software (University Hospital Leiden). The RV endocardial border was manually traced frame-by-frame to allow calculation of systolic and diastolic volumes, stroke volume and ejection fraction. RESULTS: RV diastolic volume 237 ± 54.2 ml, RV systolic volume 115.9 ± 31.1 ml, RV stroke volume 121 ± 12.2 ml, RV ejection fraction $51.3 \pm 7.3\%$. Interobserver and intraobserver agreement is acceptable. CONCLUSION: MRI is a straightforward method of assessing RV volumes in repaired Fallot's tetralogy and demonstrates that these are grossly increased. The impact of different surgical techniques on RV function will be discussed.

POSTER 0502

Breath-hold cine MRI measurement of left ventricular ejection fraction using automatic cardiac analysis

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PURPOSE: This study compares the measurement of left ventricular (LV) ejection fraction (LVEF) by breath-hold cine MRI and computer analysis of the data with radionuclide ventriculography (RNV). MATERIALS & METHODS: 38 patients had MRI studies using a 1.5 T MR Signa GEMS scanner, torso-phased array coil and ECG gating. Using fast-card view-sharing breath-hold cine MRI, a series of short axis cardiac images of 8 mm thickness and 13 to 19 phases per cardiac cycle (one plane per breath-hold) were obtained to include the entire LV. All the images (total per patient 105 to 209) were analysed on an Advantage Windows work-station using a cardiac analysis programme (CAP). Automatic LV endocardial border detection for each image was checked visually and, if necessary, corrected manually. Maximum and minimum LV cavity volumes for each plane were selected automatically and Simpson's rule applied to automatically calculate the LVEF. First pass radionuclide ventriculography was performed on the same day. Linear regression and correlation coefficient r for the two methods were calculated. RESULTS: The MRI LV short axis images were obtained in 10 to 12 breath-holds, each of 15 s duration. Total scan time was less than 8 min. Data analysis time was approximately 10 min. The correlation coefficient for the two methods was 0.75. CONCLUSION: MRI measurement of LVEF using fast breath-hold cine imaging and automatic cardiac analysis is a viable alternative method to RNV.

POSTER 0503

Use of vibrational angioplasty in a peripheral atherosclerotic model

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PURPOSE: To use an established rabbit atherosclerotic model to test the safety and efficacy of vibrational angioplasty in peripheral atherosclerotic disease. MATERIALS: A hand device, in combination with a purpose-built support catheter, was tested in a rabbit iliac model with fibrous and organized thrombotic occlusions. The wires used were flexible 0.014 inch wires, the catheter was 3 F expanding to 4.1 F proximally. METHODS: The atherosclerotic lesions were produced in rabbits fed on a high cholesterol peanut oil diet produced for angioplasty testing, a few rabbits produced densely fibrous occlusions. Seven lesions were challenged with conventional techniques and, if this failed, with vibrational angioplasty at 90 Hz. RESULTS: Two lesions were successfully crossed with conventional techniques, with a perforation occurring in the third lesion. The remaining four lesions were successfully crossed using angioplasty with no complications. CONCLUSIONS: In this model we have demonstrated the effectiveness and safety of vibrational angioplasty compared with conventional guidewire crossing techniques. These results may be translatable into human experience.

POSTER 0504

Transcatheter closure of atrial septal defects

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PURPOSE: To report on the recent clinical trials of a new device for the transcatheter closure of secundum atrial septal defects. MATERIALS: The "Angel Wing" device differs from earlier designs in that it effects a "patch closure" of the defect. The device consists of two titanium wire frames joined at their centres by a sewn circular patch. Once deployed, this patch sits within and occludes the defect, the frames spring open on either side of the atrial septum to anchor the device. METHOD: The device, which is preloaded in its delivery system, is deployed via the femoral vein using a standard Seldinger approach. The system is manoeuvred under fluoroscopic and US control until device deployment is completed; Doppler echocardiography and right atrial angiography are then used to demonstrate the presence and degree of any residual blood flow across the defect. RESULTS: To date 13 procedures have been performed, 11 were considered totally successful. The other two cases required emergency surgical intervention to retrieve devices which could not be positioned satisfactorily. CONCLUSION: This new device seems to offer a safe and effective alternative to surgical closure of secundum atrial septal defects in selected patients, provided that immediate surgical back-up is available.

POSTER 0505

Magnetic resonance Fourier velocimetry of blood flow through cardiac valve: comparison with Doppler echocardiography

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PURPOSE: Non-invasive measurement of blood flow velocity through the cardiac valves has important clinical applications. The aim of this study was to investigate the ability of cine MR Fourier velocimetry to measure flow through healthy cardiac valves and to compare MR and Doppler peak velocity measurements. MATERIALS & METHODS: 10 healthy volunteers (age mean $\pm$standard deviation, 24 ± 4 years) without history of valvular disease were studied. In each subject, aortic, pulmonary, mitral and tricuspid valves were evaluated with MR and Doppler. A whole-body mobile MR machine was used, operating at 0.5 T with actively-shielded magnetic field gradient coils capable of 20 mT m^{-1} at a slew rate of 60 mT m^{-1} ms^{-1}. RESULTS: The heart rate during MR and Doppler studies was not significantly different. Peak systolic flow velocity in the aortic and pulmonary valves and peak early and late diastolic flow velocity in the mitral and tricuspid valves, measured with MRI and Doppler echocardiography, correlated well. The mean difference between the two measurements (MR – Doppler) was 63 mm s^{-1}, with a 95% confidence interval of (-180 mm s^{-1}, $+310$ mm s^{-1}). The agreement between two observers interpreting the same MR velocity maps was close. The mean difference between their two measurements was 23 mm s^{-1}, with a 95% confidence interval of (-20 mm s^{-1}, $+60$ mm s^{-1}). There was no significant difference between MR and Doppler, or between the two MR observers. CONCLUSION: MR Fourier velocimetry has the necessary ease, reliability and speed to measure blood flow through the cardiac valves. Measurement of peak blood velocity through the cardiac valves by this method showed satisfactory agreement with Doppler, but its clinical application for assessing diseased cardiac valves needs to be established.

Gastrointestinal Tract

POSTER 0601

Can the patient accurately localize dysphagia? Barium study correlation

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PURPOSE: We assessed the accuracy of patients' ability to localize the site of dysphagia and its implications for radiological practice during the barium swallow examination. Several radiological texts dispute the value of such information. MATERIALS & METHODS: 100 consecutive patients with dysphagia were asked to localize the site of discomfort in relation to the skin surface. The ability of each patient to do so precisely or vaguely was noted. A detailed barium examination of the pharynx, oesophagus and stomach was performed using rapid sequence imaging and videofluoroscopy. RESULTS: Patients who had symptoms originating above the level of the sternal notch were highly accurate at localizing disease. Localization became less precise as symptoms moved caudally towards the epigastrium. No dysphagia from a pharyngeal abnormality was referred below the level sternal angle. Lateralization of symptoms was highly accurate in determining the site of pathology. CONCLUSION: In certain limited circumstances, the examination can be usefully targeted to the region of perceived dysphagia. This increases patient throughput and reduces patient radiation dose, whilst improving the diagnostic accuracy of the barium swallow.

POSTER 0602

Oesophageal carcinoma in the octogenarian: options for management

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PURPOSE: To determine the outcome of management of oesophageal carcinoma patients over the age of 80 years. MATERIALS & METHODS: The records of all octogenarians referred to the Department of Thoracic Surgery 1986–1995 for management of oesophageal carcinoma were examined and the results of various surgical interventions assessed. The relative cost of these interventions was calculated in an endeavour to decide on both the most appropriate procedures in terms of the risks and potential benefits to the patients and the cost-effectiveness. RESULTS: Of the 69 octogenarians referred for management of dysphagia, 26 underwent resection, nine had placement of a pulsion tube, 27 a traction tube, and seven patients had an expandable metal stent inserted. The operative mortality in these procedures was 15.45%, 12.5%, 34.80% and 14.28%, respectively, with mean hospital stays of 17 days, 5 days, 13 days and 7 days. The overall cost of resection is far higher than the other procedures, but mean survival is also longer. The end cost per month of survival is £165 for resection, £808 for pulsion tubes, £633 for traction tubes and £718 for stents. CONCLUSION: Oesophagectomy appears to offer the best value for money in the octogenarian. Tubes and stents seem to have similar costs in this age group, but survival of patients is poor because treatment is aimed at palliation not cure. Placement of traction tubes has a significant operative mortality and probably represents the worst value for money, this procedure is only performed when surgical exploration has shown the tumour to be unresectable.

POSTER 0603

3D reconstruction of oesophageal carcinoma: a pictorial review

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PURPOSE: To demonstrate the potential advantages of 3D reconstruction of the oesophagus in oesophageal carcinoma. PATIENTS & METHODS: Over the past 2 years, we have performed a total of 122 spiral CT examinations in patients with oesophageal carcinoma. A single breath-hold, combined with oesophageal distention (by administering per-oral gas and an iv antispasmodic agent) enables reconstruction of a 3D image of the oesophagus and gastric cardia. RESULTS: In patients with thoracic oesophageal carcinoma, this has five potential advantages. Firstly, it allows 3D localization of the tumour site relative to the trachea and lungs. Secondly,

it gives an approximate guide to tumour length and the relationship to the gastro-oesophageal junction. Overall tumour perception is increased. Thirdly, as the inner wall of the oesophagus is represented, an image resembling a "barium swallow" is obtained. This is potentially beneficial in patients at risk of aspiration. Fourthly, it may give a visual guide to tumour reduction following chemotherapy. Finally, simulated endoluminal visualization of the tumour is possible. CONCLUSION: In this pictorial review we will demonstrate these advantages.

POSTER 0604

Evaluating the response of oesophageal carcinoma treated with chemotherapy by spiral CT

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PURPOSE: Pre-operative chemotherapy for oesophageal carcinoma may improve prognosis. CT is used in the initial assessment and in post-chemotherapy surveillance. We have accordingly modified our CT technique. The aims of this study were: (1) to determine the accuracy of tumour volume assessment on CT and assess tumour response to chemotherapy. (2) To compare TNM staging post-chemotherapy on CT with the final histological staging. PATIENTS & METHODS: 72 patients with oesophageal carcinoma underwent spiral CT of the thorax/upper abdomen. The oesophagus was distended by administering an iv antispasmodic agent and per-oral gas. Tumour staging (TNM) and volume were recorded. 50/72 patients received chemotherapy (followed by additional CT assessment). 38/50 patients proceeded to oesophagectomy within an average of 17.6 days. The excised tumour volume was measured by a water displacement method. The final histological TNM staging was documented. RESULTS: Oesophageal distension was uniformly achieved in the thoracic but not in the cervical oesophagus. CT tumour volume measurements compared favourably with those of the excised specimen ($r=0.934$). Mean tumour volume prior to chemotherapy was 63.3 ml. 41/50 patients responded to chemotherapy (mean volume reduction 26.3 ml). Post-chemotherapy CT TNM staging was equal to final histological staging in 24/38 (63%). 8/38 (23%) were understaged by CT and 6/38 (16%) overstaged by CT. CONCLUSIONS: Oesophageal distension to improve visualization can be achieved safely and effectively. Although deficiencies with TNM staging still exist, spiral CT is useful in deciding the suitability of patients with oesophageal carcinoma for chemotherapy and in monitoring the response to this treatment.

POSTER 0605

Correlation of CT with histopathological findings in patients with gastro-oesophageal carcinomas following neoadjuvant chemotherapy

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PURPOSE: Pre-operative (neoadjuvant) chemotherapy offers the potential of "down-staging" tumours. The aim of this study was to evaluate the role of CT in assessing residual masses and loco-regional disease following neoadjuvant chemotherapy in non-metastatic carcinomas of the stomach. METHODS & MATERIALS: 25 patients have been entered into our on-going neoadjuvant programme. Post-chemotherapy pre-operative CTs were assessed blindly by two observers for residual masses and loco-regional spread to the gastro-hepatic ligament, greater omentum, adjacent organs and lymph nodes. The results of CT were compared with histopathological findings at surgery. RESULTS: To date, 20 patients have undergone surgery. Tumour sites were gastro-oesophageal junction (35%), gastric body (35%) and gastric antrum (30%). Residual masses were demonstrated on CT in 19 patients; in 79% of these, active malignancy was demonstrated histopathologically. Active tumour was also present in the one patient in whom a residual mass could not be identified. The overall sensitivity, specificity, positive and negative predictive values for identifying loco-regional disease on CT were 62%, 43%, 62% and 38%, respectively. There were two false positive CT studies for pancreatic invasion and two false negatives for peritoneal and pleural invasion. CONCLUSION: Following chemotherapy, residual masses are seen on CT in 95% of cases and are likely to contain active tumour. CT is not accurate at identifying residual loco-regional spread and should not preclude surgery in those patients who have received neoadjuvant chemotherapy.

POSTER 0606

Virtual colonoscopy: the feasibility of a pig model for optimization of study parameters

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PURPOSE: Virtual colonoscopy (VC) is an exciting new imaging technique combining helical CT scanning with newly-developed virtual reality computer software. The reconstructed images simulate the endoluminal view obtained at conventional colonoscopy and allow visualization of the colon where passage of the colonoscope is impossible. However, the optimal scanning parameters are currently poorly defined. The aim of this study was to determine the feasibility of a pig model to address this issue. METHODS: An 80 cm segment of pig colon was resected and lavaged thoroughly. After partial eversion, artificial polyps (ranging from 3 to 9 mm diameter) were created by invagination of the mucosa and suture of the base. The bowel was completely surrounded by 6 l of US gel and placed in a Picker PQ 5000 spiral CT scanner. A series of six scans was obtained with various parameter changes according to a predefined protocol. A continuous volume CT dataset was reconstructed and reformatted into the VC presentation (epi-Scope™). The virtual reality images were reviewed to determine the visibility of the endoluminal lesions. RESULTS: There was a wide variation in the effectiveness of the reconstructed scans. The best VC identified clearly 16 of 18 polyps and was able to visualize the 3 mm polyp (parameters: pitch = 1.25; beam collimation = 2 mm; reconstructed effective slice thickness = 2 mm; 250 mA; 110 kV). The worst VC only identified four of 18 polyps, and was unable to identify clearly any polyp smaller than 8 mm in diameter (pitch = 2; beam collimation = 5 mm; reconstructed effective slice thickness = 5 mm; 250 mA; 110 kV). CONCLUSION: Under ideal conditions, polyps as small as 3 mm can be detected by VC. This study demonstrates the feasibility of using a pig model to assess the effectiveness of VC and suggests the need for further studies to determine optimal scanning parameters.

POSTER 0607

Dual-phase helical CT during arterial portography in patients with portal venous obstructive hepatic tumours

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PURPOSE: To evaluate dual-phase helical CT during arterial portography (DP-CTAP) in the detection of portal venous obstructive hepatic tumours. METHODS & MATERIALS: Pre-operative DP-CTAP (120 kV, 210 mA, collimation 5 mm, table speed 10 mm s^{-1}) was performed in 55 patients (36 female, 28 male) with carcinomas of the pancreas ($n=22$) or bile ducts ($n=15$), hepatocellular carcinoma ($n=5$) and other tumours ($n=13$). 75 ml of contrast material (300 mg%, 1.5 ml s^{-1}) were injected in the superior mesenteric ($n=34$) or the splenic artery ($n=21$). Phase one of CTAP (CTAP-1) started after 30 s, phase two (CTAP-2) was done 35–51 (mean 42) s after completion of CTAP-1. CT findings were correlated with the operative results. RESULTS: Sensitivity of CTAP-1 (76%) was significantly greater than that of CTAP-2 (64%) ($p<0.001$). 61/32 perfusion anomalies and 15/8 pseudolesions were noted during CTAP-1/CTAP-2. CONCLUSION: DP-CTAP showed relatively low detection rates of hepatic lesions in patients with portal venous obstructive tumours. However, it is helpful in differentiating perfusion anomalies from liver tumours.

POSTER 0608

Is the normal common bile duct better visualized before or after a fatty meal, in normal subjects, with magnetic resonance cholangiography, using a 3D fast spin echo sequence?

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PURPOSE: To establish whether the undilated common hepatic and common bile ducts (CD) can reliably be directly visualized using a 3D spin echo sequence and whether imaging is improved after a fatty meal. MATERIALS & METHODS: 16 asymptomatic volunteers (male to female ratio is nine to 7, mean age 33.3, range 25–52) were imaged after a 6 h fast and 30 min after 40 g of fat. Imaging was performed using a general body coil on a 1.5 T Philips Gyroscan ACS II scanner using a multislab respiratory-triggered 3D FSE T_2 weighted sequence (TE/TR 180/4000) in an angled coronal plane. Images were reconstructed using a maximum intensity projection (MIP) algorithm on a Philips Easyvision workstation and the

maximum duct diameter was measured and the percentage of the length of the common hepatic and bile ducts visualized was estimated. RESULTS: Mean duct diameter was 5.5 ± 0.9 mm fasted, 5.2 ± 1.1 mm after a fatty meal. The complete common duct was only seen in two of the fasted examination and eight post-fatty-meal on MIP images. 50% or more of the duct was visualized in 11/16 fasted and 12/16 post-fatty-meal. Overall, the CD was better seen in 10 subjects after a fatty meal and equally well in one. Reasons for non-visualization of duct segments were: obscuring fluid-filled duodenum, empty duct and distended cystic duct. CONCLUSION: Good visualization was obtained which may be improved after a fatty meal. A hypointense duodenal contrast agent would be useful. The method may have utility in screening before laparoscopic cholecystectomy.

POSTER 0609

Eosinophilic liver abscess: imaging findings and clinical significance

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PURPOSE: Eosinophilia is found in a variety of disorders and eosinophils are known to infiltrate any organ, causing tissue damage. We describe the imaging findings of eosinophilic liver abscess (ELA) in patients with eosinophilia, and correlate the findings with clinical findings. MATERIALS & METHODS: Sonographic (US) and CT findings of eight patients (five men and three women aged 35–58 years; mean age, 46 years) with biopsy proven ELAs were retrospectively analysed, and correlated with clinical records. Various degrees of eosinophilia are found in all patients. Their underlying diseases were: stomach cancer in two patients, lymphoma in one patient, carcinoid in one patient, anisakiasis in two patients, suspected clonorchiasis in one patient, and hypereosinophilic syndrome in one patient. Three-phase helical CT scans were obtained in six patients. RESULTS: On helical CT, all ELAs were depicted as ill-defined, round or oval, non-enhancing hypoattenuating lesions with a diameter of less than 2 cm in all three phases, most prominent in portal venous phase. Most ELAs were adjacent to the portal venous branches. Numbers of ELAs were one to five in seven patients, but one with hypereosinophilic syndrome had innumerable ELAs. The number of ELAs and degrees of eosinophilia were fairly well correlated. All ELAs were seen at US as ill-defined hypoechoic focal lesions adjacent to the portal vein. CONCLUSIONS: ELA should be considered in patients with focal hepatic lesion showing imaging findings described as above and eosinophilia; they should be differentiated from metastatic foci in patients with malignancies.

POSTER 0610

Gall stone ileus: diagnostic strategies and pitfalls

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PURPOSE: Gall stone ileus is a disease of the elderly and therefore of increasing clinical significance with current demographic changes. A pre-operative diagnosis is usually made in only 30–40% of cases. We have reviewed our recent experience. METHODS: We reviewed notes and imaging of all patients treated at our hospital for gall stone ileus between 1991 and 1996. RESULTS: 10 of the 11 patients were above the age of 70. Three positive plain film diagnoses were correctly made. A contrast study provided the diagnosis of obstruction, indicating surgery, in four cases, with one gall stone identified. One patient was operated on for unresolving cholecystitis, seen ultrasonically. In three cases radiological findings were incorrectly assessed, with two false positive and one false negative findings. Four patients, including all three plain film radiological diagnoses, were operated on within 48 h of admission. Median time to surgery for the other seven patients was 6 days (range 3–11). 10 patients underwent an enterolithotomy. One of these patients also had Bouveret's syndrome, requiring an additional gastrotomy. The eleventh patient, also with Bouveret's syndrome was treated by gastroenterostomy. There was one perioperative death. Cholecystoduodenal fistula was demonstrated surgically in eight cases and inferred in one. There was one previous cholecystectomy with choledochoduodenostomy. CONCLUSIONS: Gall stone ileus can be a difficult diagnosis to make radiologically, with a classical plain film diagnosis being made in only three of 11 cases. Other cases suffer considerable delay prior to surgery. We discuss radiological pitfalls and diagnostic approaches.

POSTER 0611

The changing face of emphysematous cholecystitis

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PURPOSE: To assess whether the increased use of US and CT has influenced treatment of emphysematous cholecystitis. MATERIAL & METHOD: A computer search of all radiology reports in our hospital over a 5 year period identified eight cases of emphysematous cholecystitis. The radiology and clinical notes were reviewed. RESULTS: In only one case was the diagnosis made on plain abdominal radiography. US scans were performed in all cases and in five a diagnosis of emphysematous cholecystitis was made, but three were negative due to non-visualization of the gall bladder. The diagnosis in the three negative cases was made by CT. At presentation only one of the eight patients appeared to be clinically unwell. All patients were treated with antibiotics, but three had persisting symptoms and signs and underwent routine cholecystectomy within 3–5 days. The remaining five patients were treated conservatively. CONCLUSION: US and CT are more sensitive than the abdominal X-ray for the diagnosis of emphysematous cholecystitis. The diagnosis is now being made in less severe cases, which do not have the characteristic abdominal X-ray features, and for these patients conservative management is often appropriate.

POSTER 0612

Dynamic contrast-enhanced MRI of perianal fistulae

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We have developed a new, non-invasive MRI technique, for assessment of perianal inflammatory disease. We describe the technique and illustrate the range of normal and abnormal appearances of the perianal region, based on our experience of 80 consecutive cases with surgical proof and clinical follow-up. We demonstrate the MRI appearances of perianal fistulae, with reference to Park's classification and the spectrum of perianal abscess disease. We will also illustrate the potential to identify associated pelvic enteric disease. We contrast the findings of fistulous and non-fistulous perianal inflammatory conditions and describe pitfalls in the interpretation of MRI images of the perianal region.

POSTER 0613

MRI perianal fistulae using endo-anal and body coils: a pictorial review

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PURPOSE: Fistula *in ano* may cause considerable distress to the patient and difficulty for the surgeon. The balance between eradication of infection and maintainance of continence depends upon accurate pre-operative assessment of fistula geography, best achieved by MRI, which demonstrates collections and tracks which would otherwise be missed. This pictorial review will portray MRI diagnosis of all main fistula types; inter-, trans-, supra-, and extra-sphincteric. METHODS: Patients were studied on a 1.0 T system (Philips Gyroscan), using the body coil and a prototype endoanal surface coil. After coil insertion, the subject is turned supine and an axial 3D gradient echo T_2 weighted sequence performed to encompass the entire anal canal (TR/TE 30/13, 256×256 matrix, FOV 100 mm, 4 mm slice thickness and 2 mm interslice gap, 2 NEX), followed by axial and coronal STIR sequences using the body coil (TR/TE 1500/15, 256×256 matrix, FOV 375 mm, 6 mm slice thickness, 2 mm interslice gap, 4 NEX). The entire study takes less than 30 min room time. Examinations are reported on a dedicated workstation (Philips Easyvision), allowing reconstruction of the anal canal in any orientation to facilitate identification of internal fistula openings. RESULTS: Identification of internal openings is facilitated by endoanal coil imaging, which images the intersphincteric space in exquisite detail. In contrast, body coil imaging allows identification of distant tracks and collections, including supralevator inflammation, which most often underly post-operative recurrence. CONCLUSION: MRI is generally accepted as the "gold standard" for diagnosis of fistula *in ano*. Combined endoanal and body coil examination further facilitates pre-operative determination of fistula anatomy.

POSTER 0614

Dynamic MRI of pelvic floor prolapse: a pictorial review

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PURPOSE: Pelvic floor weakness can cause stress incontinence, uterovaginal prolapse and defaecatory symptoms. Traditionally, sites of weakness are identified by a combination of clinical

examination and evacuation proctography, modified by contrast opacification of the bladder, vagina and small bowel. This examination is invasive, embarrassing, uncomfortable, time-consuming and involves irradiation. In an attempt to overcome these criticisms, we have developed fast dynamic pelvic MRI, now a standard examination at our institution. This review will illustrate diagnosis of pelvic floor weakness by this technique. METHODS: Examination requires no special preparation, and is rapid, taking approximately 10 min room time. Studies are performed on a 1.0 T whole body system (Philips Gyroscan), using the body coil. T_1 weighted fast field echo sequences are used (TR/TE 79/2.5) in axial, coronal and saggital orientation (256 × 256 matrix, FOV 340 mm, 8 mm slice thickness with 2 mm interslice gap, 4 NEX), at rest and while the patient bears down "as if opening their bowels." Equivalent images at rest and during straining are reported on a dedicated workstation (Philips Easyvision). RESULTS: The dynamic study enables identification of specific sites of pelvic floor weakness; cystocoele, enterocoele, rectocoele and rectal prolapse. Unlike contrast studies, the pelvic floor musculature is directly visualized, so that muscular defects can be identified and perineal herniation diagnosed. Excessive pelvic floor descent at rest and during straining is also imaged. CONCLUSIONS: Dynamic pelvic MRI is a new procedure which is rapid and easy to perform and which challenges evacuation proctography for diagnosis of pelvic floor weakness.

POSTER 0615
Defecography in evaluation of enterocele

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PURPOSE: Enterocele is a peritoneal sac containing intestine. In women it lies between the posterior vaginal wall and anterior rectal wall and may be difficult to clearly define on clinical examination. The purpose of this study was to define the role of defecography in the diagnosis of the pelvic floor abnormalities commonly found in association with enterocele. MATERIALS & METHODS: 49 patients (age 30–83 years) undergoing defecography for various anorectal symptoms or rectal evacuation difficulties, were found to have an enterocele. 31 with Grade 3 or 4 (Group A) enterocele and 18 with Grade 1 or 2 enterocele (Group B). 31 control patients without an enterocele undergoing defecography for various anorectal symptoms were matched for age with group A. The defecography parameters measured in all 80 patients were: anorectal angle resting and during straining, perineal descent, presence and size of the rectocele, presence and grade of enterocele, internal intussception or external rectal prolapse. RESULTS: There was no difference regarding age or symptomatology between the enterocele and control group. 10 (32%) of the 31 patients in group A and 12 (66%) of the 18 patients in group B had undergone a hysterectomy, whereas only one (0.03%) out of 31 patients in the control group had had a hysterectomy. Almost half the patients in group A and B had had pelvic trauma during childhood. Intussception and rectal prolapse was found in 91% in group A and 78% in group B, but in only 42% in the control group. Pelvic floor descent was increased significantly in 74% of the enterocele group A compared with 26% in the control group. Rectocele was found more commonly in group B (39%). The anorectal angle values did differ significantly between the groups. CONCLUSION: Defecography plays a vital role in the objective demonstration of enterocele and associated pelvic floor abnormalities. Rectal intussception and prolapse, and an increased pelvic floor descent, are often associated with an enterocele.

POSTER 0616
Defecography in pre- and post-operative evaluation of patients with rectocele

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PURPOSE: The purpose of this study was to define the diagnostic value of defecography in patients undergoing surgery for rectocele. MATERIALS & METHODS: 75 patients (mean age 54 years) have undergone a combined recto–vaginal septum repair. For functional evaluation the patients underwent a manometry of the anal canal, electromyography and defecography. Various defecography parameters were measured pre- and post-operatively. RESULTS: The double-sided combined rectovaginal septum repair was successful in 53 patients (71%). Preoperatively defecography was valuable in: objective demonstration of rectocele and diagnosis of associated enterocele. The surgical outcome was not influenced by: size of the rectocele, anorectal angle values, or internal intussception. Post-operative defecography showed absence of rectocele in patients with successful surgical results. CONCLUSION: Defecography is valuable for the objective evaluation of rectocele pre-operatively and to diagnose an associated enterocele. The size of rectocele or ability to empty it does not appear to influence the clinical success. The anorectal angle values did not influence the surgical results.

POSTER 0617
Bowel preparation for upper abdominal US

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PURPOSE: It is common practice to administer water during an upper abdominal US in order to improve visualization of the pancreas. We have assessed the use of water when given as a routine immediately prior to upper abdominal US. Our results show a significant improvement in pancreatic visualization with no increase in examination time and no significant reduction in the diagnostic quality of the rest of the scan. MATERIALS & METHODS: Outpatient and GP referrals attending for abdominal US were studied. Group A consisted of 50 patients who had been fasted for 6 h. Group B consisted of 50 age, sex and weight matched patients who were fasted and were also given 300 ml of water to drink immediately prior to examination. The scans were performed by one of four operators. Standardized images of the abdomen were obtained. A measurement of gall bladder volume was made. For each patient, the overall examination time was recorded. All the images were reviewed by two consultant radiologists who were blinded to the preparation method. Images were scored for clarity using a standard technique. RESULTS: Group B showed improved pancreatic visualization with no deterioration in quality of the rest of the scan. The bowel preparation technique in Group B was well-tolerated. CONCLUSION: This study suggests that the use of water routinely prior to upper abdominal US significantly improves pancreatic visualization without any demonstrable drawbacks. A brief review of the literature on bowel preparation for abdominal US is presented.

POSTER 0618
Comparison of the quality of barium enema examinations between radiographers and radiologists

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INTRODUCTION: With the ever increasing demands on radiologists' time, radiographers are undertaking tasks which previously were the preserve of the radiologist. To maintain high radiological standards it is important that the quality of the examinations performed by radiographers are comparable with those of radiologists. These standards include diagnostic quality of the images, examination time, screening time and patient dose. We compare the quality of barium examinations performed by radiographers with those carried out by different grades of radiologist in a district general hospital. METHOD: 176 barium examinations performed at the Royal Wolverhampton hospital were retrospectively reviewed. For each examination the screening time, patient dose received and the total time the patient spent in the department were recorded. All films were reviewed by a consultant radiologist for diagnostic quality. RESULTS: All 176 examinations were performed on outpatients using the same screening room with an undercouch tube. 62 examinations were performed by two radiographers, 17 by radiology registrars, 46 by a senior registrar and 49 by a consultant. Only four examinations were felt to be inadequate, three from registrars and one from a senior registrar. The average screening time for the radiographers was 110 s compared with 144 s for registrars and 113 s for the consultant. The patient dose was 1968, 2097 and 2409 cGy cm^2, respectively. CONCLUSION: Overall the quality of the examination performed by radiographers is comparable with those done by radiologists. Radiographers have lower screening times and patient doses compared with junior radiologists. Radiographers performing barium enema examinations maintain standards and are an efficient use of resources.

POSTER 0619
Imaging of Burkitt's and Burkitt-like lymphoma

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PURPOSE: This is the first British series to evaluate the radiological appearances at presentation and follow-up of Burkitt's type lymphomas in the adult population, in order to assess patterns of involvement which may be characteristic of this disease.

MATERIALS & METHODS: The radiological findings in 24 adult patients with Burkitt's lymphoma presenting to the Wessex Oncology Unit over the past 10 years were retrospectively reviewed. This included plain radiographs, contrast studies, US and CT scans at presentation and follow-up. RESULTS: The mean age of presentation was 36 years, range 18–60. The majority of patients presented with abdominal involvement only [12 (50%)] of whom 10 had extranodal masses involving bowel and mesentary, in five confined to the ileocaecal region. Six patients presented as surgical emergencies. Six (25%) had disseminated disease at diagnosis, of whom three were HIV positive. All these patients had widespread lymphadenopathy, three had hepatomegaly and other intraabdominal involvement associated with head and neck masses, one patient presented with bilateral pleural effusions with ascites. Three of the patients within this group had bone marrow disease. Four (17%) presented with head and neck pathology and two (8.3%) presented with isolated axillary lymph node masses. All but two patients had predominantly extranodal disease and only one patient had any involvement of the thorax. CONCLUSION: Burkitt's lymphoma is a predominantly extranodal disease at presentation and the most common site of involvement is the abdomen, with a particular predilection for the ileocaecal region. This differs from classical African Burkitt's which also tends to occur extranodally, but in the jaw and neck region. The HIV positive patients in our group had disseminated disease at presentation.

POSTER 0620

Spiral CT scanning in detection of desmoid tumours in familial adenomatous polyposis

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PURPOSE: Desmoids are reported to occur in 4–18% of familial adenomatous polyposis (FAP) patients; the true incidence is probably higher, as small desmoids may go undetected. Routine CT screening for desmoids is recommended in some centres. The aims of this study were to establish the true incidence of intraabdominal desmoids in FAP and to document the behaviour of desmoids detected when asymptomatic. MATERIALS & METHODS: Outpatients with FAP, with no clinical evidence of desmoid, were recruited from the *Polyposis Registry* and underwent abdominopelvic spiral CT scan. RESULTS: 72 patients, 98% of whom were post-colectomy, were scanned. 16 (22%) had abnormal mesenteric appearances at CT suggesting an intraabdominal desmoid. There was no significant difference in gender, family history, age at prophylactic surgery or type of surgery between those with desmoid and those without. The time since laparotomy was less ($p=0.0014$) in those with desmoids (mean 5 years) than in those with no evidence of desmoid (mean 13 years). Patients found to have a desmoid mass, rather than diffuse mesenteric thickening, were within 3 years of surgery and became symptomatic within 6 weeks of CT. CONCLUSION: Desmoids are present in approximately one-third of FAP patients (clinically apparent in about 10% and subclinical in 22%). The finding that patients with desmoids had abdominal surgery more recently than those with a normal CT is consistent with the known association of desmoids with recent surgery. The rapid development of symptoms in those with a desmoid mass suggests that CT adds little to clinical follow-up.

POSTER 0621

The value of routine lung window imaging in abdominal CT

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PURPOSE: Imaging of lung bases on lung windows is routine practice in abdominal CT. The purpose of this study was to investigate the contribution of this practice to patient management. MATERIALS & METHODS: 350 consecutive abdominal CT scans performed over a 15 month period were reviewed retrospectively. Specialist oncology patients were excluded. The scans were from 183 male and 167 female patients, mean age 59 (age range 10–100). The abdominal scans, including lung bases, were imaged on soft tissue windows (WW340, WL 40). The lung bases were also imaged on lung windows (WW1600, WL 600). These scans were retrospectively reviewed. Positive findings in the lung bases were assessed in relation to previous patient imaging and patient management. RESULTS: The mean number of images performed on lung window settings was seven (range 3–23). 63 of the 350 patients (18%) had positive findings in the lung bases. Only six of the 63 (9.5%) had abnormalities in the lung bases seen more clearly on lung windows settings (atelectasis (three), consolidation (two) and bulla (one)). Subsequent clinical and radiological review of these cases identified no contribution of these findings to management. CONCLUSION: Review of 350 non-oncological abdominal CT scans identified no contribution to patient management of routine imaging of lung bases on lung window setting. The time involved in extra processing, extra reporting time and the increase in cost do not appear to be justified.

POSTER 0622

Visceral fat measurement using CT: which slice, and how reliable?

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There has been an increasing interest in the medical world in the relationship of visceral fat to the following interrelated common diseases: atherosclerosis; systemic hypertension and diabetes. It is now well known that visceral fat is the most important component of body fat that is related to these diseases and dyslipidaemic states. Measurement of visceral fat has been performed using a limited or a single CT slice. However, the selection of the slice position: transumbilical, lower costal margin, intermediate between the two, iliac crests, or L4–L5 have been arbitary. We have been interested in establishing a better understanding of the degree of agreement that single slices or combinations of slices have with the total amount of visceral fat. Currently, we have studied 20 subjects and found that the best correlation of a single slice is the lower costal margin ($r^2=0.9338$). The addition of a second slice, through the iliac crests, raises this to $r^2=0.9824$.

POSTER 0623

When rectocoele has a clinical importance—defaecography evaluation

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PURPOSE: Changes in rectal morphologies are often the cause of rectal obstipation (RO). Rectocoela is most often found during defaecography in patients with RO, as well as in asymptomatic patients. The aim of this study was to evaluate the clinical importance of rectocoela in patients with RO and a feeling of incomplete evacuation during defaecography. MATERIAL & METHODS: In 112 asymptomatic people (84 women and 28 men) with an average age of 52 years, defaecography was performed. In 32 rectocoela was found. Depth of rectocoela and percentage of rectal evacuation (RE) was measured. Among 141 patients with RO we found rectocoela in 36. All of them had a feeling of incomplete evacuation, pain and/or a feeling of pressure on the pelvic floor during evacuation. In 12 patients defaecography was repeated 4 weeks after surgery (rectocoele repair). The results were compared by McNamar test. RESULTS: In 32 asymptomatic patients with rectocoela, the average RE was 79%. An average depth of rectocoela was 2.5 cm. In 36 patients with RO and rectocoela the depth of rectocoele was 5.1 cm ($t=12.83$, $p=0.003$ and $t=6.8$, $p=0.004$). After rectocoela repair in seven patients there was no rectocoela on defaecography; in five the average depth of rectocoela was 1.7 cm. Average RE was 75%. All of them were asymptomatic. CONCLUSION: Depth of rectocoela is the main predictive factor of clinical importance.

Genitourinary Tract

POSTER 0701

MRI of the scrotum when sonography and clinical findings are suspicious

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PURPOSE: To examine the value of MRI in distinguishing inconclusive findings of the testicles, epididymis and the surrounding fascia. MATERIAL & METHOD: 120 patients, aged 9–79 years, with sonographically and clinically suspicious findings underwent MRI (Magnetom 1.5 T, SE T_2: 2500/80 saggital or coronal, pre and post 0.1 mmol Gd-DTPA: SE T_1: 750/15 coronal and T_1 FLASH 2D 450/10/80 transversal, SD 3 mm, matrix 256 × 256). The scrotum was taped to the perineum, the penis to the abdomen. To minimize any motion artifacts, the abdominal wall was immobilized with a strap. Using a holding device, a high-resolution "eye–ear" spindle was positioned above the scrotum, but without touching it. The results were compared with sonographic studies and with any histological findings. RESULTS: (1) A testicular tumour was

found in 24/120 patients (17 non-seminomatous germ-cell tumours, five seminomatous germ-cell tumours, one Leydig's cell tumour, one B-cell lymphoma, one epidermoid cyst). There were no false negatives, and the two false positive findings involved parenchymal bleeding. In 36/120 patients, the inflammatory signs in the epididymis involved nine cases of orchitis, eight granuloma, four with circumscribed abscess formation accompanied by pyodermia and nine with hemorrhagic imbibition. The loss of perfusion in one testicle was evaluated as a sign of torsion in 12 patients. Three patients showed hyperemia that was interpreted as retorsion. Eight of 120 post-traumatic testicular lesions exhibited 5/8 parenchymal intravasation, 3/8 a rupture of the tunica albugina; 33/120 had normal findings, eight of the 33 normal showed post-operative scarring, 5/33 had a spermatocele and 2/33 small cysts. This method showed sensitivity of 100% and a specificity of 97% regarding the diagnosis of testicular cancer. With regard to inflammatory processes, the sensitivity was 91% and specificity 86%. CONCLUSION: When the sonographic findings are suspicious, MRI is especially suited for distinguishing between cancerous, trauma-related and inflammatory pathologies. Sonographically abnormal findings usually do not require further clarification.

POSTER 0702

US-guided percutaneous biopsy of the kidneys: our experience with 1000 patients

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During the period October 1987–March 1996, 1000 percutaneous renal biopsies were performed at the Institute of Urology and Nephrology of the CCS in Belgrade. All biopsies were ultrasonographically guided. Biopsies were performed on 840 native kidneys and 160 transplanted kidneys. In 35 cases the biopsy failed to provide a sufficient number of glomeruli for pathohistological diagnosis (3.5%). In successful biopsies, the average number of glomeruli for pathohistological analyses was nine. The most frequent complication following the biopsy was subcapsular haematoma in 106 cases (10.6%), followed by the development of haematuria in 80 patients (8%). Dilatation of the pyelocaliceal system was evidenced in 0.4%, and was the result of massive haematuria and coagulum formation. Infections developed in 4% of the patients as a consequence of poor sterilization of instruments. No other complications were evidenced. The number of complications recorded in our series following the percutaneous biopsy of the kidneys was significantly lower than the data presented in the referential literature. This result may be due to the use of US-guided needle biopsy, which enables precise localization and selection of the renal segment to be used for biopsy.

POSTER 0703

Metal stents in treatment of post-operative uretero-intestinal anastomoses

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PURPOSE: This study looks at the use of metal stents in the recanalization of post-operative uretero-intestinal anastomoses. The procedure has been used for 2 years. MATERIALS & METHODS: 11 patients (42–68 years) were treated. Strictures had developed ipsilaterally 3–9 years after surgery. Bilateral stricture was evident in one patient. Unsatisfactory therapeutic effect of balloon-catheter dilatation was determined by excretory urography and echotomographs after 6 weeks treatment. Metal stents, 4–6 cm long and 6–10 mm in diameter were inserted. Metal prostheses to the bilateral stricture were placed in the same procedure and in succession due to the vicinity of the site of anastomosis. The drainage catheter was left in place for a week. There were no complications. RESULTS: In 10 patients treated in this manner anastomosis-patency was established. Therapeutic efficacy was checked by renal functional excretory urography and echotomographic examination. Urea and creatinine levels, measured at 1, 3 and 6 months after the procedure and normal morphology and renal function indicate the high efficacy of this treatment regime. CONCLUSION: Placing a metal stent has proved to be the optimal therapeutic solution.

POSTER 0704

Recanalization of post-operative ureteral strictures with metal stents: 3 years of experience

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The method was applied to 16 patients. We used the percutaneous approach and Strecker stents 5 mm wide and 4–7 cm long. Prior to the use of the metal stent we performed balloon-catheter recanalization (4 and 5 cm wide). The PCN catheter was left for 7 days for control. Recanalization was achieved in 12 cases with this method. There were no complications. We were not able to place the nephrostomic guide wire distally from the stricture. The placement of metal endoprosthesis is an effective and simple method of recanalization of post-operative strictures, especially in patients with contraindications for further surgical treatment. The method has its place in the diverse interventional-uroradiological algorithm of this frequent indication.

Musculoskeletal

POSTER 0801

Are supine trauma oblique views superior to swimmers views to image the cervico-thoracic junction?

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PURPOSE: To establish the most reliable view to demonstrate the cervico–thoracic junction where the standard three series views have failed. MATERIALS: 427 consecutive patients attending an accident and emergency department requiring cervical spine radiology for acute trauma were studied. METHODS: A two-phase prospective study was performed, consisting of two successive 20 week periods. In the first phase when the standard three series views failed to demonstrate the cervico–thoracic junction, swimmers views were performed. In phase two, trauma obliques were performed when the standard three series was inadequate. RESULTS: 60 of 230 (26%) patients in phase one required additional views (swimmers) compared with 62 of 197 patients (32%) in phase two (trauma obliques) (no significant difference). The anterior and posterior elements of the cervico–thoracic junction were satisfactorily imaged in 37% (22/60 patients) of swimmers views and 36% (22/62 patients) of trauma obliques (no significant difference). However, trauma obliques were significantly better at visualizing the posterior elements (72% *vs* 37%, $p<0.001$, χ^2 test). There was an overall dose reduction (1.6 mGy *vs* 7.2 mGy) with trauma obliques. CONCLUSION: Where the standard three series fails to demonstrate the cervico–thoracic junction, the swimmers view remains optimal for assessing vertebral body alignment. However, in the unconscious patient in whom fracture dislocation must be rapidly excluded, trauma obliques are safer and more likely to demonstrate the posterior elements. They therefore constitute an invaluable additional view in trauma radiology.

POSTER 0802

Interobserver variability in the assessment of degenerative changes on lumbar spine MRI

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PURPOSE: To assess the variability in reporting degenerative changes on lumbar spine MRI. METHOD: Three radiologists independently reported the routine three sequence lumbar spine MRI examinations of 79 patients investigated for low back pain. Precise definitions and example images were provided for each abnormality in an attempt to standardize nomenclature. The intervertebral disc was graded for degeneration and height reduction. Herniation of the disc was reported in terms of bulge, protrusion and extrusion and graded for size. Marrow end plate changes, facet joint degeneration, central canal and foraminal stenosis were all graded. Interobserver variability was assessed by the κ coefficient for disc herniation and marrow end plate changes and weighted κ for the remaining abnormalities. RESULTS: Good agreement was obtained for grading disc degeneration (0.87), disc height reduction (0.76), facet joint degeneration (0.75) and central canal stenosis (0.75). Moderate agreement was reached for disc herniation (0.6), size of disc protrusions (0.57) and foraminal stenosis (0.47). Reviewing the disagreements on disc herniations, it was evident that all three radiologists were reporting the same abnormalities but using different terms. The difference between a broad-based protrusion and an asymmetrical disc bulge caused particular confusion. CONCLUSION: Good agreement exists in reporting a range of abnormalities in relation to degenerative disease, although there is disagreement in distinguishing between a broad-based protrusion and a disc bulge. The diagnosis of a protrusion is more likely to lead to surgical management; clinicians and radiologists should be clear about the terms and definitions used.

POSTER 0803

The accuracy of detection of pars interarticularis defects on sagittal T_1 weighted lumbar spine MRI

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PURPOSE: To assess the ability of MRI to detect pars interarticularis defects on sagittal T_1 weighted sections of the lumbar spine. MATERIALS & METHODS: 50 patients who had MRI and lumbar spine radiographs as investigations for low back pain were included: 24 consecutive patients with reported pars defects and a control group of 26. The L4/5 and L5/S1 levels of sagittal T_1 weighted lumbar spine MRI were reviewed independently by two experienced musculoskeletal radiologists and one general radiology trainee, blinded to the clinical details. The pars were classified on MRI as being normal (if definite marrow continuity was demonstrated), abnormal, or equivocal. The findings were compared with the plain films which were reviewed separately. RESULTS: 50 patients (400 pars) had 52 pars defects detected on MRI. The accuracy was 94% (specificity 97%, sensitivity 87%, positive predictive value 90% and negative predictive value 95%). CONCLUSION: There is an increasing trend away from using plain films to assess low back pain. For the diagnosis of pars defects lumbar spine MRI provides an accurate substitute.

POSTER 0804

MRI of paraspinal abscesses: a pictorial comparison with CT

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PURPOSE: MRI, with its high contrast resolution, is a sensitive technique for the detection of fluid collections, in particular those involving the psoas muscle. We have reviewed the MRI of a series of retroperitoneal abscesses and compared it with the findings on CT. MATERIALS & METHODS: A total of 13 retroperitoneal abscesses were imaged with MRI over a 2 year period. T_1W and T_2W sequences were obtained in the axial, sagittal and coronal planes. CT scanning was undertaken in 10 patients. Six patients had post-therapy follow-up MRI. Aetiological factors were noted, along with microbiology results, imaging features, management and outcome. Particular attention was paid to the extent of disease seen on the two imaging modalities. RESULTS: The mean age of presentation was 50.2 years (range 18–77 years, M = 6, F = 7). There were 10 psoas abscesses, one in the iliacus and two in quadratus lumborum. Sources of infection for the secondary abscesses were lumbar spine and renal tract. MRI clearly demonstrated all collections as discrete areas of increased signal on T_2W images and reduced signal on T_1W images. Surrounding inflammatory changes were seen to be more extensive than on CT. All sources of infection with a secondary paraspinal collection were identified with MRI. CONCLUSION: High resolution without the need for iv contrast and a multiplanar capacity enable MRI to accurately delineate the size of a collection and extent of soft tissue inflammation. MRI also provides valuable confirmatory information on the aetiology, with the commonest source of infection being the lumbar spine. This enables decisions as to the appropriate type of management to be made confidently. MRI is particulary useful in the post-therapy follow-up to assess change in abscess volume and surrounding inflammation.

POSTER 0805

MRI of the painful wrist: a pictorial essay

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The standard position described in most texts for MRI of the wrist involves the patient lying supine with the arm extended above the head. Many patients find this uncomfortable, leading to problems with patient movement. In addition, it is not always easy to ensure neutral alignment, which is essential in the assessment of possible carpel instability. These problems are overcome by the use of a dedicated small parts permanent magnet, but such systems are not widely available and have the disadvantage of long acquisition times with consequent degradation of the image because of patient movement. We have overcome these difficulties by positioning the patient supine with the arm alongside the body and the wrist in a true neutral position. The key to achieving this comfortable position is the ability to offset the magnetic field, which is possible with our system (IGE Signa, 1.5 T). Dual-phased array coils are used, employing T_2* GRE volume sequences for the intrinsic ligaments and triangular fibrocartilage, SE T_1 and FSE T_2 fat-saturated sequences for other indications. We illustrate our experience of 75 scans for a variety of conditions performed over a 2 year period.

POSTER 0806

Calcific tendinitis of the gluteus maximus tendon with erosion of cortical bone

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Calcific tendinitis of the gluteus maximus tendon is unusual and only eight cases associated with erosions of cortical bone have been reported. We present three further cases which demonstrate variation in appearances of the amorphous calcification in the tendon and cortical erosions on plain radiographs. Isotope bone scans show focal increased activity and CT clearly demonstrates erosion of cortical bone and calcification within the tendon insertion of gluteus maximus. Follow-up examinations in two cases demonstrated resolution of the changes. We believe this series demonstrates the radiological features and natural history of a common condition occurring at an unusual site. Its recognition is important in order to avoid unnecessary surgical intervention. Resolution of the calcification and cortical erosions has not been previously described.

POSTER 0807

MRI of myositis ossificans

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PURPOSE: Myositis ossificans (MO), in the absence of a history of preceeding trauma, may present with clinical and radiographical features of a soft tissue sarcoma. A retrospective review of eight cases of MO was performed to assess whether MRI revealed any characteristic features. METHODS: The MRI scans of eight cases referred to an orthopaedic oncology service with a presumptive diagnosis of a soft tissue sarcoma, but subsequently proven to have MO, were reviewed. T_1 weighted, T_2 weighted FSE and STIR sequences were obtained. In five cases Gd-DTPA was administered. RESULTS: All cases showed a non-specific ill-defined soft tissue mass on T_1 weighted images isointense with muscle. On T_2 weighted images a focal high signal-intensity mass was revealed with a thin low signal-intensity rim corresponding to the radiographic peripheral mineralization. All cases showed surrounding soft tissue oedema confined to the muscle compartment. The conspicuity of these features was greatly increased on the STIR images. Gadolinium showed florid enhancement in all cases. CONCLUSIONS: The STIR images were considered characteristic if not pathognomic of MO. With time the mass effect of MO and oedema reduced, contrary to the expected behaviour of a soft tissue sarcoma. The use of gadolinium was not found to be of any diagnostic benefit.

POSTER 0808

Diagnostic problems with atypical bone islands

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PURPOSE: The diagnosis of bone islands is usually straightforward due to the characteristic radiographic appearances and normal activity on isotope bone scanning. Problems may arise when atypical imaging features are demonstrated. This study presents six such cases referred to an orthopaedic oncology centre. METHODS: Six cases, with increased activity on bone scanning, were referred with the presumptive diagnosis of a bone-forming neoplasm. In five cases there has been histological confirmation of the diagnosis of a bone island. RESULTS: All cases showed sclerotic intramedullary bone formation of varying size. In two cases arising within the sacrum there was evidence of bony expansion. All showed focal increased activity on bone scanning which had prompted the concern regarding possibly malignancy *e.g.* low grade osteosarcoma. MRI was performed in five cases in order to assess the lesions further. Two exhibited the typical appearances of low signal intensity on all sequences. In three, however, further concern regarding the possibility of malignancy was raised by the demonstration of high signal within or surrounding the lesion on T_2 weighted and/or STIR sequences. Of the five cases in which the diagnosis of a bone island was confirmed histologically two underwent two biopsies. The diagnosis in the sixth case was supported by follow-up imaging studies. CONCLUSION: The majority of bone islands pose no diagnostic problems. Increased activity on a bone scan and hyperintense signal on MRI are atypical but do not exclude the diagnosis. If biopsy is performed it is important to liaise with the pathologist as the result

is frequently "normal", which may be taken to indicate that the biopsy had failed to sample the relevant pathological area.

POSTER 0809

The role of MRI in the differential diagnosis of malignant solitary pelvic bone tumours

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AIM: To assess the role of MRI in the differential diagnosis of malignant pelvic bone tumours. METHOD: The plain radiographs, CT and MRI examinations of patients with histologically proven tumours were retrospectively assessed. Patients in whom a diagnosis could be made on plain radiograph or CT (where cartilaginous or osseous mineralization was noted) were then excluded from further assessment. The criteria for MRI assessment were inhomogeneity of the soft-tissue component of the tumour on T_1 and T_2 weighted images, lobulation and the presence of septation (partial or complete). Inhomogeneity was graded as mild, moderate or marked. Cases were independently assessed by two radiologists, unaware of the diagnosis. RESULTS: The radiographs of 40 patients were examined, mean age 41 years (range 14–71). A diagnosis was made on the plain radiograph or CT in 24 patients (19 chondrosarcomas, five osteosarcomas). On MRI, all eight cases of malignant round cell tumour (MRCT) were found to be mildly inhomogenous on T_1W and mildly or moderately inhomogenous on T_2W. In six, lobulation was absent and in all eight multiple septations were identified, six complete and two partial. The other tumours (two chondrosarcomas, two osteosarcomas, one plasmacytoma, one myeloma, one lymphoma and one metastasis) showed a greater degree of inhomogeneity, septation was not a striking feature.

POSTER 0810

Initial experience with arthrography of the hip

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PURPOSE: To investigate MRI hip arthrography in patients with unexplained hip pain. MATERIALS & METHODS: Eight patients (all female, mean age 28.7 years, range 20–52) with unexplained hip pain underwent 12 hip arthrograms. Five subjects had hip dysplasia. A needle was introduced into the hip joint under fluoroscopic control, a small test injection of iodinated contrast was given and up to 15 ml of a very dilute solution of Gd-DTPA (0.1 ml in 25 ml normal saline) was injected. Images were obtained using a phased array body coil on a Siemens 1.0 T Magnetom Impact scanner. 3 mm slices were obtained in three planes with a fat-saturated T_1W spin echo sequence (TE/TR 14/918). The acetabular labrum and ligamentum teres were assessed. RESULTS: The procedure was well-tolerated. Intraarticular structures were well demonstrated in all subjects. No loose bodies were seen. Six acetabular labra had inferior linear or triangular contrast-filled defects diagnosed as partial tears, three were thickened, blunted or had abnormal intralabral signal, without a tear, and three appeared normal. One ligamentum teres was thickened. The coronal plane was most useful. Some surgical correlation is anticipated. CONCLUSION: MRI hip arthrography allows relatively non-invasive visualization and assessment of intraarticular structures which otherwise would require arthroscopy or open joint exploration. It is particularly useful in demonstrating the acetabular labrum.

POSTER 0811

Synovial herniation pits: a characteristic appearance on MRI

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INTRODUCTION: Herniation pits of the femoral neck were first described by Pitt et al in 1982. They are a common, benign finding on plain films and are recognized by a characteristic appearance and location. Appearances on MRI have been described in a few cases. We describe four cases where MRI showed a target sign which has not previously been reported. MATERIALS & METHODS: Four patients underwent MRI scanning of the hip. In three cases the examination was performed to exclude a labral tear and in the fourth to evaluate a lucent lesion seen on the plain film. Scans were performed on a Siemens 1.0 T Impact machine. Sequences performed were in three cases coronal T_1 SE and FLASH, and axial T_2 FSE. Two had an additional coronal STIR. The fourth case had coronal and axial STIR and T_1 SE sequences. RESULTS: All four cases showed a similar appearance. The lesions were situated in the superior aspect of the proximal portion of the femoral neck and were in contact with the cortex. There was a "target" appearance with a central portion with signal characteristics in keeping with fluid, an outer band with signal characteristics in keeping with fat and a low signal rim, in keeping with sclerosis seen on the plain films. Plain films confirmed the classical appearance of a herniation pit. CONCLUSION: The target sign on MRI has not previously been described. When it is present and the lesion is in the characteristic position, we feel that there is no need to perform an additional plain film. It is important to recognize herniation pits on MRI as they are a benign incidental finding and should not be mistaken for pathology.

POSTER 0812

CT and air arthrography CT in diagnosing loose bodies in the knee

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AIM: Loose bodies are a frequent cause of knee symptoms and mimic a torn meniscus. Some may not be radio-opaque, making radiographic localization difficult in some cases. Loose bodies arise from osteochondral fractures, synovial chondromatosis, osteochondritis dissecans, and osteoarthritis. Imaging diagnostics in the knee are often encumbered by the size of the joint capsule and the various knee joint compartments, leading us to investigate the accuracy of CT and air arthrography CT. MATERIAL & METHOD: We surgically fixed osseous and cartilaginous articular bodies 3 mm and 6 mm in size at defined locations under water, to avoid intraarticular air pockets. Air was introduced as a negative contrast medium via an *in situ* catheter. The knee joints were scanned by CT in 3 mm thick, continuous axial layering and documented in pre-established bone and soft-tissue windows with a defined centre. RESULTS: (1) The accuracy of CT was 100% in the suprapatellar recess for both 6 mm and 3 mm bone fragments, 94% and 75% in the intercondylar space and 94% and 88% in the post-condylar space. Air arthrography CT improved the accuracy from 75% to 88% for 3 mm osseous bodies in the intercondylar space. (2) For 6 mm and 3 mm cartilaginous bodies, suprapatellar accuracy was 67% and 54%, intercondylar accuracy was 50% and 38% and post-condylar accuracy was 81% and 38%. In air arthrography CT, the diagnostic accuracy improved significantly in the suprapatellar recess (6 mm: 83%, 3 mm: 63%), the intercondylar space (6 mm: 69%, 3 mm: 63%) and the post-condylar space (3 mm: 50%) ($p < 0.01$). There was no improvement for the 6 mm cartilaginous bodies in the post-condylar compartment. CONCLUSION: CT is excellently suited to detecting osseous intraarticular bodies. It is possible to achieve an additional improvement in accuracy in the intercondylar space using air arthrography CT. Hyaline intraarticular bodies are markedly more difficult to delineate in the CT image; however, accuracy is significantly improved in all compartments of the knee joint by air arthrography CT.

POSTER 0813

Direct sagittal CT of the calcaneus: technical approach

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PURPOSE: We describe a simple method of acquiring direct sagittal CT scans of the calcaneus using helical acquisition with simplified patient positioning. MATERIALS: The patient is seated at the head of the CT table with the foot exactly in front of the CT scanner parallel to the gantry. The patient is advised to maintain that position while the table moves a short distance. No additional piece of equipment, such as a fixture, is required. The scans were acquired with a helical CT scanner with 140 kVp and 274 mA. We used a 2 mm collimation with a table increment of 3 mm s^{-1} (pitch of 1.5). Image reconstruction was performed in 2 mm using a high resolution algorithm and 180° linear interpolation. 2D reconstructions in an axial or coronal plane can also be done if required. The entire ankle can be imaged in 18–24 s using this technique. RESULTS: Direct sagittal scans show more accurately height loss of the calcaneus, the sinus tarsi, the sustentaculum tali, disruption of the posterior facet, the subtalar facet joints, calcaneocuboid joint involvement and allow the measurement of the decrease in Boehler's angle. The Boehler's angle can be wrongly measured if multiple overlapping fragments obscure the reference points. The Boehler's angle is the classic radiographic sign for evaluating the severity of a calcaneus fracture and the direct sagittal scans can show the reference points exactly. This is very important because the clinical outcome of intraarticular fractures correlate with the incongruity of

the posterior subtalar joint and a decrease in Boehler's angle. Like axial and coronal scans, sagittal scans can determine the number and displacement of major fragments. CONCLUSION: We developed a new, quick and easy technique for direct sagittal CT imaging of the calcaneus. The posterior subtalar joint and the Boehler's angle, which are most important for clinical outcome, are shown in a direct manner. The short calcaneus *z*-axis results in this technique lead to a rapid study, with minimal patient-motion artefacts.

POSTER 0814

MRI of the tarsometatarsal joint: analysis of 11 patients with Lisfranc dislocation

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PURPOSE: We evaluated the diagnostic capabilities of MRI in the assessment of ligamentous and bony abnormalities in patients with Lisfranc injuries. MATERIALS & METHODS: 11 patients with plantar hyperflexion injuries of the foot underwent conventional radiography and MRI in all three planes using SE T_1, fast SE T_2 and STIR sequences. In four patients an SPGR 3D volume sequence in the coronal plane was also performed. RESULTS: Conventional radiographs revealed tarso–metatarsal joint malalignment in all patients, metatarsal fractures in four patients, and tarsal fractures in four patients. MRI showed joint malalignment in every case and disruption of the Lisfranc ligament in eight patients; three patients had a normal Lisfranc ligament, associated with avulsion fractures of the second metatarsal base or the medial cuneiform bone. Fractures of the metatarsal bases were evident in 10 cases, and fractures of the tarsal bones in 10 cases. CONCLUSION: MRI allows the detection of disruption of the Lisfranc ligament and tarsal and metatarsal fractures more accurately than conventional radiography; therefore it may be a valuable technique in the assessment of patients after hyperflexion trauma when results of routine radiographs are not conclusive.

POSTER 0815

Tumours of the foot: 5 years experience with MRI

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PURPOSE: Tumours of the foot are uncommon, accounting for less than 3% of all musculoskeletal tumours. This presentation illustrates the value of MRI in establishing the diagnosis and anatomical extent in a series of patients presenting with a mass in the foot. METHODS: 60 patients, out of a total of 3093 referred to an orthopaedic oncology centre in a 5 year period commencing January 1992, were found to have a bone or soft tissue "tumour" of the foot. 50 patients underwent MRI on a 1 T super-conducting magnet (Siemens Impact) using the transmit/receive head coil to obtain T_1 weighted, T_2 weighted FSE and STIR sequences in at least two orthogonal planes. A retrospective review of the scans correlated the findings with the final histological diagnosis. RESULTS: The final diagnosis was as follows; 19 bone tumours, 26 soft tissue tumours and five osteomyelitis (mimicking tumours). Despite the recognized limited ability of MRI to characterize many bone or soft tissue tumours, a number of specific diagnoses can be strongly suspected, including lipoma, haemangioma, fibromatosis, PVNS and benign bone lesions containing fluid–fluid levels (typically ABC). Diagnostic accuracy can be improved by taking into account the patient's age and the nature and frequency of various tumours in the foot. CONCLUSION: Investigation of musculoskeletal masses in the foot should always commence with the conventional radiograph. MRI, however, with its inherent superior soft tissue contrast and multiplanar capability, has enabled us to distinguish with considerable accuracy between tumour and infection and to indicate the specific diagnosis in many cases. MRI is also essential in staging malignant tumours in the foot and for the investigation of recurrent disease.

POSTER 0816

A pictorial review of the MRI appearances of osteoid osteoma

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PURPOSE: To provide a pictorial review of the MRI findings of osteoid osteoma located in the intra-medullary, intra-cortical, subperiosteal and intra-articular sites. One example of each is shown. METHODS & MATERIALS: The MRI of all patients was undertaken using a Siemens Magnetom 1 T superconducting magnet with images obtained in three planes, using the following sequences: T_1 spin echo (SE), (TR = 600.0 ms; TE = 15.0 ms); T_2 turbo spin echo (TSE), (TR = 5000 ms; TE = 96.0 ms); short T_1 inversion recovery (STIR), (TR = 6000 ms; TE = 90.0 ms). Contrast enhanced T_1 SE studies were obtained in all of the cases shown. RESULTS: A nidus was identified in all cases as a lesion of low to intermediate signal intensity on T_1 weighted imaging (WI) and of intermediate to high signal intensity on T_2 WI. Calcification within the nidus was seen as central signal void. The extent of associated bone marrow oedema and soft tissue inflammation was clearly demonstrated on STIR sequences, but were less conspicuous on T_2 TSE studies. Moderate enhancement of the nidus with iv gadolinium was demonstrated. CONCLUSION: In our experience, MRI has proven comparable to CT in its ability to demonstrate a nidus. It has the added advantages of demonstrating associated bone marrow, soft tissue and intra-articular abnormalities and avoiding further irradiation of the predominantly young population affected. We therefore feel there is a definite place for this imaging modality in the diagnosis of osteoid osteoma.

POSTER 0817

MRI of vertebral osteoblastomas

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PURPOSE: The purpose of this paper is to determine if MRI is able to diagnose osteoblastoma of vertebral origin. To diagnose a vertebral tumour we need to detect the lesion, determine its extent and establish its possible type. There is no wide tumoral series that permits us to define typical MRI pictures within spinal tumours. The osteoblastoma is no exception, however the phenomenon designated "Flare" has been described as a frequent manifestation of these lesions. MATERIALS & METHODS: 10 explorations of eight patients have been evaluated. Two patients had a recurrence giving a new lesion after incomplete excision in initial treatment. RESULTS: Detection of the lesion was possible in all cases, only three of them presented the "flare" sign. The real extent of the lesions was shown in five cases where Gd-DTPA was administered for positive enhancement. Determining the type of the tumour was possible in four of the five cases located in the vertebral arch. All cases had a low signal in the T_1 weighted images and high IS in the T_2 weighted images. CONCLUSIONS: We believe that inflammatory changes present in this lesion can help its detection but they are not constant. The administration of contrast is necessary to determine the extent of the tumour. The classical criteria of diagnosis to determine the type of tumour are useful in cases where the vertebral arch is affected, but in the event of the vertebral body being affected there are no typical attributes.

POSTER 0818

Cross-sectional imaging of malignant change in diaphyseal aclasis

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PURPOSE: Malignant degeneration occurs in less than 5% of patients with diaphyseal aclasis. We present our experience of cross-sectional imaging (CT and/or MRI) of 20 patients with surgically confirmed malignant transformation. METHODS: We retrospectively reviewed the imaging of all patients with diaphyseal aclasis and malignant degeneration presenting to our orthopaedic oncology service. The CT and MRI appearances were studied and correlated with the histological diagnoses. RESULTS: A total of 20 patients were included in this study (aged 20–67 years), 13 males and seven females. Chondrosarcomas accounted for 18, dedifferentiated chondrosarcoma one and liposarcoma one. Nine lesions were sited in the pelvis, six in the femur, three in the tibia and one each in the humerus and scapula, respectively. The tumours ranged in size from 5 cm to 31 cm. The thickness of the cartilage cap was not an important diagnostic discriminator in this series which probably reflects referral bias. On MRI the chondrosarcomas appeared lobulated with a signal intensity similar for all lesions (intermediate on T_1 weighted, high on T_2 weighted images). CT demonstrated calcification not otherwise identified on MRI. MRI, however, proved invaluable when differentiating tumours from other soft tissue masses associated with diaphyseal aclasis (*e.g.* aneurysm and bursitis). CONCLUSION: MRI is valuable in confirming malignant transformation and is essential in staging these cases. CT is adequate for staging but has limitations when differentiating tumour from associated non-neoplastic masses.

POSTER 0819

Imaging of peripheral neuromas: potential pitfalls of US and MRI

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INTRODUCTION: Peripheral neuromas are relatively common and often present as a palpable mass, sometimes associated with pain or paraesthesia. A pictorial review of the US and MRI appearances of these tumours is presented to highlight some common imaging features, as well as potential diagnostic pitfalls. MATERIALS & METHODS: A retrospective review was made of 19 cases, 10 peripheral neuromas and nine subcutaneous lesions with similar locations and imaging features, presenting over a 2 year period. High resolution sonography and MRI was performed in each case. The imaging findings were compared with histological results. RESULTS: A pictorial summary of typical US and MRI features of neuromas is presented with emphasis on useful imaging signs to differentiate them from other lesions, in particular ganglion cysts. CONCLUSION: US and MRI are both sensitive imaging methods for detecting peripheral neuromas, but in some cases may not be specific. Local pressure with the US probe can induce paraesthesia in the nerve distribution of a neuroma, while Doppler US may demonstrate increased tumour vascularity. MRI can identify the nerve of origin as well as the relationship to surrounding structures. In some cases, iv gadolinium is necessary and can enhance some neuromas. Radiologists need to be aware of other soft tissue lesions with similar imaging features.

POSTER 0820

Imaging of DuPuytrens contracture using a specialized extremity MR system

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INTRODUCTION: Imaging of the hand and wrist is difficult on whole body systems due to the uncomfortable position which the patient must assume, with the arm outstretched. The aim of this study was to investigate the use of a specialized MR system for imaging of the hands of patients with DuPuytrens contracture. METHODS: Eight patients suffering from DuPuytrens contracture were imaged using a specialized extremity MRI system operating at 7.1 MHz to investigate the location of the structures of the hand prior to US imaging. All patients were being prepared for surgical intervention at a future date. Images were acquired in a dedicated hand/wrist coil using a T_1 weighted sequence (TR/TE = 500/20, slice thickness of 5 mm, FOV of 160 mm, 160 × 256 resolution and NEX = 4). RESULTS: MR images with good signal-to-noise ratio and resolution were acquired which clearly delineated the tendons and their positions relative to the musculature and joints of the hand. It was not possible to reliably visualize the small vessels which supply the fingers, except in a few cases. These were clearly observed using US. DISCUSSION: All patients found the imaging procedure on the specialized scanner acceptable and comfortable. Further development is required to visualize flow in the small vessels feeding the fingers, although the basic anatomical structures were well visualized. Specialized MR systems may provide an attractive and cost-effective complement to US for examinations of the hand and wrist.

POSTER 0821

Localization of needles for steroid injection using a specialized extremity MRI system

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AIM: To investigate the use of open access specialized MRI systems for locating needles used to inject steroids into painful foot joints. METHODS: Five patients were imaged using a specialized extremity MRI system operating at 7.1 MHz prior to and post-steroid injection into the heel using T_1 weighted images. Skin markers were used to visualize the potential injection site. Injections were carried out outside the magnet in these preliminary experiments, but the needle position was visualized *in situ* in selected cases. Post-injection images were also acquired. RESULTS: The position of the injection site relative to the target could be clearly observed in all cases. Visualization of the needle location relative to the target site could also be observed with the needle *in situ* although the non-MR-compatible needles used to minimize pain gave a relatively large susceptibility artefact on the images. DISCUSSION: All patients easily tolerated the procedure and positioning of the foot within the scanner was straightforward with the needle *in situ*. Specialized extremity MRI systems may provide a cost-effective method for monitoring needle location for steroid injection in regions of complex anatomy, such as the ankle, wrist or knee.

POSTER 0822

A comparison of high resolution MRI and high frequency US in the imaging of cutaneous malignant melanoma

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Malignant melanoma is an increasing cause of morbidity and mortality in the UK. The prognosis is closely related to the depth of invasion. Pre-operative assessment, however, is usually confined to visual inspection and palpation, which gives little information regarding the depth of tumour invasion. The purpose of this study was to assess the role of imaging in accurately defining the tumour dimensions, with the aim of giving the surgeon a pre-operative indication of prognosis and an accurate guide to the required width of excision. To date, four patients have been assessed by MRI using a 2.5 cm surface coil, specially commissioned for use with a 0.5 T GE Vectra whole body MRI scanner. Patients have also been assessed with high frequency US using a 20 MHz probe (Dermascan, Cortex Technology, Denmark). Conventional spin echo and 3D gradient echo sequences were used. Tumours were most conspicuous on T_1 weighted images and demonstrated thickening and hyper-intensity of the epidermis, with variable extension into the underlying dermis. On US, melanoma displayed homogeneous hypoechogenicity, subjacent to a thin hyperechogenic layer of intact epidermis more superficially. Both techniques have, so far, shown very close correlation with histological tumour depth and width. Formal statistical analysis will be undertaken when further patients have been imaged.

POSTER 0823

Coralline hydroxyapatite bone graft substitutes: evaluation of density with dual energy X-ray absorptiometry (DXA)

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PURPOSE: To evaluate whether dual-energy X-ray absorptiometry (DXA) is a reliable method of determining the density of natural coralline hydroxyapatite (HA) blocks used as bone graft substitutes. MATERIALS & METHODS: To evaluate the basic density of HA blocks from the same coral heads, with and without titanium meshes, densitometry of 12 HA 500 (genus *Goniopora*) and 12 HA 200 blocks (genus *Porites*) was performed. In addition, density measurements of 30 HA blocks (HA 500: $n = 15$; HA 200: $n = 15$) from different coral heads were obtained to assess if the originating coral head influences the basic density of blocks within one coral genera. In order to assess standard deviation, serial measurements on eight coralline HA blocks, four with and four without titanium meshes were performed. In the *ex vivo* study, densitometry of 12 HA blocks (HA 500: $n = 4$; HA 200: $n = 8$) used as bone graft substitutes in the mandibles and craniums of adult mongrel dogs was performed. Densities were measured after bone ingrowth for 2 and 4 months, respectively. All measurements were obtained with a Lunar DPX unit with scan mode "slow 750" in the spine program with the regions-of-interest selected manually. Bone ingrowth was assessed by computer-assisted histomorphometry. Statistical analysis correlated the densities of plain HA blocks with and without meshes to the specific weights of the blocks. RESULTS: Significant positive correlation was found between the density of each HA block (both coral species) with and without titanium meshes and the calculated specific weights. Densitometry values showed no significant differences between different coral heads. Standard deviation ranged between ±3.8% and ±4.1% (HA 500) and between ±3.0% and ±3.8% (HA 200). HA 500 blocks marked increased densities between 15% and 34% after 4 months in three specimens in which bone ingrowth between 16.9% and 21.1% was revealed by histomorphometry; no increase of density was observed in one specimen which showed signs of infection. Despite bone invasion between 12% and 25.8% no increased densities were observed for HA 200 implants. CONCLUSION: DXA is an accurate and reproducible method for assessing the densities of plain coralline blocks and to monitor bone ingrowth into coralline HA 500 blocks, but not into HA 200 block implants.

POSTER 0824

The fractal dimension of cancellous bone as a new parameter to determine bone structure in osteoporosis

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PURPOSE: In this study a new parameter for the classification of the trabecular structure was developed which is independent of the bone mineral density (BMD). MATERIAL AND METHODS: BMD of 46 posthumously extracted lumbar vertebrae was determined by quantitative CT (QCT). The midvertebral slice of 30 specimens (8 mm thickness) was sawn out and X-rayed on mammography film, the resulting images were scanned with a resolution of 0.067 mm. High resolution CT images were acquired from 16 lumbar vertebrae with a resolution of approximately 0.2 mm. The fractal dimension D of the trabecular area was computed independently of the binarization threshold T, the resulting function $D(T)$ was normalized by the average image grey value. Two parameters were extracted from $D(T)$ (p_1 the average slope at $T>0$ and p_2 the threshold value at which the dimension $D=1$ is reached) and correlated with BMD. RESULTS: The images of the trabecular structure show fractal behaviour. The significantly steeper function $D(T)$ in cases beginning demineralization than in severely osteoporotical cases, allows a discrimination of the degree of osteoporosis. Both parameters p_1 and p_2 show a high correlation with BMD (correlation coefficients: $r_1=-0.95$ and $r_2=-0.91$ for the digitized X-ray images, $r_1=-0.91$ and $r_2=-0.93$ for the CT images). CONCLUSION: Using this method we found a structural parameter which is well-suited to assess the degree of osteoporosis and shows good accordance with clinical diagnosis.

Vascular & Interventional Radiology

POSTER 0901

Carotid Doppler US: influence on patient management

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PURPOSE: To determine the influence of an abnormal carotid Doppler US report on patient management. METHOD: Demographic details, indications and scan results of patients undergoing their first carotid Doppler US (CDUS) were recorded prospectively during the initial 18 months of a newly introduced service. Subsequent management in all those with abnormal results was ascertained from case-notes. RESULTS: 276 patients underwent CDUS. 60 patients were recommended to undergo angiography, 48 for CDUS detected stenosis (>60% severity) and 12 for technically inadequate CDUS studies. Of the 48 with CDUS stenosis 23 underwent angiography. In 22 of these the degree of angiographic stenosis correlated to within 5% of the CDUS predicted stenosis (PPV = 96%). 25 of the 48 patients with CDUS stenosis did not undergo angiography, nine due to CT detected cerebrovascular disease, two due to complete occlusion on CDUS and 14 due to clinical assessment of unsuitability for surgery. Of the 12 patients with technically inadequate CDUS, four underwent angiography without detection of significant disease and eight were not further investigated. Of the 22 patients with CDUS stenosis undergoing angiography, 12 underwent surgery. 10 patients with confirmed disease did not undergo surgery for a variety of reasons. CONCLUSION: CDUS is an accurate method of diagnosing carotid artery disease. However, in our study group, subsequent management following an abnormal CDUS is equally likely to be governed by pre-existing factors. We have found that incomplete initial clinical assessment results in over-investigation in a significant number of patients.

POSTER 0902

Common carotid artery bifurcation: evaluation with spiral CT, multiplanar and 3D reconstruction

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AIM: Atherosclerotic disease at the carotid bifurcation is a well-known risk factor for cerebral ischemic episodes and infarction. In addition, patients with significant carotid artery stenosis have been seen to benefit from carotid endarterectomy, which reduces the risk of a possible stroke. Conventional angiography, which is considered the most accurate technique for diagnosis of carotid bifurcation stenosis, is not free of risk. Thus, accurate evaluation of the carotid bifurcation with noninvasive techniques remains an important goal. The aim of this work is to determine whether spiral CT angiography with multiplanar (MPR), multiprojection volume (MPVR), and 3D reconstruction and maximum intensity projection (MIP) rendering can be used to accurately quantify carotid stenoses and differentiate stenoses from occlusions. MATERIALS & METHODS: The carotid bifuraction was evaluated in five normal patients (referred to our department for spiral TC of the neck for pathological problems not involving vascular structures) in order to optimize data acquisition technique, delay time, and 3D reconstruction parameters. In a second phase of the study, a total of 40 carotid bifurcation were evaluated with spiral CT in 20 patients with symptomatic carotid disease who were referred for surgical evaluation. CT scan parameters were as follow: 120 KV, 200 mA, 512 × 512 matrix, section thickness 5 mm, pitch 1:1. The 5 mm sections were reconstructed at 2 mm increments. 100 ml of a non-ionic contrast material (300 mg iodine per ml) was mechanically injected at a rate of 2.5 ml s^{-1}, with a scan delay of 30 s. In all cases MPR, MPVR and 3D reconstruction and MIP rendering images were obtained and the degree of carotid stenosis was quantified. The stenosis were graded as follow: mild < 30% diameter reduction, moderate = 30–69%, severe = 70–99%, and occlusion = 100%. Calcification were evaluated with the MIP rendering images. Colour Doppler US was performed in all cases and results of stenosis evaluation were correlated with spiral CT results. RESULTS: A total of 40 carotid bifurcations were studied and all degrees of carotid disease were represented. All carotid bifurcations were clearly identified at spiral CT. Comparison of data demonstrated excellent correlation between results of spiral CT and colour Doppler US. In 38 of 40 carotid arteries (95%), patients were placed in the same category of stenosis. Calcifications were present in 55% of cases and were well-evaluated with MIP rendering images. CONCLUSIONS: Spiral CT provided an accurate, noninvasive anatomic depiction of carotid bifurcation and most of the information needed before endoarterectomy. MPR, MPVR and 3D reconstructions represent an important diagnostic tool providing information about the degree and longitudinal extension of the stenosis. MIP rendering provided a good evaluation of calciphic plaques.

POSTER 0903

Draped aorta: CT sign of contained leak of aortic aneurysms

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PURPOSE: To evaluate the usefulness of a new CT sign ("draped aorta") in the diagnosis of a contained leak in an aortic aneurysm. METHOD: In a retrospective analysis of 307 CT scans of aortic aneurysm, 10 patients were identified in whom an area of the aortic wall was unidentifiable and the posterior aorta was closely applied to the spine following the contour of the vertebra; the draped aorta sign. In seven cases the draped aorta was the only sign of aortic wall deficiency on the images. The surgical findings in all 10 patients were reviewed. RESULTS: At surgery, seven patients were found to have a deficient aortic wall and a contained leak, two patients had a deficient wall and a mycotic aneurysm. One patient had a false aneurysm at an aortic graft anastomosis. CONCLUSION: On CT images the draped aorta sign is highly indicative of deficiency of the aortic wall and a contained leak of an aortic aneurysm. It is important that such cases are identified, since clinical features may be misleading and massive haemorrhage may occur at any time. The draped aorta may be the only indication that this life-threatening situation exists.

POSTER 0904

The value of non-invasive assessment in the follow-up of aorto–iliac stenting

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PURPOSE: Aorto–iliac stenting represents a major financial investment. Traditional clinical review provides only subjective outcome data. To obtain objective data to prove the benefit of stenting and to detect early restenosis (within the stent or iliac segment) prior to occlusion, an interventional follow-up clinic was established. METHOD: 130 patients stented within the last 6 years were invited to attend for non-invasive review. Of these, 15 were deceased and 21 declined. The remaining 94 patients underwent clinical assessment, ankle-brachial pressure index (ABPI) measurements and colour Doppler imaging. RESULTS: Clinical and ABPI assessment show clear benefit for patients treated by stenting. 14 patients had significantly abnormal non-invasive indices and proceeded to angiography, aiming to treat any suitable lesion during that

examination. At angiography, 11 had significant narrowing requiring angioplasty (seven intimal hyperplasia within the stent, four focal atheroma elsewhere in the segment). Three had diffuse iliac disease but no focal stenosis. CONCLUSIONS: Stenting is effective, but requires active follow-up. Non-invasive follow-up detects more "at risk" stents than clinical assessment. This study fulfils our objectives of providing objective outcome data and identifying patients requiring re-intervention prior to symptoms of occlusion.

POSTER 0905

Conventional lower limb venography or duplex Doppler US?

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PURPOSE: Conventional lower limb venography in many radiology departments is being replaced by duplex Doppler US (DDU). DDU evaluation of the femoro–popliteal segment is simple, quick and sensitive, but assessment of the deep veins of the calf requires more skill, more time and colour Doppler. It is generally not a service offered, hence the caveat "this examination does not exclude thrombus in the deep veins of the calf". We undertook a retrospective analysis of lower limb venography over a 15 month period to assess the potential effect of introducing femoro–popliteal DDU as the major diagnostic tool in patients with suspected deep vein thrombosis (DVT). METHODS: The reports of venograms during that period were analysed and we looked at the clinical management of patients with isolated below the knee DVTs. RESULTS: 551 lower limb venograms were performed. 304(55%) were normal, 151(28%) had ileo–femoral or popliteal thrombus and 66 patients (13%) had isolated "below the knee" thrombus. 45 patients (68%) with isolated "below the knee" thrombus were anticoagulated with warfarin, four patients (6%) were anticoagulated for additional reasons, 17 patients (26%) received no post-procedure anticoagulant therapy. CONCLUSION: There is no doubt that DDU has a role in the investigation of suspected DVT. However, in view of the varied clinical management of patients with "below the knee" DVTs, we conclude that any decision to replace conventional venography with US, or complement one with the other should be made by radiologists and clinicians together, to ensure that any changes are in the best interest of the patient.

POSTER 0906

The radiological investigation of suspected lower limb deep vein thrombosis

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PURPOSE: A postal survey was performed to determine the current practices and attitudes of radiologists towards the imaging of suspected lower limb deep vein thrombosis. METHODS: 127 departments responded to a questionnaire sent in March 1996. RESULTS: 87% of hospitals possess colour Doppler US (CDUS) machines and 46% of departments perform US as the first-line investigation in over 90% of cases. 33% used venography for over 50% of cases. 30% of departments considered calf vein visualization with CDUS to be generally adequate and 34% thought that clinicians in their hospitals invariably anticoagulated patients with isolated calf thrombus. In hospitals where venography is routinely used as the first-line investigation, the most common reasons were; the perceived inferiority of US in demonstrating below knee clot, its time-consuming nature and the limited access to suitable US machine. CONCLUSION: The widespread use of US is encouraging. A significant minority of departments depend principally upon venography in the diagnosis of deep vein thrombosis. The diversity of approaches between departments makes it difficult for radiologists to claim authority in guiding other clinicians.

POSTER 0907

Use of limited compression studies for the diagnosis of lower limb deep vein thrombosis

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PURPOSE: Colour flow Doppler studies (CFDS) are the investigation of choice in the diagnosis of deep vein thrombosis (DVT) of the lower limbs. Loss of compressibility in a vein is an important indicator of thrombosis. Recent studies indicate limited compression studies (LCS) may be as effective as CFDS. The purpose of our study is to prospectively validate this finding. METHOD: Nominated registrars at three hospitals performed the studies on 186 consecutive referrals for CFDS. In each case, the LCS was performed first and the results committed to paper. This was followed by full CFDS. In LCS, the common femoral vein was compressed from the inguinal ligament to its bifurcation. The popliteal vein was then compressed from the adductor canal to its trifurcation. In CFDS the whole proximal system was interrogated using Doppler. In some studies time taken to perform LCS was noted. RESULTS: 186 patients and 192 legs were examined. 52 DVTs were diagnosed. In 48, findings of the LCS and CFDS were identical. Four studies were non-concordant. Of these, three were calf DVTs and one was localized to the superficial femoral vein. In two studies technical difficulties prevented compression. LCS took on average 5.3 min whilst CFDS took 15–20 min. CONCLUSION: LCS was 98% sensitive for DVTs above the popliteal trifurcation. LCS is cost-effective, easier to perform and provides mobile non-Doppler DVT diagnosis. Within the proximal venous system LCS is a suitable alternative to CFDS, except at the distal superficial femoral vein.

POSTER 0908

MRA and MRI of symptomatic peripheral vascular malformations

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PURPOSE: To define the appearance of peripheral vascular malformations at magnetic resonance angiography (MRA) and assess the role of MRI and MRA in the investigation of these lesions. PATIENTS & METHOD: 14 patients with a suspected vascular malformation underwent MRI and MRA, performed on a 0.5 T GE Vectra superconducting system (International General Electric, Slough). Multisection T_1 weighted spin echo and T_2 weighted FSE pulse sequences were performed in all cases, inversion recovery FSE sequence in two cases, and 2D time of flight (2D TOF) and/or 2D phase contrast (PC) MRA performed in 13 cases. 11 patients had digital subtraction angiography (DSA) using a Phillips Integris V3000 digital angiographic unit. The findings at MRA and MRI were compared with the catheter angiograms, and the effective diagnostic input of MRA and MRI was determined. RESULTS: MRA demonstrated major feeding vessels and multiple intralesional vessels relating to the high flow lesions, features absent in the low flow lesions. However, small feeding vessels to the AVMs were not clearly identified. MRI clearly demonstrated the anatomical extent of all lesions. AVMs ($n=6$) and venous malformations ($n=6$) were reliably distinguished, the former containing multiple serpentine signal voids on T_1 and T_2 weighted imaging, the latter being hyperintense to fat on T_2 weighted images. Two other high flow lesions diagnosed clinically as vascular malformations appeared solid on MRI, histology diagnosing a carotid body tumour and an angiomyolipoma. CONCLUSION: Although 2D TOF MRA can distinguish AVMs from venous malformations, the technique adds little extra information to the diagnostic process, and cannot compete with catheter angiography for the detailed demonstration of AVM feeding vessels. Spin echo sequences also characterize vascular malformations, though the primary role of MRI is to demonstrate their anatomical extent.

POSTER 0909

MR venography in malignancy

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OBJECTIVES: MR angiography (MRA) of the venous system, termed MR venography (MRV), has been used in a series of patients with a history of malignancy and suspected superior vena cava obstruction (SVCO) or inferior vena cava obstruction (IVCO). The scans were initially performed on a Picker Vista HP 2055 and latterly on a Siemens 1 T Magnetom Impact. The present sequences are T_1 weighted spin echo, STIR transverse and T_2 weighted coronal views to demonstrate anatomy and pathology adjacent to the vessels. For the IVC we use 2D time-of-flight (2D TOF) using the multichunk technique to cover the length of the IVC and iliac veins. 2D TOF is used for the SVC and a breath-hold gradient echo sequence following bolus injection of iv Gd-DTPA is used to show the subclavian and brachiocephalic veins. MRV was performed in patients with primary and secondary carcinoma of the bronchus, carcinoma of the breast, teratoma, melanoma, renal cell carcinoma, lymphoma and other malignancies. MRV was able to demonstrate and distinguish mass lesions and fibrosis compressing the venous system, tumour within the veins and thrombus. MRV was easier to perform than pedal venography and provided excellent images of the subclavian, brachiocephalic and iliac vessels, in addition to the SVC and IVC, and provided information about the soft tissues surrounding the venous system not available on standard venography. In cases of SVCO or IVCO, MRV is suggested as an excellent method of diagnosis and assessment.

POSTER 0910

Day-case angiography: patient satisfaction survey

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PURPOSE: The aim of this study was to determine patient attitude to, and safety of, day-case angiography. METHOD: A postal survey was made of 103 patients undergoing day-case angiography in 1994/95. 85 patients responded, giving a compliance of 82.5%. The questionnaire addressed five areas of concern namely: access to the department, the appointment, the department, the procedure and complications. RESULTS: 84 patients were happy with the appointment arrangements, except one who felt 48 h was too short notice. Apart from one patient, who had a delay of 90 min between appointment time and the procedure being performed, all were satisfied with the prompt service. However, 16% were unhappy with the conditions of the recovery area and made sensible comments for improvements. This particular aspect has been remedied since the survey. Once at home, 96% of patients were happy with the information given relating to potential problems after angiography. 38% experienced some bruising in the groin but in no case was there any significant bleeding requiring hospital admission or other intervention. CONCLUSION: This retrospective survey further supports day-case angiography as a safe and practical procedure.

POSTER 0911

Carotid bifurcation endarterectomy and intraoperative transluminal angioplasty of proximal common carotid artery stenosis: an alternative to extrathoracic bypass

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PURPOSE: Proximal common carotid artery (CCA) stenosis is rarely detected in isolation. When found with carotid bifurcation disease, extrathoracic bypass has been the operation of choice. Intraoperative endovascular management of CCA stenosis in combination with carotid endarterectomy is described in two patients. MATERIALS & METHODS: In one patient a carotid Doppler US (CDUS) demonstrated an internal carotid artery (ICA) stenosis of >70% with low flow in the CCA. Arch aortography confirmed the left ICA stenosis together with a marked stenosis of the proximal left CCA. Percutaneous transluminal angioplasty (PTA) of the CCA failed. Extrathoracic bypass was not possible due to a previous coronary artery bypass using the left internal mammary artery. A standard endarterectomy was performed and through the arteriotomy, whilst the ICA was clamped, a Woley catheter wire was passed across the tight proximal CCA stenosis in a retrograde direction. A 5 mm balloon was positioned across the lesion and a successful balloon dilatation performed. In the second case, a significant stenosis of the left ICA was managed by endarterectomy and a proximal stenosis of the CCA managed in a similar fashion as in the first case, by a retrograde balloon dilatation. RESULTS: Both patients made an uneventful recovery. Post-operative CDUS confirmed a return to normal flow. CONCLUSION: The approach described allows balloon dilatation of the proximal CCA lesion whilst the ICA is clamped, preventing simultaneous embolization to the cerebral circulation. Intraoperative balloon dilatation of the CCA avoids the potential morbidity associated with extrathoracic bypass. This raises the issue of whether carotid endarterectomy should be performed without prior angiography to image the whole of the CCA.

POSTER 0912

The use of the hydrolyser catheter in acute pulmonary embolism

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PURPOSE: To investigate the use of the hydrolyser catheter in acute pulmonary embolism. MATERIALS: A 7 F catheter which runs over a 0.025 inch wire was used in all cases. This device has a double lumen with a backward-pointing jet at the tip of the catheter through which saline is pumped from an injector at 5–7 $cm^3\ s^{-1}$. This jet is directed over an oval aperture connected to a large lumen. When the saline jet is activated, a Venturi effect is generated at the catheter tip. METHODS: In five patients aged 53–76 years with angiographically diagnosed, acute, multiple pulmonary embolism, presenting in shock and not responding to thrombolytic therapy, the hydrolyser catheter was utilized as the first-line therapy to reduce the embolic load. In two patients the catheter was introduced via the jugular vein and in the remaining three patients via the femoral vein. RESULTS: In all five patients there was a reduction in the amount of embolic material after deployment of the catheter. Two patients required further follow-up therapy of heparin, one patient having further systemic thrombolysis. No complications resulted from the use of the hydrolyser catheter. All patients demonstrated significant clinical improvement. CONCLUSIONS: The hydrolyser catheter is a safe addition to the interventional treatment of acute pulmonary embolism.

POSTER 0913

Endovascular repair of aortic aneurysms adjuvant procedures and troubleshooting

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PURPOSE: Endovascular aortic aneurysm repair using the modular vanguard endoprosthesis is technically feasible, but problems with stent delivery, endoleakage and other associated complications may be encountered. We present our experience of adjuvant procedures in 20 patients and review the role of other potential interventional techniques. MATERIALS & METHODS: Stent delivery problems related to catheterization of the asymmetric limb may be overcome by using an "over-the-top" technique. Adjuvant procedures performed included pre-operative embolization of patent inferior mesenteric (IMA) (six) and lumbar arteries (two), intraoperative angioplasty (four), temporary iliac artery occlusion to prevent distal embolism (one), treatment of intraoperative proximal (three) and distal (two) endoleaks, treatment of femoral artery pseudoaneurysm using compression US and thrombin injection. RESULTS: IMA embolization was unsuccessful in three of six cases due to unfavourable anatomy. Treatment of a proximal endoleak using a homemade cuff extension was unsuccessful in one case, necessitating conversion to open repair. All other leaks were effectively treated with angioplasty, iliac limb extension or proximal cuff extension. DISCUSSION: Interventional radiology has much to offer in this relatively new field of endovascular therapy. The role of pre-operative embolization is uncertain, but late endoleaks usually occur from retrograde flow from patent IMA or lumbar arteries. During conventional surgical repair, back-bleeding vessels are usually oversewn to maintain a haemostatic operative field and this probably contributes to long-term exclusion of the aneurysm sac. Treatment of proximal leaks is potentially hazardous and it may be preferable to re-intervene later when sac thrombosis is established.

POSTER 0914

Percutaneous transfemoral fenestration of aortic dissections for lower limb ischaemia

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PURPOSE: To present the results of percutaneous fenestration in patients with lower limb ischaemia following aortic dissection. MATERIALS & METHODS: We present four cases (two male, two female) with ischaemia to a lower limb as a result of compromise to the aortic bifurcation by an aortic dissection flap. One patient developed an aortic dissection following aortic valve surgery. Another had an iatrogenic ilio–aortic dissection created at the time of cardiac catheterization. The other two cases were spontaneous aortic dissections, one patient required aortic valve surgery after fenestration for type A dissection. All were treated with percutaneous fenestration with a 10 mm angioplasty balloon. The technique of fenestration will be discussed. The patients were followed up with duplex US imaging or iv digital subtraction angiography. RESULTS: All patients had initially successful fenestration. One died as a result of complications following aortic valve replacement surgery for a type A dissection. Two had improvement of symptoms at follow-up and imaging showed patency of the fenestration. The other patient required repeat fenestration because of recurrence of critical ischaemia in one lower limb. This patient developed acute renal failure and died 2 days after the repeat fenestration. CONCLUSION: Percutaneous fenestration can be helpful in the management of patients with iatrogenic or spontaneous aortic dissections compromising the lower limbs.

POSTER 0915

Unilateral *vs* bilateral iliac stenting of proximal common iliac disease

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PURPOSE: To compare treatment of stenotic and occlusive disease of the common iliac artery within cm of the aortic bifurcation, using either a single or bilateral "kissing" stents. MATERIALS &

METHODS: A retrospective review identified 26 patients with unilateral proximal common iliac artery disease who underwent stenting. Pre- and post-procedure ABPI, clinical assessment and duplex sonography were compared at 12 months follow-up. RESULTS: Primary technical success rate was 95%. All stented patients had abolition of trans-stenotic pressure gradients post-stenting. Both groups continue to be followed-up. At present, a single patient with bilateral iliac stents has occluded the stent on the symptomatic side. All other stents remain patent without evidence of restenosis. CONCLUSION: These early results suggest that unilateral common iliac stenting is as effective as the formation of a neo-bifurcation with "kissing" stents. Unilateral stents do not place the asymptomatic limb at risk and represent considerable financial saving.

POSTER 0916

A stitch in time?

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PURPOSE: Achieving haemostasis following arteriography and interventional vascular procedures may be difficult, particularly if clotting factors are deranged. This paper evaluates the use of an arterial suture to obtain haemostasis. MATERIALS/METHODS: The utility of a percutaneously insertable, over-the-wire, arterial closure device (Perclose™) using 3/0 suture material was assessed for eight patients undergoing interventional vascular procedures. RESULTS: Successful haemostasis was achieved using the Perclose device in five of the eight patients. One patient was fully anticoagulated on Warfarin for mitral valve disease. In two cases adequate marking was not obtained from the blood vessel and in one case a small leak occurred at the site of attempted arterial closure. Haemostasis was secured in these cases by manual compression. CONCLUSION: The Perclose device is a useful tool for arterial haemostasis following interventional vascular procedures. If correctly used it enables immediate patient mobilization following the procedure.

POSTER 0917

Embolization of bleeding false aneurysms following knee arthrodesis or arthroplasty

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INTRODUCTION: False aneurysm formation following knee replacement or arthrodesis is very rare and presentation is usually with a pulsatile mass. Traditional treatment has been with surgical exploration and ligation. We describe two cases of bleeding false aneurysms treated by percutaneous arterial embolization. PATIENTS & METHODS: Two male patients (ages 59 and 72) were referred with recurrent bleeding from a false aneurysm within 20 days of knee surgery (case one, total knee replacement, case two, knee arthrodesis). In both cases the false aneurysm was shown to arise from the left medial inferior geniculate artery at arteriography and active bleeding resulted in recurrent haemarthrosis (case one) and wound bleeding (case two). RESULTS: Ipsilateral antegrade approach with selective catheterization of the inferior medial geniculate artery and successful embolization with two 1 cm 3 mm coils in each case. No recurrence of symptoms was recorded at follow-up at 3 years (case 2) and 6 months (case 1). CONCLUSION: Bleeding false aneurysms following knee surgery can be rapidly and successfully treated by percutaneous embolization. This method will be compared with traditional surgical management.

POSTER 0918

Central vein stenting in haemodialysis patients

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In a 17 month period from January 1995 to May 1996, eight stent placements were attempted in seven patients. There were three males and four females, age range 51–72, mean 60 years. The indications were a severely swollen arm on the side of an arterio–venous fistula with poor dialysis in two patients and no dialysis catheter access in five patients, all secondary to brachiocephalic vein or superior vena cava stenosis. A total of five Wallstents, one Palmaz stent and one Memotherm stent were placed. One patient received two stents and one other had placement failure. The access site used was the femoral vein in three cases and the subclavian vein in four cases. One patient has died, but all other stents remain patent at follow-up. The arm swelling remains reduced in both previously affected cases. In conclusion, central vein stenting offers continued dialysis access for patients who previously had very limited venous access options.

POSTER 0919

A simple method of central line insertion using US guidance

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The insertion of central lines under US guidance has become a routine procedure at Addenbrooke's Hospital. Many of the patients have undergone previous line insertions and consequently have soft tissue scarring or venous occlusions. Patients are also referred following failed attempts at line insertion without guidance and may have large haematomas. We present a method of performing US guided central line insertions based on our experience of various approaches in over 200 procedures. Pitfalls and potential complications are described. A video presentation of the technique is shown which may be helpful to radiologists who wish to introduce the procedure to their own departments.

Obstetrics & Gynaecology

POSTER 1001

Imaging features in placental site trophoblastic disease

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PURPOSE: To determine the patterns of disease in placental site trophoblastic disease (PSTT), a rare variant of choriocarcinoma, and compare the imaging features with those of choriocarcinoma. METHODS & MATERIALS: 23 patients with PSTT between 1975 and 1996 were identified from the gestational tumour registry. We reviewed the imaging findings of all these patients. RESULTS: In three patients the primary tumour was calcified, this was identified by CT in all patients and by transabdominal US in one patient. In choriocarcinoma calcification is relatively rare. The tumours on US show as a transonic area with markedly increased vascularity. The median pulsatility index of the tumour vessels was 1.5 (0.5–5.1), which is higher than that of choriocarcinoma, suggesting a less vascular component. Metastases occurred in seven patients, nodal metastases in two. This is exceedingly rare in choriocarcinoma. All seven patients had lung metastases which cavitated in one patient. Two patients had liver metastases which are also extremely rare in choriocarcinoma. One patient had metastatic bone disease. DISCUSSION: The patterns of disease in PSTT are described and the differences from choriocarcinoma discussed. Awareness of these features may allow identification of patients with PSTT who should be treated with a different approach from choriocarcinoma.

POSTER 1002

MRI in patients with gestational trophoblastic disease

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PURPOSE: The purpose of our study was to describe the MRI characteristics of patients with gestational trophoblastic disease (GTD) before and after therapy; and to correlate these findings with human gonadotrophin levels and the specific histology of GTD. PATIENTS & METHODS: 13 women (mean age 30.1 years) with elevated human gonadotrophin (hCG) levels and histologically proven GTD underwent MRI examinations of the pelvis. MRI was performed on a 1.5 T unit. Axial and sagittal proton density, and T_2 weighted and sagittal T_1 weighted sequences were obtained. Four patients underwent follow-up studies after 4 and 8 weeks to monitor the response to therapy. GTD was histologically proven with curettage in 11 patients and with hysterectomy in two cases. RESULTS: Nine patients had a diffusely enlarged uterus with pathological signal intensities. In four patients a focal tumour mass was observed. All patients showed loss of the zonal anatomy of the uterus in at least one local area. In 11 cases no uterus zones could be identified throughout the entire uterus. Tumour neovasculature was evident in all patients. In all three cases in which follow-up imaging studies were obtained uterus size, signal intensities, identification of uterus zones and uterus vessels returned to normal. CONCLUSION: MRI shows trophoblastic tumour infiltration as diffuse uterus enlargement, focal tumour masses, loss of zonal anatomy of the uterus and pathological uterine vasculature, which seems to be the most reliable MRI finding in patients with GTD. No correlation was found between MRI changes and hCG levels or specific histological types of GTD.

POSTER 1003

CT appearances following surgery for ovarian cancer: post-operative change or residual disease?

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AIMS: To evaluate abdomino–pelvic CT findings resulting from total abdominal hysterectomy (TAH), bilateral salpingo–oophorectomy (BSO) and omentectomy for FIGO Stage I ovarian cancer. METHOD: The post-operative CT scans of 22 patients (age range 29–72 years) who had undergone complete surgical resection of tumour by TAH and BSO 3–14 weeks previously were reviewed. 12 patients had Stage I borderline and 10 patients had Stage IA ovarian cancer. No patient had been treated with chemotherapy or radiotherapy and all patients had normal CA125 levels after surgery. Two independent observers assessed the vaginal vault, round ligaments, bladder, rectum, perirectal fat, pelvic side walls, omental bed, abdominal wall, surgical scar, inguinal regions and bones. All patients had clinical follow-up of 11 to 78 months (median 27 months) and 10 patients also had follow-up CT scans after 6 months. RESULTS: The following abnormalities were seen: (1) Thickened round ligament ($n=11$; bilateral in eight) with bulbous masses at the surgically transected end ($n=6$; bilateral in four). (2) Vaginal vault thickening ($n=10$) either uniform ($n=5$) or bulbous (bilateral in two). (3) Omental bed stranding/nodularity ($n=11$). (4) Peritoneal thickening underlying the scar ($n=5$). Appearances either remained stable or improved in all patients with follow-up scans and no patients showed progression. CONCLUSION: Patients with ovarian cancer who have undergone TAH and BSO with complete surgical resection of the tumour have residual abnormalities identifiable on CT. Round ligament and vaginal vault thickening are routinely seen; peritoneal thickening underlying the surgical scar and omental stranding/nodularity are occasionally observed. In isolation these findings should not be attributed to residual disease.

POSTER 1004

Histological identification of the junctional zone as determined by transvaginal US

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PURPOSE: The study aims to correlate histological and US findings to define alterations in cellular composition, which are postulated to be responsible for the hypoechoic inner uterine muscle layer (junctional zone, JZ), seen ultrasonographically. MATERIALS & METHODS: Five hysterectomy specimens removed from patients with dysfunctional uterine bleeding, in whom pre-operative transvaginal US (TVS) (ALT Ultramark 4, 5 MHz probe) had revealed no focal abnormality, were re-scanned *ex situ* using a 5 MHz transducer. After assessment of the uterine zonal anatomy, a Nottingham breast location biopsy needle was inserted under US control into the boundary between myometrium and junctional zone (JZ). After fixation, sections from full thickness blocks taken at the level of the biopsy needles, were subjected to haematoxylin and eosin, CD31, Feulgens and smooth muscle actin staining. Using a CAS system, measurements were made of nuclear size. Vascular endothelium and smooth muscle was calculated from 75 well-defined nuclei and the percentage area of 15 high power fields which stained for nuclear area. RESULTS: The CD31 and actin results demonstrated similar percentages of stained area, superficial and deep to the localization wire. The mean nuclear area for these regions (45.4 *vs* 41.5 μM^2) was similar but the percentage nuclear area stained was significantly greater for the region deep to the localization wire (mean $\pm$SD; 25.1 ± 4.7 *vs* 13.6 ± 1.4; $p=0.04$). CONCLUSION: Histological analysis demonstrated a greater nuclear area, secondary to increased cell number in the JZ, compared with the outer myometrium. The mechanism by which this results in altered echogenicity is currently under investigation.

POSTER 1005

Investigation of antenatal pelvic dilatation in a district general hospital: a prospective study

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Detection of renal pelvis dilatation (ARPD) by antenatal US was first described 16 years ago. However, the definition of normal fetal renal pelvis size is still uncertain and methods of investigation of abnormal cases in the postnatal period remain unclear. Studies regarding the significance of these findings have come largely from tertiary units with selective referral patterns. PURPOSE: To determine the types and percentages of renal tract abnormalities associated with ARPD in an unselected population. To establish an upper limit of "normal" for antenatal renal pelvis measurements. METHODS: All infants with an antero–posterior renal pelvis diameter $\geq$ 5 mm on routine antenatal anomaly scan at 20 weeks gestation were eligible. All babies were investigated according to a pre-determined protocol by a combination of US, micturating cystography and diuretic renography. RESULTS: Over a period of 18 months 141 children were enrolled, of which 81 have been born and investigated. 55 (67%) infants had no abnormality found. Vesico–ureteric reflux (VUR) was demonstrated on micturating cystography in 17/78 (21%). 9/17 (52%) of this group had a normal postnatal US scan. 5/81 (6%) had significant hold-up of diuretic renography. 4/81 (5%) had other renal anomalies. There was no relationship between the severity of the VUR and the degree of dilatation of antenatal US, VUR being found in four cases where the ARPD was only 5 mm. CONCLUSION: We conclude that all infants with ARPD of 5 mm or greater have a significant risk (33%) of renal abnormality and that an upper limit of normality for the fetal renal pelvis cannot be defined at present.

POSTER 1006

Prophylaxis of pain post-hysterosalpingography: a prospective study of lignocaine combined with iodinated contrast medium

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PURPOSE: Previous studies have documented that hysterosalpingography (HSG) may be an uncomfortable procedure and that patients experience pain following the examination. Intraperitoneal surface anaesthesia has recently been used to alleviate the pain of fallopian tube sterilization. We are currently studying the effect of intrauterine lignocaine on pain following HSG. METHOD: A double-blind placebo-controlled study is being performed comparing lignocaine (maximum 80 mg) with normal saline mixed with non-ionic water soluble contrast medium. The HSG is performed in a standard manner. A pain questionnaire, using both visual analogue and descriptive scales, is completed by the patient immediately after the examination and at 24 h. Patients are also asked to describe their normal period pain levels as a control. RESULTS: 45 patients have been studied to date. Seven patients have been excluded from further analysis: two patients were lost to follow-up, two had no peritoneal spill and three patients had poor catheter seals with contrast leakage. No significant difference was demonstrated between the two groups with respect to their pain levels over 24 h. There is a tendency for the lignocaine group to immediately rate their HSG pain more favourably than their period pain, but at 12 h this group tends to experience more pain than the control group. CONCLUSION: Patients continue to experience pain up to 24 h after an HSG. The addition of lignocaine to the contrast medium does not alleviate this.

Breast Imaging

POSTER 1101

Open-access breast US for GPs: is it worthwhile?

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An open-access service for breast US for GPs was established over 2 years ago. Strict guidelines were circulated to all practices in our area which included age ranges and indications for referral. PURPOSE: To assess the adherence to guidelines for breast US by GPs and to assess the percentage and significance of pathology detected. METHODS: A prospective study was performed of 60 sequential patients referred from GPs for breast US alone. Reasons for referral were examined and results categorized as normal, non-cancerous pathology or cancer. All examinations were carried out by an experienced consultant radiologist. MATERIALS: Each examination was performed on an Aloka SSD-650 US machine using a 7.5 MHz probe. RESULTS: Referral guidelines were adhered to in 40/60 (66.6%) patients but not in the remaining 20/60 (33.3%). 47/60 (78%) had normal examinations. 12/60 (20%) had non-malignant pathology. 1/60 (1.6%) had a malignancy. This would have been likely to present to a breast surgeon had the open access US service not been available. CONCLUSIONS: Adherence to guidelines is moderate, but could be improved. Open access breast US for GPs is unlikely to contribute to the detection of breast cancer in the population for which it is appropriate as the primary investigation and largely serves to reassure the patient and her GP.

POSTER 1102

US appearances of galactocoeles

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PURPOSE: A galactocoele is an uncommon breast lesion consisting of a cyst containing milk, which tends to occur in young women during lactation. The purpose of our study was to review the US features of galactocoeles presenting to the Nottingham Breast Unit. MATERIALS & METHODS: Eight women presented to the Nottingham Breast Unit between 1994 and 1995 with a breast lump, found after investigation to be a galactocoele. US was performed by a radiologist experienced in breast imaging and the following features were documented: echogenicity, homogeneity, margin definition and the presence or absence of distal attenuation or enhancement. RESULTS: Five of the eight women were breast feeding at the time of presentation and two had given birth within the previous 12 months. The remaining subject had developed a galactocoele in the same place during a previous pregnancy. All the US scans were abnormal. 50% of the lesions were cystic or multicystic, 37% mixed cystic/solid and 13% appeared solid. Two of the galactocoeles with apparent solid elements in our series had poorly defined margins, suggestive of an intracystic carcinoma. The pathognomonic feature of a fat fluid level was seen in only one case. CONCLUSION: Galactocoeles commonly appear on US as multicystic or mixed cystic solid lesions with distal acoustic enhancement. Inhomogeneous solid components mean that the US appearances can mimic an intracystic carcinoma. The true nature of such masses are, however, suggested by a history of recent parturition, the aspiration of milk and complete resolution at clinical follow-up.

POSTER 1103

Can lesion shape features be of use to the mammographer?

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PURPOSE: To determine whether certain shape analysis tools might significantly segregate benign from malignant lesions within a digital environment. MATERIALS & METHODS: Recently developed shape analysis tools are based on circularity (shape number difference, shape number, maximum enclosed circle ratio, perimeter/area ratio), gross shape irregularity (convex hull) or a measure of perimeter irregularity (standard deviation of the tangent gradient and fractal dimension). A set of validated digital mammograms were analysed using these morphological tools. The mammograms were displayed on a 21 inch Trinitron Mitsubishi monitor as two 1024×1024 images using an image display and analysis system (MIDAS), running from a Dec Alpha station. Lesion shapes were extracted and stored for further analysis by a radiologist using a standard graphics programme on MIDAS. Statistical significance of the numerical results was determined by ANOVA. RESULTS: Benign and malignant lesions were significantly differentiated by measures of circularity and gross shape irregularity, including convex hull ($p < 0.004$), shape number difference ($p < 0.01$) and shape number ($p < 0.04$). The remaining five features showed no significant differentiation ($p > 0.1$). CONCLUSION: Shape analysis features, notably those defining circularity and gross shape irregularity, can significantly segregate benign from malignant lesions. Future work will assess the clinical benefit of morphological analysis within the rapidly expanding digital environment.

POSTER 1104

Quantitative spatial assessment of contrast uptake heterogeneity of breast tumours by dynamic MRI

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PURPOSE: Empirical MRI observations have shown peripheral enhancement to be a characteristic of breast cancer. Our aim was to quantify and assess contrast uptake differences between peripheral and central parts of primary breast tumours using dynamic MRI. MATERIALS & METHODS: 87 women were studied. An experienced reader drew regions of interest (ROI) that corresponded as much as possible to the anatomical extent of lesions, and assessed each lesion for the presence or absence of peripheral enhancement. Each ROI was processed by a parallel thinning algorithm to define subregions, representing the lesion centre and periphery, with preservation of the original ROI skeleton. The mean signal intensity of every region and subregion was calculated at each time-point to construct time–intensity plots. Differential enhancement between tumour periphery and centre was quantified in a manner analogous to image contrast. RESULTS: 60 malignant and 30 benign lesions were examined. Fibroadenomas accounted for 87% of the benign lesions. Peripheral enhancement was seen in carcinomas only (sensitivity = 0.33, specificity = 1.00). Strongly significant differences in differential enhancement (periphery *vs* centre image contrast) were found between benign and malignant lesions; these were maximal about 3 min post-contrast ($p < 0.0005$). Moreover, central areas showed a much greater relative change in signal intensity with time ($p < 0.0005$). This previously unappreciated phenomenon was more obvious in benign lesions (50% *vs* 95% signal intensity increase for the periphery and centre, respectively, $p < 0.0005$), but was also apparent in malignant tumours (55% *vs* 85%, $p < 0.0005$). CONCLUSION: There are significant contrast uptake differences between peripheral and central elements of both benign and malignant lesions. These observations probably reflect the substantial "within tumour" spatial heterogeneity and have direct implications for protocols of regional sampling of dynamic breast MRI data.

POSTER 1105

MRI of breast implant failure

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PURPOSE: There has been much recent public and regulatory concern with the safety of silicone breast prostheses. Fewer than 100 000 prostheses have been placed in the UK and complications are rarely encountered. We illustrate the typical imaging findings of implant failure with reference to optimal MRI techniques. METHODS: 12 single lumen silicone prostheses in nine patients were examined using a dedicated breast coil on a Siemens 1.5 T Vision system. T_1 weighted SE and T_2 weighted FSE and STIR sequences were obtained. The FSE T_2 weighted images were obtained using fat, water and silicone suppression. Dynamic Gd-DTPA enhancement was used in six patients. Capsular retraction with infolded membranes were seen in five; prostheses rupture was seen in four (extracapsular three, intracapsular one); gel bleed in two; free silicone induced inflammatory reaction in three; fibrosis in the absence of silicone in two; silicone in regional lymph nodes in one; a large post-operative fluid collection in one and recurrent cancer in one. CONCLUSIONS: MRI is useful for evaluating implant integrity. The use of selective suppression of fat, water and silicone can help clarify abnormalities.

POSTER 1106

Sterilization during breast biopsy procedures: assessment of practice in NHS breast-screening units

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PURPOSE: This study assesses the sterility of breast biopsies under US. METHODS: All breast-screening units received a questionnaire, 73 replied. RESULTS: An average 300 biopsies per year were performed (range 0 to 3100). Nine centres performed < 50/year and four centres >900/year. The mean number of US biopsies was 80/year. 17 centres performed >100 biopsies/year and 18 centres <10 biopsies/year. Written consent was obtained for FNA in 3/73 centres; 41 centres perform Tru-cut biopsies, seven obtain written consent prior to this procedure. Only one centre gets written consent for both procedures. 27/73 use sterile packs for FNAs. 29/41 centres performing Tru-cut biopsies use sterile packs. The majority of centres (55) sterilize the skin with a Steriswab only, 29 centres use an alcohol solution and a minority (13) of centres use both. 24 units sterilize the transducer with an alcohol wipe prior to biopsy, 46 centres do not. One unit only immerses the transducer in sterilizing fluid. Two units cover the transducer with a sterile condom. For core biopsies, nine units only used hospital standard CSSD procedures to sterilize the gun. 12 units used disposable equipment and eight of these specified disposable needles. Only 21/73 units had been advised by their infections control advisor. Only four minor infections following biopsy occurred, two in one centre and one each in other units. 21059 biopsies were performed. CONCLUSION: The infection rate is 0.019% despite many uncomplicated sterilization procedures.

POSTER 1107

Interstitial laser photocoagulation for fibroadenomata of the breast

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PURPOSE: Breast fibroadenomata most frequently occur in young women and are often multiple. Surgical resection can lead to multiple scars. The aim of this study was to evaluate the potential role

for interstitial laser photocoagulation (ILP) for the non-surgical, *in situ* destruction of breast fibroadenomata. MATERIALS & METHODS: 15 patients with discrete palpable lumps (median diameter 28 mm) which had the ultrasonographic and cytological (C2) features of benign fibroadenomata were studied. Between two and four, 18G needles were passed into the tumours under US guidance and 400 μm optical fibres passed through each of these. The fibroadenomata were treated with a diode laser (805 nm, 2W per fibre for up to 500 s). Response was assessed by follow-up US ($n=15$) and contrast enhanced MRI ($n=6$). Five patients underwent surgical excision. RESULTS: Serial US showed size reduction in all treated fibroadenomata (mean reduction of 40% at 8 weeks). Histology showed >90% necrosis in the five excised tumours. MR showed the area of necrosis as an area on non-enhancement within the tumour. The unresected fibroadenomata have shown a progressive and sustained reduction in size on US. CONCLUSION: ILP is a promising, minimally-invasive treatment for fibroadenomata of the breast.

Nuclear Medicine

POSTER 1201
In vivo biodistribution and kinetics of a US contrast agent (Quantison™) by radiolabelling and γ scintigraphy

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PURPOSE: Quantison™ is an air-filled microcapsule formulation, mean diameter 4.0 μm having a shell of cross-linked human serum albumin, mixed with a glucose excipient. This material is currently undergoing clinical evaluation for use as an iv US contrast agent. As part of the safety evaluation of this agent, *in vivo* biodistribution and kinetics were examined by radiolabelling the microcapsules and imaging using a γ camera. MATERIALS & METHODS: 12 healthy male subjects (age range 30–44 years) were administered approximately 50 million microcapsules per kg body weight, radiolabelled with 50 MBq ^{123}I. Imaging was performed over 58 h using a large field of view γ camera and the amount of labelled material present in the blood, urine and faeces measured. RESULTS: No adverse events were observed. Imaging demonstrated that the liver was the organ with the highest uptake and that uptake in the lungs was low (less than 2%). There was also evidence of myocardial perfusion and a small amount of uptake was visible in the bone marrow. Assay of activity in the blood and urine confirmed the imaging findings. CONCLUSION: Overall, this novel study demonstrates the safety of Quantison™ and confirms the satisfactory biodistribution of the agent. Together with the clinical US findings these data suggest that the proportion of microcapsules remaining in the circulation are highly reflective of US, even at low concentrations.

POSTER 1202
Synthetic peptide imaging of venous thrombosis

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PURPOSE: The non-invasive imaging of venous thrombosis has always been problematical. Contrast venography has been the effective "gold standard", however it can be technically difficult, uncomfortable for the patient and cannot differentiate between fresh and old clot. A new synthetic peptide (P280-Diatide, Inc., Londonderry, NH, USA) has been developed which can be complexed to ^{99}Tc^{m} and recognizes the IIb/IIIa receptor on activated platelets. It should therefore identify active clot formation and platelet activation. METHOD: We report our experience with eight adult patients with suspected acute peripheral deep vein thrombosis. The patients were imaged with 740MBq of ^{99}Tc^{m} P280 over a 3 h period. All patients underwent standard contrast venography. RESULTS: There was rapid clearance of the ^{99}Tc^{m} P280 from the blood pool and excellent images were obtained 60 and 120 min post-injection. There were no adverse reactions to the peptide. Within the venous structures there was concordance between the two techniques in all but one patient, with proven multiple pulmonary emboli, who had a positive ^{99}Tc^{m} P280 scan and a negative contrast venography. In addition, there was also localization in sites of synovial joint inflammation (two patients) and cutaneous petechiae in a third patient with a calf cellulitis. CONCLUSION: These results demonstrate that imaging with radiolabelled synthetic peptides may open up new areas where nuclear medicine has previously been unhelpful and can provide an alternative to invasive or uncomfortable radiological studies.

POSTER 1203
Comparative study of radioimmunoimaging and US in diagnosis of ovarian neoplasma

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PURPOSE: To study the clinical value of radioimmunoimaging (RII) in the early and distinctive diagnosis of ovarian cancer. Also to compare the diagnostic efficacy of RII with US in ovarian neoplasms. METHODS: The ^{99}Tc^{m} labelled anti-CEA monoclonal antibody C50 was used. RII and US diagnosis were both performed in 62 patients with ovarian tumours. Diagnosis was pathologically proved after operation, tumours included 12 malignant and 50 benign. RESULTS: The sensitivity, specificity and accuracy of RII and US were 100%, 82%, 85.5% and 83.3%, 96%, 93.5% respectively. The detection rate of gynecological tumours of RII and US were 88.3% and 50%. The multiple sensitivity and specificity of two serial tests were 83.3%, 99.3% respectively. CONCLUSIONS: The sensitivity and detection rate of gynecological tumours of RII were better than US particularly in finding metastasis. RII combined with US is more satisfactory for the diagnosis of ovarian tumours.

Radiotherapy & Oncology

POSTER 1301
Drug interaction with radiopharmaceuticals: a study using a statistical analysis

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PURPOSE: The effects of therapeutic drugs on biodistribution have long been recognized as a relevant factor in the interpretation of scintigraphic images. We have studied the influence of cyclophosphamide on the biodistribution, in mice, of ^{99}Tc^{m}-radiopharmaceuticals. MATERIALS & METHODS: Cyclophosphamide was administered to BALB/cJ mice and the radiopharmaceutical (^{99}Tc^{m}GHA, Na^{99}Tc^{m}O$_4$, ^{99}Tc^{m}MDP, ^{99}Tc^{m}DTPA) (150 kBq) administered 1 h later. The animals were sacrified, their organs isolated and the activity determined in a well-counter. The percentage of activity in the organs was calculated by four methods: dividing (1) the activity in each organ by the sum of activities in all organs; (2) the activity in each organ by the activity administered; (3) the result obtained in method (1) by the mass of the specific organ; and (4) the result obtained in method (2) by the mass of the specific organ. RESULTS: The results show that cyclophosphamide: reduces the mass of the spleen; decreases Na^{99}Tc^{m}O$_4$ in the ovary, kidney and heart; increases ^{99}Tc^{m}GHA in the ovary, uterus, spleen and heart; decreases ^{99}Tc^{m}MDP in the uterus, heart and lung; and increases ^{99}Tc^{m}DTPA in the ovary, kidney and brain. CONCLUSION: We concluded that the comparison of the cyclophosphamide effect on radiopharmaceutical biodistribution and the analysis of these results using statistical procedures, related to grouping techniques ("Cluster analysis"), allows the identification of the following sub-compartments and compartments: splenic-genital (ovary, uterus and spleen); metabolic (liver and kidney); cardio–respiratory (lung and heart); and individual organs (stomach, thyroid and brain).

POSTER 1302
Biodistribution and pharmacokinetics of ^{111}In-DTPA-labelled STEALTH® liposomes in patients with solid tumours

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PURPOSE: To investigate the biodistribution and pharmacokinetics of ^{111}In-DTPA-labelled STEALTH® liposomes (IDLSL) (SEQUUS™ Pharmaceuticals Inc., Menlo Park, USA) in patients with solid cancers. MATERIALS & METHODS: 17 patients (nine male and eight female, median age 59 years) with various solid cancers (five breast, five head and neck, four lung, two glioma, one cervix) received 67–100 MBq of IDLSL on day one. Blood samples and whole body γ camera images were taken at 0.5, 4, 24, 48, 72, 96 and 240 h and sequential 24 h urine collections were performed for 4 days. SPECT imaging was performed when indicated.

RESULTS: The tumour was imaged in 15/17 patients (four out of five breast, all head and neck, three out of four lung, both glioma, and cervix). The median $t_{1/2}$ of IDLSL was 60.3 (range 40–103) h. The median cumulative urinary ^{111}In excretion was 17.8% (range 3.5–27.8) of the injected dose. IDLSL uptake in various tissues was estimated from regions of interest on the whole body and SPECT images. Prominent uptake was seen in the liver (10–15%), lungs (4–9%) and spleen (2–8%). Tumour uptake in the first 96 h varied from 0.5–4% of the injected dose. CONCLUSION: These data confirm that STEALTH liposomes have a prolonged circulation half-life and localize specifically in solid tumour tissue. They have potential applications in the targeted delivery of cytotoxic chemotherapy, radiosensitizing drugs and β emitting radionuclides.

POSTER 1303

An activity-based costing of radiotherapy treatments

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PURPOSE: Recent changes within the NHS, brought about by the White Paper "Working for Patients" (1989), have resulted in a need to more fully understand the cost of radiotherapy services. The purpose of this study was to review existing literature on the subject and to cost radiotherapy treatment using an activity-based costing method. METHODS: Data collection took place in three departmental areas, the simulator, planning and treatment units over a 6 month period and included 989 subjects. The length of time that equipment was used by patients was recorded, along with anatomical region treated, treatment details, number and grade of staff involved. Groups of like time in each of the three areas were established using a Bonferroni test ($p<0.05$), (modified least squares difference test). Costs per procedure/fraction were then calculated using the averaged group time multiplied by the cost per minute to operate/run each unit. RESULTS & CONCLUSION: Considerable differences in cost between this method and the existing costing method were found, especially when comparing the cost for hypofractionated treatments. These differences occurred because of the variation in sophistication between the two cost mechanisms. The more sensitive nature of this costing mechanism suggests that cost comparisons/cost benefit studies should use an activity-based model. This gives a more realistic reflection of cost allowing more rational capital investment within the department.

POSTER 1304

Drag perfusion of the bronchial artery in the treatment of late bronchogenic carcinoma

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141 cases of late advanced primary carcinoma of the lung were treated by intraarterial drug perfusion through the bronchial artery (a total of 312 injections). Many cases were proved pathologically and clinical staging was Stage III in 118 cases and Stage IV in 23. The short-term effects were as follows: complete remission in two patients; partial remission in 32; no change in 67; and progression in 40. The effective rate of treatment was 24.11% without untoward complications. Preliminary results indicate that intraarterial drug perfusion through the bronchial artery is safe and effective in the combined treatment of carcinoma of the lung.

POSTER 1305

Radiation complications after combined radiotherapy in patients with locally advanced cervix uterine cancer

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236 patients with locally-advanced cervix uterine cancer were investigated. All patients received combined intracavitary and external split-course radiotherapy. The control group (174 patients) received intracavitary γ-therapy with ^{60}Co. The main group (42 patients) was treated with intracavitary ^{137}Cs. Estimation of treatment tolerance showed a lower reaction rate in the main group of patients during radiotherapy. Investigation of local radiation reactions showed that the number of enterocolites, epithelites of cervix uterine, among patients of both groups did not differ significantly. At the same time, no rectites were observed in the main group, while in the control group they were noted in 4.1% of patients. Cystitis rate was 5.4% and 6.9%, respectively. The late cystitis rate in the first group of patients was considerably lower than in the second group: 4.8% *vs* 14.9% respectively. No late rectites were noted in the first group while in the second group their rate was 16.1%. The number of enterocolites in the first group was also less, 3.2% against 9.2% in the second group. The observation period of the first group of patients was shorter (but not less than 1 year). Therefore the data presented may change. But considering the fact that later complications occur mainly in the first and second years of follow-up, no significant changes are expected.

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POSTER 1306
An audit of fractionated total body irradiation toxicity and dosimetry

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PURPOSE: A simple technique for giving fractionated total body irradiation (TBI) at Cookridge Hospital, Leeds has been used since 1989. This paper describes our technique and results as a model for possible use in other centres. METHOD: We followed up all patients who were treated with TBI, using this technique, who underwent an allogeneic bone marrow transplant (BMT) between October 1989 and December 1995. The notes were audited. Our technique will be described. We gave 14.4 Gy in eight fractions over 4 days to all patients with an unrelated donor and 12 Gy in six fractions over 3 days to those with a sibling donor. RESULTS: 48 patients were treated (26 adults and 22 children). Dosimetry revealed acceptable lung and abdominal dose homogeneity. Details of the dosimetry, the conditioning regime and the patients' disease state will be presented. The most troublesome acute toxicity was mucositis. 38 patients developed mucositis requiring iv opiates. The mean duration of opiate administration was significantly greater in the 12 Gy group (4.9 days CI 1.2–8.6) than in the 14.4 Gy group (12.9 days CI 9.7–16.1) and in adults more than in children. No cataracts or radiation pneumonitis have been seen. Details of causes of death will be presented. None of the deaths were proven to be due to TBI. CONCLUSION: TBI was relatively simple to administer, achieved acceptable dose homogeneity and was well-tolerated.

Physics

POSTER 1401
BANG gel dosimetry and the verification of intensity modulated radiotherapy plans

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PURPOSE: Intensity modulated (IM) radiotherapy offers the potential for greater conformation of dose to tumour and, therefore, tumour dose-escalation. A disadvantage of the IM approach is that quality-assurance matters, such as dose-distribution prediction and verification, become even more critical. Current methods of dose verification (film, TLDs, ion chambers and diodes) are inadequate for verifying IM dose-distributions, as they do not yield a full 3D map of the delivered dose. Recently a new type of "BANG gel" dosimeter based on the principle of radiation-induced polymerization has been proposed, which can measure the dose in full 3D. Here we present a study investigating the application of BANG gel dosimetry to verifying an intensity-modulated plan. METHOD: An inverse-planning algorithm was used to compute IM profiles for a nine coplanar field plan for a body phantom. The phantom consisted of a patient-sized perspex elliptical ring with a cylindrical gel-insert situated centrally and with diameter 16.5 cm. The combined phantom was irradiated with the nine IM fields via the multi-leaf intensity-modulation collimator (NOMOS MIMIC) and the gel then imaged in a 1.5 T MRI scanner to determine a 3D map of the R_2 relaxivity in the gel. The R_2 map can be converted into a 3D distribution of absorbed dose by applying a calibration curve. RESULTS: The dose-distribution measured by the BANG gel dosimeter was found to closely correspond to that predicted by the delivery model. A detailed analysis will be presented.

POSTER 1402
A comparison of diode detectors and TLD for tumour dose audit in external beam radiotherapy

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PURPOSE AND MATERIALS: The purpose of this work was to compare the use of Scanditronix *p*-type semiconductor diode detectors and LiF:Mg,Ti (TLD 700) extremity monitors used in conjunction with an automated TLD facility (Harshaw 6600) for making entrance and exit dose measurements in external beam radiotherapy. METHODS: Delivered tumour doses were estimated for a variety of radical treatments from entrance and exit measurements. Performance of both types of dosimeter was investigated and calibration techniques were established. Tumour doses were estimated from exit dose measurements made with TLD for patients receiving pelvic, head and neck and breast treatments. In a separate study, tumour doses were derived from entrance or exit measurements using diodes for the above treatments and, in addition, for oesophagus and bronchus treatments. RESULTS: Tumour doses were within $\pm 5\%$ of the prescribed doses in 96% and 91% of treatments for the diode and TLD studies respectively. Although the off-line processing of TLD dosimeters minimizes the time spent on *in vivo* dosimetry at the time of treatment, this is offset by an inferior precision of TLD [$\pm 2\%$ (± 1 sd)] compared with diodes [$\pm 0.2\%$ (± 1 sd)]. In addition, the lack of complete electronic equilibrium, associated with the extremity monitors, necessitates an exit surface obliquity correction which is not required with diode detectors.

POSTER 1403
The use of wavelet analysis for the detection of small airways disease from CT images

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PURPOSE: Conventional studies which aim to elucidate the pathological state of small airways in patients rely on findings of grossly diseased lobectomy specimens, or on indirect evidence from lung functional tests. CT provides an alternative way of assessing the extent of small airway disease and makes possible a more precise estimation of severity. The common feature of small airway disease on CT is areas of decreased attenuation relative to adjacent normal lung parenchyma. The certain identification of such areas is difficult in practice, particularly if they are poorly marginated. MATERIALS: Validation of the technique has been performed using a patient study group consisting of 15 cases with varying degrees of severity of obliterative bronchiolitis. METHODS: This study presents a novel approach to the enhancement of feature differences between normal and diseased lung parenchyma, so that reliable visual assessment can be made. It is accomplished using a hybrid structural filtering and wavelet feature reconstruction technique to localize and enhance salient, as well as subtle, image features so that an attenuation index with regard to the extent of the disease can be derived. CONCLUSIONS: The use of high resolution CT imaging, combined with the proposed image enhancement and classification technique, hold the potential for providing a robust and sensitive solution to detecting and quantifying the presence and extent of small airways disease. Technically, the proposed hybrid structure filtering technique represents a novel approach to image feature identification.

POSTER 1404
Simulator for endovascular repair of abdominal aortic aneurysms

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A prototype simulator for endovascular repair of abdominal aortic aneurysms (AAAs) has been developed. The main design considerations were that the system should not require the use of X-ray and that it should be kept as simple as possible, while providing all the

important features for catheter guidewire-imaging training. Our system consists of interchangeable models of human AAA produced from spiral CT images using computer-aided design and manufacture techniques. The anatomically accurate models, having renal, iliac and femoral arteries, are fabricated from optically clear silicone elastomer which mimics the flexible properties of natural arteries. The system is perfused with a blood-analogue fluid in pulsatile flow. "Fluoroscopic imaging" is simulated by a computerized video imaging system. A video-camera, supported on a C-arm joined to a movable gantry, provides images in the antero–posterior, oblique and lateral planes of the AAA on a monitor. Bony landmarks are provided by an abdominal X-ray film placed behind the AAA. By altering the refractive index of the circulating fluid, the lumen of the AAA model can be made invisible under normal imaging conditions. Aortograms can be simulated by injecting ink via a catheter while initiating the acquisition of a number of video frames upon activation of a footswitch. The imaging system also allows "road-mapping" procedures to be simulated for accurate deployment of the stent-graft. Once deployed, the stent-graft can be retrieved via the "supra renal aorta".

POSTER 1405

Assessing accuracy and reproducibility of quantitative analysis

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PURPOSE: Using quantitative analysis as an effective method of assessing the accuracy and reproducibility of measurements obtained during coronary arteriography. MATERIALS: The Southampton University Hospitals Trust workshops manufactured a test-tool from a Perspex block with precision-drilled holes representing the normal range of coronary vessel size. Each end of the drilled hole was threaded and caps were fitted whose removal allowed easy filling or drainage of contrast media. A further hole was drilled to house a length of 7 F coronary catheter, this is used to calibrate the test tool for quantitative analysis. METHOD: To assess the accuracy and reproducibility of quantitative analysis, the drilled holes were filled with optimum strength contrast media. The test tool was then placed in the equipment isocentre and images were recorded by cine angiography and stored on the system's hard disc. The images were recalled and measurements taken after calibration using both manual and automatic edge-detection methods. RESULTS: The system tested showed accuracy to be >95% and reproducibility >90% when using automatic edge-detection. However, with manual edge-detection the wide range of measurements obtained caused both accuracy and reproducibility to decrease substantially. CONCLUSIONS: Results have shown that with automatic edge-detection, measurements can be accurate and reproducible. The use of manual edge-detection was a source of intraoperator variability which affected both accuracy and reproducibility. It is anticipated the test tool will be used to compare the present system with the CASS II system which was recently installed.

POSTER 1406

***In vitro* study for the development of a novel high-density barium preparation for colonic examination**

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Barium preparation for radiological examination of the internal tract requires the control of a variety of physical properties. Since the discovery of double contrast, preparations of low viscosity and high density are essential for high resolution images. The particle-size distributions of various commercially available barium sulphate suspensions were determined by scanning electron microscopy and laser diffraction. Aqueous mixtures of barium sulphate polysaccharide were evaluated for suspension stability. The interaction of the colloidal barium sulphate particles–gum–water system has been studied by proton NMR relaxation decay curves. The analysis of longitudinal and transverse magnetization decay curves of water protons give information on the dynamic state of water-polysaccharide systems. Polymer networking involves the formation of a stable cluster. The lifetime of the cluster is comparable with water proton relaxation times and as such gives information about both the water and water–polymer interactions. From our results obtained from barium preparation coating *in vivo*, we have created an intestinal mucus–mucosa model which has been utilized for phantom imaging. This has shown the ability to produce an X-ray opaque coating visualizing the "mucosa" surface pattern. Scanning electron microscopy of the coating on intestinal mucosa has been investigated. To conclude, the use of our novel barium preparation gives a high resolution image. We consider this to be an alternative to contrast chromoscopy which uses an indigo carmine capsule.

POSTER 1407

Multileaf collimation: a necessity in a modern department

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The Christie Hospital NHS Trust became the UK pilot site for the multileaf collimator (MLC) in 1990. Since then the development of conformal radiotherapy has been actively pursued. The Radiotherapy Department now has two linear accelerators with MLC capability in full clinical use. The MLC is a computer-controlled device which can shape (conform) the radiotherapy beam to the shape of the tumour or tumour site. The inherent advantages of MLC treatment techniques are a significant reduction in the treatment volume and a subsequent reduction in tissue irradiation. An additional advantage has been the reduction in treatment planning and improved accuracy of radiotherapy delivery. In many centres custom-made blocks or templates are produced for each patient and a considerable amount of time is spent in this preparation. The MLC cannot carry out more than can be achieved by the use of customized blocks, but the ease with which irregular shapes can be produced enables the patient to be planned and treated more rapidly. There is also practical scope for the day-to-day modification of beams in response to positioning errors. The ability to treat irregular shapes without adjusting the patient position leads to an improvement in the accuracy of radiotherapy delivery and delineation of field edges. The poster will show the various MLC techniques currently used and those presently under consideration.

POSTER 1408

Factors influencing the accuracy and precision of mapping T_1 and T_2 relaxation rates in MRI

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PURPOSE: The purpose of this work is to examine the dependence of the accuracy and precision of T_1 and T_2 mapped parameters on field strength, scanner type and scanner manufacturer. The ability to accurately and reliably make measurements of tissue T_1 and T_2 relaxation rates is very important for quantitative tissue characterization. MATERIALS & METHODS: The UK Department of Health MRI evaluation centre (MagNET) carries out independent assessments of the imaging performance of MRI systems as they are released into the UK market place. As part of this evaluation programme, MagNET make measurements of T_1 and T_2 relaxation rates over a clinical range with the Eurospin gel test object TO5. Two sets of measurements are made over a 24 h period, from which percentage error in precision can be calculated. Percentage error in accuracy is calculated using reference theoretical T_1 and T_2 relaxation rates. RESULTS: A large database of T_1 and T_2 accuracy and precision measurements has been collected since 1988 and published in 41 MDA blue cover evaluation reports. A series of comparison graphs are plotted to establish the influence of each factor. CONCLUSION: A comprehensive study of the measurement data shows significant parameter dependence on the manufacturer and the type of system. The results also indicate no apparent parameter dependence on field strength.

POSTER 1409

Health education needs of breast cancer patients invited to participate in clinical trials

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OBJECTIVE: Currently only 8% of eligible patients enter trials of primary cancer treatments in the UK. Overcoming this reluctance to participate is of great concern to research bodies and clinicians alike. The aim of this research is to allow women with breast cancer to participate in identifying the priorities for improving accrual rates. METHODS/PATIENTS: A standard qualitative research methodology of triangulation was undertaken with 30 breast cancer patients, 10 of whom took part, 10 who agreed to participate but later withdrew and 10 who refused to participate in a research study. Each patient completed a short questionnaire on medical history and educational status. Individual taped interviews were followed by focus-group participation to stimulate discussion on improvements in the recruitment process, with particular attention to quality and delivery of information, loss of control and responsibility for failure. RESULTS: Preliminary results indicate the importance of educational status, quality and timing of information received,

recruitment by dedicated clinical trialist and basic parameters of anxiety state and personality variables. CONCLUSION: Patients invited into clinical trials would be more willing to participate if both the quality of research information and the timing of its delivery were optimized. It is hoped that the methodology developed can act as a working model for assessing health education needs for any clinical trial participants.

POSTER 1410

RF electrode arrays for thermal ablation

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INTRODUCTION: Radiofrequency thermal ablation is an important tool for minimally invasive therapy. Detailed design of the applicator requires investigation for optimal thermal lesion size relative to the number of needle insertions required. We have investigated thermal deposition as a function of number and spacing of electrodes on a specialized 0.17 T and a 1.5 T whole body imager. METHODS: Electrode arrays consisting of four copper wires located on a plastic former on the corners of squares of size 1, 2 and 3 cm have been driven with continuous wave radiofrequency of 15 watts at 7.1 MHz for between 200 and 600 s. Samples of chicken muscle were used. Imaging was performed using T_1 weighted sequences following the thermal procedure. In separate experiments detailed thermal profiles were measured. RESULTS: Thermal lesions could be generated with volumes proportional to the spacing of the electrodes and the total energy deposited. The thermal response also depended on the volume into which the energy was deposited as would be expected from calorimetric considerations. T_1 weighted images clearly defined the region of heating which correlated well with the size of the lesion as observed visually following cutting of the sample. DISCUSSION: RF electrode arrays can potentially increase the volume of tissue irradiated relative to the number of needle insertions required for the applicator, thus providing a benefit to the patient undergoing minimally invasive therapy.

POSTER 1411

Non-subjective brain volume measurements by 2D cluster analysis

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PURPOSE: To develop a robust, non-subjective method of measuring cerebrospinal fluid (CSF), white and grey matter volumes from dual echo MR images. METHODS: A SE3565/(20 and 90) sequence was used on a Siemens 42SPE 1 T imager. 31 contiguous 5 mm slices were collected in the Talairach plane with FOV = 250 mm, MA = 192 × 256. Measurements were validated on an agarose test object. The data was analysed with the software package Analyze. Extracranial tissues were removed by editing the T_2 images. The volumes were measured using the "unsupervised chain method" in the multispectral option. Suitable slices were used for non-subjective training. 10 subjects with a wide range of atrophy were also scanned using a high-resolution turboFLASH sequence, with voxel size 1 × 1 × 1.5 mm. Whole brain volumes were found by semi-automatic editing in Analyze. RESULTS: The error in the known volume of the agarose object was: white matter, −1.7%; grey matter, −11.4%; CSF + 2% (negative indicating under-estimate). The error in the grey matter was partly due to object construction. Two subjects, scanned five times, had reproducibility errors of white matter < 5%, grey matter < 6%, CSF < 10%. Correlation of multispectral and turboFLASH measurements gave a straight line with slope 0.95, correlation coefficient 0.95, intercept −103 cc. This offset is equivalent to one pixel depth over the surface of the brain and represents a systematic difference in methods. CONCLUSION: Despite 5 mm slice width data being subject to partial voluming, this method gives a reproducible, accurate and completely non-subjective measurement of brain volume.

POSTER 1412

Detecting stellate distortions in digital mammography via statistical models

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PURPOSE: Mammograms are complex in appearance and early signs of disease are often subtle or small. Abnormalities, such as stellate distortions, often present patterns of linear structures with a focused appearance. Most current automatic detection techniques are limited to features known to be important, such as radiating linear structure concurrency, spread of focus and radial distance. We present the results of an abnormality detection experiment based on a generic pattern representation and statistical model that is both complete and uncommitted. METHODS: Since digitized mammograms usually contain only subtle evidence of systematic pattern structure, partially masked by a substantial clutter of linear features, it is essential to be able to extract the structured pattern. We demonstrate the use of factor analysis to separately model the random and systematic pattern structure variation over a training population extracted from digitized mammograms. RESULTS: We show how a model trained purely on lesion data can be used to differentiate between lesion and non-lesion pixels. We present ROC results of "leave one mammogram out" pixel classification experiments producing a total correct pixel classification of 92%. We demonstrate the application of the model to lesion detection, using a data set of 38 digitized mammograms and present lesion classification results in the form of FROC curves for lesions of 2.5 mm and above. We demonstrate a ratio of true to false positives of unity with a sensitivity of approximately 80%. CONCLUSIONS: The application of this generic technique to mammographic line patterns demonstrates successful classification without the need for *a priori* knowledge. Results from previous experiments to determine the stringent lesion detection performance required by automated systems show that our representation performs close to the required level.

POSTER 1413

An MRI phantom for measuring the spatial resolution of an MRI scanner

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METHODS & MATERIALS: MRI is used routinely for high resolution imaging of the inner ear, hippocampal body and lumbar spine. We were interested in the spatial resolution of our GE Signa 1.5 T scanner. A quality assurance phantom for assessing the spatial resolution of T_1 and T_2 weighted imaging sequences has been designed and manufactured to ISO 9000. The spatial resolution phantom contains four Perspex inserts, each with holes drilled at various sizes and spacings. The L-shaped layout of holes allows assessment of spatial resolution in both the frequency and phase directions. The inserts were positioned orthogonally in a Perspex housing to enable measurement in the orthogonal planes and obliquely. The Perspex phantom was filled with a very fine oil to provide the MRI signal. The phantom has been scanned using both T_1 and FSE techniques and has been used to assess the effect of increasing echo train length in FSE on small bright objects. RESULTS: Our findings show that our scanner performs slightly outside the expected pixel-limited resolution. The effect of increasing echo train length in FSE techniques on small bright objects is also presented.

POSTER 1414

An investigation into tissue mimicking gels for an MRA phantom

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PURPOSE: MagNET, the UK magnetic resonance assessment team, are using the UHDC pulsatile flow system (Quest Image Inc.) with an MRA test object to investigate the image quality of angiographic sequences on MRI scanners from different manufacturers. The aim of the work presented here is to examine the use of tissue-mimicking gels to surround the flow tubes in order to achieve clinical relevance. METHODS: A compensated waveform that reproduces a carotid waveform at the centre of the magnet is used to overcome the problem of waveform damping when using the pulsatile pump. The MRA test object was designed by Bristol General Hospital to assess the ability of MRA packages to image flow-through vessels. The choice of gel has been investigated using different Eurospin gels to compare the gel T_1/T_2 value with that of tissue. Fat saturation techniques developed for clinical studies of blood flow have been examined using the flow system and test object. RESULTS: Images have been compared from three MRI scanners of the same field strength, but from different manufacturers. A quality assurance protocol using fat supression methods is suggested from a review of clinical sequences and the experimental results. CONCLUSION: It is intended that the results from this work will enable a set of protocols, test objects and operating conditions to be chosen for the investigation of blood-flow imaging techniques in MRI. MagNET aims to include MRA tests in 1997 blue cover publications.

POSTER 1415
QA yes but US?
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Regular quality assurance (QA) testing of US equipment by users has been strongly recommended by the Institute of Physical Sciences in Medicine, who have published a detailed methodology booklet on the subject. Prompted by the results of a limited survey which indicated that regular user testing of US equipment was not being performed, an extensive survey of US users in diverse specialities was initiated, with questionaires being sent to 150 users. Results indicated a high level of understanding of both the principles and necessity of QA. Respondents indicated that although QA testing was regularly performed on X-ray, CT and MRI equipment, this was not the case for US. Perceptions of need for US QA testing, and practical problems involved, were highlighted by the survey. These are discussed, and suggestions are offered by the authors to address these issues in the light of the results.

POSTER 1416
Evaluation of methodology for normalization to a reference density for quantitative mammographic assessment
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INTRODUCTION: Computer analysis of digitized mammograms may be useful in the quantitative evaluation of changes in breast parenchymal density. In mammography, many factors may affect the resulting radiographic breast density, in particular the automatic exposure control may set significantly different exposures for mammograms of the same breast. AIM: To investigate whether a method of normalization to a reference density could be used to correct for differences in radiographic breast density. METHODS: Graduated density strips were produced by X-raying a Perspex step wedge at a range of exposures (20 mAs to 180 mAs); these were digitized using a charge-coupled device (CCD) system (Cosimcar 1:1.4 12.5 mm lens) and a drum scanning microdensitometer (DSMD) (Photoscan P-1000). An optical densitometer was used to calibrate the test strips. RESULTS: The CCD had a logarithmic linear response ($r=0.996$) from 1.32 to 3.15 OD. The DSMD had a linear response ($r=0.999$) from 0.35 to 3.34 OD. For the CCD, the logarithm of ratios of mean pixel values of adjacent step densities were calculated; the mean log ratio was 0.35 (SD 0.04) over mean pixel value range 25–144. For the DSMD, the mean difference in mean pixel value of adjacent step densities was 32 (SD 3.2) over mean pixel value range 66–207. CONCLUSION: Over a specified range of pixel values it may be possible to normalize radiographic breast densities to a reference density, such as pectoralis major muscle or a step wedge test tool.

POSTER 1417
Can the Lomb–Scargle periodogram identify systematic errors in MR data?
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PURPOSE: Various sources of systematic error exist for both MRI and magnetic resonance spectroscopy (MRS) data. In this study, we use the Lomb–Scargle periodogram to analyse κ-space data. We investigate the usefulness of this technique for detecting suspected periodic and quasi-periodic perturbations in MR signals, introduced by respiratory motion. MATERIALS & METHODS: Experimental MRI and MRS data was collected from a 1.5 T Picker prototype system. The subject of the study was a simple phantom, consisting of a Perspex cylinder (height 10 cm, diameter 5 cm), filled with a $CuSO_4$ solution. A mechanical device induced a periodic vertical motion to the cylinder. We acquired data using both 2D-FT imaging and 1D spectroscopic CSI methods. Images and spectra were obtained for static and periodically moving phantoms. Furthermore, ROPE acquisitions of the moving phantom were also obtained using both 2D-FT imaging and 1D CSI spectroscopy. The Lomb–Scargle periodogram analysis was performed on all sets of data. RESULTS AND CONCLUSIONS: Comparisons between the power spectra of the moving phantom's real and imaginary κ-space data clearly identified multiple periodic signal harmonics, well displaced from the main peak of the power spectrum. Quantitative observations were made for imaging data. Power spectra of spectroscopic data identified the existence of significant harmonics, a reduced total power of the signal and an increased level of noise. The method proved to be capable of accurately identifying the character of the motion artefact.

POSTER 1418
The use of US velocity to monitor fracture healing: a feasibility study using phantoms
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PURPOSE: Non-invasive evaluation of the mechanical integrity of fracture healing may allow more precise timing of fixation device removal, quantitative recommendations for weight bearing and the prediction of abnormal fracture healing patterns. Traditionally, fracture healing has been monitored using manual manipulation of the fracture site and evaluation of X-ray images. This is rather qualitative, subjective and unreliable. US has been proposed as a possible method of assessing fracture healing. METHODS: A tibia phantom was developed using PMMA (Perspex) to mimic cortical bone and natural rubber to mimic soft tissue. Fracture healing was simulated by varying the thickness between the two Perspex blocks. US velocity through the composite was measured using SoundScan 2000 (Myriad, Israel). SoundScan 2000 consists of a single unit US probe which houses two sets of transducers. One set (0.25 MHz), placed at an angle and 50 mm apart, measures the transit time and velocity thus calculated. The other set (1.0 MHz) uses pulse echo technique to correct for soft tissue thickness. RESULTS AND CONCLUSIONS: Precision of US velocity was calculated from repeated measurements to be 0.5%. The minimum sample thickness measurable was 3 mm. US velocity predicted the simulated fracture gap with a very high accuracy. There was a highly significant correlation between the measured US velocity and the theoretically predicted values ($R^2=0.998$). This suggests that US velocity measured with SoundScan 2000 could be used to monitor fracture healing where an increase in velocity indicates the healing process. The collateral tibia could be used as control to quantify the degree of healing.

Space resulting from late withdrawal of abstract.

POSTER 1420
A non-metallic co-axial MRI-compatible biopsy system
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PURPOSE: To develop an MRI compatible needle for use in MRI-guided biopsy procedures. MATERIALS & METHODS: Carbon fibre tubing in a heat stable resin base was produced approximating to 18 G with an inner bore of 1.2 mm. A Luer-lock connector was attached, the distal end bevelled and a metallic trocar was inserted. The needles were scanned *in vitro* at 1.5 T. Simultaneous comparison was made with a commercially-available 18 G metallic MRI-compatible needle. The effects of sequence design and angle to Bo axis on size of artifact, was examined. A spring-loaded core biopsy needle was inserted through the needle sheath co-axially. The needles were used *in vivo*, in five patients undergoing MRI-guided procedures. RESULTS: Carbon fibre needles were seen as a signal void on spin and gradient echo sequences. The visualized tip

position related directly to actual position *in vitro*. The signal void diameter from the carbon needle was 25–30% of that from the metallic needle. The carbon needle artefact was angle independent relative to Bo axis. CONCLUSION: Carbon fibre is a suitable material for MRI-guided needles. It produces little artefact and compares favorably with commercially available metallic needles. The needles can be used for FNAB, co-axially-guided core biopsy, and optic fibre for thermocoagulative interstitial therapy.

POSTER 1421

Comparison of two transmit/receive systems for visualizing catheters in MRI

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PURPOSE: To evaluate two forms of rf receiver and transmitter suitable for improvising visualization of catheters inside an interventional MRI system. INTRODUCTION: The variable appearance of blood on MRI (due to flow effects) and other locations where a catheter or other device may be inserted, makes it desirable to have a means of visualization which avoids any uncertainties. METHODS: Two forms of transmit/receive (T/R) catheter coil were made. One was a T/R version of a twisted pair coil described previously [1]; the other was a simple dipole. A Picker Asset machine (0.5 T) was modified so that a low power rf source (*circa* 1W) was available to drive the catheters in transmit mode. Normal T/R decoupling was incorporated in the feed to the catheters. RESULTS: Phantom imaging results were obtained using all combinations of machine and catheter transmission and reception. These showed that visualization was possible in all modes, but that the best configuration differed from one design to another. DISCUSSION AND CONCLUSION: Both devices can be made of very small diameter, and are compatible with their intended application, in regions without significant proton density (as distinct from the vascular system where the reasons for loss of signal are due to flow), the catheters can be threaded through thin fluid filled tubes, which can then be imaged. REFERENCE: (1) Burl M et al, Proceedings of the 4th Annual Meeting of ISMRM. New York: ISMRM, 1996.

POSTER 1422

Human lead metabolism: investigations with *in vivo* X-ray fluorescence

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PURPOSE: To improve understanding of the metabolism of lead in humans. MATERIALS: O'Flaherty's physiologically-based model of lead kinetics (which uses the Advanced Continuous Simulation Language, MGA software) was tested, with measured values of bone lead concentration from lead smelter workers in New Brunswick, Canada and environmentally-exposed residents of Ontario, Canada. METHODS: Bone lead content was assessed *in vivo* by X-ray fluorescence, which is based on the detection of characteristic X-rays following excitation of lead atoms by a ^{109}Cd γ ray source. The quantity of lead in bone was used as a marker of body burden and compared with a cumulative blood lead index and "background" environmental exposure conditions. The computer model was implemented in an attempt to describe the results from both the lead industry workers and the more typically-exposed controls. RESULTS: Workers hired in the early years of smelter operation demonstrated a more efficient uptake of lead from blood to bone than those hired more recently. Environmentally exposed controls also revealed a different pattern of uptake. With some refining, the kinetic model was capable of explaining the observations. CONCLUSION: The relation between lead exposure as measured by a cumulative blood index and eventual body burden is non-linear for the more heavily exposed smelter population. Changes in background environmental exposure over time are reflected in a control population. These results are consistent with a theoretical treatment of lead kinetics which incorporates the concept of a concentration-dependent partitioning of lead between plasma and whole blood.

POSTER 1423

Hysteresis as a factor in the *in vivo* measurement of temperature by MRI

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PURPOSE: To evaluate the potential impact on measurement accuracy of the hysteresis effects observed in volunteer studies of peripheral muscle subjected to thermal stress. INTRODUCTION: Significant hysteresis effects have been observed in measurements of temperatures made in human peripheral muscle using both the chemical shift [1] and T_1 methods [2]. These introduce potentially significant (5 °C or more) uncertainty into the results of the methods in monitoring thermal therapies. METHODS: Experiments at both 0.15 T and 1.0 T used long TR, short TE acquisitions to monitor proton density, and inversion recovery and short TR experiments to acquire T_1 weighted data. Chemical shift data were acquired at 1.0 T using GRE sequences with extended TE (30–60 ms). RESULTS: Phantom data repeatedly showed little or no hysteresis. Data from volunteer peripheral muscle showed hysteresis effects which were relatively small unless the local proton density changed significantly as the thermal stress was applied. This, too, showed a marked hysteresis in such regions. DISCUSSION AND CONCLUSIONS: Size changes with thermal stress are quite marked in peripheral muscle [3] and are a factor in various thermal ablations [4]. The probable sources of these are the formation of edema, though blood flow changes may contribute. In either case, proton density increase will be accompanied by changes in T_1 which are independent of temperature. Chemical shift results are contaminated by alterations in tissue susceptibility which can also arise from the proton density changes. REFERENCES: (1) Ishihara Y et al, Magn Reson Med 1995; 34 (6): 814–823. (2) Young I R et al, Magn Reson Med 1996; 36: 366–374. (3) Young I R et al, Magn Reson Med 1994; 31 (3): 342–345. (4) Delpy D T et al, Phys Med Biol 1988; 33: 1433–1442.

POSTER 1424

Practical quality assurance on MRI scanners

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The complicated nature of MRI systems requires that quality assurance tests ensure optimum imaging performance. This poster describes tests performed during performance assessments of three MRI systems. The manufacturers' tests objects were used, together with the widely recognized diagnostic sonar Eurospin test set. The following tests were performed on commissioning: dual and single image SNR, fractional uniformity, slice width, slice position, slice warp, resolution, MTF determination, ghosting, geometric distortion and linearity (head and body coils only). Image analysis made use of a mixture of on-board scanner software and PC based programs. Comparison is made between results obtained, relevant manufacturers' specifications and data obtained by the Medical Devices Agency in the blue cover report on the scanner. A cut-down series of tests for regular quality assurance (QA) is also discussed, together with results from radiographers' daily QA programmes. It is possible to make a useful independent assessment of several aspects of imaging performance using simplified methods with limited scan time and analysis tools. Results confirm the need for regular QA to ensure that equipment is fully optimized.

POSTER 1425

Automatic parenchymal classification in digital mammograms

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PURPOSE: Quantitative measures of mammographic densities are considered to be one of the best indicators of breast cancer risk. We have developed a method of automatically classifying digitized mammograms into established breast cancer risk categories. MATERIALS: Our data consisted of 120 mammograms from the Manchester Breast Screening Service, digitized to 50 μm pixel size on a laser scanner. The mammograms were graded into established categories of parenchymal pattern by two expert breast radiologists to provide the "gold standard" against which our new objective method could be assessed. METHODS: The breast tissue area was segmented from the pectoral muscle and background using an automated model trained on shape and grey-level information. Compressed breast thickness was measured directly from the mammogram via the magnification of lead markers on the compression plate. The breast tissue was separated into fatty and glandular regions using a grey-level calibration device imaged on every film, thus enabling the implementation of a percentage gland classifier. Glandular patterns were quantified using texture measures. RESULTS: The relationship between our automatic classifiers and conventional subjective classification has been determined and is discussed in the context of establishing an objective means of predicting breast cancer risk. CONCLUSIONS: We have developed an objective method of classifying the quantity and pattern of glandular tissue in mammograms. Applications of this method include measuring parenchymal changes over time in mammograms of the same woman; this would enable the assessment and quantification of

objective changes in breast cancer risk as a result of factors such as ageing, HRT or treatment with anti-cancer drugs.

POSTER 1426

Modelling exposure changes in mammograms

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PURPOSE: Grey-levels in mammograms can be calibrated in terms of the projected thickness of fatty and glandular tissue by the use of a calibration device (step-wedge) imaged alongside the breast. To do this successfully, changes in X-ray exposure which affect correction factors for *e.g.* scatter need to be modelled. We have developed a method of simulating exposure changes in digitized mammograms. MATERIALS: 10 calibration films of tissue-equivalent phantoms were obtained at known exposures. All films featured the step-wedge, and were digitized to 50 μm pixel size on a laser scanner. METHODS: The grey-level transformation required to display a film at a different effective exposure was calculated by comparing the images of the stepwedge on the film of interest and the relevant calibration film. The new exposure was then simulated by applying this transformation at each pixel. RESULTS: Application of our method to images of tissue-equivalent phantoms has shown that it is successful in simulating new exposures to within 0.03 units of optical density. CONCLUSIONS: Our method successfully models exposure changes in mammograms, allowing us to apply the appropriate system corrections to calibrate grey-levels in the mammogram and hence measure breast tissue composition. This calibration will enable automated, objective classification of glandular patterns and more accurate measurement of changes in tumour volume between successive mammograms.

POSTER 1427

Are deterministic effects a real possibility in interventional neuroradiology?

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The purpose of the study was to measure actual skin doses received by patients undergoing therapeutic neuroradiological procedures. These were used to determine whether, when taken in conjunction with possible repeat procedures and skin doses arising from their associated diagnostic procedures, the total skin dose approached or exceeded the threshold for erythema. Practical methods of skin dose reduction were investigated. Therapeutic procedures were carried out on a digital fluoroscopy C-arm unit and skin doses measured using lithium fluoride chips. In addition, dose–area product readings were recorded. Patient records were also reviewed to establish doses arising from other ionizing radiation procedures carried out within a short time period of the current procedure. A Rando head phantom was used to simulate the clinical procedures and measure skin doses likely to be received. For the phantom, eye doses were also assessed and the effect on doses of using additional copper filtration was investigated. Patient results indicated that skin doses in some of the longer procedures could, at a specific location, be sufficient to cause a skin reaction. Patients should therefore continue to be observed for some weeks after the procedure to check for radiation-induced skin reactions, or possibly eye damage. Skin dose can be significantly reduced using copper filtration, but further work is required to establish whether image quality is significantly adversely affected.

POSTER 1428

Radiation exposure to the hands and thyroids of orthopaedic surgeons during trauma surgery

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PURPOSE: The use of fluoroscopy as an aid to orthopaedic surgery is well-established. In this work a comparison of radiation doses to the hands and thyroids of orthopaedic surgeons is reported. Comparison is also made with reports from other centres. METHODS: 19 surgeons from two centres were monitored for a 6 week period for a total of 81 operations. There were eight separate types of operation. Dose measurement was performed with LiF dosimeters attached to the surgeons' fingers or inserted into the thyroid collar. The interchip variability was less than 6%. Surgeons wore two finger dosimeters, one specific to the surgeon and one specific to the operation. RESULTS: The average annual extremity dose from the busier of the two centres is estimated at 32 mSv per surgeon. The average dose per operation ranged from 7 to 1105 μSv. The average dose per surgeon per operation ranged from zero to 801 mSv. Thyroid doses were very small. The data underlying these results will be discussed in the presentation. CONCLUSION: The results of this study are encouraging, but do not allow for any complacency. It is clear that doses in one centre cannot be assumed to be representative of another centre and that assessment should be based on dose monitoring at departmental level. Four general recommendations aimed at reducing staff doses can be made as a result of this study.

POSTER 1429

Estimation of paediatric radiation dose on a Lunar DPX-L densitometer

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PURPOSE: To estimate paediatric entrance surface doses (ESD) and effective doses (ED) of PA spine and total body scans on a Lunar DPX-L densitometer. MATERIALS & METHOD: Two anthropomorphic paediatric phantoms representing average 5 and 10 year old female children were used. Each phantom was loaded with thermoluminescent dosemeters (TLD) at the posterior surface and at various organ locations before being scanned using the paediatric software in the PA spine and total body modes. ESD were determined directly from the measured values, whereas ED were determined by calculation using the percentage depth–dose curve, percentage of the organ irradiated and organ weighting factors. The TLD were calibrated and read out by the National Radiological Protection Board, UK. RESULTS: The measured ESD were 6.00 μGy (PA spine) and 0.12 μGy (total body), which are smaller by factors of 1.6 (PA spine) and 2.5 (total body) than the manufacturer's quoted values. These values are also small in comparison with 160 μGy (5-year-old) and 560 μGy (10-year-old) for a chest X-ray. The ED for PA spine were 0.27 μSv (5-year-old) and 0.21 μSv (10-year-old) which compare with 18.5 μSv (5-year-old) and 62.5 μSv (10-year-old) for a chest X-ray. The ED for total body were 0.04 μSv (5-year-old) and 0.03 μSv (10-year-old). CONCLUSIONS: The ED for 5- and 10-year-old children are very low and similar to adults' values we have previously reported (0.21 μSv PA spine, 0.08 μSv proximal femur). The doses are two orders of magnitude less than those for a chest X-ray.

POSTER 1430

Patient dose reduction in hysterosalpingography: a comparative study

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PURPOSE: To establish if the use of a digital screening system led to a significant reduction in the gonadal dose received by women undergoing hysterosalpingography (HSG). METHOD: A prospective study was undertaken of two groups of women who were undergoing HSG. The first group of 20 women (Group 1) was imaged using a non-digital fluoroscopic unit with hard copy images obtained by standard film–screen radiography. The second group of 24 women (Group 2) was imaged with a digital fluoroscopic unit with hard copy images being taken from stored digital images, without the need for further patient exposure. Eight thermoluminescent dosimeters were placed on each patient in standard positions before HSG, to determine entrance and exit surface doses. Organ doses were calculated using a National Radiation Protection Board (NRPB) software package based on the NRPB document R262. RESULTS: In Group 1 the median estimated ovarian dose was 3.4 mGy (range 0.3–11.1 mGy) compared with 0.64 mGy (range 0.06–1.3 mGy) in Group 2. The median effective dose was 2.5 mSv (range 0.2–8.0 mSv) in Group 1, whereas in Group 2 it was 0.5 (range 0.04–1.0 mSv). CONCLUSION: Our results indicate that a significant patient dose reduction is achievable in patients undergoing HSG when a digital screening system, without standard film–screen radiography, is used rather than an analogue system, with standard film–screen radiography. Our data illustrates that the dose reduction achievable can be of the order of five times less.

POSTER 1431

Patient radiation dose assessment with the Monte Carlo technique in X-ray examination

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PURPOSE: Patient radiation doses are needed for radiation risk assessment and for the optimization of examination techniques. Organ doses depend, among other things, on patient size and the

resulting radiation risk depends on the patient's age. We have developed an organ-dose calculation method which allows changing the height and weight of the phantom model. MATERIAL & METHODS: The Monte Carlo program for calculating organ doses (PCXMC) is written in Pascal and runs under Windows 3.1 on a PC. The program uses mathematical phantoms representing a newborn, children of 1, 5, 10 and 15 years of age, and adult patients. Organ dose calculation can be made for any X-ray spectrum and X-ray beam geometry, *e.g.* any transversal and sagittal angle of beam direction is allowed. In addition, the height and weight of the phantoms can be changed. RESULTS: Organ doses for pediatric and adult patients undergoing conventional X-ray examinations were compared with results calculated by the NRPB. The agreement is good. Examples of organ doses in projections used in cardio–angiographic examinations and in interventional procedures for patients of various sizes are presented. CONCLUSION: This type of dose calculation program is needed, especially in paediatric X-ray examinations, where patient sizes may vary greatly.

POSTER 1432
Risk of inhalation of radioiodines in laboratories

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PURPOSE: Inhalation of radioiodines during use is generally accepted as presenting a significant risk of radiation exposure. This study investigates whether this assessment of risk is justified. METHOD: Two situations involving radioiodine solutions were considered: opening sealed containers and work with open containers. We have investigated the first situation using calculations based on published values of the partition of radioiodine between iodide solutions and the gas phase, making conservative assumptions about removal by ventilation and adsorption. The second situation was examined both theoretically and experimentally. Theoretical predictions were made using published kinetic data for the oxidation of iodide to volatile molecular iodine. The experimental data were obtained by measuring the loss of ^{125}I from 0.1 M iodide solutions in a fume cupboard and on an open bench. RESULTS: A realistic model predicts, for example, that when a closed container with 370 MBq of labelled iodide is opened in a laboratory of volume 300 m^3, inhalation of the enclosed gas-phase radioiodine would lead to an exposure of only a few μSv. The calculations and measurements of subsequent release of radioiodine from the solutions predict annual doses not greater than tens of μSv for realistic scenarios of work on an open bench. CONCLUSION: This work indicates that the inhalation risk is lower than that implied by commercial information and the literature.

POSTER 1433
A comprehensive survey of the radiation dose received by NHS staff in Northamptonshire from radon

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Northamptonshire has been declared a radon affected area and a large survey of NHS premises, using track etch detectors, has shown a similar pattern to domestic premises—a log normal distribution with around 1% of rooms having levels over 1000 Bq m^{-3}. A comprehensive survey of the distribution of raised radon levels within buildings, the temporal variation of radon gas and the occupancy of staff was conducted. This showed that moderately small numbers of staff received significant radiation doses, of which the highest was 21 mSv per annum and many were over 6 mSv per annum. In magnitude and extent the doses received were far more significant than doses received by NHS radiation workers. This is, however, not matched by any significant variation in the incidence in lung cancer rates in the county, presumably due to the greater risk from smoking. An estimate of the lung cancer risk to NHS staff in Northamptonshire will be presented.

POSTER 1434
Contribution of latest equipment design to the safety of interventional procedures

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Interventional fluoroscopy-guided procedures need special attention to safety for the patient, as well as for the clinical staff. These procedures are increasing in numbers per year, as are the demands on equipment performance. The risk of radiation exposure has to be reduced, especially for long complex procedures. This can be addressed by the following measures. *Collimation*: Consideration of the impact of field size on scattered radiation and contrast. Collimation without radiation; *Beam quality*: Reduction in radiation which does not contribute to the image. The effectiveness of filtration and the limits of tube loading should be considered, as well as the effectiveness of selecting higher kV values; *Pulsed fluoroscopy*: This results in dose saving. Reduced frame rate has an effect on the detectability of small, low contrast details. The contribution of advanced image processing should be considered; *Dose monitoring*: The accumulated patient entrance dose which impinges at the physician's working position should be well below deterministic risk levels; *Guiding tools*: Placing small catheters, guidewires etc. into complex vessel structures gives benefits in reducing fluoro time, as well as general risk to the patient from support by a "reference" image (side-by-side comparison), a "fluoro fade" (overlay of the vessel tree on top of the fluoro image), or by "roadmap" (subtracted fluoro).

Radiography

POSTER 1501
Pre-test anxiety: the effect of medical information

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PURPOSE: This study investigated four areas: (1) the amount of information women are currently receiving prior to a breast biopsy procedure; (2) the amount of information women want to receive and when they would like to receive it; (3) the level of anxiety experienced by women just prior to having a breast biopsy and (4) to what extent providing women with an increased level of information would reduce pre-text anxiety. MATERIALS & METHODS: The sample consisted of a series of 76 women admitted to the Radiology Department of The Toronto Hospital between August 1994 and December 1995 for a breast needle localization/biopsy. The study was conducted in two phases. 52 participants in Phase I received information at the level currently provided. 25 participants in Phase II received a specific fully-detailed information package. Anxiety was measured pre- and post-procedure employing the Spielberger A-state, trait anxiety scale. RESULTS: Results of the study indicate that women currently receive variable levels of information at no specific time prior to the test. When questioned regarding information required the results varied; the majority of women wished to receive detailed information, with a minority requiring no information. Of note was the finding that only 5% of women wished to be told in advance about potential complications. Significantly higher than normal levels of pre-text anxiety were reported by individuals in both Phases I and II of the study. CONCLUSION: The increased level of information provided to women in Phase II did not result in a corresponding decrease in anxiety when compared with Phase I.

POSTER 1502
Existence of schemes of work for dealing with cases of suspected child abuse within the imaging department

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BACKGROUND: Child abuse exists in almost every area of society. During a radiographer's working life, they could come into contact with large numbers of children, some of whom may be being abused. Schemes of work exist to guide staff in the appropriate action to be taken in a case of suspected abuse. This survey investigated the existence of such schemes and their content. METHOD: A large study was conducted using a postal questionnaire sent out to all imaging departments within the North Western Regional Health Authority. The questionnaire contained both qualitative and quantitative questions. RESULTS: 222 completed questionnaires were returned. 31% stated that a scheme of work was in existence, 36% indicated there was no scheme of work. 33% did not know if one was available. The scope of the schemes varied from a simple list of projections to be taken in cases of suspected physical child abuse, to detailed information on who should be present during the examination, the time when the examination should be carried out, who should view the films and details of who can request imaging. One scheme included guidelines on the reporting of suspected abuse, consent, restraint and the imaging of the child. CONCLUSION: While schemes of work to guide staff in cases of suspected child abuse were known to 31% of the respondents, they had divergent content. The data also suggests that local and regional practice may not be consistent.

POSTER 1503

Radiographers and the Children Act 1989

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BACKGROUND: Under current legislation, all staff working with children have a duty to safeguard and promote the welfare of the child, as well as having knowledge of the legislation pertaining to children. Radiographers may come into contact with children daily in their work, and should therefore promote child welfare. The aim of this study was to discover how much knowledge radiographers had of the Children Act 1989 and what they felt were the implications arising from this legislation. METHOD: The study made use of a questionnaire sent to all departments of medical imaging within the North Western Regional Health Authority (NWRHA). A pilot study preceded the main study. RESULTS: 74.8% of the radiographers surveyed had not read the Children Act 1989 or any Department of Health legislation about this Act. Implications arising from the legislation were seen as having three main themes: the rights of the child (with respect to consent and restraint); the duty to report suspected abuse; and the definition of parental responsibility. 37.4% of the respondents indicated that these three implications were not adequately addressed in their departments and 32.9% did not know if any implications were addressed. 18% of the respondents suggested that their department had a policy for the implementation of the Children Act 1989. The main methods of achieving this were to follow the local Child Protection Procedures or a written protocol within the imaging department. CONCLUSIONS: While few radiographers had read the Children Act 1989 or guidance related to it, they showed a moderate awareness of the implications for the imaging department staff. However, formal implementation of the Children Act 1989 within imaging departments is quite limited.

POSTER 1504

Disclosure of information: what do cancer patients want to know?

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PURPOSE: To assess the needs of patients with cancer for information about their condition. MATERIALS: 269 cancer patients from a regional cancer centre and two university hospitals were invited to participate in the study. The patients were selected by age, sex, socioeconomic status, and tumour site to be representative of cancer patients in West Scotland. METHODS: Cross-sectional surveys of patients views were effected by means of a semi-structured interview with questionnaire. The main outcome measures patients' need to know whether they had cancer, the medical name of their illness, progress through treatment, how treatment works, side-effects of treatment, chances of cure and treatment options. RESULTS: 79% (95% confidence interval 73% to 84%) of patients wanted as much information as possible and 96% (93%–98%) had a need, or an absolute need to know if their illness was cancer. Most patients, 91% (87% to 94%) also wanted to know the chance of cure and 94% (90%–97%) about side-effects of treatment. When replies were cross-tabulated with patients' age, sex, deprivation score, and type of treatment there was a linear trend for patients from more affluent backgrounds to want more information and those from deprived areas to want less. There was a strong preference, 60% (53%–66%), for diagnosis of cancer to be given by a hospital doctor. CONCLUSION: Almost all cancer patients wanted to know about prognosis, treatment options, and side-effects of treatment.

POSTER 1505

An evaluation of the comparative effectiveness of three methods of multimedia learning

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AIM: To compare the effectiveness of a multimedia computer assisted learning (CAL) system based on a guided discovery approach with two control groups based on a standard electronic book and a multimedia lecture. Two multimedia CAL prototypes were developed for a section of an undergraduate radiographer curriculum. Each CAL system used the same screen layout and navigation aids. The multimedia lecture's content was closely matched to the CAL prototypes. METHOD: The three multimedia treatments were assessed using three groups of second year radiography students. Each group studied a specified area of nuclear medicine using one of three methods. These treatments were embedded as part of the normal undergraduate course. Detailed information on learning effectiveness was gathered from each group together with the students' assessment of the learning method. A range of quantitative and qualitative measurements were taken. Pre- and post-session knowledge was established through a multiple choice questionnaire. The students were also provided with a taster of the alternative methods so that they could provide comparative comments on them. RESULTS: All three groups showed a significant improvement between pre- and post-session knowledge. Both CAL conditions elicited favourable reactions. The CORE group had a higher knowledge gain than the other two groups. The students generally stated a preference for the guided discovery approach rather than the standard electronic book approach. The reasons for preferring the guided discovery method included the integrated subject approach (as opposed to a more open hypertext format in the electronic book) and the use of guided discovery as a means of learning. The price paid for these advantages was the greater time taken.

POSTER 1506

Doctoral education in radiography: is it the future?

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Important advances have taken place within the radiography profession in the last decade. Education has moved from hospital schools into university departments and qualification into the profession has moved from diploma level to degree. At present, however, radiography does not have a sound research base. This poster intends to address the need for doctoral programmes to provide theoretical underpinning of the profession, and for continuing change to allow radiography to naturally evolve into a research-orientated profession, with radiographers who are highly specialized in specific areas. The poster will show the need to establish ourselves as academics, as well as clinical specialists, for the future of the profession. It also attempts to make some judgements on the technical, clinical and academic faces of radiography and how they are all inextricably intertwined. It will also address the issue of professionalization, from a research and from a clinical-patient centred field. This poster emphasizes the need to acknowledge the purpose of research in radiography and, from that acknowledgement, to recognize that the next step is to develop doctoral programs. Doctoral education will allow the radiography profession to critically develop its own unique identity and result in an enhancement of clinical practice, ensuring that the profession survives into the 21st century.

POSTER 1507

A national forum for radiographic reporting: its importance and value

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Reporting of diagnostic imaging examinations by radiographers is slowly becoming part of the professional skill mix within departments of clinical radiology. As a result, a number of partnerships between clinical radiology departments and academic radiography centres have developed to provide competence-based, accredited education programmes for those radiographers who are, or will be, contributing to the reporting service. The various centres involved have also collaborated to ensure that developing knowledge and experiences in radiographic reporting is both shared and disseminated rapidly and widely. This poster documents briefly the background to radiographic reporting. It describes the nature of the collaborations between individual clinical departments and academic centres, and across the various centres (six at present). It identifies the benefits and difficulties associated with these complex, collaborative arrangements. The poster concludes that collaboration at a national level serves to ensure that the introduction of radiographic reporting is founded upon sound education and evidence-based practice principles and in accordance with the guidelines of the relevant professional bodies.

POSTER 1508

A survey of film/screen/processor speeds in neonatal radiography

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PURPOSE: An MRC and North Thames Health Authority project "Investigating the relationship between quality of the diagnostic image for neonatal chest X-rays and the radiation exposure used"

has revealed a disturbing trend regarding the speed of film/screen/processor combinations. This presentation increases awareness of the critical importance of optimizing film/screen/processor combinations in neonatal radiography. MATERIALS & METHOD: Six sites' film/screen/processor combinations used for mobile neonatal chest X-rays were investigated to determine their "actual" speeds. Using a standard X-ray generator, sensitometric strips were produced on each site's film/screen/processor combination at 50 and 60 KVp. Speed was defined as the reciprocal of the exposure needed, in mGy, to produce a net optical density of 1. RESULTS: Preliminary results have shown that the actual speeds in current clinical practice are alarmingly low (speed classes 50–180) with the lowest speeds being from sites who routinely use small, slow and infrequently-used film processors. These speeds are very much lower than the quoted manufacturers' speeds of 300+. CONCLUSION: There is a considerable gap between manufacturers' speed for film/screen combinations and the actual speed when used in neonatal radiography imaging systems. Such a gap is explained by the relative effects of the radiographic voltage used and the use of dedicated neonatal image processors. Recommendations will be made on how to optimize neonatal imaging systems.

POSTER 1509

"Aluminium + copper" additional filtration in neonatal radiography?

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PURPOSE: The CEC document *Quality Criteria for Diagnostic Radiographic Images in Paediatrics* recommends an additional filtration of "1 mm aluminium + 0.1 mm copper" for mobile neonatal chest examinations. The purpose was to determine the "effectiveness" of the additional filter for reducing patient dose, in the context of its effect on image contrast and tube load. MATERIALS & METHOD: Two water phantoms representing 1 kg and 3 kg neonates were constructed. Entrance skin and mid-depth doses were measured using TLDs (with and without the additional filter) and corresponding integral doses calculated. Image contrast was evaluated by comparing optical densities incurred over an aluminium step wedge. Tube load was defined in terms of incurred heat units. RESULTS: The CEC filter afforded large reductions in skin and integral doses of 44–49% and 24–26%, respectively, for the 1 kg model, and 52–60% and 41–44%, respectively, for the 3 kg model. Such dose reductions were associated with marked decreases in contrast, being more pronounced for a "high" kVp technique. The maximum increase in tube load was a two-fold increase in heat units. CONCLUSIONS: The CEC additional filter demonstrated large reductions in patient dose with minimal effect on tube life in phantom neonatal radiography. The over-riding determinant of its overall effectiveness are the associated decreases in contrast. It was concluded that the CEC additional filter has an "acceptable" degree of contrast loss for the participating hospital when used in conjunction with a "low" kVp technique. The filter could not be universally recommended, since the reductions in contrast may prove "unacceptable" for other imaging systems.

POSTER 1510

A case study outlining the value of CT in the classification of spinal trauma

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PURPOSE: To outline the value of CT performed during a unique spinal trauma case study to classify fractures. The case referred to was that of a 49-year-old male presenting with multiple fractures to the cervical and thoracic spine, fully conscious and orientated and with no sensory deficit. MATERIALS: A standard X-ray unit, IGE CT Pace plus with real-time reconstruction facilities and a Siemens Polytron S-Plus/Multistar C-arm digital fluoroscopic unit were used. METHODS: A lateral cervical spine was performed at the referring hospital before the patient's transferral to the Neurosurgical Unit at Hope Hospital. At Hope Hospital, CT was performed as follows: 2 mm thick contiguous axial sections from the base of skull to C3, and from C6 to T1; 10 mm thick contiguous axial sections from the lung apices to the diaphragm; fluoroscopy of the cervical spine. RESULTS: These images showed: bilateral fractures of the atlas; a coronal fracture through the odontoid process and body of the axis; facet joint separation/subluxation between the axis and C3; fractured spinous processes of C6, C7, and T2, T3, T4; fractured right first and third ribs; fractured right transverse processes of T3, T4, T5; fractured right pedicle and left lamina of T4; bi-lateral pleural effusions. CONCLUSION: CT provided invaluable classification of the bony involvement. This enabled the neurosurgeon to apply successfully a halo vest to stabilize the cervical fractures. These included fractures under the general terms of: a fractured atlas; a hangman's fracture; an odontoid process fracture; clayshovellers' fractures.

POSTER 1511

A project to assess the validity of training radiographers to carry out plain film reporting

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MATERIALS & METHODS: Four radiographers were selected to undertake a part-time training programme in radiographical reporting for a period of two years. Most of the programme was work-based and consisted of tutorials, self-directed study and radiological reporting observation. Study of the musculoskeletal system and chest and abdomen took place. Assessment was undertaken at the end of each year and consisted of reporting of 50 musculoskeletal films, 50 chest films and 40 abdomen films. Two other comparison groups were established consisting of four radiographers without additional training in plain film reporting and four trainee radiologists. A "gold standard" was established by three consultant radiologists triple-reporting 200 musculoskeletal films and 100 chest and abdomen films. 50 films were selected for each category which included a range of normal and abnormal appearances. A standard report form was used to categorize the responses. RESULTS: The three comparison groups were compared against the "gold standard". The levels of agreement were: musculoskeletal system–project radiographers 95%, control radiographers 84%, trainee radiologists 81%; chest–project radiographers 83%, control radiographers 72%, trainee radiologists 73%; abdomen–project radiographers 78%, control radiographers 65%, trainee radiologists 58%. CONCLUSION: Additional statistical analysis has been performed, the levels of agreement between the "gold standard" and the project radiographers would appear to indicate a high level of agreement. The results indicate that an appropriate training programme in plain film reporting for radiographers is valid and appropriate.

POSTER 1512

Trauma radiology: the accuracy of radiographers' assessment of appendicular trauma

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PURPOSE: Extension of the role of the radiographer in trauma radiology can only progress if the accuracy of their observations is shown to be high. Such figures can be used as a standard for audit. In most district general hospital accident and emergency (A&E) departments, most bony injuries occur in the appendicular skeleton and many of these cases are managed by emergency nurse practitioners. METHODS: Consecutive radiographs of patients attending the A&E department over one month following appendicular trauma were immediately assessed for bony injury by the casualty radiographer directing the examination. These radiographers had recently attended a course in pattern recognition of appendicular trauma. Films were triaged into three categories: no bony injury, bony injury (specifying the precise abnormality) and other important pathology. The radiologist report was used as the "gold standard". RESULTS: 784 examinations were assessed by a total of 25 radiographers. 237 injuries were correctly identified and 488 examinations correctly passed as normal. There were 28 (3.6%) over-calls (false positives) and 23 (2.9%) false negatives. Approximately half (11/23) of the latter were unimportant injuries to the foot or hand. The diagnostic accuracy was 93.4%, sensitivity 91% and specificity 94.5%. CONCLUSION: These high values attest the value of immediate radiographic assessment in appendicular trauma and have provided a local standard against which to audit.

POSTER 1513

A novel scoring-protocol for the detection of early osteoarthritis changes

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The sequencing and defining of osteoarthritis (OA) changes from plain radiographs has presented problems of both semantics and interobserver congruency. The fact that plain radiographs do not show cartilage directly and that cartilage is thought to be the primary lesion site for OA, has added to the problem of early diagnosis. The use of the Mankin scoring scheme of numerically grading pathologies and the grading using a specific histopathological stain,

does not lend itself to easy interpretation by the clinician. A revised cartilage scoring scheme, (RCS) that might be used with CT scans, was thought to offer advantages. 18 coronal sections were taken from the knee joint of a murine osteoarthritic model. These were age-ranged individuals (between 1 and 20 months). The cartilage was scored using a protocol from zero to nine; they grade from "normal" = 0, through cleft formation and cell cloning ≤ 5, to frank eburnation ≤ 9. The sections were then graded using the Mankin score as a base marker for relative appraisal. They were then re-graded using RCS. An independent histologist also graded the slides. The results show that there is a statistically significant agreement between the scores given between the histologists and that early discrete degenerative histology can be defined, (2 to 3 months). We conclude that this novel scoring protocol of early chondritic OA lesions can give valuable information as to the early pathological aetiology of this degenerative joint disease.

POSTER 1514

Can limited MRI scanning replace the lumbar radiograph?

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PURPOSE: To establish whether a single MRI sequence of the lumbar spine is a more useful diagnostic tool than lumbar spine radiographs. MATERIALS & METHODS: The radiographs and MRI scans of the lumbar spine of 20 patients were reviewed retrospectively. Patients with known cancers or scolioses were excluded from the study. All patients had AP and lateral lumbar spine radiographs. MRI was performed at 1 or 1.5 T. Sagittal T_1W spin echo and T_2W gradient echo scans were acquired. The radiographs, T_1 and T_2 images were reviewed separately and in random order by a consultant radiologist who was blinded to clinical information. For each investigation, abnormalities of the following were systematically reported; intervertebral discs, spinal segmentation, calibre of the spinal canal, posterior osteophytes, apophyseal joints and vertebral end plates. RESULTS: Abnormalities were seen on 13 radiographs, 16 T_1W and 17 T_2W MR scans. Two patients showed no abnormality on any study. Abnormalities missed on radiographs were mainly related to discs. The T_2W sequence was the most sensitive study for disc abnormality but missed apophyseal joint changes. No abnormality of significance seen on the radiograph was missed by the MR scan if both sequences were used together. CONCLUSION: All significant abnormalities shown by a lumbar spine radiograph can be seen on a limited MR scan using sagittal T_1 and T_2 images. The use of limited MR in place of radiographs would identify significant discogenic spine disease which may be missed by radiographs and would reduce the use of ionizing radiation.

POSTER 1515

Renal anomalies in the paediatric age group: nuclear medicine appearances

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A pictorial essay is presented of the nuclear medicine appearances of paediatric renal anomalies. Important features that may be of value in establishing the diagnosis are highlighted and correlative imaging is presented where appropriate. All examinations were performed as part of routine investigation of either urinary tract infection or antenatal US abnormalities.

POSTER 1516

The radiographical assessment of sedimentation samples taken from the sea bed

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PURPOSE: The aim of the study was to produce radiographs with optimum contrast, density and resolution to enable structures within sea bed sediment to be visualized and assessed. MATERIALS: The sediment was collected in pipes of varying length, the maximum length being 2.9 m. Equipment used was: Philips Compact Diagnost I, MCP 50 generator, table bucky, DuPont Quanta fast detail intensifying screens, cassette sizes: 35 × 43 cm, 18 × 43 cm; 24 × 30 cm. DuPont Cronex 10S duplitized X-ray film (120 sheets), Kodak 'X-Omat' Processor, Model ME-3, (dry-to-dry processing time 119 s). METHODS: Lead legends were attached along the length of the X-ray table at 5 cm intervals to aid identification of levels within each pipe. Each pipe was placed in turn along the length of the table and immobilized with sandbags and radiolucent pads. Several films were used to image the full length of each pipe. Exposure factors were 73 kV, 50 mAs. RESULTS: The kilovoltage used was sufficient to penetrate the material and demonstrate structures and layering within the sediment with suitable contrast. The structures demonstrated were mainly the remains of sea creatures, for example various types of shells. CONCLUSIONS: The technique described is extremely useful in the geological assessment of sedimentation samples and identifies where the pipe could be cut without damaging items of interest. Accurate assessments were made regarding the nature and position of objects deposited within the sediment. A high standard of image quality was obtained.

Management

POSTER 1601

The diffusion of MRI and CT scanning facilities in the UK

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The most recent comprehensive study of the provision of CT and MRI scanners in the UK was performed by Professor Langton Hewer in 1990. This study collated data from Health Authorities and Health Boards throughout the UK. In view of the changes in the organization of the health services in the UK, the current study took a different approach. Between May and August 1996, all radiology departments of acute NHS Trusts were telephoned and the provision of MRI and CT was ascertained. This survey was followed by a postal questionnaire asking for details about each scanner and the number of investigations performed by each machine. A similar, though slightly less detailed, questionnaire was sent to private hospitals listed in the 1996 NHS Year Book. Response to both questionnaires has been encouraging and the data is currently being entered into a geographic information system (GIS) to enable the distribution of scanners and the number of scans performed, to be shown by area and related to population density. The results so far indicate that in the NHS there are 270 CT and 120 MRI scanners, but a number of these are privately owned. Furthermore, the North Thames area has the largest number of MRI scanners per head of population at 3.67/million, whereas the West Midlands at 1.15/million and Trent at 1.21/million have the lowest number. It is also evident that many Trusts without MRI on site either buy time on scanners in private hospitals, or use a mobile scanning facility.

POSTER 1602

Influence of feedback on GP referral patterns

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PURPOSE: To determine the effect of feedback on GP referral practice. MATERIALS & METHOD: 11 general practices in our health district were divided into four groups. Group (1) received feedback on their referral practice in the form of (a) statistical data about their referral pattern and (b) sticky labels appended to their imaging reports in which randomly selected advice relevant to general practice (extracted from the Royal College of Radiologists' booklet *Making the Best Use of a Department of Clinical Radiology*) was given. Group (2) received feedback in the form of statistical data only; Group (3) in the form of sticky labels only. Group (4) received no feedback in either form and acted as a control group. Feedback was provided over a 9 month period and referral patterns in the final 3 months were compared with referral patterns in a 3 month period prior to the onset of feedback. RESULTS: Feedback to GPs resulted in a statistically significant reduction in requests for radiology (significant at 95% confidence interval) in groups (2) and (3). There was no significant reduction in group (1) nor in the control group (4). CONCLUSION: Feedback to GPs can significantly alter request patterns, especially with regard to plain films, but there is a limit to the impact of such mechanisms on referral practice.

POSTER 1603

Intravenous contrast media: are they being administered safely?

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PURPOSE: iv contrast media are relatively safe but potentially life-threatening systemic reactions do occur. A recent RCR booklet: *Advice On The Management of Reactions To Intravenous Contrast Media*, has been issued. This study is the first cycle of a national audit of these guidelines. It aims to determine whether radiology

departments are adhering to the essential points concerning prevention, early recognition and prompt treatment of adverse reactions, and whether they are adequately equipped for the proposed contrast media reaction management protocols. In order to standardize the audit, it was specifically directed at the use of iv contrast media in iv urography. METHODS: A questionnaire was formulated and sent to the superintendent radiographers of 295 clinical radiology departments in the UK of which 233 replied. RESULTS: In almost all departments, there was provision for basic life support training, regular checking of equipment, drugs and prompt access to emergency medical help. Certain "first line" drugs *e.g.* bronchodilator nebulizers and monitoring equipment were not instantly accessible in the majority of departments. A significant number of departments did not adequately supervise the post-injection patient and there was considerable variation in the pre-injection management of high risk patients. The majority of departments did not conform to the guidelines referring to the administration of iv contrast to children. CONCLUSION: Certain areas of the guidelines are being neglected by many radiology departments. If this can be brought to their attention and remedied, they will be better prepared to deal with severe contrast reactions.

Miscellaneous

POSTER 1701
Risk of cross-contamination with iv infusion sets in CT

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AIM: To assess the risk of cross-contamination resulting from a system of syringes recently introduced to our CT department for contrast injections. METHOD: The system of injection sets (Sedat, Irigny, France) allows use of the same syringe in the injection pump for all the patients receiving contrast in one day. There are two valves in the reusable portion and a further valve in the single-use patient line. We undertook bench tests to measure the pressure at which the valves in the system failed. We then used Labstix (Bayer Diagnostics) to detect the presence of blood in contrast taken from the 'upstream' end of the patient line. RESULTS: The valve preventing back-flow into the reused tubing consistently withstood a pressure of 18 atmospheres. Between 18 and 20 atmospheres 75% tubes ruptured, but there was no flow across the valve in any of the tubes. Low pressure tests demonstrated that there was no slow diffusion across the valves when lower pressure was maintained for up to 48 h. 50 consecutive patient lines were tested and no blood was detected "upstream" from the valve in any of them. The financial saving is only 50p when two patients are receiving contrast, but this rises to £18.50 for five patients and £48.50 for 10 patients. CONCLUSION: On-going savings are to be welcomed, but it is imperative to ensure that no unacceptable risk is incurred. We have demonstrated no measurable risk of cross-contamination using the injection system described and intend to continue taking advantage of the financial saving achieved.

POSTER 1702
A high flow needle designed for iv injections for CT enhancement

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PURPOSE: To assess a novel butterfly needle designed to reduce resistance during injection of contrast medium. MATERIALS: The needle has an external diameter of 18G (1.1 mm) for most of its length, with a slight shoulder down to a tip of 20 G (0.9 mm). METHODS: 90 consecutive patients undergoing bolus-enhanced CT were randomly assigned to three groups. In two control groups (31 patients each) conventional 21 G and 19 G needles were used. The new needle was used in the third group (28 patients). All patients received a rapid, hand-injected bolus of 100 ml Omnipaque 300, usually using a vein around the wrist or hand. Various parameters were assessed (10 point scoring system): ease of venupuncture, resistance to injection, pain/bruising, image quality. RESULTS: Intravenous access was slightly more difficult with the new needle: mean score 5.32 (SD2.99) compared with scores of 2.74 and 3.10 for the 21 and 19 G needles, respectively. However, the subsequent injection was easier with the new needle: mean resistance score 1.88 (1.42), 21 G: 6.68, 19 G: 2.81. The patients did not record any difference in pain or bruising. The resulting images using the new needle were judged slightly better [6.67 (1.71), 21 G: 5.61, 19 G: 6.10]. CONCLUSION: The larger internal calibre of the new needle clearly reduces resistance to injection of contrast medium compared with conventional butterfly needles. However, venous access via wrist or hand veins was found to be more difficult in some patients. The new needle may prove more useful in the antecubital fossa.

POSTER 1703
Silvanus Phillips Thompson, radiology and the Röntgen Society

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1997 is the centenary of the founding of the Röntgen Society, parent body of all the national radiological societies in Britain. Though the initial idea of such a society came from a group of medical men, membership was offered to any candidate who had shown scientific interest in Röntgen's rays. By electing S P Thompson as its first president, the society chose not only an eminent scientist and a brilliant teacher, but also a man with wide interests in history, literature, painting and philosophy. They could have chosen no-one better to lead a group whose first aim was to discuss the Röntgen rays "in relation to Medicine, the Arts and Sciences". Thompson's archive in the Institute of Electrical Engineers contains his library of historical and current scientific literature and other memorabilia, illustrated in this presentation.

POSTER 1704
J J Thomson and the physics of radiology

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Joseph John Thomson OM, 1856–1940, like most British physicists of his era, began his studies in mathematics and theoretical physics, but his research and teaching career at Cambridge covered the growth and flowering of practical, experimental physics in Britain. Experiments with cathode rays confirmed Crookes' finding of their particulate nature and led to the measurement of the mass of the electron. Further research on X-rays and naturally radioactive elements laid the foundation for work on the fundamental structure of the atom. This consolidated the theoretical background for the development of radiology and medical physics for years to come. Thomson's laboratory staff performed clinical radiography for local practitioners during the first few months after the announcement of Röntgen's discovery.

POSTER 1705
Development of a methodology for systematic literature reviews in diagnostic imaging

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PURPOSE: Synthesis of evidence from the literature may be quantitative or qualitative. The former is appropriate when randomized controlled trials have been performed, but such trials are rare in diagnostic imaging. For qualitative reviews, it is necessary to devise a methodology for assessing the quality of reported studies which is applicable to, and applicable over a range of diagnostic imaging techniques. METHODS: The proposed methodology was applied as a pilot scheme to reports of studies of the use of endoscopic US (EUS) in oesophageal cancer and helical CT for liver neoplasms. Only studies evaluating diagnostic performance were examined; case reports and technical performance evaluations were excluded. Categories assessed as indicators of study quality were: technical quality; levels of test, review and work-up bias; use of a reference test; range of diagnostic applications; clinical description; numbers in study; evaluation of radiation dosage and complications; and economic assessment. A multidisciplinary review team was employed to maintain uniformity of interpretation and ensure objectivity. RESULTS: Assessment of technical quality involved extracting information about many factors, especially for EUS, where a variety of instruments is in use. Categories added during the pilot included investigator experience and use of diagnostic criteria. Few economic descriptions were found. As expected, studies did not cluster as either low or high quality, but were distributed over a range of rankings. CONCLUSION: The methodology is usable in practice and is now being applied in full systematic reviews in diagnostic imaging.

Notes

*info*RAD™

National Indoor Arena

The *info*RAD™ area in the main exhibition hall of the NIA is dedicated to interactive computer displays presented by exhibitors from all sectors: academic, healthcare and commercial.

The *info*RAD™ event is concerned with Healthcare Informatics, a rapidly developing area covering the use of computers for the management, application and analysis of health related information.

Exhibits encompass a range of topics including information systems, the use of DICOM, education and image display. Authors will be present between 1200 and 1400 daily. Abstracts appear over the following pages, in alphabetical order according to the name of the exhibit supervisor. A separate *info*RAD™ guide is included in the registration packs.

There is a complementary programme of *info*RAD™ scientific sessions, shown in the main Congress programme.

*info*RAD™ is a tradename used by kind permission of the RSNA.

WebCT: a new tool for the development of Web-based material in radiology

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The World Wide Web Course Tool (WebCT) has been developed by the University of British Columbia to assist educators with or without technical expertise to create sophisticated Web-based courses. Authors use a standard Web browser such as Netscape to create courses, and students use their browsers to access the course material. WebCT also provides a variety of sophisticated tools which permit authors to add features not normally associated with Web-based courses, such as student conferencing, e-mail and on-line chat facilities, self-evaluation tests, attachment of personal annotations to Web pages, and automatic indexing and searching of pages and image databases. Course organizers benefit from tools providing access control by password (public Web access may also be permitted), scheduled and timed quizzes, and sophisticated student progress tracking, providing immediate and detailed knowledge of students' progress through the course. Many of these features greatly facilitate the development of courses in radiology in conjunction with a library of digitized images. We are using WebCT to develop a complete undergraduate course in radiology, designed to integrate with the new case-based undergraduate curriculum being introduced at UBC. Appropriate imaging studies will be provided for each hypothetical case in the curriculum, with links to supplementary material, further imaging examples, and with on-line evaluations and end-of-course assessments. This approach allows easy development of sophisticated courses, and permits a degree of interaction and feedback absent from previous Web-based teaching materials. Delegates will be able to learn more about this method of course development, and to interact with our present courses and tutorials.

Training materials for medical imaging: online co-ordinator of global WWW resources

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There are a number of advantages in using the World Wide Web to deliver and support teaching and learning in medical education. The ability to provide multiuser access to archives of images, remotely and at any time of day is particularly attractive to radiology. WWW materials are delivered in a platform independent manner, thus opening access to a wider range of people. CD ROM material is expensive to make and cannot be used until the whole resource has been produced. In contrast, the development of Web material is incremental and can be edited at any stage. The use of material outside the home institution for support of local courses is problematic. Firstly, because of the difficulty of identifying relevant quality material and, secondly, because of the potentially poor fit to taught undergraduate and postgraduate course designs. In the Leeds Interactive Medical Education project (LIME) an online system has been developed. A questionnaire is used by those teaching in a subject area to review available resources in terms of content validity, user interface, educational style and, if relevant, the fit to the local curriculum. Quality indicators such as the likely stability of the site are covered separately. To date, 75 radiology and 33 medical physics resources have been identified and the reviewing task has begun. Reviewed sites are entered into a WWW searchable database. By directing users to authenticated, peer-reviewed material this approach makes better use of limited teaching and learning time. [http://www.leeds.ac.uk/medicine/lime/]

Desktop volume rendering

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At the *info*RAD™ 1996 exhibition the authors presented their breakthrough in developing fast 3D surface, maximum intensity projection (MIP) and MPR oblique slice software for CT and MRI scan visualization on Windows 95 PCs. Since then they have significantly enhanced their VoxWin and VoxarLib software with the addition of a real-time Full Volume Renderer. At the *info*RAD™ 1997 exhibition they will present and demonstrate this new capability on an inexpensive Windows PC. Full Volume Rendering makes it much easier to use 3D visualization for diagnosis from CT and MRI scans, by eliminating the difficult requirement of choosing an accurate surface threshold. It is often very difficult or impossible with MRI data to choose such a threshold, but Full Volume Rendering eliminates this requirement. By allowing you rapidly and interactively to vary the transparency of different tissues, it reveals details which are hidden in conventional 3D surface visualization. To date, real-time Full Volume Rendering capabilities have only been available at large cost to users with high-end Silicon Graphics (or similar) workstations. By developing innovative processing techniques, the authors have been able to replace that high level of computer power with an inexpensive Windows PC, making Full Volume Rendering an affordable choice for a far greater number of radiologists.

The development of a multimedia package to deliver a radiography Master's programme

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This exhibition will demonstrate how a relatively small academic department can use a modern multimedia authoring package to generate a full Master's programme for radiography education. The University College of St Martin's Department of Radiography & Imaging Science has, over the last year, developed a Master's programme that will be delivered mainly by multimedia presentation distributed on CD ROM. The display will demonstrate how modern computer terminology can be integrated with traditional learning material to produce a balanced educational programme at Master's level. The display will include an example of a module from the Master's degree which is made up of CD ROM presentation, Course Reader and Course Textbook. The display also includes a section showing how the course was developed and the technical equipment required. This part of the presentation will cover the challenges of using text, pictures, sound and video in such a course. Media capture will be considered in depth. Added to this the display will demonstrate how the package can be used by students to study for a Master's degree with limited disturbance to their work. The package has been developed on a PC system and students who embark on the course will also require use of a PC to undertake the course.

Developing your own radiological management system

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This exhibit will demonstrate that it is possible to design and develop your own Radiological Information System. This RIS was designed and developed by a consultant radiologist who is not a professional computer programmer. The RIS is based on Microsoft Access 1.1 running under windows 3.11 on an IBM compatible personal computer. No programming language was required in writing the software. This RIS system has now been running successfully for more than a year in Newark Hospital X-ray Department. The exhibit will demonstrate the high level of sophistication that can be achieved on a modern commercial relational database system. The RIS will manage information regarding patients' demographic data, produce the required Korner's statistics, produce and retrieve radiology reports and manage the X-ray film files. It is hoped that this exhibit may inspire other people to try to develop their own RIS

database and that there will be opportunity to demonstrate the simple computer skills necessary to develop your own relational database.

Using DICOM on a PC platform

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The exhibit displays information on DICOM software available for the PC (DOS/Windows) platform. Sending DICOM images to a PC over a local area network. The process of establishing a DICOM link from a dedicated medical imaging workstation to a PC running Windows NT is described. A public domain software product installed as a service under Windows NT provides an "Image Storage Service Class Provider" facility, allowing images to be pushed from the image source as workstations often fail to provide the image analysis facilities required to enable quantitative analysis of images. The wide range of software tools and programming languages available for the PC make it a suitable platform for this type of analysis. The quantitative analysis of images of MR test objects is presented as an example of how DICOM format images can be processed on a PC. The exhibit, when unmanned, will take the form of a rolling "PowerPoint" presentation. The image analysis tools will be available for use when the exhibit is manned.

The X-ray Files

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Explore the varied radiology and educational resources now available on the Internet and World Wide Web. Start at The X-ray Files, a large UK based source of radiology case material, and explore the teaching cases and tutorials within. Follow the links page to other major teaching sites around the world, to the new electronic journals, to online textbooks and to the Web sites of organizations such as the RSNA. Discover Radiology newsgroups, and learn how to search the Internet for the information you need. In short, discover through the X-ray Files how the Internet can change the way you learn and practise radiology.

Patient education video production using digital photography

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Patient education in oncology is essential and this information is usually given verbally or with written materials. However, it is difficult to explain procedures such as radiation therapy treatment using these methods because it is hard for patients to conceptualize a form of treatment for which many have no frame of reference. The use of audiovisual materials may improve patient understanding of such complicated treatment. Educational videos have been shown to benefit patients by increasing knowledge and decreasing anxiety prior to starting treatment. Previously, the cost of producing videos has limited their use, and information regarding treatment procedures of a particular institution are uncommon. Therefore, we decided to produce a video for breast cancer patients specifically designed to explain the process of radiation therapy treatment used at our centre. Using digital photography along with commercially available software and hardware it is possible to produce a video at low cost that demonstrates in-house radiation therapy procedures to patients awaiting treatment. Using a Kodak DC-50 digital camera and commercially available software a slideshow production is generated using still pictures. A slide scanner and document scanner are used to digitize other images. A voiceover and musical soundtrack are added. Digital files are transferred to a television set using a VGA to NTSC converter and the video is captured on videotape. The digital production can be used for multimedia presentations, and can easily be updated as needed. Future productions will use video images captured on an analog camcorder and converted to digital images.

Digital camera images by e-mail

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Kodak Picture Postcard Software may be used with a DC40, or other digital camera, for copying and e-mailing radiographic images, etc. While the image quality is unlikely to be suitable for diagnosis, this technique may prove useful for reporting and rapid, low-cost, communication between remote sites. This technique will be demonstrated, and discussed.

Software interface to allow querying and retrieval of DICOM images on a standard Web browser

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Before a hospital can dispense with radiological film it must provide means for images and associated data to be retrieved and viewed in the locations in which films are currently viewed, such as wards and outpatient clinics. In practice, this requires images to be transmitted over the hospital network and displayed on standard personal computers. Because of the large number of such viewing stations, the cost of specialized software for this task remains high. The cost of training a large number of clinical staff to use the software could also be significant. This exhibit demonstrates the potential of standard World Wide Web browsers to achieve the required retrieval and display task, using a software gateway. Browsers connect to the gateway using Hypertext Transfer Protocol (http), the protocol used for World Wide Web connections. The gateway then interprets the http request and issues DICOM query/retrieve requests to one or more DICOM hosts. Information, both textual and pictorial, returned from the DICOM query is then translated into human readable form, and passed back to the browser via http. Advantages of this type of system include low cost, centralization of security controls at the gateway, and re-use of existing user skills. The main disadvantage, at present, is the lack of local image manipulation on the viewing station, requiring retransmission of images even to achieve simple changes such as windowing. This could, however, easily be overcome in the future using appropriate browser add-ins.

A PC-based DICOM teleradiology workstation

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The authors will demonstrate their medical transfer and viewing. This software is based on the UCDavis DICOM library and runs under Windows 95 or Windows NT. Images can be received from DICOM compliant equipment and are stored in a hierarchical directory structure based on patient information. The software is easy to install and configure on a PC and provides a simple means for extraction of medical images for research, education or teleradiology purposes. The viewer takes full advantage of Windows 95 ActiveX (OLE) features to allow embedding of images within documents, etc. and includes multipane display, cine, interpolation and real-time windowing. The demonstration will be in the form of an interactive Web-based presentation and there will be a demonstration of the software described. Additional information will be placed on the Web browser to support posters and presentations from members of the Addenbrooke's and Papworth radiology departments and give an overview of current research in Cambridge. A fully functional evaluation version of the software will be made freely available for download from the World Wide Web.

Multimedia staff information system for obstetric ultrasound

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For the purpose of augmenting patient care, local health service information is often provided to health care professionals. Until recently, the main methods of conveying this information have been paper based and/or word of mouth. In an attempt to improve the quality of information provided to health professionals, a computer based approach is currently being evaluated. Using a centralized computer program, a prototype information system about the local obstetric ultrasound service has been developed and is to be made available over broadband cable to a range of professionals in the Salford Royal Hospitals NHS Trust and its surrounding community sites. The prototype, developed in Toolbook V 4.0, makes use of multimedia. It runs under Windows 3.1 or higher and requires at least a DX4 486 PC with 16 Mbytes of RAM and 400 Mbytes of disk (uncompressed). The content and media mix were developed by a large multiprofessional team, including obstetricians, general practitioners, midwives and sonographers. The user interface is highly graphical and software tools support free text searching, electronic notepad, various browse options, a database interface and video and sound controls. Content ranges from quite specific detail about the operation and management of the local sonography

department to general information about ultrasound education and training. For the purpose of this conference, the prototype is presented on a standalone multimedia computer. The prototype is currently being evaluated for usability, content accuracy, quality and range, media appropriateness and usefulness.

New workstation technologies in medicine

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Physicians depend on MRI, CT, ultrasound and high resolution 2D scanning systems to assist them with diagnosis, planning and treatment. The challenge is to make effective use of the large quantity of detailed information that is generated. Silicon Graphics has put into place a dedicated team of people to address this and related problems and develop solutions for the medical market. This exhibit will show some of the technologies that are being worked on by Silicon Graphics and our partners, and give you the opportunity for hands-on experience with our latest advances. Real-time volume rendering of medical data from several different modalities will be demonstrated. Real-time performance is achieved through an algorithm that makes use of hardware texture mapping. Also on display will be examples of the Virtual Reality Markup Language (VRML), and how this technology for bringing 3D graphics to the World Wide Web is useful for medical applications and telemedicine. Image processing techniques, wavelet compression and more will also be covered. State-of-the-art applications from software developers including IBM UK, and Focus Medical will be demonstrated too. IBM will be showing TOSCA (Tool for Segmentation, Correlation and Analysis); Focus Medical will be showing their image registration software.

Interactive radiology tutorials using the Calscribe template for Asymmetrix Toolbook 4

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Asymmetrix Toolbook 4 is a commercially available authoring software program allowing the production of sophisticated interactive educational programs. It is very powerful and versatile software on which to develop interactive templates. The Educational Technology Service at the University of Bristol has developed a template utilizing a variety of different page styles with different functions and interactive facilities. This sits on top of Toolbook 4 enabling the software to be used by most people after a 1-day workshop. This template has been adopted by the Academic Clinical Radiology Department at the University of Bristol to be used in the development of teaching material. This series of tutorials, suitable for use in the teaching of Medical and Dental Students and of postgraduate radiology students studying for FRCR Parts I and II, have been produced in the University Department of Clinical Radiology, Bristol Royal Infirmary, using the Calscribe template. The tutorials demonstrate the facility of use of all the different question types within Calscribe and also contain many high quality scanned radiological images, giving far superior reproduction than the written page is able to. These will increasingly be developed by junior radiologists within the department and are being used in their teaching and revision programme. The tutorials will be presented and the versatility of the various types of interactive questions will be demonstrated, together with the quality of the images used.

Interactive radiology tutorial design using HTML

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Our exhibit will educate the participant as to the ease with which an interactive radiology tutorial can be designed using the HyperText Markup Language (HTML), a common platform with which World Wide Web documents are designed. The exhibit will review the step-by-step design of such an exhibit on a desktop computer equipped with a digital camera or scanner and will provide numerous examples using actual HTML tutorials on various radiology topics.

Interactive radiotherapy planning for students

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A computer-based system has been developed which teaches the craft of planning external beam radiotherapy treatments. The first part teaches the fundamental principles which underly planning techniques, while the second part gives experience in the use of a simple, generic planning program to produce clinical dose distributions. Part 1: Hand-planning techniques are almost obsolete, and computer planning systems may prevent trainees from getting a good "feel" for physical dose distributions. Part 1 addresses this by presenting around 40 pages of text and diagrams which include numerical problems to test the user's grasp of the on-screen dose distributions. IRPS Part 1 has been in routine use in Sheffield for some time for the training of planning MTOs, radiographers, undergraduate physicists, medical physicists and radiation oncologists. Part 2: Students choose from 36 patient contours and then freely use a menu-driven 2D planning algorithm to produce an acceptable plan. Inhomogoneities and critical organs must be considered. Guidance is provided via introductory help, an assessment algorithm which analyses each dose distribution and a series of "hints" which steer the user towards an adequate distribution. IRPS will run well on a 486-based PC under DOS or Windows. The system allows supervisors to keep track of students' progress and should prove useful wherever training in planning techniques is required.

Calibration concept for medical display technology

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Barco provides medical displays or display systems for medical application fields such as CR and CT, MRI and ultrasound. These displays go beyond the generally accepted idea of a display and specifically address the needs of the medical world: maintaining and managing the display's diagnostic performance over time, location and different devices. To guarantee this, the Barco medical display solutions incorporate all the necessary elements to ensure the performance in the display chain. The display unit and all image parameters are totally digitally controlled, in the corners of the screen as well as in the centre, guaranteeing maximum spatial resolution and luminance uniformity over the viewing area. On top of this digital platform, a system for stabilization and calibration of the light-output is built, standing for inherent stability of the overall system. The digital concept makes all controls available on the host system through a digital serial link with the display. The additional software is running on the host system controlling both the graphic board's look-up tables as well as all display parameters. To guarantee device independence and maximize dynamic range and resolution, control of the graphic board as well as of the display is required. The software, in combination with an optical sensor, enables automatic calibration of the output luminance and perceptual linearization of the luminance response function according to the ACR/NEMA grey scale display function standard. Additionally, user-friendly and automated routines are incorporated for display installation, maintenance and trouble-shooting. The final result is the closest a display can get towards softcopy diagnostic requirements. In addition, the displays offer low cost of ownership by providing calibration and maintenance tools which can be applied by non-technical personnel.

Saving time and money—X-Ray QA the Jimmy's way

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Routine quality assurance measurements on diagnostic X-ray sets are an essential part of the provision of a safe and effective service to patients. Waiting list initiatives and increasing workloads mean there is pressure to minimize "downtime". We have developed a quality assurance programme to monitor the most important performance characteristics of diagnostic X-ray equipment. This was originally carried out using manual recording of parameters measured with a Keithley Triad quality assurance system. In order to save time and to streamline the collection of data, the Triad has been interfaced to a Pentium PC 120 MHz laptop computer and a program has been written using Visual Basic to capture the data automatically. Raw data collected includes kV wave forms, dose and time. The program then calculates values such as HVL (from which it deduces filtration) and maximum leakage. Templates for results of AEC, tomo and electrical and mechanical checks are also provided. Previous results from the same set are stored and are displayed at the time of the measurements so that changes and trends can be identified. The data are used to generate reports on the functional state of the equipment with minimal intervention.

The development has resulted in a system which is easy to use, reliable and has significantly reduced the time spent on surveys. The demonstration will show the Keithley Triad interfaced to the laptop with input signals to simulate a typical X ray survey. Examples of report printouts will also be included.

3D image fusion of multimodal tomographic images in clinical practice

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In some cases superimposition of multimodal tomographic images supplies additional information. However, this technology is not often applied because of expensive software and hardware, long computing time and handling problems. We have developed the computer program IMAGO, which allows correct image fusion of CT, MR, SPECT and PET data in clinical routine in adequate time. Primary data are transferred from the acquisition systems or the PACS to our SGI-workstation using the local area network. Anisotropic image sets (in any orientation) are projected into a three-dimensional isotropic matrix (256\263 data points). Missing layers are interpolated. The resulting 3D data cubes are interactively manipulated by rotation, translation and scaling to achieve correct superimposition using anatomical markers. The results are presented by tomographic images in the three orthogonal plains. The procedure is independent of the primary data orientation. IMAGO allows correct image fusion even if the primary data overlap only in parts. Processing time is approximately 15–30 min. Image fusion has been in practical use in our department for more than 6 months. It is employed for the matching of bone scintigraphy, tumour scintigraphy, perfusion scintigraphy and receptor ligands scintigraphy with CT, MR and PET images. It allows reliable anatomical location as well as correct diagnosis within a short time. Thus, image fusion essentially influences therapeutical procedures. A pilot study is in progress in co-operation with the Department of Radiotherapy. Brain tumours, being invisible on CT, are localized with MRI and transferred into CT-based treatment planning. IMAGO improves marking of the correct target volume.

Digital film viewer—a novel film reading technology: hands-on experience

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Digital technologies can substantially improve radiological film reading and interpretation accuracy by utilizing novel electro-optical technologies. Although conventional light boxes are commonly used to read medical X-ray film, they have some severe limitations. Extensive psychophysical research has established that radiological lesion detectability degrades when viewing conditions are not optimized. Although X-ray film contains an enormous amount of data, a conventional light box typically enables the human reader to perceive only a fraction of this information. The SmartLight Digital Film Viewer was designed to optimize electronically film reading acuity and minimize visual fatigue. An artificial vision system monitors the faceplate at all times, identifies the location of the film, and analyses the image recorded on the film. The system automatically masks light emanating from "non-image" areas, thus eliminating glare. It automatically adjusts illumination intensity and chromaticity based on film density. The system adapts and optimizes ambient room light to reader activity. Micro-optic beam formers suppress light scatter within the film for improved image contrast. In addition, means are provided to allow the operator to eliminate cognitive distraction and optimize illumination of clinically important image parts. Preliminary clinical evaluation demonstrates that these capabilities facilitate improved quality and increased diagnostic confidence in the interpretation of radiographic films. The Digital Film Viewer was designed to meet the upcoming European Guidelines on Quality Criteria for Diagnostic Radiographic Images (EUR #16260 and EUR #16261)—Image Viewing Conditions.

An oncology department Intranet for information dissemination and other clinical services

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Local departmental computer networks can be set up to adopt Internet protocols and software to form Intranets. Such networks may use freely available Internet browsers (such as Netscape and Internet Explorer) and appropriate content serving software to act as an advanced information dissemination system. Here, we exhibit such a system for the Oncology Centre at the North Middlesex Hospital developed by COIN, the Clinical Oncology Information Network, which is used to provide up-to-date information to the oncology care team, as well as added-value services. The Intranet is Web-based and hence documents may contain text (of varying fonts, size, etc.), graphics, sounds, animations and so on. The documents may be hyperlinked; *i.e.* associations are created between that document (or part of a document) and another relevant document held elsewhere on the system. Local Intranets are typically more secure and faster than equivalent Internet services as external access is restricted (or indeed not available). This Intranet is not merely a static dissemination tool as it is searchable and enables feedback between the users and the department. It also includes Javascript-based added-value services such as a body surface area calculator and a chemotherapy prescribing module. The adoption of standard Internet protocols and tools enables Intranets to be implemented on a wide variety of computer platforms in different departments as such technology is not architecture specific. Recent developments in the field have enabled Intranets to be linked with databases so that they can be used to audit data and indeed serve all the needs for departmental systems.

BIR Library and Information Service

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Library and Information Service, British Institute of Radiology, 36 Portland Place, London W1N 4AT, UK

The main aim of the exhibit is to demonstrate one of the most popular services offered by the BIR Library, that of the CD ROM literature search facility. Delegates will have the chance either to have a search conducted for them on their chosen subject or to gain hands-on experience and instruction on how to carry out their own search. In either case, searches can be printed out and the results taken away. Visitors to the exhibit will also have the opportunity to evaluate the system and its relevance to their research. The databases RADLINE and RADIOLOGY AND NUCLEAR MEDICINE will be available as well as HEALTH and the more recent HEALTHSTAR. These databases contain both references and abstracts from journals, monographs and some technical reports emphasizing radiology, radiography and their allied disciplines. The Librarian will be available to answer any questions either about literature searching or about the other various services offered by the Library.

Clinical Oncology MAISY—an integrated, computerized audit and administrative system

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Clinical Oncology MAISY is a custom-designed, Paradox-based clinical and administrative system devised by the Clinical Oncology Department at Derbyshire Royal Infirmary, and commercially available through the software writers, Compucorp. Designed in accordance with NHS IMT strategy principles and with consideration for the overlapping needs of clinics, secretarial and other staff, information need only be input once, to be shared among all appropriate members of the clinical team. With network access from 17 terminals sited in radiotherapy treatment units, examination rooms, wards and offices; key elements of patients' history, diagnosis, treatment and follow-up can be captured and made immediately available online for action and analysis. Key features of the system include: interface with hospital PAS via "Reflections" software for direct download of patient demographic and GP data; integral interface with MS "Word" for production of notes, annotations, discharge summaries, etc.; comprehensive, user-defined "response" dataset (including ICD10 diagnostic codes) enabling double-click data entry; integral Paradox report-writer facilitating production of routine and *ad hoc* management, contracting and audit reports and integral security features restricting read/write access to appropriate personnel. MAISY has now been used successfully for over 2 years by clinicians, radiographers and managers, and nursing, pharmacy, secretarial and audit staff to input, view, report and analyse history, diagnostic, treatment and outcome data accumulating a valuable dataset of over 2000 patient treatments and outcomes. Examples of all of these functions will be demonstrated.

Portal image processing system (PIPS)

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We have developed a software package for the enhancement, display and analysis of medical images on a PC-486 or Pentium computer running under Windows 3.11, 95 or NT. The portal image

processing system (PIPS) was originally designed for processing electronic portal images and digitized portal films, but it also has numerous applications in other areas of medical imaging. Image enhancement options include filters for noise reduction and for edge enhancement and detection, as well as several histogram equalization and manipulation techniques, and grey-scale morphological operations. Registration of image pairs is accomplished by fiducial point, template or chamfer matching techniques; and displacements, rotations or scaling factors are determined quantitatively and displayed visually as images of regret. Image comparison tools include a real-time magnifying glass and see-through window, dual cursor display and readouts, and a variety of algebraic and Boolean operations. Tools are provided for measuring distances, areas and angles, for reading pixel values, histograms and profiles, and for displaying topographical maps. Many of the procedures are automatic, while a macro facility allows repetitive processing of similar images. Routines are included for automating several quality assurance procedures used in radiation therapy. Other applications include the viewing, registration and analysis of CT and MRI scans, digitized radiographs, nuclear medicine images, dental radiographs, etc. To allow for special applications, additional routines provided by the user can be incorporated into the PIPS system. PIPS is compatible with most common file formats, including DICOM 3.

An image processing package designed for end users to add their own functions

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A medical image processing package has been developed initially as a teaching aid, but now extended so that users, especially in developing countries, can add their own application functions. The package was initially designed (with the aid of the IAEA) for nuclear medicine and has now been distributed to over 150 centres in over 40 countries. Many users wish to add their own special functions or to develop new packages using a common library. This facility has been added and enhanced. Support is provided over the Internet by FTP of the package and email for advice. Care is required to maintain control over the package so that it does not "hybridize" nor allow interactions between different users' code sections to occur. Both functions in C/C++ and macrofunctions can be added and intermixed to provide different functionality to different end users. This continues to be of particular value as a teaching aid.

OMNI: organizing medical networked information

S M Welsh
Library, National Institute for Medical Research, Mill Hill, London NW7 1AA, UK

Come and see the OMNI gateway to Internet resources, and our new service—the OMNI Harvester. OMNI is one of the UK's largest gateways to medical Internet resources. Our database of high quality material now numbers 1400 items. In addition, in 1997 we are launching the OMNI Harvester, an experimental service. The Harvester is an automatically compiled full text index, covering many thousands more resources. OMNI also creates Internet training materials available at no charge in print and online, copies of these will be supplied to interested delegates.

A PC-based image archiving system for X-ray angiographic images

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[1]*NI Medical Physics Agency,* [2]*Department of Computing Science, University of Ulster, Coleraine, and* [3]*Radiology Department, Royal Hospitals Trust, Belfast, N. Ireland*

Many existing digital X-ray systems have low hard disk space and slow tape archival methods. We have developed and installed a low cost PC based archiving system using a standard pentium PC, a custom database interface and high resolution video frame grabber. Our exhibit will allow users to view X-ray angiographic images captured using the high resolution video frame grabber. The interface allows entry of patient details and images which, after capture, are displayed as a series of thumbnail sketches. Each full image can be displayed by double-clicking the thumbnail. The system allows storage of 800 images and using standard lossless compression this can be increased by about 40%. In practice, 12 weeks of patient images are on-line before being removed. Facility for hard copy is provided by a standard printer and quality is sufficient for records although not diagnosis. Archiving to tape was performed over lunchtime and at the end of the afternoon session. It is estimated that 1 h of radiographer time per day is saved using this system. Images are stored in Windows bitmap format for ease of partability and compatibility with other Windows products.

A 4 year experience with vendorless telenuclear medicine

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Telemedicine is an expensive investment when enacted from commercial vendors in a multiphysician department. We have a 4 year experience in developing an "off-the-shelf" telemedicine network that utilizes non-proprietary software and hardware solutions (cost <$3000/node). The existing hospital network utilizes TCP/IP connectivity between five vendors to provide an extensive local area network. Connectivity from the remote sites occur through standard analog modem connections at 19.2 kilobauds. Images are directly transmitted to laptop Macintosh® computers and converted into 8-bit TIFF format. A stand-alone software application (NucMed Image) has been adapted from the freeware application "NIH Image" for display and analysis. Time–activity curves, SPECT reconstruction and 3-dimensional image co-registration can be performed on the laptop computer and results transmitted back to the central laboratory for hard copy generation and archiving. The current system has been installed on remote terminals for six physicians. No call-back of the attending physician or in-house coverage by house staff has occurred for the last 4 years (five procedures/week average, 1000+ procedures). Only one procedure has had the report modified after review on the conventional nuclear medicine computer on the following workday (a lung scan downgraded from intermediate probability to low). CONCLUSION: Reliable remote telenuclear medicine can be provided through a vendorless, inexpensive workstation using "off-the-shelf" technology.

The acquisition of radiological diagnostic information using hand-held technology

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The exhibit demonstrates an innovative new method for collecting radiological information for the national PERFORMS self-assessment scheme for breast screening radiologists. The original system involved radiologists completing a reporting form with their diagnostic decisions for each mammographic case examined. Films and reporting books were returned to a central point for analysis. This took at least 2 h with individual radiologists receiving the report detailing their performance ideally within 2 weeks. The new information system has been developed using the Psion Workabout hand-held computer, fitted with a bar-code reader. Each mammographic case is now identified by a unique bar-code and diagnostic information is entered using further bar-codes to identify decision categories. Data collection has been enhanced by replacing reporting books with these hand-held computers. This technology greatly increases the efficiency of PERFORMS as the information transfer is quick and it eliminates the possibility of human transcription errors. Once the set of mammographic cases have been examined, the information is transmitted electronically to our central computer which analyses the data. The results are then faxed back to the radiologists within 1 h of them sending us their diagnoses. These results contain information which can be compared with the films themselves thereby incorporating a new training element into the PERFORMS scheme. This exhibit demonstrates the ease of using this technology and the potential benefits for the radiologists.

"RASCAL"—radiology and surgery computer aided learning: an interactive teaching program on head injury

J M Young, R Sargesson, C Ingham Clark, J Murphy, S Alison, N Atkinson, R Hobbs, N Kaveh, I Lambert, J McCurdy, J Rodin, P Tuson, D Yoo Foo and J Crowcroft
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Head injury is predicted by the World Health Organisation to 2020. Appropriate and up-to-date management is crucial to outcome. RASCAL is a pilot teaching project. It is modular in design with clinical and radiology elements. The radiology modules include: indication for skull radiographs and computed tomography, and interpretation of the skull radiograph. It is interactive, incorporating images, video, text and audio. It can be used as a teaching program, for revision or as a reference. In this way it can be used to promote evidence-based medicine and to support clinical decision making. The program is delivered over the Web from the University network. CD-ROM delivery is also envisaged, allowing greater interactivity. This project is appropriate for undergraduates and postgraduates and paramedical personnel.

MEDIATE—a tool for assisting training in description, interpretation and diagnosis from MR images

[1]N Jeffery, [2]B A Teather, [2]D Teather, [3]G H du Boulay, [1]B du Boulay and [1]M Sharples

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MEDIATE is a collaborative venture that brings together expertise in cognitive modelling, human computer interaction, intelligent tutoring systems design, medical imaging and medical statistics. This exhibit will demonstrate one development of the MEDIATE collaboration, the MR-Tutor (first prize winner at *info*RAD™ 1996). The MR-Tutor runs on PCs under Linux and offers an archive of abnormal MR scans of the head (indexed by lesion appearance and diagnosis) linked to a prototype knowledge based training system aimed at teaching both: (1) a standard and systematic approach to interpretation and description, and (2) the diagnosis of lesions visible in the scans. The training system uses a novel graphical display to show the significance of competing diagnoses and displays the overlap of cases for confusable diseases. As part of the project the MR-Tutor is being evaluated with trainee radiologists at various levels, and investigations of current radiology training are being undertaken so as to develop a system that can best fit into the working practices of radiology registrars.

Monday 19 May

1035–1045
Work in Progress
Synchrotron Radiation
Hall 10b

Please note: Synchrotron Radiation State of the Art Symposium begins at 0900. See pp. 6–7 for abstracts.

1035

Determination of the optimum wavelength for mammography using synchrotron radiation

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Despite the fact that X-ray mammography is one of the most widely used diagnostic techniques in medicine, with more than 1 million patients being screened in the UK annually, very little work has been performed on the X-ray attenuation of the various normal and diseased breast tissues. It is these X-ray attenuation coefficients which are the inherent physical properties that determine image contrast in mammograms. Accurate knowledge of them is therefore necessary if any mammography system, either conventional or novel, is to be optimized for the detection of disease. Tuneable monochromatic X-ray beams from the Daresbury synchrotron have been used to determine the linear attenuation coefficients of approximately 30 samples of various types of normal breast tissue over the energy range 15–25 keV in 100 eV steps. Future work will evaluate the coefficients of both malignant and benign tissue samples and also extend the energy range to both higher and lower energies.

1600–1700
Work in Progress
Bones & Musculoskeletal
Hall 1

1600

Indirect MR arthrography of the shoulder

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PURPOSE: To evaluate and optimize MR shoulder arthrography using intravenous injections of gadolinium. MATERIAL & METHODS: We studied eight patients who had suspected shoulder instability. Examinations were performed on a 1 T GE Horizon scanner using a dedicated shoulder coil. Patients were scanned before and after intravenous injection of 0.1 mmol kg^{-1} of dimeglumine gadopentate. The shoulder was exercised vigorously for 10 min after the injection before proceeding to the post-injection scan. The anterior and posterior glenoid, labra and capsular insertions, the morphology of the humeral head and the superior, middle and inferior glenohumeral ligaments were assessed on pre- and post-injection examinations. Results of pre- and post-injection scans were compared and also with, where available, conventional MR shoulder arthrograms. RESULTS: Fat saturated T_1 weighted sequences performed after intravenous injection of contrast showed strong joint enhancement but inconsistent joint distension. Pre- and post-contrast scans showed similar pathologies. CONCLUSION: Intravenous injection of dimeglumine gadopentate followed by vigorous exercise of the shoulder produces a variable arthrographic effect on fat suppressed T_1 weighted MR scans. The efficacy and value of the technique are discussed.

1610

Neural network diagnosis of Colles fractures

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PURPOSE: This research is an enquiry into the performance of artificial intelligence in a well defined radiological reporting task compared with the performance of student radiographers. MATERIALS: 550 images of PA wrist projections were digitized from hard copies and stored on an optical disc. There were 166 fracture images and 384 with no bony injury, as reported by radiologists. All the fracture radiographers were graded into I, II and III degree Colles fractures. The digitized images were used as a training bank for a multilayer perceptron neural network. METHODS: The output of the neural network when tested with a test bank selection of images was designed to give a probability rating of the presence of a fracture from 0 to 1, to six decimal places. The test bank consisted of 105 fractures and 105 no fracture images. The same test bank was presented to 20 3rd year students on a 3 year BSc Radiography programme. RESULTS: The decision data from the students and the neural network were subjected to ROC analysis and the Az values calculated. Mean value of Az for the students was 0.91 and for the neural net 0.96 for all grades of fracture detection. CONCLUSION: For a simple detection task for fractures of the radius and ulnar a three layer perceptron neural network can perform to the level of final year student radiographers.

1620

To evaluate the role of ultrasound and MRI in suspected Morton's neuroma

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PURPOSE: To evaluate the role of ultrasound and MRI in suspected Morton's Neuroma (MN). MATERIALS & METHODS: 41 patients with suspected MN have been included. All had MRI using a Siemens 1.0 T scanner and extremity coil. T_1 weighted SE and STIR sequences were acquired with additional out of phase (OOPS) T_1 weighted gradient images in some cases. Gadolinium was given in a few patients. In 24 cases both feet were MRI scanned. 21 of the patients underwent bilateral foot ultrasound using a 7.5/10 MHz transducer. Imaging results were compared with pathological and clinical findings. RESULTS: Of 41 patients, MRI diagnosed 52 MNs in 30 patients. T_1 weighted SE was the most sensitive sequence. Three of seven neuromas enhanced with gadolinium. Multiple MNs were seen in 16 patients and bilateral MNs in 14. The symptomatic and MRI diagnosed site differed in two patients. In 10/14 bilateral cases one foot was asymptomatic. Ultrasound detected 14 of 33 neuromas seen on MRI. No neuroma was seen on ultrasound only. Symptomatic MNs were, on average, slightly larger than asymptomatic ones but not always so. Of 11 lesions resected so far, pathology confirmed seven MNs identified on MRI, with one false negative, one possible false positive and two true negative studies. Ultrasound compared with pathology produced one true positive, one false positive and two false negative results. CONCLUSION: Preliminary findings strongly suggest that MRI detects more MNs than ultrasound but some MRI detected MNs may be clinically asymptomatic.

1630

US bone analysis in children with anorexia nervosa

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PURPOSE: The use of ultrasound as a method of detecting osteopenia and osteoporosis in children and young adults has been assessed in this pilot study. MATERIALS: 32 females aged between 11 and 21 years participated in this prospective study. All ultrasound measurements were taken with a commercially available McCue Contact Ultrasound Bone Analyser (CUBA), adapted for paediatric use. METHODS: All patients presenting with a diagnosis of anorexia nervosa were invited to participate in the study. Broadband ultrasound attenuation (BUA) through the left calcaneum was measured and recorded for each patient. Each patient underwent a pelvic ultrasound scan to assess pubertal status on the same day as the BUA scan. RESULTS: 15 (47%) patients with a mean age of 15.5 ± 2.5 years had a BUA value less than 100%. 17 children with a BUA greater than or equal to 100% had a mean age of 14.8 ± 2.2 years. There was no significant difference in pubertal status between the two groups. Four girls in the normal BUA group and three girls in the low BUA group had polycystic ovaries. The BUA short-term coefficient of variation calculated from five repeated scans on each of two volunteers was 1.59%. Results of DXA scans have not been compared because of an inconsistency in the time of scanning in relation to the ultrasound scans. CONCLUSION: BUA appears to be a useful, simple, non-invasive, inexpensive method of assessing bone density in children and young adults.

1640

The measurement of fine structures by CT

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QCT studies indicate that the density of the cortical shell of lumbar vertebrae changes significantly with age and the onset of osteoporosis and hence may be a factor contributing to fracture risk. However, these measurements may be subject to error because the thickness of the shell ($\sim$0.5 mm) is less than the spatial resolution of conventional CT systems. To investigate these errors CT measurements were performed on aluminium sheets of known thickness simulating compact bone. The peak CT numbers (CT_{peak}) and full width half maximum (fwhm) of the image profiles were measured and their variation with aluminium thickness determined. It was found that accurate measurement of density and thickness is possible only when the object thickness is greater than twice the spatial resolution of the system, *i.e.* $\sim$3 mm. For thicknesses below this value there is a progressive overestimation. Hence CT measurement of the cortical shell will underestimate density and overestimate thickness. We found that $CT_{peak} \times$ fwhm and thickness are linearly related and this provides a method of calculating the true dimensions of thin structures. A test of this method on vertebral specimens gave accurate estimates of the thickness of the cortical shell

1650

The application of trabecular bone density values in the detection of osteoporosis within the community

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PURPOSE: To investigate the application of trabecular bone density values within a self-selected population within a GP practice in Peterborough. MATERIALS: pQCT peripheral wrist scanner. METHODS: 130 patients completed a risk factor questionnaire and bone densitometry of the wrist in order to assess the cortical and trabecular bone density within the distal radius. Scoring of the completed questionnaires and determination of "relative risk" values were compared with the bone mineral density (BMD) values of trabecular bone from the scanner. RESULTS: Of the 130 patients assessed through the questionnaire: 105 were classified as within the normal range, 22 were classified as osteopenic and three were classified as osteoporotic. Using neural network analysis the accuracy of the questionnaire when compared with pQCT scan values was 84%. CONCLUSION: Initial results for the measurement and application of trabecular BMD to the identification of at risk individuals is encouraging. The formulation of a questionnaire related to trabecular BMD is also of interest and further work is required in order to confirm the application and usage of such a questionnaire in a community based setting. The relationship of trabecular BMD values relative to scoring "at risk" individuals requires the acquisition of further measurements in order to confirm application of such a procedure to clinical and community practice.

WORK in PROGRESS

Tuesday 20 May

0900–0930
Work in Progress
Breast
Hall 11a

0900

Interval cancers: an inductive approach

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PURPOSE: Breast screening programmes do not detect all existing cancers, as some are occult whilst others are very subtle and are missed. Additionally, cancers with a rigorous nature develop subsequent to screening. To analyse and define these and other interval cancer classifications within the NHSBSP a database of over 2500 cases was established in 1992. To aid screening detection of cancer, inductive learning techniques have been applied as a knowledge elicitation tool to build three interval cancer diagnostic profiles. MATERIALS & METHODS: To define a Diagnostic Profile, the fields from the database which were used are: mammography findings, mammographic background pattern, site of abnormality and clinical findings at diagnosis. For the Mammographic Screening Profile the mammography findings at the screening prior to detection of the interval cancer were used, and for the Mammographic Diagnostic Profile mammography findings at diagnosis were applied. The data were analysed by the c4.5 Inductive Learning Program which used the interval cancer types for classification. RESULTS: For each profile the data set has been classified and diagnostic decision trees developed isolating the key interval cancer factors and features. Within the three profiles there are differing attributes which have been defined by the program as most predictive of the interval cancer classifications. CONCLUSION: Using the diagnostic decision trees developed by the c4.5 Inductive Learning Program the salient attributes of each classification of interval cancer have been identified. Incorporating this knowledge into the training of breast screening radiologists may increase cancer detection, thus decreasing interval cancers.

0910

The effect of hormone replacement therapy on the sensitivity of mammographic screening

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PURPOSE: The aim of this study was to assess the effect of hormone replacement therapy (HRT) on the sensitivity of mammographic screening by comparing HRT usage in women with screen detected breast cancers with HRT usage in women presenting with interval cancers. METHODS: Information about HRT usage has been collected on all patients with breast cancers detected by the West of Scotland Breast Screening Service since October 1990. In women with interval cancers, HRT usage at the time of their previous screening mammogram was recorded. RESULTS: There have been 1031 screen detected cancers on our unit between October 1990 and November 1996. Of these, 175 (17%) were taking HRT at the time of screening. Over the same time period data are available on 359 women with interval cancers, 84 (23%) of whom were taking HRT at the time of their previous screen. A significantly higher number of women with interval cancers were taking HRT ($p<0.01$). Of women presenting with an interval cancer within the first year of a "normal screen", 34% were using HRT. CONCLUSION: Women presenting with interval cancers are more likely to have been using HRT than women with screen detected cancers. Further study is necessary to ascertain the reason for this, but our results raise the possibility that HRT usage may reduce the sensitivity of mammographic screening.

0920

Dynamic gadolinium enhanced MRI of the axilla in patients with breast cancer: comparison with pathology of excised nodes

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BACKGROUND: The only way of accurately staging the axilla in patients with breast cancer is surgical sampling or clearance of axillary lymph nodes. At present there is no documented, reliable non-invasive method of determining whether axillary lymph nodes contain metastatic tumour. Gadolinium enhanced magnetic resonance mammography has been shown to be a sensitive method for detecting breast cancer and can distinguish between post-therapy fibrosis and recurrent tumour in women with treated breast cancer. We have fortuitously observed enhancement of pathological nodes in patients with locally advanced cancer. AIM: To assess the positive and negative predictive values of dynamic gadolinium enhanced MRI of the axilla in women with breast cancer by comparing quantitative evaluation of enhancement with pathology of excised nodes. METHOD: Women who will undergo axillary node sampling or clearance, as part of breast cancer surgery, are imaged during the week prior to surgery. Imaging is performed in the supine position using a wrap around flexible surface coil and the following protocol: 3D T_1W FLASH oblique sagittal; 3D T_1W FLASH high resolution coronal; 3D PDW FLASH oblique sagittal; 3D T_1W FLASH oblique sagittal dynamic series—before and after 0.1 mmol kg^{-1} iv bolus of Gd DTPA; 3D T_1W FLASH high resolution coronal. Image subtraction and quantification of any enhancement is performed using a computerized threshold technique. Results are correlated with pathology. PRELIMINARY RESULTS: Of the 10 patients imaged, eight have shown no enhancement with negative pathology. Two patients with positive nodes have shown variable enhancement. Patient recruitment and refinement of the methods of quantification continue.

1010–1110
Work in Progress
Vascular & Interventional Radiology
Hall 11b

1010

Evaluation of in-stent restenosis of peripheral arterial stents and stent grafts: intravascular ultrasound *versus* angiography

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PURPOSE: To compare intravascular ultrasound (IVUS) with standard peripheral angiography (DSA) in determination of in-stent restenosis of peripheral arterial stents and stent grafts. MATERIAL & METHODS: 29 pelvic and 23 femoral stents (1 Palmaz stent, 9 Wallstents, 22 covered and 20 uncovered nitinol stents) in 42 patients were evaluated by DSA and IVUS at 13.6 ± 8.7 months after implantation. The degree of stenosis on DSA and IVUS were compared for each location. Morphological features and topography of the stenoses were also assessed. RESULTS: DSA and IVUS correlate well in the determination of in-stent restenosis ($r^2=0.96$). On average, DSA underestimated the grade of stenoses by $14.2\pm6.3\%$ compared with IVUS ($p<0.01$). Underestimation was independent of severity of in-stent restenosis (up to 85%) and stent type. IVUS revealed incomplete stent expansion in 15 cases *versus* five cases on DSA. CONCLUSIONS: IVUS provides excellent information regarding severity of in-stent restenosis, plaque morphology, predilection of neointimal tissue accumulation and complete or incomplete stent expansion. Peripheral DSA underestimates in-stent restenosis in stents and stent grafts. IVUS is superior to peripheral DSA in detection of incomplete stent expansion.

1020

Determination of neointima proliferation and plaque morphology in covered *versus* uncovered nitinol stents with intravascular ultrasound

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PURPOSE: To investigate neointima tissue accumulation and plaque morphology in covered (CNS) *versus* uncovered (UCNS) nitinol stents with intravascular ultrasound (IVUS). MATERIAL & METHODS: 16 pelvic UCNS (9.6 ± 1.8 mm diameter, 52 ± 19.6 mm length) in 14 patients and 22 CNS (5 pelvic, 17 femoral stents, 6.8 ± 1.8 diameter, 66.2 ± 41.7 mm length) in 15 patients were evaluated with IVUS at 12.8 ± 7.4 (UCNS) and 13.3 ± 6.9 (CNS) months after implantation. The maximum plaque area was measured. Qualitative analyses of plaque composition and lesion topography were also assessed. RESULTS: Maximum stenoses of $18.7\pm13.2\%$ in UCNS and $48.4\pm24\%$ in CNS ($p<0.01$) were

found. Maximum plaque area was $9.8 \pm 6.6\ mm^2$ (UCNS) and $27.3 \pm 18.6\ mm^2$ (CNS) ($p < 0.01$). Predilection of neointimal tissue accumulation were found in the proximal and distal ends of the CNS. In contrast, no predilection of neointima formation was found in UCNS. Completeness of stent expansion was comparable for both stent types. Only soft neointimal plaques were found. CONCLUSIONS: IVUS provides excellent information regarding severity of in-stent restenosis, plaque morphology, predilection of neointimal tissue accumulation and complete or incomplete stent expansion. CNS showed significant larger plaque areas and higher graded stenoses compared with UCNS. The ends of CNS had a predilection of neointima formation.

1030

Treating claudication in nine words

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PURPOSE: The cost of treating vascular disease is high. This ongoing prospective study compares the impact of percutaneous transluminal angioplasty (PTA) and a supervised exercise programme (SEP). MATERIALS & METHODS: 40 patients, with intermittent claudication and a lesion suitable for angioplasty on angiography, were studied using a quasi two group, experimental design. 29 patients were treated with PTA and 11 with SEP. Outcome measures evaluated prior to, and at 1 and 3 months post-treatment, included: patient reported maximum walking distance (PRMWD), and quality of life (QOL) using the Short Form 36 (SF36) and Euro QOL; intermittent claudication distance (IC) and maximum treadmill walking distance (MTWD) recorded by standardized treadmill testing at $2.5\ km\ h^{-1}$ on a 10° incline; ankle to brachial pressure indices (ABPI) recorded both prior to, and immediately after treadmill testing; lower limb perfusion parameters, determined using an isotope influx technique (ILBF). RESULTS: In both groups, statistical analysis using Wilcoxon matched pairs revealed significant improvements ($p < 0.005$) in PRMWD and several SF36 and Euro QOL measured QOL domains; ICD and MTWD also improved significantly. However, only in the PTA group was a significant improvement seen in ABPI and ILBF measurements. The SEP group demonstrated no improvement to indicators of lower limb perfusion. CONCLUSIONS: PTA and SEP are both effective in providing symptomatic relief in the treatment of intermittent claudication. However, they seem to do this by different mechanisms.

1040

CT angiography of aorto-iliac occlusive disease

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PURPOSE: To assess the accuracy of CT angiography of the aorto-iliac segment. METHODS: We conducted a review of CT angiograms of the aorto-iliac segment performed at our centre between June 1994 and October 1996 for assessment of occlusive vascular disease. During this period 58 such studies were performed. Studies were acquired on a Picker PQ 2000 CT scanner using 4 mm collimation and pitch of 1.5. Contrast was injected at $2.5\ ml\ s^{-1}$ and the vessels from the infrarenal aorta to the superficial femoral artery were imaged. Data were reconstructed using maximum intensity projections and curved coronal reconstructions. A comparison of the findings of CT angiography and formal angiography was made. CT and angiographic images were analysed and significant stenoses and occlusions detected by each modality were documented. RESULTS: Of the 58 cases 26 cases subsequently underwent formal angiography. Formal angiography identified a total of 14 significant stenoses and 14 occlusions. CT correctly identified 13/14 occlusions and 13/14 stenoses. CT misclassified one stenosis as an occlusion and one occlusion as a stenosis. Length and site of lesion also showed a close correspondence between the two modalities. All normal vessels were correctly classified by CT. CONCLUSION: CT angiography is an accurate non-invasive means of assessing the aorto-iliac vessels. There have been little previous data on the use of this technique in aorto-iliac occlusive disease. It is particularly valuable in patients with severe aorto-iliac disease where it can obviate the need for a diagnostic transbrachial study.

1050

A comparison of CT angiography *versus* other modalities in carotid artery imaging

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PURPOSE: To compare carotid artery CT angiography with other invasive and non-invasive modalities. MATERIALS: 176 vessels in 88 patients were evaluated by both colour Doppler ultrasound and CT angiography between May 1995 and December 1996. 130 of these vessels were evaluated by MR angiography and 58 by formal angiography. METHODS: CT angiography was performed on a Picker PQ 2000 CT scanner. After a pilot study to determine bolus timing and bifurcation level, images were acquired using a slice thickness of 2 mm and pitch of 1.5 after intravenous contrast injection of 75 ml at $2.5\ ml\ s^{-1}$. Stenoses were assessed using axial data and MIP reconstructions. MR angiography using 2D and 3D TOF images was performed on a Siemens 1 T scanner. The degree of stenosis measured by NASCET criteria was compared for each modality and rates of concurrence for detecting 70–99% (surgical) stenoses were calculated. RESULTS: CT angiography and Doppler ultrasound were technically successful on 87/88 patients and formal angiography was successful on all 29 subjects submitted for these investigations. 10/65 patients were unable to undergo MR angiography owing to claustrophobia or contraindication. CT and formal angiography concurred in 53/58 cases (92%) in predicting 70–99% stenosis. CT and ultrasound concurred in 148/176 vessels (84%). CT and MRA concurred in 120/130 vessels (92%). CONCLUSION: These results confirm CT angiography as an accurate technique in assessing carotid artery stenosis with a high technical success rate. As such it is a useful addition to the battery of investigations for assessing carotid artery stenosis.

1100

Duplex assessment of venous surgery by the junior surgeon

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PURPOSE: Varicose veins surgery is associated with significant recurrence rates ranging from 7 to 65%. Pre- and post-operative Duplex scans and a consultant led venous service are suggested methods to combat this. MATERIALS & METHODS: A prospective study of 30 patients (23 women and 7 men), median age 48 years (range 23–68) with primary varicose veins were undertaken. The SFJ, the LSV, the SPJ, and the SSV were scanned pre- and post-operatively by a consultant radiologist or an experienced vascular technician, using an Acuson 128 machine and linear 5 MHz probe. 26 patients had SFJ incompetence and LSV reflux alone; two patients had SPJ incompetence and SSV reflux alone and two patients had incompetence and reflux at both sites. Surgery was performed by an SHO supervised by a consultant vascular surgeon. RESULTS: Of the 28 SFJ and four SPJs found to be incompetent pre-operatively, 27 SFJs and three SPJs had been successfully ligated on post-operative Duplex. In one patient, who had surgery at both levels, the SFJ and SPJ were not identified due to a post-operative groin abscess and moderate lower limb oedema impeding Duplex visualization. CONCLUSION: A consultant led venous service and pre-operative Duplex scan are recommended as measures to prevent varicose vein recurrence. The development of post-operative reflux may be due to a number of factors including imaging problems and disease progression. (SFJ, saphenofemoral junction; SPJ, saphenopopliteal junction; LSV, long saphenous vein; SSV, short saphenous vein.)

1110–1200
Work in Progress
Gynaecology & Urology
Olympian Suite

1110

Serum prostate specific antigen: predictor of MR staging in prostate carcinoma

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PURPOSE: To assess the correlation between the serum prostate specific antigen (PSA) values and MR staging/bone scan findings in patients with prostate carcinoma. METHODS & MATERIALS: 77 cases (mean age 66 years, range 51–88 years) with histologically proven adenocarcinoma of the prostate were included in the study. 64 of them had untreated tumour (Group A) and 13 were identified as having residual or recurrent tumour (Group B). 64 cases underwent bone scan. All MR examinations were performed on a Philips Gyroscan T5 II (Philips Medical System). Spin echo sequences were

employed to obtain the T_1 and T_2 weighted images. MR staging of the prostate carcinoma was based on the Whitmore–Jewett staging system. Statistical analyses were performed using S-PLUS software package (StatSci, USA). RESULTS: The mean (±SD) PSA level prior to treatment was 37.02 ± 86.60 ng ml^{-1} in Group A and 84.89 ± 42.19 ng ml^{-1} in Group B. Using the Spearman rank correlation test, the PSA level showed significant correlation with the MR staging in both Group A ($p<0.01$, $r=0.33$) and Group B ($p<0.01$, $r=0.71$). The mean PSA levels of the positive and negative bone scans were 97.71 ± 159.95 ng ml^{-1} and 37.35 ± 92.49 ng ml^{-1}, respectively. There was no significant difference in the PSA level in patients with a negative bone scan compared with those with a positive bone scan ($p=0.10$, Student's t-test). CONCLUSION: Our study demonstrated the serum PSA value to be a significant predictor for MR staging of prostate carcinoma while no correlation between the PSA values and bone scan findings was presented in this population.

1120

Radiological investigation of renal colic revisited: helical CT without contrast compared with intravenous pyelography (IVP)

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PURPOSE: The aim of our study was to compare plain helical CT with IVP in order to evaluate and define the place of CT in the radiological assessment of renal colic. MATERIAL & METHODS: This prospective study has been conducted on a GE Prospeed scanner, in a series of 30 patients suffering from renal colic. Helical CT without contrast was performed in each case and doubled-blinded to an IVP which followed immediately. RESULTS: Preliminary results prove CT to be very quick and efficient in assessing the abdominal and pelvic regions in the event of renal colic. Compared with IVP, it has the same sensitivity in detecting ureteral obstruction, but seems to be superior in identification, location and evaluation of the characteristics of urinary stones. Moreover, CT can depict several signs associated with renal colic such as morphological alterations of fat tissue in the renal sinus. CONCLUSIONS: The results of this study indicate that helical CT without contrast is more efficient than IVP in the radiological evaluation of renal colic and should be the method of choice where possible.

1130

An assessment of the diagnostic yield of 25 G fine needle aspiration in patients with suspected malignant disease

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PURPOSE: 25 G fine needle aspiration (FNA) is widely used as a diagnostic tool in superficial lesions (*e.g.* thyroid). We describe the use of a similar technique in deeper lesions and evaluate its role as a diagnostic tool in patients with malignant disease. METHOD: From June 1995 to February 1997, 44 patients with suspected malignancy (31 male, 13 female, mean age 64.6 years) underwent 25 G FNA. Sites biopsied were liver (15), lung (19) and other soft tissues (10). Biopsies were ultrasound or CT guided. Immediate microscopic evaluation of material was made by the radiologist (AB) using Diff quick stain. If cellularity was low an 18 G core biopsy was taken (eight patients). RESULTS: 25 G aspirate provided diagnostic results in 86.4% of all cases. The diagnostic yield from lung biopsies was 100% and 86.6% for liver. For soft tissues the yield was 60%. All six non-diagnostic FNAs had 18 G core biopsies which provided additional information in four cases. A small pneumothorax (not requiring treatment) has been the only complication. CONCLUSION: 25 G FNA provides excellent yield in lung and liver lesions and is a procedure that is easy to perform and has a very low morbidity. The need for core biopsy can be obviated in the majority of cases by performing immediate assessment of cellularity.

1140

MR dynamic enhancement pattern of cervical carcinoma: potential indicator of tumour regression rate during radiotherapy

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PURPOSE: This prospective study aims to determine the association during radiotherapy between cervical carcinoma regression rate (CCRR) and MR dynamic enhancement patterns (DEP). METHODS & MATERIALS: MR examinations, each including a T_2 weighted (T_2W) sequence and a dynamic Gd-DTPA enhanced sequence (seven slices per 60 s interval over 6 min), were performed fortnightly, during radiotherapy in nine patients with FIGO Stage IB–IIIB cervical carcinoma. Tumour volume was estimated using planimetry on T_2W. CCRR was calculated from the average of three repeated volume measurements. To delineate tumours on dynamic images, boundaries were transferred from co-registered T_2W sequences using purpose-designed software. Various characteristics of tumour enhancement were recorded. RESULTS: Initial tumour volumes ranged from 12 to 227 cm^3. During radiotherapy, tumour volume decreased exponentially with time ($p<0.01$). CCRR ranged from 1.7 to 14.5, mean 7.0 ± 4.3 (units: percentage reduction of volume per day). Of the enhancement characteristics recorded, the most prominent for bulky tumours in early dynamic phases (1–3 min) were peripheral distribution, and heterogeneity *versus* homogeneity. Among five cases with below-mean CCRR, four showed peripheral DEP and four exhibited heterogeneous DEP (three demonstrated both), while in four cases with above-mean CCRR, three exhibited relatively homogeneous DEP while only one presented peripheral and heterogeneous DEP ($p<0.01$, Fisher's exact test). CONCLUSION: Our initial results show peripheral and heterogeneous tumour enhancement in early dynamic phases to be associated with slow tumour regression, indicating that the MR dynamic enhancement patterns may be useful in designing the treatment schedule for cervical carcinoma.

1150

Comparative analyses of computed tomography and ultrasound in the diagnosis of retroperitoneal metastases of testicular tumours

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PURPOSE: The relative effectiveness of computed tomography (CT) and ultrasound (US) in detecting retroperitoneal lymph node metastases of testicular tumours was studied. METHODS: 104 patients with confirmed testicular tumours underwent examination using CT and US. MATERIALS: 56% of patients had right, 41% left and 2% both side tumours. 33 patients had seminomas and 71 had non-seminomatous tumours. RESULTS: In 76 (80%) patients retroperitoneal metastases were revealed: 33% had metastases of the paracaval lymph node, 19% paraaortal and 48% both. Analysis of the relative effectiveness of CT and US was made using morphological data received from 52 patients who had undergone lymphadenectomy. Distribution of patients according to stages was as follows: T1–3 N_0M_0, 9; T2–3 N_1M_0, 16; T2–4 N_2M_0, 16; T2–4 N_2M_0, 17; T1–3 N_3M_0, 10 patients. Specificity, sensitivity and accuracy using CT were 95%, 92% and 89%, respectively, and using US were 91%, 79% and 82%, respectively. CONCLUSION: Computed tomography is a more effective diagnostic method than ultrasound for detecting, staging and assessing the operability of retroperitoneal metastases of testicular tumours, and also for confirming complete metastatic regression. However, for monitoring the effectiveness of treatment, the use of ultrasound together with specific radioimmunoassay detection is sufficient.

1500–1510
Work in Progress
Nuclear Medicine
Hall 10b

Please note: Nuclear Medicine Scientific Session begins at 1400. See pp. 47 48 for abstracts.

1500

Preliminary assessment of a new gamma camera based PET system

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PURPOSE: Recent advances in gamma camera technology have meant that state-of-the-art dual-headed SPECT systems may be upgraded to perform true coincidence PET imaging at a fraction of the cost of dedicated PET scanners. The first such system in the UK (an ADAC Vertex EPIC2 fitted with the molecular coincidence detection (MCD) upgrade) was installed in our department at the beginning of the year and is in the process of being evaluated for

a variety of clinical studies. MATERIALS & METHODS: Measurements have been performed to confirm the manufacturer's figures for resolution and sensitivity. Additional measurements have been made using ^{68}Ge line and point sources, and ^{18}F point and uniform sources. A Jaszczak phantom filled with ^{18}F has been imaged and representative brain and cardiac phantoms studies will follow. A major consideration with this technology is the contribution of activity outside the field-of-view for which appropriate phantom measurements have also been performed to assess the degradation in image quality for more realistic clinical situations. RESULTS: A spatial resolution of ~5 mm at FWHM is achieved along with a sensitivity of ~2.7 cps $Bq^{-1}cm^{-3}$ (still an order of magnitude down on that of dedicated systems operating in the comparable 3D mode). Random coincidences, dependent on the activity throughout the whole patient, limit the true coincidence count rates to ~13 kcps. In the Jaszczak phantom, cold rods are visible down to ~7 mm in diameter. CONCLUSIONS: With an appropriate choice of studies such a system offers a viable alternative to dedicated PET scanners. Initial clinical images, in a variety of oncology patients, will also be presented.

Wednesday 21 May

0900–0950
Work in Progress
Radiographic Reporting
Hall 10a

0900

Radiographic reporting of the axial and appendicular skeleton by radiographers and nurse practitioners

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PURPOSE: This paper presents a comparison of the performance of radiographers who have undertaken a Postgraduate Certificate course in Image Interpretation with peer groups of radiographers and nurse practitioners of similar years' experience but who have not received additional training. METHODS: A broadly representative sample of 120 radiographic examinations of all regions of the musculoskeletal system were selected with a normal to abnormal ratio of 65:55. The three groups were compared by evaluating their sensitivities and specificities, against a gold standard determined by a consensus of at least two consultant radiologists. INTERIM RESULTS: The mean sensitivity for the radiographers who have undertaken the course of study was 95.0% and the specificity 98.9%. A mean score combining the sensitivity and specificity produced a highly significant difference compared with the radiographers who have not undertaken the course, with figures of 96.9% and 80.1%, respectively ($p<0.005$). Data for the nurse practitioners will be available at *Radiology 1997*. CONCLUSIONS: A significant difference was demonstrated between the two groups of radiographers. The performance of nurse practitioners has yet to be determined. We hope that our results can contribute to the continuing debate concerning competence in reporting of the musculoskeletal system by radiographers and nurse practitioners.

0910

Monitoring the effectiveness of a clinical reporting and educational programme: are radiographers getting it right?

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Changes within the National Health Service have been influential on the scope of duties undertaken by healthcare professionals. For example, some tasks which were once considered to be those of medical practitioners are now delegated to appropriately trained staff. This change in practice and the current trends in professional role development for radiographers have led to the development of a postgraduate education programme for radiographers in order to underpin the skills of reporting plain films of skeletal trauma and orthopaedics. The purpose of this paper is to investigate the effectiveness of the education programme in relation to the accuracy of the radiographers' reports whilst also monitoring their levels of confidence in this accuracy. METHODS: Five radiographers participated in the pilot study. Detailed records were kept throughout the pilot programme of all 500 reports completed by each radiographer and their personal confidence level in the accuracy of these reports. The reports were compared with those of a radiologist, and the sensitivity, specificity and overall accuracy were monitored for each radiographer. RESULTS: Quantitative findings from the pilot programme have shown a marked improvement in sensitivity and specificity between the first 100 films reported and the last 100 films reported by each radiographer. The mean accuracy level rose from 89.2% at the beginning of the pilot programme to 97.8% at the end. Qualitative findings demonstrated that the radiographers' confidence levels in the accuracy of their reports also showed a marked increase, with the radiographers being confident with less than half of the first 100 films reported, increasing to being confident with almost 90% of the final 100 films reported. CONCLUSION: This paper reports on research in progress and seeks to demonstrate that with relevant learning support, experienced radiographers can improve and maintain their reporting accuracy to a level which is similar to that of radiologists; moreover, within a relatively short period of time, radiographers' confidence in their own ability to be accurate showed a marked improvement.

0920

A thematic analysis of accredited education programmes in radiographic reporting

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PURPOSE: During the past 2 years reporting by radiographers of skeletal, particularly accident and emergency, examinations has begun to be implemented and a number of postgraduate courses in radiographic reporting have become available. This paper presents a thematic analysis of reporting courses validated and accredited prior to January 1997. MATERIALS & METHODS: A questionnaire was developed and circulated to course centres in order to capture data about the reporting courses. Data captured included information on the rationale and philosophy of the course; course structure; attendance; teaching and learning methods; assessment; relationships with clinical radiology departments; and quality assurance. Information on courses' definitions of the "gold standard" report was also gathered. Data were then subjected to thematic analysis using a panel of three reviewers. RESULTS & CONCLUSIONS: Early results demonstrate that the predominant course model is the postgraduate certificate. Commonality in the rationale and philosophy underpinning courses is apparent and tends to reflect current health policies. A range of assessment strategies are evident and all courses use some form of competence assessment related to a gold standard radiological report. Strong relationships with clinical radiology departments are demonstrated with radiologists being used as mentors in all courses. Tentatively, it may be concluded that there is a diversity of practice within courses but all courses share a common view on the importance of competence. More work is necessary, especially in relation to assessment, if parity amongst courses is to be explicit.

0930

The accuracy of radiographers' reports in examinations of the skeletal system

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PURPOSE: This paper reports on the first postgraduate programme aiming to prepare radiographers to provide written reports on examinations of the skeletal system. METHOD & MATERIALS: (i) A 200 station objective structured examination (OSE) was used to assess the reporting competence of the radiographers who formed the second intake of this 1 year programme. 57% of examinations included were of the appendicular skeleton and the prevalence of abnormal cases was 45%. All examinations had been reported independently by three consultant radiologists. The radiographic reports were marked for agreement with the radiological reports and any equivocal reports were reviewed by an external radiologist. Accuracy, sensitivity and specificity rates were calculated. The external radiologist reviewed independently all radiographic reports for agreement, and accuracy rates were again calculated. Accuracy percentages determined by the programme team and independently by the external consultant agreed well and the correlation ($r=0.95$) was highly significant ($p=0.003$). (ii) Over 6000 further radiographic reports were generated towards the end of and following the programme in a pre-implementation clinical trial. Reports were compared with the radiological report, and accuracy, sensitivity and specificity rates calculated. RESULTS & CONCLUSIONS: Results of the OSE and early results from the pre-implementation clinical trial suggest that reporting radiographers reach and are able to maintain the high standards specified by this programme. In principle, funding from ST NHSE has been agreed to further the investigation of the implementation of radiographer reporting in four NHS Trusts.

0940

The implementation of radiographic reporting—a preliminary survey

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PURPOSE: As part of the response to the increasing divide between demand and resources within departments of clinical radiology, a growing number of radiographers are developing their roles in order to contribute to the radiology reporting service. This paper presents the results of a survey that examined the contribution to the clinical radiology service of radiographers who have completed accredited

education programmes in reporting. MATERIALS & METHODS: A questionnaire was designed for distribution to all radiographers who have successfully completed recognized education programmes in reporting. The questionnaire sought data regarding the nature of reporting duties undertaken; the limitations imposed on those duties; role relationships with radiologists relative to reporting; and matters related to employment, audit and continuing education. Data gathered were subjected to both quantitative and qualitative analysis. RESULTS & CONCLUSIONS: At the time of the survey less than 20 radiographers had completed accredited programmes and were contributing to the reporting service. Generally, it was evident that completion of the accredited programme was followed by a clinical implementation trial period before radiographers commenced their full reporting role. Reporting tended to be limited to skeletal work, predominantly accident and emergency work. Schemes of work and protocols, and regular audit were seen to be important. It may be concluded that much caution is evident in the introduction of this early group of reporting radiographers. It will be necessary to undertake further work on the implementation into practice of reporting radiographers.

1045–1055
Work in Progress
Imaging Technology 1
Hall 10b

Please note: Imaging Technology 1 State of the Art Symposium beings at 0900. See p. 60 for abstracts.

1045
Psychophysical limitations of radiological film reading and proposed solution—a novel film reading technology

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PURPOSE: Continuous efforts have improved the quality of radiological image capture, but a 100 year old technology is still being used in the most crucial step—film reading and interpretation. This presentation outlines film–light box combination limitations and proposes a digital film reading technology to alleviate them. Five root causes degrade film readers' performance: (1) insufficient illumination intensity degrades contrast and acuity; (2) illumination chromaticity is not film-density adapted and does not enable optimal detail perception; (3) light box diffused light scatters within the film and reduces perceived contrast; (4) extraneous light from non-covered light box areas decreases contrast discrimination; (5) improper ambient light level reduces lesion detectability. Although X-ray film contains an enormous amount of data, a conventional light box enables the reader to perceive only a fraction of this information. Regulatory bodies have also paid attention to the potential clinical consequences of light box limitation and recent European Guidelines on Quality Criteria for Diagnostic Radiographic Images (EUR # 16260 and EUR # 16261) have been issued. MATERIALS: A digital film viewer was developed to replace the traditional light box. RESULTS: Clinical evaluation demonstrates that the digital film viewer capabilities facilitate improved reading quality of radiographic films. The digital film viewer meets 1996 EC guidelines fully and automatically. CONCLUSIONS: The digital film viewer overcomes light box limitations and sets new benchmarks for quality radiological reading.

1100–1200
Work in Progress
Gastrointestinal Tract
Hall 10a

1100
The clinical effectiveness of the Gianturco oesophageal stent

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A retrospective study of 76 patients was performed to evaluate the outcome of the Gianturco oesophageal stent for palliation of oesophageal malignancy. In 74 patients (97%) initial stent deployment was successful. Following stenting, 94% of patients experienced significant improvement in dysphagia and all could at least take a semi-solid diet. At the time of death 92% of patients could still swallow better than prior to stenting. 85% of patients died with their original stent *in situ* and functioning. In 15% re-intervention or an alternative type of treatment was required to palliate further dysphagia, in the majority due to tumour overgrowth. Medial time from stent insertion to death was 2 months. The commonest side-effects of stenting were chest pain (22%) which tended to settle spontaneously within a week although in a few percent this persisted. Symptomatic gastro-oesophageal reflux occurred in 10% and required medical therapy. In one patient, stent migration into the stomach occurred on two occasions. In both cases the stent was passed per rectally without any complications. In two further patients a minor degree of migration was seen at 24 h but did not require any intervention and both patients subsequently swallowed normally. In our experience the Gianturco stent is a safe and effective way of palliating malignant dysphagia. It is well tolerated, achieves good immediate and long-term improvement in dysphagia and has an acceptable complication rate with a very low migration rate despite 30% of stents being placed with their distal end in the stomach. The presentation will highlight the effectiveness of the stent in palliating tumours at different sites of the oesophagus, particularly at the cardia.

1110
MR elastography of human liver specimens: initial results

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PURPOSE: To measure shear modulus in human liver specimens as an initial step in assessing the feasibility of MR elastography as a new imaging method. METHODS & MATERIALS: Fresh human liver core specimens were obtained and studied in a clinical whole body 1.5 T MR system. 150–400 Hz cyclical shear waves were applied to the specimens within the bore of the system using a purpose-built electro-mechanical actuator. The induced displacements in the liver were visualized using a phase contrast type pulse sequence synchronized with and sensitized to the direction of the applied shear waves. The resulting displacement maps allow calculation of the local shear wave velocity and shear modulus. RESULTS: Five specimens have been studied at present. Shear waves were clearly visible in all the specimens and attenuation values increased with increasing shear wave frequency. Calculated shear moduli for human liver were in the range 2.86–9.54 kPa.

1120
Magnetic resonance cholangiography in obstructive jaundice

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Magnetic resonance cholangiography (MRC) was first described in 1986. Subsequent technical advances have allowed non-invasive cholangiography with diagnostic accuracy approaching that of direct cholangiography. We used MRC to evaluate 24 patients referred to our hospital with obstructive jaundice between March 1995 and October 1996. Indications for MRC (with patient numbers) were: pre-surgical evaluation (9); failed or non-diagnostic endoscopic retrograde cholangiopancreatography (6); the presence of a Roux loop (5); possible malignancy coexisting with primary sclerosing cholangitis (2) and obstruction secondary to biliary calculi (2). Subsequent diagnoses were: primary sclerosing cholangitis (9); gallstones (6); cholangiocarcinoma (4); post-operative ischaemic biliary strictures (2); pancreatic carcinoma (1); primary biliary cirrhosis (1) and dysfunction of the sphincter of Oddi (1). In each case, the information provided by MRC has been compared with other imaging modalities and any available surgical or pathological findings. Technically satisfactory MRC was obtained in 23 of the 24 patients. In 16, MRC correlated well with other investigations and with clinical details. In eight of these MRC was the only imaging required. In seven further cases, MRC provided useful information but additional imaging was necessary in one; and in three others, whilst MRC had accurately staged the primary tumour, surgery revealed peritoneal disease not evident on MRC or other imaging modalities. We suggest that there is a role for MRC as a second line investigation following ultrasound scanning in patients with obstructive jaundice as it enables appropriate further management to be planned and may avoid radiation and potentially risky invasive procedures.

1130

Magnetic resonance cholangiography on a 0.5 T scanner

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PURPOSE: The use of magnetic resonance cholangiography (MRC) has been described in the radiological literature, but studies have focused on the use of high field scanners (1.5 T) in specialized centres. We elected to assess the usefulness of MRC using a 0.5 T scanner in the setting of a district general hospital, to investigate patients with jaundice or deranged liver function tests. MATERIALS & METHODS: To date, 10 patients have been entered into a prospective trial comparing MRC with ERCP performed within 24 h. The patients were scanned on a Philips Gyroscan T5 Release 3 0.5 T scanner, using a T_2 weighted fast spin echo sequence without breath-hold. Scans were interpreted independently by two radiologists for the presence of obstruction and, if present, the site, nature (intrinsic or extrinsic) and likely pathology. ERCPs were reported by the consultant gastroenterologist performing the procedure and were taken as the gold standard. RESULTS: Bile duct calibre (dilated in eight, normal in two) and the level of obstruction (distal CBD in seven, proximal CBD in one) were assessed accurately in every case. So far, calculi have been reliably differentiated from tumour, and extrinsic compression from intrinsic lesions, but it has not been possible to predict reliably the histology. Additional information was gained in one case from MRC by the demonstration of multiple hepatic abscesses complicating an ampullary carcinoma. CONCLUSION: New MRI software means that good quality diagnostically accurate MRC images may be obtained at 0.5 T. This may broaden the application of the technique.

1140

Magnetic resonance imaging of fistula *in ano*: are endoanal coils necessary?

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PURPOSE: MRI is the gold standard for pre-operative assessment of fistula *in ano*; namely the course of the primary track, site of secondary extensions, and level of enteric communication. It has recently been suggested that endoanal coils best achieve this. However, it is possible their limited field-of-view may fail to image distant sepsis which most often underlies post-operative recurrence. This hypothesis has been tested by a prospective, blinded study. METHODS: 16 consecutive unselected patients with a diagnosis of fistula *in ano* have been studied to date. Axial and coronal T_2 weighted images of the ano-rectum were obtained using a prototype endoanal coil (Philips Medical Systems, UK), followed by standard axial and coronal STIR sequences using the body coil, and information obtained independently compared by blinded assessors. RESULTS: Endoanal imaging was unobtainable in four subjects, all of whom had extensive sepsis on body coil studies; three could not tolerate coil insertion and movement artefact impaired interpretation in a fourth. In the remaining 12, endoanal imaging found one intersphincteric and six transphincteric fistulas; three sinuses and two normal studies. Subsequent body coil study revealed further sepsis in five (42%) of these; two extrasphincteric tracks, one suprasphincteric extension, a gluteal track and a track into the labia majora. In no case was endoanal information additive to body coil studies. CONCLUSIONS: Assuming insertion could be tolerated, endoanal imaging missed sepsis in 42% of subjects due to field-of-view limitations, despite superior spatial resolution. In contrast, conventional body coil imaging better demonstrated those aspects of fistula disease most likely to cause management problems. Endoanal imaging alone is inadequate for fistula classification.

1150

Small bowel examination by breath-hold MRI

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PURPOSE: To demonstrate the feasibility of using water as a contrast medium for breath-held MRI examinations of the small bowel, in a similar fashion to current MRCP techniques. MATERIALS & METHODS: Six fasted adult volunteers were asked to drink up to 2 l of water over a period of 5–10 min. They were then examined in the coronal or oblique coronal planes at intervals using a breath-hold single shot RARE sequence (SSFSE) either as single thick slab or multiple slices. This sequence completes data acquisition for each slice in approximately 750 ms, fast enough to freeze bowel peristalsis. Other imaging parameters were TE 700 ms, 256 × 256 matrix, 0.5 NEX, slice thickness 10–50 mm, slice number 1–10 and spectral fat suppression. RESULTS: In all six volunteers the stomach and proximal small bowel were well demonstrated as free of peristaltic artefacts and with excellent background tissue suppression. In five of the volunteers it was possible to obtain views of the terminal ileum but in one the water was reabsorbed before reaching the caecum.

1500–1510
Work in Progress
Physics Mammography
Hall 10b

Please note: Physics Mammography Scientific Session begins at 1400. See pp. 72–74 for abstracts.

1500

Analysis of pharmacokinetic breast MRI using a model of contrast enhancement

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PURPOSE: The use of a pharmacokinetic model for quantitative analysis of breast MRI requires assumptions to be made about the way in which the contrast agent is injected into the patient's bloodstream. Previous work has modelled the injection as either instantaneous or as a continuous infusion over a long period of time. We derive a pharmacokinetic model using Laplace Transforms which allows us to experiment with and compare different injection models. MATERIALS & METHODS: MR images were obtained on a 1.5 T machine using a bilateral breast coil. Gd-DTPA, at a standard dose of 0.1 mmol kg^{-1} was injected as a bolus with saline flush into a peripheral vein. A 16 slice, 47 s duration, 2D GRE acquisition was performed before, immediately, and every 60 s after Gd injection. Images were transferred to a remote work-station for off-line processing. RESULTS: A comparison is presented between the forms of the model derived for instantaneous and continuous infusion cases with other, more realistic injection functions, *e.g.* ramped injection models. We present results which show that the model can be fitted to regions that are enhancing significantly relative to their surroundings. These fitted models predict a malignant nature for lesions that are missed in an X-ray mammogram. CONCLUSION: A model based analysis of pharmacokinetic breast MRI sequences can provide useful information to a clinician. Reliance on any model for lesion detection should consider the problem of patient movement and mis-registration.

1530–1610
Work in Progress
Radiography
Hall 10a

1530

A computerized positioning device for patient positioning in diagnostic medical imaging

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Reject analysis studies have shown that a major cause of over-exposure in diagnostic radiography is due to incorrect patient positioning. The work in progress presented here plans to develop a computerized fail-safe positioning device which will accurately centre the X-ray beam to the correct anatomical area required of a given radiographic projection and monitor patient movement. This system will also map the required area of collimation and measure focus-to-film distance (FFD). The system consists of a three-dimensional video (CCD) camera recording system, video processor, monitor and computer with mathematical co-processor, system version 6. A pilot study of the range of normal and abnormal biological configurations in patient populations has been undertaken. A triangulation measurement of the area under investigation is made and the position of the X-ray primary beam calculated using a software program specifically written for this purpose. A database has been created and is accessed during the positioning of patients. Retro-reflective markers also map the collimation area and monitor patient movement. FFD is measured during calibration of the camera system. Initial measurements (X-ray beam alignment) have shown that an accuracy of ±1 mm in patient positioning is possible

for spinal investigations. This system has also improved the accuracy of collimation (80%) and FFD (100%). Software is now being written for the positioning of patients both for the axial and appendicular skeleton. This system is expected to reduce the overall radiation dose to patients by as much as 50% and result in substantial savings to hospital funds.

1540

A study of the interrelated agreement for the assessment of bone scans

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Radionuclide bone scintigraphy continues to play an important role in the staging of disease in Oncology. However, around 40% of patients require further diagnostic investigations, usually plain film radiography, in order to provide a full diagnosis. This study assessed the ability of the radiographer/medical technical officer (MTO) to play a more proactive role in patient management. A radiologist and two radiographer trained MTOs were asked to classify 50 bone scans as normal, abnormal insignificant or equivocal before deciding whether plain radiography was required. The opinions of the MTOs were correlated with those of the reporting radiologist using the kappa statistical test for interrater agreement. With the study three-quarters completed, we have measured a 63% agreement in classification of the scan ($\kappa = 0.5$). More importantly there have been no significant disagreements. Simplifying the data into two groups: normal or not significant and equivocal or significant increases the agreement to 82%. The "refer for X-ray" agreement was 77% ($\kappa = 0.52$). In 14% of cases the MTO's recommendation of X-rays was not substantiated by the radiologist and in 10% of cases the MTO failed to recommend an X-ray when the radiologist thought one necessary. A relatively poor agreement between the MTOs on when to refer for X-rays ($\kappa = 0.29$) implies that the criteria used should be more clearly defined before any change in current clinical practice was made. These preliminary findings suggest that experienced radiographers and MTOs could play a role in the initial assessment of the bone scan and by referring patients with suspicious areas for X-rays ensure that the radiologist has all the evidence before him when making a diagnosis.

1550

What should a community ultrasound service look like?

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PURPOSE: This paper reports the views of health professionals on the suitability of a community ultrasound service. This is in the context of the discussions about the introduction of a community based ultrasound service. Attention is given to the difficulties of setting up such a service and the possible constraints. MATERIALS & METHODS: 500 health professionals from seven clinical sites and general practices, in what was the North West Thames region, were asked to complete a questionnaire inviting them to consider the introduction of a community ultrasound service. A number of areas were covered by the questionnaire. These included where the service should be sited, who should carry out the service, what features were important, and whether they considered community ultrasound to be a suitable service. RESULTS: The results of the survey reveal that the majority of the individuals asked felt there was potential for an ultrasound service based in the community. In general, radiographers were seen as the most suitable people to staff the service and health centres were popular as sites for such a service. As might be expected there were variations among the professional groups and geographical locations as to the type of service and who should staff the service. The reasons for this are not clear but the differences might be attributable to the variance in the perceived needs of the service by the various groupings. CONCLUSIONS: These findings are discussed in the light of the demands upon the hospital based service and the potential conflicts of running two services upon the quality of service.

1600

An analysis of a community based multimedia patient information system for obstetric ultrasound

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A prototype computer-based multimedia information system was developed for patients who are to attend the local hospital for an obstetric ultrasound scan. The system gives essential information about patient preparation and the scanning process. The system was installed in a medical practice within the catchment area of the local hospital. On a weekly basis, as part of the normal routine, a community midwife conducts a half-day antenatal clinic. A prospective trial was set up to establish patients' reactions and comments about the system. All new patients attending the antenatal clinic are invited by the midwife to use the system. Multiple methods are used to collect data. A mixed response to the system is emerging. Some patients, who have previous computer experience and present as being "well educated", generally like the system, although this group would like to see much more information than currently exists. Patients with no previous experience of computers are generally nervous of using the system but appear to gain confidence during their attempts. Some patients do not want to interact personally with the computer and rely entirely on the healthcare professional to take them through the information system. When two patients work together through the information system they appear to be more confident. Overall the reactions have been quite positive. There is a need to develop a better approach to integrating the information system into the antenatal appointment, so that the information system is seen as a tool for informing patients rather than an academic exercise by a university.

1545–1635
Work in Progress
Neuroradiology
Hall 11b

1545

Magnetic resonance imaging in the neurosciences: changes in clinical utility 1988–1995

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Following the introduction of a magnetic resonance imaging (MRI) unit in Coventry in 1988, a study to assess the effect of MRI on the diagnostic pathway and cost-effectiveness of MRI indicated that, in the context of the neurosciences, MRI was originally used as an additional investigation with significant financial implications. The purpose of this study is to re-appraise the position of MRI in the diagnostic pathway in the neurosciences in 1995 in comparison to 1988. We performed a retrospective analysis of a representative sample ($n = 176$) of neuroscience patients referred to a regional, superconducting, 1.5 T MRI service over a 6 month period. The diagnostic pathway was determined from clinical records and an attempt to analyse cost in the 1995 sample of patients is currently being undertaken. Initial results confirm that MRI has replaced the use of myelography and is increasingly establishing itself as a substitute for other investigations.

1555

Ceramide resonance in highly malignant glioma of the brain

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The most advanced method of therapy did not change the overall median survival of 32 weeks in patients with glioblastoma multiforme, the most frequent highly malignant brain tumour. The histopathological classification of gliomas is still unclear and nuclear magnetic resonance spectroscopy (NMRS) is a promising biomedical analysis monitoring the sequential metabolic malignant transformation from normal to cancerous cell and opening new pathways to immunotherapy of cancer. Our method of homogenization [1] made possible the observation of monounsaturated oleic acid high intensity at 5.3 5.4 ppm, of the ceramide resonance of ganglioside in 16 cases of glioblastoma multiforme and in two metastatic brain tumours by ^{1}H NMRS (Bruker AMX-600 spectrometer, Florence). This ceramide resonance (5.3–5.4 ppm) was not detected in the normal human brain in 12 low malignant gliomas and in two meningiomas. The GLC analysis of fatty acids of the gangliosides

extracted from glioblastoma multiforme revealed a dramatic elevation of oleic acid which was observed at 5.3 ppm ^{1}H resonance. Our observation emphasizes the role of aberrant ganglioside precursors in the grading and invasiveness of cancer cells [2, 3].

References

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1605

Brain compartment analysis in the Edinburgh cohort of HIV-positive drug users

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PURPOSE: To assess if magnetic resonance imaging (MRI) can distinguish patients with AIDS dementia complex (ADC) from non-demented HIV-positive patients. MATERIALS: (1) A case control study with four groups of 25 patients. Group 1: patients with ADC scanned near the time of onset of dementia. Group 2: HIV-positive non-demented patients scanned at the same interval from sero-conversion as their matched controls. Group 3: HIV-negative drug users. Group 4: normal controls. The subjects were matched by age, sex, IQ and date of sero-conversion where appropriate. (2) A longitudinal study of 25 HIV-positive patients progressing to ADC and 25 matched HIV-positive non-demented patients scanned serially. METHODS: Total brain, grey and white matter and CSF volumes were measured using the "unsupervised chain method" ANALYZE image analysis software. The MRI scans were performed on a Siemens 42 SPE 1 T imager. RESULTS: Preliminary analysis shows: (1) The CSF, whole brain, grey and white matter volumes normalized for intracranial volume are not significantly different for groups 2, 3 and 4. (2) The whole brain and grey matter volumes for the ADC group are significantly smaller than for the other cohorts ($p < 0.001$). (3) The whole brain and grey matter volumes for the ADC group atrophy at a faster rate than for the HIV-positive non-demented group. CONCLUSION: (1) MRI can distinguish ADC patients from HIV-positive non-demented patients. (2) It may be possible to identify patients at risk from developing ADC thus allowing timed therapeutic intervention with antiviral agents that cross the blood–brain barrier.

1615

Electron paramagnetic resonance spectroscopic study of free radicals in spinal cord ischaemia: a stroke model

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The sequential metabolic phenomena during reperfusion are poorly understood in the stroke and it is very difficult to reproduce experimental models of brain ischaemia for the intricate variety of anastomosis between the cavernous carotids, external carotids and vertebro-basilar system. We have reproduced the histological and metabolic alteration of stroke in a rabbit spinal cord ischaemia model after temporary abdominal aortic occlusion. With our *ex vivo* method, free radicals were detected using an EPR spectrometer (Bruker E-SRC 200D, Bratislava) in six rabbit spinal cords after 25 min of abdominal aortic occlusion. There were no free radicals after 1 h of reperfusion, with free radicals reappearing after 2 h of reperfusion, respectively, in six and five rabbit spinal cords. Six rabbits were used as a control. Analogous sequential metabolic changes were detected by ^{1}H NMR spectroscopy (Bruker AMX 600 spectrometer, Florence) using our method of homogenization. There was increased resonance intensity of lipids and lactate after 25 min of abdominal aortic occlusion and also decreased N-acetylaspartate (NAA) in 10 rabbit spinal cords. After 1 h of reperfusion a temporary amelioration of the lipid, lactate and NAA alteration was noted in 10 rabbit spinal cords. After 2 h of reperfusion metabolic worsening of lipid, lactate and NAA alteration was observed. The hypothesis was made that antioxidant mechanisms of defense caused transient improvement.

1625

Evaluation of carotid endarterectomy with sequential MR perfusion imaging

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PURPOSE: The efficacy of carotid endarterectomy (CE) in individuals with severe (>70%) carotid stenosis may be due to normalization of cerebral blood flow and/or a reduction in emboli formation. Newly developed dynamic MR imaging techniques can measure cerebral perfusion and may delineate ischaemic tissue. The identification of pre-operative perfusion abnormalities may be prognostically significant. MATERIALS & METHODS: We prospectively studied 10 patients being investigated for clinically suspected carotid stenosis using single slice, gradient recalled echo sequences following the intravenous administration of 0.2 mmol kg^{-1} Gd-DTPA. Patients were studied pre-operatively, 3–5 days post-CE, and 3 months later. RESULTS: Two patients were subsequently excluded when MRA and conventional angiography demonstrated complete internal carotid artery occlusion and middle cerebral artery branch occlusions. One patient could not tolerate MR post-operatively. Of the seven patients who had perfusion studies before and after CE, all patients initially had abnormal perfusion characteristics as determined by bolus arrival time (BAT) images. Two patients imaged at 3 months had an improvement in their early post-operative BAT images which continued to improve at 3 months. Another patient had changes consistent with early hyperperfusion post-operatively, which had improved by 3 months. This patient may have been at risk of haemorrhagic infarction. CONCLUSION: MR perfusion imaging could prove a valuable adjunct in the identification of patients most likely to benefit from CE. Improvements in MR perfusion characteristics continue long after initial surgery and may be secondary to carotid remodelling.

1600–1610
Work in Progress
Protection of the Patient
Hall 10b

Please note: Protection of the Patient Scientific Session begins at 1520. See p. 75 for abstracts.

1600

Optimization of dose and image quality in fluoroscopy

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INTRODUCTION: In interventional radiology the optimization of image quality and patient dose is vital. Optimization is particularly important given the patient and staff dose levels associated with these often long and difficult procedures. In general, the major fraction of the patient and staff dose arises from the fluoroscopy component of these procedures. Consequently, the optimization of this aspect of interventional procedures is a first option. Recently, radiological equipment manufacturers have introduced pulsed mode fluoroscopy facilities on new units for reducing doses. PURPOSE: The optimization of dose and image quality in the presence of scattered radiation during fluoroscopy by using quantitative test objects. In addition, to assess and compare the performance of different modes of operation in fluoroscopy. METHOD: A set of optimization test plates has been designed and manufactured. These test objects have been used to assess the contrast detail in the presence of different amounts of scattered radiation. Detail contrasts have been calculated for scattered spectra. The contrast detail performance of several fluoroscopic systems operating in continuous mode and various types of pulsed mode operations have been measured. RESULTS: The contrast detail performance of different fluoroscopic modes of operation are presented. CONCLUSION: The selection of fluoroscopic mode of operation has direct consequences for both image quality and patient dose during interventional radiology.

Notes

Posters

National Indoor Arena Concourse Area

Work in Progress

Neuroradiology

POSTER 0209

A review of current practices in imaging of acoustic neuroma

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MRI is now undisputed as the best technique available for imaging of the acoustic canal. Recent developments in techniques have shown that turbo spin echo (TSE) high definition scans can reduce the need for contrast studies. At the Leicester Royal Infirmary MRI Unit, an audit of 150 patients referred for acoustic canal imaging is being undertaken. A TSE axial 3 mm sequence is performed, followed by a further TSE coronal 3 mm scan if CSF is not clearly demonstrated in the acoustic canal. The radiographer completes a questionnaire after reviewing each sequence to decide if a contrast study is required. All scans are reviewed by a single neuroradiologist so that patients will be recalled for contrast studies if necessary. If the results show that the recall rate and the predicted contrast examinations rate is less than 5% then change will be implemented in the management of these patients. This could have major effects on the cost of acoustic canal MRI.

Chest

POSTER 0404

Lung torsion as a rare post-operative complication: hidden hints in plain radiographs and CT

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INTRODUCTION: Lung torsion is a rare but serious clinical picture, primarily occurring after surgical interventions and trauma. We report on a patient with post-operative lower lobe torsion. CASE REPORT: A 70-year-old patient with a distal oesophageal carcinoma underwent oesophagectomy with elevation of the stomach in the dorsal mediastinum. For this purpose, a right thoracotomy was performed. During post-operative ICU monitoring, the survey radiographs in the prone position revealed a reduced transparency in the right midzone that increased over 2 days. The areas, corresponding to inflated, non-typical segment borders, were visualized in the upper and lateral lower zone. CT also provided impressive evidence of a complete reduction in transparency in the right lung areas that could not be classified as typical lung borders. The bronchopneumograms were negative; the opacity revealed slightly convex borders and an interruption in the bronchus at the level of torsion was visualized. After thoracoscopic localization of the main bronchus, only the right lower lobe was found to have a right-hand torsion of about 180° with craniodorsal displacement and a livid bluish discoloration of the surface. The upper and middle lobes displayed normal circulation and inflation. After thoracoscopic retorsion manoeuvres and repositioning, successive recirculation up to the periphery of the lung was achieved. CONCLUSION: Even though it is a rare complication, lung torsion must be considered in the differential diagnosis, especially after chest surgery with atypically acute shadows. CT is the best imaging modality and must be performed.

Gastrointestinal Tract

POSTER 0624

Doppler perfusion index: an interobserver variability study

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PURPOSE: Previous studies have shown that measurement of the Doppler perfusion index (DPI) using duplex colour Doppler sonography (DCDS) enables the early detection of occult liver metastases in patients with colorectal cancer. The purpose of this study was to investigate the interobserver variability of this technique. MATERIALS & METHODS: Using DCDS, the blood flows in the common hepatic artery and portal vein were measured blinded in 20 patients, by two observers on the same day and under the same conditions. Observer 1 was a consultant radiologist (EL), and observer 2 was a suitably trained physicist (KO). The DPI was calculated as the ratio of hepatic arterial to the total liver blood flow. RESULTS: The mean DPI values for the two observers did not differ significantly (observer 1, 0.26 (SD 0.12); observer 2, 0.25 (SD 0.12); $p > 0.05$). The mean interobserver absolute variability in the DPI was 0.05 (SD 0.04). The observers agreed on the DPI status (normal < 0.30, abnormal > 0.30) in 18 out of 20 patients. Analysis of the cross-sectional areas (XA) and time average mean velocities (TAMV) for the hepatic artery and portal vein did not show any statistical differences between observers. The mean interobserver variability of XA and TAMV were approximately 17% and 25% of the mean values, respectively. These values were comparable with data obtained from previous intraobserver variability studies for the two observers. CONCLUSIONS: Similar DPI values were obtained from 20 patients by two different observers, showing the reproducibility of DCDS in the measurement of hepatic perfusion.

POSTER 0625

Clinical experiences using a new liver contrast agent for MRI

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Recently there has been much interest in superparamagnetic iron oxides (SPIOs) as contrast agents for hepatic MRI [1]. Blakeborough et al [2] reported that SPIO based contrast agents improved the sensitivity of MRI in the detection of focal liver lesions compared with those enhanced with gadolinium based contrast agents. We have been involved in phase III B clinical trials to determine the safety and efficacy of a SPIO based contrast agent, SH U 555 A (Schering AG). In our centre we have been fortunate to study a wide variety of liver lesions, including metastases, hepatomas and focal nodular hyperplasia. The scan protocol currently involves a combination of T_1 and T_2 weighted images before and after the administration of the contrast agent. A series of T_1 weighted scans is acquired following the injection of contrast medium, permitting the visualization of contrast uptake in the tissues. Dosage is a simple choice between two small volumes, depending on the patient's weight, and this is given as a rapid bolus injection, in contrast to other formulations currently available. SPIOs are usually thought of as T_2 relaxivity agents; however, T_1 effects have also been noted, probably at low concentrations. This opens up new opportunities to investigate differential diagnosis of focal liver lesions. Representative images demonstrating various pathologies are presented. Our experience indicates exciting possibilities with this new contrast agent for magnetic resonance imaging of the liver.

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Genitourinary Tract

POSTER 0705

Excretory urogram revisited in the times of ultrasound and computed tomography

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PURPOSE: The aim of this retrospective study was to examine the extent to which a excretory urogram (EUG) provides additional information to ultrasound diagnostic procedures (US) in flank trauma, painless macrohaematuria, renal colic and inflammatory lesions. PATIENTS & METHODS: 475 patients underwent an EUG with conventional tomography and US due to flank trauma (102), renal colic (146), painless macrohaematuria (12),

microhaematuria without colic (113), renal tumors (44), and urotuberculosis (4). In cases of solid renal mass and renal trauma with macrohaematuria, computed tomography (CT) was always additionally performed. The mean age of the patients was 64 (19-84) years. RESULTS: (1) In almost all negative US findings, EUG essentially provided no additional information. (2) All renal duct obstructions demonstrated in EUG were also depicted in US, whereby localization was clearly more successful on the X-ray flow images. (3) 32 of the 146 renal colic patients with a normal initial US showed a small concrement on the EUG, always spontaneously passable, with uretral tracing, which was always visualized in the control sonography as hydronephrosis. Three of the 32 stones could be sonographically identified pre-vesically. (4) Conventionally performed tomography did not add any additional information to the US, which would have made the CT superfluous. (5) As a complication, there was a fornix rupture in four EUGs performed in connection with a colic. CONCLUSION: An EUG is only indicated for further diagnostic confirmation and therapy planning if a dilation of the pelvicalyceal system is found in the US. In recurring colics, a control sonography is primarily required; a late renal stasis can, thus, be non-invasively diagnosed without the risk of a fornix rupture. Unclear renal masses always require a CT scan, making an EUG superfluous. There is no indication for conventional renal tomography.

Musculoskeletal

POSTER 0825

Nurses, Ottawa ankle rules and X-rays

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PURPOSE: It has been suggested that nurse practitioners in the Accident and Emergency Department have a lower threshold for requesting X-rays than Senior House Officers (SHOs). This study compares the referral rate, of patients presenting with ankle injuries, for radiography by nurse practitioners with that of Senior House Officers. METHOD: Nurses, trained in the use of Ottawa ankle rules, assessed 665 patients presenting with ankle injury and requested radiographs as felt appropriate. All patients were subsequently examined by a doctor. During the same period, 700 patients were assessed by SHOs not specifically trained in the use of the Ottawa ankle rules. In the second part of the study the nurses assessed a further 700 patients while the SHOs, having been made familiar with the Ottawa ankle rules, assessed a similar number of patients. The incidence of missed fractures was determined by re-attendances within a 4 week period. RESULTS: Of the 1365 patients assessed by nurse practitioners 73% were X-rayed (24% fractured). Of the 700 patients assessed by SHOs prior to their familiarization with the Ottawa ankle rules, 91% were X-rayed ($p = 0.001$). Following specific instruction with regard to the Ottawa ankle rules the referral rate of the SHOs for the second 700 patients was 74% ($p = 0.001$) (overall fracture rate 19%). The "miss rate" in each group was minimal and equal. CONCLUSION: Appropriately trained nurses have a referral rate for ankle X-rays equal to similarly trained SHOs and request fewer X-rays than inexperienced junior doctors. Our study supports the increasing role of the nurse practitioner.

Vascular & Interventional Radiology

POSTER 0920

3-dimensional breath-hold post-contrast MR angiography on a 1 T Picker Vista MR system

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PURPOSE: Illustrate the use of breath-hold, 3-dimensional, time-of-flight, post-contrast MR angiographic techniques to evaluate arterial and venous occlusive diseases. MATERIALS & METHODS: 30 patients were studied utilizing a 1.0 T Picker Vista MR, standard body coil (without the use of phased array coils or power drive) and commercially available 9.3 software. An additional 10 patients were studied utilizing a flexible wrap around body coil, 9.4 software and use of Centric 3D breath-hold techniques which compensated respiratory artefacts. 15 cm^3 of intravenous contrast (Gadolinium-Berlex, Wayne, New Jersey) was dynamically administered to each patient regardless of the body weight. The average age of the patients was 65 years. A total of 18 images, 2.4 mm thick, could be acquired during a single 26 s breath-hold. A total of three acquisitions were performed for each patient. Diseases evaluated included atherosclerotic stenoses, fibromuscular dysplasia, Takayashu arteritis, aneurysms, embolic occlusions and veno-occlusive pathologies involving carotid, vertebral, subclavian, aortic, pulmonary, mesenteric and peripheral medium sized arteries. Venous evaluation included inferior vena cava, hepatic, portal and iliac veins. Either clinical, surgical or conventional angiographic follow-up was available in all cases. RESULTS: There was a 90% correlation between the findings on the MR angiograms and conventional angiography/surgical findings for pathological entities involving large and medium sized vessels. Small peripheral vascular pathology could not be adequately evaluated with MRI. The use of flexible wrap around body coil and centric volume techniques which compensated respiratory motion artefacts significantly improved image quality. CONCLUSION: Rapid and accurate MR angiographic images can be successfully achieved for the evaluation of arterial and venous pathology involving medium and large sized vessels utilizing breath-hold 3-dimensional time-of-flight post-contrast techniques and a standard 1.0 T MR magnet. Combination of surface coil (flexible wrap around coil) and centric sequence techniques which compensate respiratory motion, further improve image quality.

POSTER 0921

Arterial and venous cystic adventitial disease in the popliteal fossa

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Cystic adventitial disease is a rare disorder characterized by cystic collections of mucinous material in vessel walls. It most commonly affects the popliteal artery and is an unusual cause of intermittent claudication. It may also affect the popliteal vein giving rise to venous compression. The imaging findings (ultrasound, magnetic resonance imaging and angiography) are illustrated with respect to two patients with involvement of the popliteal artery and vein, respectively. We conclude that MRI, which has received limited attention in previous reports, offers several advantages over other modalities in the investigation of this condition.

Nuclear Medicine

POSTER 1204

Captopril renography and its effect on patient management

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Renovascular hypertension is an important and potentially curable condition and captopril renography is increasingly recognized to have a high sensitivity and specificity in its diagnosis. Ultimately, if the result does not lead to a change in patient management, it is of little benefit. In order to assess how patient management was changed following the result of a captopril renogram, we reviewed the notes of 95 patients who had undergone this test over a 5 year period. Of these patients, significant renal artery stenosis was suggested in 16 patients (17%). Of these 16 patients, only nine (56%) underwent a change in management (seven proceeding to angiography with or without angioplasty and two having alterations in medication). This compares with 67 patients who had negative renograms, of which 16 (24%) had an alteration in management (13 angiography, three altered drug treatment) and 12 (13%) who had non-diagnostic renograms, seven (60%) of whom had a management change (three angiography, four altered drug therapy). Our study suggests that, despite evidence from the literature that captopril renography is both sensitive and specific for renal artery stenosis, clinicians still rely on other factors in determining who has significant stenosis and therefore who proceeds to further investigation or change in medication. Ultimately, this reduces the value of the test in the clinical setting.

Radiotherapy & Oncology

POSTER 1307

The radioprotective potential of BB 10010/macrophage inflammatory protein—1 alpha

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The small intestine, a rapidly proliferating tissue, is highly sensitive to cycle-specific agents such as radiation. This sensitivity increases patient morbidity and reduces the tumoricidal effectiveness of radiation for patients with abdominal or pelvic malignancies. BB-10010, a variant of macrophage inflammatory protein—1 alpha, has been shown to reduce proliferation in bone marrow and skin. The current work investigates its effectiveness in gut. A dose of either 10 ng and 5 μg was administered to mice at 2, 4, 6, 8, 10, 12 and 14 h before animal death. 15 crypts, from the midpoint of small intestine, were dissected from each animal, squashed and numbers of vincristine arrested metaphases were counted for each fifth of the crypt. A 40–50% reduction of accumulated metaphases throughout all crypt segments was observed in animals injected with 5 μg of BB 10010, 2 and 4 h before death ($p<0.0001$). The 10 ng animals showed a similar effect at 4 h ($p<0.0001$). The lower dose also showed a 40% reduction in the adluminal fifth of the crypt at 10 h after injection ($p<0.0091$). The results provide evidence of a significant reduction in numbers of intestinal cryptal cells passing through mitosis at specific time periods after administration of BB 10010. By putting these cells temporarily out of the mitotic phase of the cell cycle this protein might reduce the side-effects of radiation regimen and improve the quality of life for patients undergoing abdominal or pelvic treatments.

POSTER 1308

Angioma in the mouth cavity and maxillofacial region treated with iridium-192 implant

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Angioma occurring in the mouth and maxillofacial region is a congenital benign tumour which is common in children. 46 patients with angioma in the mouth and maxillofacial region (tongue, 17 cases; lips, 15; buccal region, 6; mouth floor, 5; wing of nose, 3) have been treated by the implant of iridium-192 (HDR) since May 1991. The median age was 10.2 years (range 3 months–25 years). The diameter of the tumours was 8–55 mm. The total tumour radiation dose was 19–21 Gy/3F/3W. A few adults with maxillofacial angioma received, in addition, 10–16 Gy, 6–9 MeV electron irradiation. The evident results of constriction were observed 3 months after the treatment. The patients were followed up over 5 years (mean 5.3 years). Normal function and shape of tongue could be seen in 100% and the comestic result was observed in 96% patients. The development of children was normal and local recurrence was not seen in patients during the follow-up period. The result is very interesting but needs more study in the future.

POSTER 1309

Results of conservative treatment in early stage breast cancer

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Local tumour excision followed by radiation therapy is now generally accepted. From March 1990 to December 1995, 30 patients with breast cancer (stage I–II) received conservative treatment comprising conservative surgery (tumourectomy and axillary excision) followed by radiation therapy using Cobalt-60, 4 MV X-rays and 9–12 MeV electrons. All patients received a dose of 45–50 Gy/23–25 F/5–6 W to the breast, and lymphatic draining regions, following a boost irradiation to the primary tumour bed (12–20 Gy/1–2 F) using HDR iridium-192 implantation. The survival at 5 years is 95%, local control 96.7%. One case had local recurrence 2.5 years after radiation, treated by salvage mastectomy. One case has bone metastases relieved with chemotherapy. The cosmetic result is good in 83.3% cases. The incidence of arm oedema was observed in 10% patients.

Physics

POSTER 1435

Fracture pattern analysis of laboratory compressed rock cores by high resolution computed tomography (HRCT)

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PURPOSE: Artificial fracture pattern in rock cylinders are visualized and quantified using HRCT. METHODS & MATERIALS: Uniaxial compression tests were performed on granite samples from the Erzgebirge, Germany. 20 cylindrical cores 100 mm in length and 52 mm in diameter were stressed to failure in a 4600 kN loading frame from Material Testing Systems. Two different loading conditions were applied. First, the force was distributed homogeneously along the top end surface (2124 mm^2) of the cylinder and, second, part of the top end surface (1691 mm^2) was loaded, forcing the core to fracture in an highly anisotropic stress field. The resulting fracture pattern inside the deformed cores with homogeneous and non-homogeneous end cap load was analysed by HRCT. Each core was continuously scanned with a slice thickness of 2 mm in three orthogonal planes. The fracture pattern from CT was compared with the stress field analysis from three-dimensional finite element (FE) calculations. RESULTS: (1) The three-dimensional fracture architecture from CT correlates well with stress concentration pattern calculated by the FE method. (2) While the homogeneous load with end cap friction results in two opposite fracture cones, the non-homogeneous load produces an asymmetric fracture pattern, from which only the first pre-fracture can be understood by the FE results obtained. CONCLUSIONS: Stepwise rock fragmentation simulated by FE calculations based on cumulative HRCT fracture analysis is very helpful in understanding the complex dynamic fracture process of rock in an highly anisotropic compressive stress field.

POSTER 1436

An added-value approach to MRI giving full quantitative haemodynamic flow data for arterial vessels

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MR angiography can offer good images of arterial anatomical structure and quantitatively measure blood flow velocity distribution in the artery. However, the limitation of the spatial resolution and partial volume effects make it very difficult to measure the near wall velocities. Even more significant is the problem of determining wall shear stress which is thought to be one of the most important haemodynamic factors causing atheroma. Another disadvantage of MR velocity measurement is the errors caused by the complex flow which limit the application of the measurement to undisturbed flow only. In this research, we use MR data combined with predictions using computational fluid dynamics (CFD) techniques to obtain full quantitatively-reliable haemodynamic flow data for an aortic bifurcation. MR angiograms were acquired by conventional 2D time-of-flight sequences, after image 3D reconstruction, numerical grids were generated in the anatomical realistic bifurcation model. Velocities were measured by a cine phase contrast sequence at two sections (upstream and downstream of the bifurcation) where flow is relatively undisturbed, as velocity boundary conditions. With the numerical grids and velocity boundary conditions, CFD was performed by the well tested CFX code from Harwell Laboratory. The results show that this approach can considerably extend MRI application in haemodynamic research and obtain full quantitative data of clinical interest. Details of the haemodynamics results will be shown in the presentation. Using the approach we have developed, a full clinical trial (in total 30 cases) will be undertaken to research the haemodynamic risk factors of formation of atheroma.
ACKNOWLEDGMENT: This work is sponsored by a British Heart Foundation research grant.

Radiography

POSTER 1517

A preliminary study of new ultrasound methods for measuring vertebral and rib rotation in scoliosis

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PURPOSE: The purpose of this work is the assessment of the feasibility and reproducibility of a new ultrasound technique to measure segmental vertebral and rib rotation in scoliosis evaluation.

MATERIALS & METHODS: An Aloka SSD 500 portable ultrasound machine in conjunction with a 3.5 MHz wide field-of-view (172 mm) linear array transducer and an inclinometer (Scoliometer). 20 adolescents referred with back asymmetry were investigated. With each subject in the prone position, readings of vertebral and rib rotation are made segmentally between T1 and S1. Readings are taken directly from the inclinometer attached to the transducer. Measurements are made twice by one observer (ASK), and then repeated twice after repositioning the subject. RESULTS: Acceptable images of the laminae and ribs are produced. Intraobserver reproducibility for vertebral and rib rotation at each level range from $\pm 1.7°$ to $\pm 3.1°$ (95% confidence limits). Multiple analysis of variance (repeated measures) show no significant positional or measurement differences. CONCLUSION: This ultrasound technique allows reproducible measurement of vertebral and rib rotation which is otherwise obtainable only by CT or MRI. Current surface methods only infer the underlying skeletal deformity. Applications include: (1) screening for scoliosis, reducing false-positive referrals to hospital and unnecessary exposure to ionizing radiation; (2) evaluating the results of spinal surgery.

Tuesday 20 May

1530–1700
College of Radiographers
Students' Scientific Session
Hall 9

1530

Developing a teaching and learning strategy for student radiographers in obstetric ultrasound

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PURPOSE: The introduction of student based learning for health professionals identified a need to review previous learning strategies. This student work aimed to: (i) develop a teaching and learning strategy using a problem based learning approach for student radiographers in obstetric ultrasound; (ii) evaluate the development of a multimedia book as a method of teaching and learning. METHOD & MATERIALS: 23 student radiographers investigated a particular aspect of obstetric ultrasound in three subgroups. Using a problem-based learning approach, each group gathered the required information to produce a multimedia book to introduce ultrasound to student radiographers. The evaluation was in two stages, with structured interviews conducted midway into the project and again at the end. RESULTS: The development stage required the students to identify and gather relevant areas of knowledge in physics, equipment and technique for obstetric ultrasound. A lecturer used this information to write the software for a multimedia book. The initial evaluation suggests that this process provided a valuable learning tool for the students in the application of theory to practice, time management skills, group dynamics and practical equipment usage. CONCLUSION: The final structured interviews are continuing, but at this stage the group already feel that this method of learning is interesting and useful. Although gathering the information and putting it together seemed time-consuming at the beginning, students were more positive when they saw the outcome. The limitations included: an extensive time commitment for software design and students focusing on one area rather than on the project as a whole.

1540

Effective lifting and handling procedures for radiographers in clinical practice

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PURPOSE: Effective lifting and handling procedures are, for radiographers, a key component in the safe movement of patients. With the incidence of back related injuries increasing within the profession, radiographers must be fully aware of the latest methods of lifting and handling in order to ensure the optimum level of care for patients and safe practices for colleagues. Evaluation of a new no-lifting policy was undertaken at Stoke Mandeville Hospital — a leading centre for spinal injuries and the handling of non-ambulant patients. METHODS: Over a 3 week period radiographer activity was observed with regard to lifting and handling procedures within the imaging department of Stoke Mandeville Hospital. The role of trained manual handling supervisors was considered, identifying how advice and new concepts of lifting were introduced into the clinical area. RESULTS: The no-lifting policy has been in operation for 3 years and a notable decrease in back related injuries amongst radiographers has been noted by the radiography service manager. In addition, staff appeared confident in the effective usage of such procedures, moving and handling a variety of patient types. CONCLUSION: The importance of correct manual handling can not be underestimated for radiographers, and practitioners must adopt safe practices both for the benefit of the patient and their own practice. The implementation of no-lifting techniques should be actively considered for all imaging departments with specially trained manual handling supervisors supporting and advising on safe lifting procedures.

1550

Reject analysis of radiographs: its use and contribution towards a portfolio of continuing professional development

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PURPOSE: This research sought to analyse reject radiographs into areas of examination, and investigate if there was a correlation between the outcome of the reject analysis and what radiographers perceived as difficult, using 13 broad areas of examination. Structured interviews with radiographers were used as part of the research to establish a link to continuing professional development and further training. MATERIALS: 12 weeks of revised forms of reject analysis were used in the research, and information from computer resources was used in the calculations. METHOD: The data were collected each Monday on a weekly basis. The numbers of examinations were taken from the computer and the quantity of films and the reject percentage calculated. A questionnaire completed by the radiographers arrived at a degree of difficulty for each of the areas of examination. RESULTS: Spearman's rank correlation confirmed a significance when viewing the two sets of data and a null hypothesis that there is no correlation was rejected. The interviews recorded with seven radiographers confirmed that the reject analysis would be of benefit to them for devising further training or retraining which could in part, fulfil the requirement of 35 hours per year for continuing professional development. Workshops and in-house training at the workplace as part of the working week would be of benefit to radiographer and employer. CONCLUSION: Further research and questionnaires to radiographers will be needed to monitor the outcome of and the impact made by the workshops.

1600

A comparison of patient dosimetry in radiography of the lumbar spine

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PURPOSE: To estimate current doses received by patients, during lumbar spine examinations, in a two centre study carried out at the newly commissioned X-ray department, The Queen Elizabeth The Queen Mother Hospital (QEQM Hospital) and at Ramsgate General Hospital. MATERIALS: Dose-area product (DAP) meters to measure dose in air and thermoluminescent dosemeters (TLDs) for measuring entrance surface dose (ESD). METHOD: ESD was measured by attaching TLDs to the patient, and exposing them in the primary beam. DAP was measured simultaneously for the same projections, using DAP meters, which are fitted to the X-ray tubes. The exposure factors for each projection, anteroposterior, lateral and lumbosacral joint (lateral) were noted. ESD and DAP values were converted to effective dose using the tables in National Radiological Protection Board (NRPB) Report R262. RESULTS: Overall, the measured ESD and DAP doses for both QEQMH and Ramsgate General are well below the limits recommended for lumbar spine projections. This demonstrates both departments are operating well within the recommended safety limits. Effective dose was calculated from NRPB R262 tables and this showed a marked difference between effective dose estimated using ESD and that using DAP readings (mean difference ratio 1.74:1). CONCLUSION: Although both ESD and DAP are recommended for dose measurements it is likely that DAP is more closely related to effective dose as it takes account of the X-ray beam area. It is also a more convenient method of estimating effective dose than ESD.

1610

The effects of altering the position of lead-rubber gonad protection during PA chest radiography

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PURPOSE: To determine by experiment the most effective use of lead-rubber protection in reducing gonad dose to male and female patients during both high and low kilovoltage PA chest radiography. There appears to be little evidence to support current practices adopted in what is the most frequently requested examination in imaging departments today. MATERIALS & METHODS: An Alderson Rando phantom was used to represent the patient which was given: no protection; posterior protection; anterior protection and anterior/posterior protection simultaneously. 10 exposures were made at 70 kVp and 120 kVp for each condition and doses at the level of the testes/ovaries were recorded using a Radcal 1015 ionization chamber capable of recording doses as low as 0.0174 μGy. The use of this ionization chamber was designed to overcome the uncertainties of using TLDs for recording the low dose levels expected. All other perceived sources of error were closely monitored throughout the procedures. RESULTS: The results showed an extremely high level of consistency at the low dose levels encountered. Similar trends were found for both high and low kilovoltages for male and female subjects but with remarkable differences between the results for the two sexes and techniques. CONCLUSION: From these results there appeared to be fairly

conclusive evidence as to which methods of gonad protection were the most effective. Several possible misconceptions by clinical staff were also highlighted and it was felt that the project offered a platform for further research leading to definitive departmental protocols.

1620

Contrast examinations of the urinary tract: their role and value in the modern imaging department

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PURPOSE: To evaluate the role and usefulness of a range of imaging investigations, *i.e.* the contrast examinations of intravenous urography (IVU) and micturating cystourethrography (MCU) along with ultrasound (US) and $^{99}Tc^{m}$-dimercaptosuccinic acid (DMSA) scintigraphy, and determine whether the imaging investigation of choice plays a significant role in the diagnosis of UTIs and the subsequent patient management. METHODS: A retrospective analysis was undertaken over the period September 1994 to September 1996. To evaluate the clinical value of each imaging investigation, the clinical management plan decided before the investigation was obtained and compared with the actual plan implemented after the result of the investigation was known, noting any change in the management of the patient. RESULTS: 20% of the patients in this study had undergone two or more different investigations. The reason for this was that the first examination alone could not conclusively diagnose a UTI and therefore had no effect on patient management. CONCLUSION: No single method of imaging can help answer all the questions posed by a paediatric patient with a UTI, but a combination of examinations is necessary to provide the relevant clinical information. However, the IVU and MCU examinations have a role to play in the modern imaging department.

1630

After the introduction of CT for pelvimetry should we now consider further dose reduction

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PURPOSE: This study sought to investigate the current practice of pelvimetry, and the possibility of reducing the radiation dose when imaging the maternal pelvis. MATERIALS & METHODS: The research design of this study was in the form of a survey. The methodology employed was through collecting secondary data from literature and primary data by means of a questionnaire. This was designed to investigate current trends in 22 diagnostic imaging departments in the South West region, and to ascertain if alternative imaging modalities would be considered to reduce the radiation dose. Conventional and CT pelvimetry were initially considered but, ultimately, other possible modalities such as digital imaging, ultrasound and MRI were investigated. These were then compared with respect to radiation dose, accuracy, cost and availability. RESULTS: Literature revealed that due to advances in technology, modalities such as digital imaging and MRI may potentially be utilized for pelvimetry. These would result in a reduced radiation dose to the patient. The survey revealed that CT was the modality of choice in the majority of respondent departments. Although six departments were equipped with an MR scanner only two departments used this technique. Current practice indicated that this was due to the increased cost of MRI, lack of scanner time and current waiting lists. Digital imaging was felt to be currently unproven for pelvimetry. CONCLUSION: The desirability of dose reduction was acknowledged. However, only when MRI becomes more readily available and cost effective can it become the modality of choice for pelvimetry.

1640

Open Forum

STUDENT WORK

Posters

National Indoor Arena Concourse Area

Student

POSTER 1801

Comparing effective dose estimations in chest radiography

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Since the NRPB endorsed the new radiological protection quantity in 1993, effective dose has become established as the standard measure for comparing the risks from diagnostic sources of radiation exposure. However, precise determination of effective dose requires knowledge of the doses to 22 separate organs. This is unlikely to be carried out routinely in any department. It is therefore important that effective dose can be estimated from quantities easily measured in any department. This study compared four such methods of estimating this value for chest radiography in a local district general department and investigated the NRPB recommendation of either entrance surface dose (ESD) or dose-area product (DAP) being appropriate measurable quantities, but that "DAP is likely to be more closely related to effective dose". In each case the following were measured: the ESD by both individually and batch calibrated TL dosimetry, and the DAP by both direct diamentor reading and indirectly from beam output multiplied by field area. It was subsequently found that the majority of cases were within reasonable agreement, but that, in particular, the indirectly calculated DAP was significantly similar to the direct measurement once the variation across the field was accounted for. Furthermore, it was established that even the individually calibrated TL dose measurements were on the limit of recommended inaccuracies ($\pm 25\%$), suggesting that DAP is possibly a better quantity, especially as the alternative involves lengthy calibrating and reading. This complements the study's suggestion of an inexpensive, simply produced graph estimating the DAP, indirectly from field area and exposure factors.

POSTER 1802

Methicillin resistant *Staphylococcus aureus* (MRSA) and the radiology department — how knowledgeable are we?

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Methicillin resistant *Staphylococcus aureus* (MRSA) is an antibiotic resistant bacterium. At present, MRSA is a global issue causing alarm among health professionals. The radiology department provides a great opportunity for the spread of infection — owing to its busy workload and rapid patient throughput. The aims of this research are: (1) To assess the degree of radiographers' knowledge of MRSA and the infection control procedures involved. (2) To assess whether this knowledge differs between Irish and United Kingdom hospitals. (3) To assess whether the level of MRSA incidence within the hospital affects the radiographers' knowledge. (4) To assess the viability of the College of Radiographers Infection Control Protocol 1990. Recent epidemics of MRSA have increased medical staff's attention, resulting in an increase of publications on the subject. This literature does not relate specifically to the radiology department, leaving a need for specific literature to be published. Six hospitals were chosen — three in the UK and three in Ireland, with the aim of surveying 60–80 radiographers in all, for this research. Infection control officers of these hospitals were also surveyed to obtain their opinions. The results showed radiographers to lack knowledge of how MRSA was spread, what patients and staff were at risk and some did not know what solution was used to clean equipment after contact with an MRSA patient. Infection control officers and radiographers disagreed with parts of the College of Radiographers 1990 Infection Control Protocol. In conclusion, it was evident that radiographers need further education on the subject and there is a need for the 1990 COR's Infection Control Protocol to be revised.

POSTER 1803

The role of the radiographer in the management of major/multiple trauma

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This study was designed to investigate the current role of radiographers in trauma management. Specific issues researched included the conditions of work and attitudes of senior departmental personnel towards this role. Also, the potential for future development and the position of radiographers in the Advanced Trauma and Life Support (ATLS) Team. The sample group included hospital departments within the UK (excluding N. Ireland, MoD and Eire). Personnel targeted were superintendents and service managers. 42 departments currently operating A&E services were randomly circulated with a 12 part questionnaire investigating the service and attitudes of staff. 33 sites (78.6%) responded. 72.7% claim to operate ATLS protocols with 6% having team nominated radiographers (pager carrying). 84.8% operate "red dot" systems but 15% provide any report, formal or informal, on their films. 73% of respondents felt that trauma radiography should be regarded as a "speciality". Concern was shown about the level of undergraduate and on-going education in the trauma field. The survey indicates that there is recognition by senior personnel that radiographers have an important part to play in the management of trauma patients. There is also the potential for radiographers to develop and extend their present role through undergraduate and post-graduate training. Radiographers should be regarded as a reservoir of expertise, as yet untapped, within the trauma team.

POSTER 1804

An experiment to compare dose received by the eyes and the thyroid from two CT scanners

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The main purpose of this research project was to compare conventional and helical CT scanners within a large teaching hospital. The study was limited to the head, and dose measurements were monitored by thermoluminescent dosemeters (TLDs). These were positioned on both eyes and the thyroid of a TO2A MRI anthropomorphic head phantom. Attempts were made to duplicate the clinical setting as much as possible. The scenario was undertaken with help from both the medical physics department and a radiographer. Before each scanner was used, image noise and resolution tests were carried out to enable a more balanced and informed picture of the dose comparison. To achieve the dosimetry for each scanner, the doses from $n=5$ scans were averaged on both scanners, with the phantom being positioned on the outset of each set of scans. The TLDs were changed between each scan and the experiment proceeded as a routine brain scan. The TLDs were subsequently read by hospital physics and it was found that the doses received from the spiral scanner were significantly higher, but on comparison of the thyroid doses with the national average they were within acceptable limits. To conclude, dose is increased using the helical scanner on this site.

POSTER 1805

The role of radiography in the management of gunshot wounds

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The occurrence of gunshot wounds (GSWs) is rapidly on the increase and with recent events, *e.g.* drug war shootings, Dunblane and drive-by-shootings, the commonly held opinion that GSWs are confined to Northern Ireland has altered. On review of subject-related literature it emerges that although there is quite a lot pertaining to nursing and medical staff, there is a notable absence of literature relating to the role of radiography in the management of GSWs. Therefore, the purpose of this work is to provide radiographers with an understanding of the types and extents of GSWs and how important an understanding of wound ballistics can be in the imaging of a GSW. The use of structured interviews with radiographers and radiologists at the three Royal Hospitals in Belfast, Liverpool and Manchester, and the research of nursing and medical articles were the methods used in obtaining the necessary information. The results of this research strongly suggest that with an increasing number of gunshot incidences, the likelihood of a radiographer coming into contact with a GSW is also increasing and therefore concludes that an understanding of wound ballistics is essential.

POSTER 1806

The darkroom disease hypothesis — fact or fiction

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PURPOSE: Two major studies investigating potential hazards to radiographers working with X-ray processing chemistry have been carried out, one in New Zealand in the late 1980s and one in the UK in the early 1990s. 19 symptoms were identified which led to the "darkroom disease" hypothesis. This hypothesis postulated that these symptoms were linked to the chemical environment radiographers were working in. It must be noted that these two studies did not employ a control group and therefore the symptoms described by radiographers may present to the same extent in any chemically non-exposed population. The current research sets out to test the darkroom hypothesis. MATERIALS & METHODS: Interviews were performed with 295 radiographers and 250 physiotherapists, the latter serving as a control group. The interviewees were asked if they experienced any of the 19 symptoms described in the earlier studies. RESULTS: Following statistical analysis of the resultant data it was shown that more radiographers suffered from sore eyes ($p<0.001$) and an unusual taste in the mouth ($p<0.0002$) compared with physiotherapists. For the remaining 17 symptoms radiographers were no more at risk than the control population. CONCLUSION: In the light of this new evidence it is proposed that the "darkroom disease" hypothesis is null and some other explanation for radiographers' symptoms needs to be sought.

STUDENT WORK

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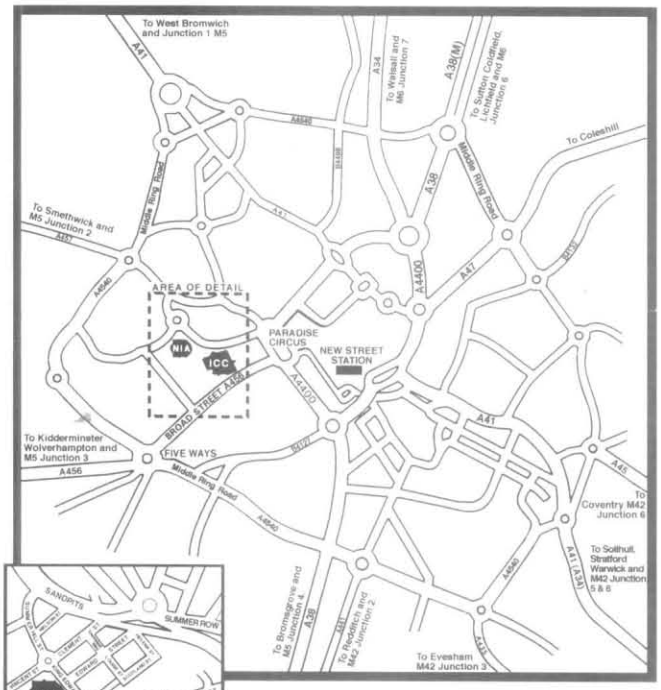

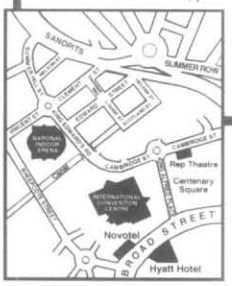

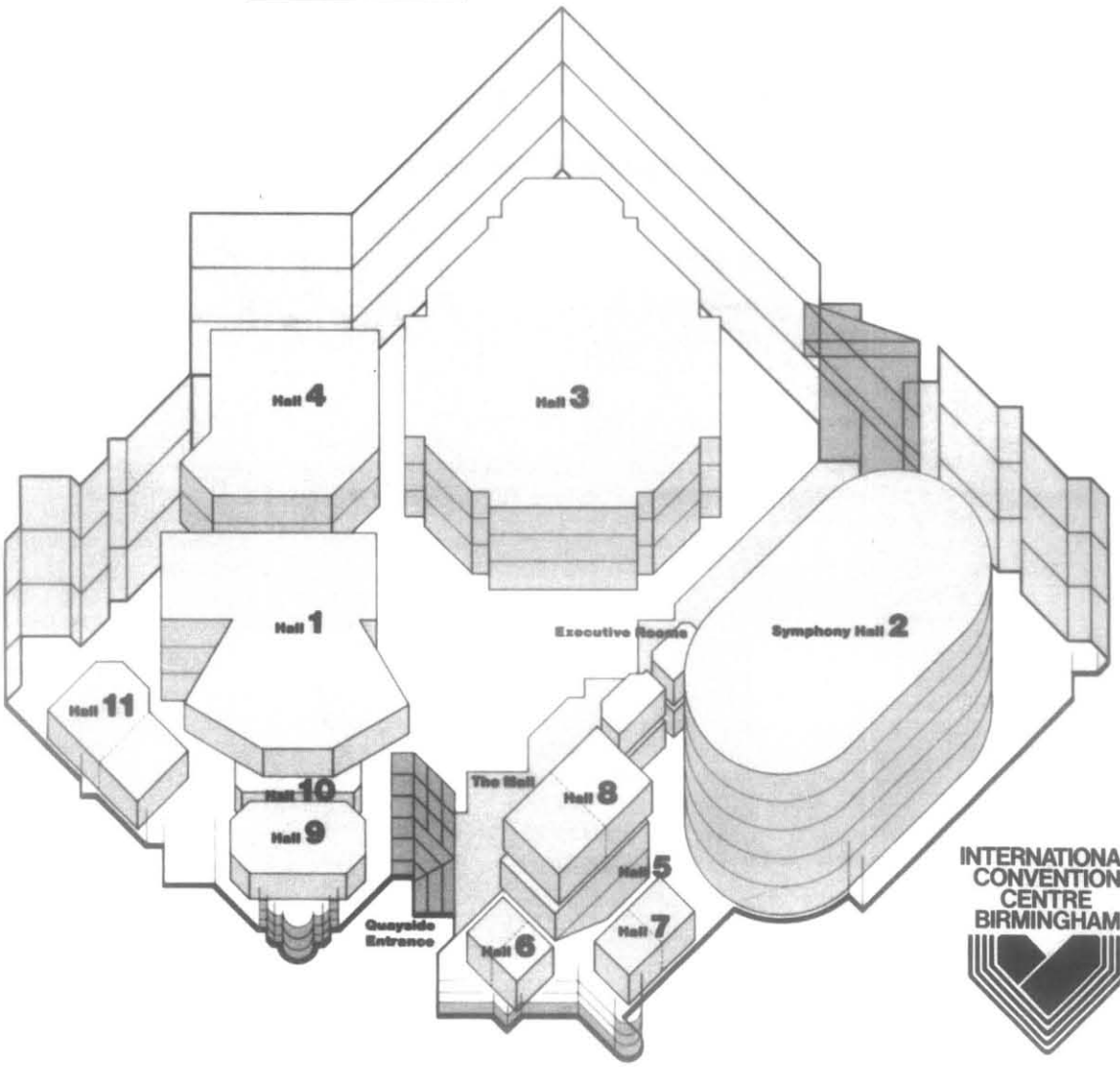

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