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POSTERS

1030–1230 Kingston Lecture Theatre
Keynote Lecture and Scientific Session
Changes in Radiological Service Delivery: Arrangements for Services

1030 Invited review: 7 day services: Torbay *vs* Wolverhampton
R Seymour
Department of Radiology, Torbay Hospital, Lawes Bridge, Torquay TQ2 7AA, UK
No abstract provided.

1045 Invited review: 7 day services: Torbay *vs* Wolverhampton
Speaker to be confirmed.

1100 Invited review: Remote reporting of results
[1]A Fisher and [2]R Harris
Departments of [1]Medical Physics and [2]Radiology, Diana Princess of Wales Hospital, Scartho Road, Grimsby DN33 2BA, UK
No abstract provided.

1130 Invited review: Remote reporting of results
S Blease
Med-Tel UK Ltd, London, UK
No abstract provided.

1145 Invited review: Booked admissions: a challenge for diagnostic departments
P Bartholomew and E Lott
Trust Headquarters, Queen Elizabeth Hospital, Gateshead NE9 6SX, UK
The NHS Plan sets targets for patient access that affect all services. Specific issues are raised for radiology departments, including possible clashes with recent ionizing radiation legislation (IRMER 2000). The Plan highlights that services should be arranged around the needs of patients and that procedures should ideally be instantly booked by referring clinicians at the time of consultation. IRMER specifies the need for individual justification by experts (practitioners) for any procedure involving ionizing radiation, which introduces a further step to the booking process not considered within the NHS Plan. Relevant NHS Plan targets will be detailed and discussed, as will practical implementation systems to satisfy both the Plan and IRMER 2000.

1200 Invited review: Booking plain film X-rays
L Schofield
Booked Admissions, Calderdale and Huddersfield NHS Trust, Huddersfield Royal Infirmary, Acre Street, Lindley, Huddersfield HD3 3EA, UK
This presentation outlines the steps taken to move from a walk-in service at a satellite hospital to a booked service for plain film X-rays using a scheduling system and a dedicated appointment centre. This increases throughput as well as the range of times available for patients, and reduces waiting times in the department. Patients have the choice of telephoning the appointment centre and booking an appointment or they may use the existing walk-in service. Booking has also been extended to include a selection of ultrasound examinations.

1215 Booked admissions: "Dates for diagnostics" at Kings College Hospital
K J Dean
King's Healthcare NHS Trust, Denmark Hill SE5 9RS, UK
Kings College Hospital has been a second and third wave, and is now a fourth wave "booked admissions" site. As part of the NHS plan, the government has set a commitment that, by 2005, every aspect of health care must be booked. Patients will be able to negotiate a date for any test or appointment within 24 h of referral. "Dates for diagnostics" began in October 2000, covering 10 diagnostic departments: CT, ultrasound, X-ray, MRI, angiography, neuroradiology, neurophysiology, nuclear medicine, cardiac non-invasive tests and the vascular laboratory. Multidisciplinary teams were established in these 10 diagnostic subgroups, containing representatives from all health care professionals involved in the booking process. Process mapping techniques were used to establish how patients obtained a date for their test, enabling all staff to understand the patient's journey through the respective departments from referral to report or result. The information gathered was then used to re-design the booking system, which resulted in a common booking system for all departments based on electronic patient referral or faxing of the diagnostic request. The patient can negotiate the appointment in person or by telephoning from the outpatient department or home. The patient then makes their follow-up outpatient appointment to coincide with their results being available. Where appropriate, the radiologist/technician will authorize the request post booking. By September 2001, 40 622 patients have benefited from the process. It is too early to establish what the impact is on the number of DNAs ("Did not attend") and cancellations.

1225 Discussion

1100–1230 Hall 11B
Refresher Course
Non-invasive Angiography

1100 Invited review: CT angiography: techniques and study optimization
G D Rubin
Stanford University Medical Center, Stanford, CA, USA
With the introduction of multidetector-row CT (MDCT), CT angiography has become a routine examination for imaging the aorta and its branches. Although CT angiography can be performed successfully with single detector-row CT scanners, MDCT offers substantial benefits for improving image quality and patient comfort. The greater speed of acquisition allows MDCT to more effectively balance the competing ideals of narrow section thickness and increased anatomical coverage. Moreover, the shorter acquisition time results in shorter breath-holding periods for patients and diminished dosing of iodinated contrast material. This lecture will describe the features of MDCT scanners that allow improved CT angiography and will discuss the parameters that are key to maximizing spatial resolution and anatomic coverage whilst minimizing artefacts. Strategies for delivering iodinated contrast material will be reviewed and issues relating to the reconstruction of CT data will be presented. Finally, methods for applying computer interpretation stations to maximize the detection of clinically relevant abnormalities will be discussed.

1125 Invited review: MR angiography: renal and peripheral
C N Ludman
Department of Clinical Radiology, University Hospital, Queen's Medical Centre, Nottingham NG7 2UH, UK
The development of contrast enhanced MR angiography (CE-MRA) has revolutionized the field of MRA. Previous techniques were poorly suited to the abdominal or peripheral vasculature. By exploiting the direct T1 shortening effects of high dose intravenous gadolinium-DTPA contrast agents, CE-MRA provides an essentially flow-independent imaging technique, enabling the rapid acquisition of high quality 3D data sets with a free choice of imaging plane. In this talk I will aim to discuss the basic principles behind CE-MRA and describe its clinical implementation for the investigation of renal and peripheral vascular disease. Accurate timing of the contrast bolus is critical and I will consider techniques for contrast administration. Imaging the peripheral vasculature requires the ability to encompass large fields of view and I will aim to illustrate some of the strategies that can be used to achieve this. I will discuss optimization of imaging protocols, including the use of breath-hold imaging for the renal arteries, and will consider the use of post-processing techniques, emphasizing those areas most prone to pitfalls and artefacts. Finally, I hope to discuss the place of CE-MRA within the range of available vascular imaging techniques, examining those areas most likely to be developed in the future.

1150 Invited review: Duplex ultrasound angiography: renal and peripheral

T S Padayachee
Ultrasonic Angiology, Guy's Campus, Kings College London, London SE1 9RT, UK

Non-invasive duplex ultrasound is the preferred first-line investigation for evaluation of patients with peripheral vascular disease in whom vascular intervention is considered. Ultrasound protocols for duplex assessment of the peripheral arteries, from the aorta down to the crural vessels, are well established. Ultrasound can provide information on disease localization, severity and plaque morphology. Sensitivities and specificities in the high 80s are reported for most vessels segments. The use of duplex ultrasound as a screening tool has helped to reduce unnecessary invasive imaging and has facilitated combined diagnostic angiography with percutaneous transluminal angioplasty procedures. Duplex ultrasound is also an excellent screening tool for assessment of renal artery stenosis. The use of colour and power Doppler has enabled visualization of the small parenchymal vessels. Contrast agents, although not used routinely, are able to further improve vessel visibility and are especially useful in low flow states. The main disadvantages of this modality are that it is highly operator dependent and, in the abdomen, bowel gas or obesity may preclude imaging of some or all of the abdominal vessels. Calcification may also limit imaging. The advantages of this technique are that it provides both anatomical and haemodynamic information in a single modality. It is ideal as a screening tool and for surveillance programmes because it can be used serially without risk. Centres using duplex ultrasound should establish their own in-house accuracy by comparison with angiography.

1215 Discussion

1100–1230 Olympian Suite 1
Refresher Course
Breast Imaging

1100 Invited review: Computer-aided detection in mammography

S M Astley and C R M Boggis
Imaging Science and Biomedical Engineering, University of Manchester, Manchester M13 9PT, UK

Mammographic screening involves interpretation of large numbers of X-ray images of the breast, the vast majority of which show no significant abnormality. The challenge for the film reader is to identify as many as possible of those images that do show signs of early cancer, whilst classifying normal images appropriately. This task is complicated by the high degree of variability of normal appearances, the subtlety of abnormal signs and the similarity between normal and abnormal features. Consequently, errors may occur, with cancers being missed or normal women recalled for further investigation. Such errors can be reduced by double reading, but with staff shortages and increasing workloads this is not always possible. Recently, computer systems have been developed in which signs of abnormality are automatically detected and the results presented to the radiologist as prompts. The aim of prompting is to draw the attention of the film reader to abnormal regions in the original mammogram that the reader had either failed to detect or had seen but wrongly dismissed. The success of prompting depends critically on the sensitivity and specificity of the algorithms used to generate the prompts; the system must detect a high percentage of genuine abnormalities, but if it erroneously prompts too many normal regions, these false prompts may cause a reduction in performance by drawing attention away from genuine abnormalities or by reducing the reader's confidence in the prompts. In this paper we review the evidence in support of prompting and consider the degree of success achieved by commercial prompting systems used in screening clinics both in the UK and abroad.

1125 Invited review: Biopsy: FNAC or core

[1]F J Gilbert and [2]P D Britton
[1]Aberdeen University, Academic Department of Radiology, Aberdeen and [2]Cambridge Breast Unit, Box 97, Addenbrooke's Hospital, Cambridge CB2 2QQ, UK

Fine needle aspiration cytology (FNAC) of the breast has been used for more than 20 years as part of the breast diagnostic process. More recently its use has declined in favour of core biopsy procedures that provide histological details. The main reasons for this are a reduced sensitivity of FNA for certain types of breast abnormality and the difficulty in attaining the expertise required to use FNA successfully. FNA offers the advantage of immediate reporting of results. Core biopsy has the advantage of providing information of invasive *vs in situ* malignancy, tumour grade and hormone receptor status. The authors will describe the techniques for both procedures, the diagnostic accuracy and limitations of both techniques. In modern breast diagnostic practice there is a role for all of the various breast biopsy techniques and radiologists should retain the skills needed to perform FNA. However, with current core biopsy techniques it is likely that FNA will play a lesser role in breast diagnosis.

1150 Invited review: Breast MRI

N R Moore
Department of Radiology, University of Oxford, Oxford OX3 9DU, UK

INTRODUCTION: Breast cancer is the commonest cancer in women; it occurs in 1 in 11 women and causes 35 000 deaths in the UK. TECHNIQUE: Breast MR images are acquired with the patient prone on a dedicated breast coil. Almost all studies require injection of gadolinium, so intravenous access should be established before positioning. High resolution, small field of view images are acquired. 3D T_1 gradient echo sequences have intrinsically high SNR, good spatial resolution and demonstrate the morphological features and dynamic enhancement characteristics of breast lesions. INTERPRETATION: Breast cancer typically enhances rapidly, within 90–120 s, to a plateau of 70–100% above baseline signal intensity. A subsequent washout increases the sensitivity and specificity for cancer. Scar tissue is characteristically of low signal on T_1 and T_2 images. Mature scar either does not enhance or enhances only to minor degree (up to 30% increase in signal). PRINCIPAL INDICATIONS: The post-operative breast mass: MRI can exclude tumour recurrence with a very high degree of certainty; the predictive value of a negative test is >98%. Tumour staging: assessment of tumour volume and local extent is more accurate with MRI than with mammography or ultrasound. Tumour diagnosis: MRI can be used to detect breast cancer in high-risk women and those presenting with metastatic disease of unknown primary. Breast implants: MRI is the most accurate technique for the assessment of breast implant integrity. PITFALLS IN DIAGNOSIS: MRI has excellent sensitivity but suboptimal specificity. Techniques for improving specificity, including interventional procedures, will be presented.

1215 Discussion

1100–1230 Hall 10
Refresher Course
Magnetic Resonance

1100 Invited review: MRI liver

S P Olliff
Radiology Department, Queen Elizabeth Hospital, Birmingham B15 2TH, UK

This presentation will cover the use of MRI for the characterization and detection of liver lesions. MRI-specific contrast agents will be discussed. The MR appearances of some parenchymal liver disease will also be presented. The relationship of MRI liver to MRCP will also be considered.

1125 Invited review: MRI of the pancreas

J A Guthrie
Department of Radiology, Lincoln Wing, St James's University Hospital, Leeds LS9 7TF, UK

Complete MR assessment of the pancreas can be performed when a pancreatic tumour is suspected, or it can be added to an MRCP examination for biliary symptoms. The principal objectives with adenocarcinomas are to identify the neoplasm and to determine whether complete resection is feasible. The portal venous structures, visceral arteries, liver and nodes need to be assessed. Axial FISP images provide an overview. HASTE acquisitions through the liver in addition to an MRCP examination are followed by T_1 with fat saturation through the pancreas. A series of 3D T_1 SGE acquisitions are obtained in capillary, portal venous and equilibrium phases. The plane depends on the location of the tumour. Gadolinium followed by saline is delivered at 4 ml s^{-1}. The first acquisition is obtained at 5 s. Normal pancreatic parenchyma is bright on T_1 FS, and adenocarcinomas are of low signal.

Dynamic imaging exploits the differences between the normal highly vascular pancreatic parenchyma and the hypovascular nature of adenocarcinomas. Conspicuity of tumours is usually maximal during the capillary phase. Liver metastases are typically small, and the combination of HASTE and thin section multiphasic dynamic T_1 GE images enables identification and characterization of small lesions. The oblique coronal plane is advantageous not only in demonstrating vascular relationships but also in demonstrating lymph nodes. FSE T_2 are of value in assessing cystic neoplasms, neuroendocrine tumours and other rarer pancreatic neoplasms. Neuroendocrine tumours and their liver metastases are usually high signal on T_2, have variable vascularity and may be multiple.

1150 Invited review: MRI of the brain in the immunocompromised host

R J S Chinn
Department of Radiology, Chelsea & Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK

The immunocompromised patient is at specific risk of involvement of the central nervous system (CNS) over and above the background level of inherent risk. In this talk, the range and variety of conditions encountered as a result of immunocompromise will be discussed. The typical MRI appearances in the brain of various infective organisms will be demonstrated. As an example, we will concentrate on infection with human immunodeficiency virus (HIV), which is the leading cause of immune suppression in the world. HIV is neurotropic and crosses the blood–brain barrier at an early stage in the disease. Thus, the CNS is a major target, with approximately two-thirds of patients developing CNS involvement during the course of their disease. The spectrum of CNS disease in Acquired Immune Deficiency Syndrome (AIDS) is wide and can be broadly categorized into the primary effects of HIV, opportunistic infections, neoplasms and vascular disease. In addition, treatment effects and other non-inflammatory effects related to the cause of immunocompromise need consideration. The variety of other causes of immunocompromise will also be addressed.

1215 Discussion

1100–1230 Olympian Suite 2
Keynote Lecture
The Diagnosis and Management of Osteoporosis: what you need to know for good practice

1100 Invited review: Osteoporosis: treatment and monitoring

R Eastell
Bone Metabolism Group, University of Sheffield, Sheffield, UK

The management of osteoporosis needs to include general measures to protect against osteoporosis, identification and treatment of other reversible causes of bone loss, and use of proven agents for the treatment of osteoporosis. General measures include improved physical activity, adequate diet (paying particular attention to calcium and vitamin D) and avoidance of behaviours that promote bone loss, such as smoking and alcohol abuse. The diseases that should be identified, other than oestrogen deficiency, include primary hyperparathyroidism, thyrotoxicosis and coeliac disease. The treatments that are proven to prevent fractures in post-menopausal women include hormone replacement therapy (HRT), raloxifene, nasal calcitonin, bisphosphonates (alendronate and risedronate) and parathyroid hormone. These treatments are known to be effective in groups of patients; however, it is helpful to observe the response of the individual. Non-response may indicate non-compliance with the treatment approach or it may indicate secondary osteoporosis. Monitoring of individuals is useful in encouraging compliance with drug regimens that are usually given for at least 5 years without apparent benefit to the patient. Bone density of the lumbar spine is the optimal physical measurement and this usually increases in response to both anti-resorptive and formation simulating therapy; these increases can usually be detected between 1 year and 2 years. Bone resorption markers can also be used to monitor treatment. Bisphosphonates and HRT result in a decrease in these markers that is maximal by 3 months; however, bone markers need to be used with care to reduce their variability.

1130 Discussion

1140 Invited review: Vertebral fracture assessment in osteoporosis

H K Genant
Department of Radiology, University of California, San Francisco, CA, USA

Vertebral fractures are the most common consequence of osteoporosis and are an important risk factor for subsequent fractures. Patients with reduced bone mineral density (BMD) and vertebral fractures have significantly increased risk for future fractures, indicating great potential for the combined use of fracture assessment and BMD in risk evaluation. Despite the established importance of fractures, however, vertebral assessment is not typically performed in the clinical evaluation of patients at risk for osteoporosis. Radiographs are the accepted standard for assessment of fractures using semi-quantitative visual evaluation or quantitative morphometric evaluation. However, spinal radiographs often are not obtained in osteoporosis assessment for a variety of practical reasons, including cost, radiation dose and the lack of office-based radiological facilities. Clinical assessment of vertebral fractures is difficult and often unreliable because most are asymptomatic. Consequently, this strong risk factor for osteoporotic fractures is often overlooked. Lateral spine images, obtained on advanced dual X-ray absorptiometry (DXA) systems, provide a practical, low radiation dose, point-of-care methodology for assessment of vertebral fractures and have the potential to address this important clinical need. The relevance of vertebral fractures and the methods of assessing them are reviewed here. Clinical data supporting the feasibility of visual evaluation of lateral spine images obtained from conventional radiographs or advanced DXA systems are reviewed, and the potential positive effects of combining this information with that obtained from standard bone densitometry in osteoporosis management are discussed.

1210 Discussion

1100–1145 Hall 9
Keynote Lecture
Trauma and Orthopaedics

1100 Invited review: Consultant radiography practice in trauma imaging

B A Snaith and W Hoban
X-Ray Department, Royal Free Hospital, London NW3 2QG, UK

This year sees the introduction of Consultant level posts in all of the Allied Health Professions. This presentation will examine the potential for the development of Consultant Radiographer posts within trauma imaging. The extent to which the role of the radiographer can develop in a multidisciplinary forum will be key to the successful implementation of this grade, and their impact on patient management is yet to be tested. The justification for and implementation of Consultant Radiographer posts will be discussed, together with the possible differences encountered in the practice between teaching and non-teaching hospitals.

1100–1230 Hall 11A
Refresher Course
Renal Imaging of Neonatal and Paediatric Patients

1100 Invited review: Micturating cystograms

J McKinstry
X-Ray Department, Royal Belfast Hospital, Falls Road, Belfast BT12 6BE, UK

No abstract provided.

1130 Invited review: Renal imaging of the paediatric patient

S M Scadden

Renal imaging of the paediatric patient will account for the majority of requests received by the Nuclear Medicine Department (for paediatric imaging). This presentation will be going back to basics on all aspect of renal imaging. All paediatric renal imaging techniques will be covered, *i.e.* direct isotope cystogram; DMSA; Mag3 renogram with and without frusemide; the dynamic renogram followed by the indirect radionuclide cystogram; renal transplant and the renal hypertension (captopril) study. For each investigation the presentation will cover

all aspects of imaging, from preparation, injection, collimator, view, count time and immobilization/distraction choice. On completion there will be a general overview, which can be employed for each and every paediatric investigation. PAEDIATRICS: P, preparation; A, assessment; E, explanation; D, dose; I, immobilization; A, amusement; T, technique; R, reduce time, dose, number of views; I, injection; C, camera; S, sedation.

1200 Invited review: Renal ultrasound

L Pearson
Radiology Department, Birmingham Children's Hospital, Steelhouse Lane, Birmingham B4 6NH, UK

Renal tract ultrasound is the most common method of investigation and follow-up of children with suspected renal tract pathology. It is useful for the demonstration of normal anatomy and forms an important part of the battery of tests available to the physician or surgeon for the characterization and evaluation of many different types of anatomy, pathology and function. Ultrasound is widely available, easy to perform and does not involve the use of ionizing radiation. Postnatal renal scanning is valuable for the neonatal evaluation of prenatally detected renal tract pathology and should be considered as the method of choice for the initial investigation of these patients. Topics to be discussed will include: normal anatomy at different ages throughout childhood; tips for scanning paediatric patients in a DGH; patient preparation and scan protocols; common anatomical variants and the more common examples of pathology that you can expect to encounter in everyday practice.

1145–1215 Hall 9
Scientific Session
Trauma and Orthopaedics

1145 A parallel approach: the impact of schuss radiography of the degenerate knee on clinical management

J F S Ritchie, M Al-Sarawan, P A Gibb, B Conry and Dr Worth
Departments of Orthopaedics and Radiology, Kent and Sussex Hospital, Tunbridge Wells, Kent, UK

Schuss radiographs are PA weight-bearing views of the knee taken in 30° of flexion. They are more sensitive detectors of osteoarthritic changes in the knee than standard extension AP views. AIM: To determine whether the increased severity of degenerate change shown on these radiographs is sufficient to change proposed orthopaedic management of patients. METHODS: 25 consecutive patients aged 45–75 years presenting to the clinic with symptoms suggestive of tibiofemoral osteoarthritis were included. Each patient underwent standard clinical assessment and weight-bearing extension AP and lateral radiographs of the knee. In addition, a digital photograph of the legs and a single schuss radiograph were taken. This information was collated onto slides, two per patient. One slide included the history and examination findings plus the photograph, and extension AP and lateral radiographs. The other was identical except that the extension AP radiograph was replaced by the schuss radiograph. The slides were randomized and shown to four consultant orthopaedic surgeons. For each slide, each consultant was asked to give his preferred management. Responses for the two slides for each patient were compared. RESULTS: The panel changed their management plan in 44% of cases. This represented a 41% reduction in arthroscopies in the schuss group, with a move towards definitive surgery. The total number of procedures proposed was also reduced. CONCLUSIONS: The schuss radiograph is a valuable tool in the assessment of knee osteoarthritis and can alter clinical management. By reducing non-therapeutic arthroscopies it may significantly reduce the total number of operations to be performed in this patient group.

1155 The role of multislice CT in the evaluation of on-call body trauma patients

H Kapadia, A K Banerjee and R Arnott
Radiology Department, Birmingham Heartlands & Solihull NHS (Teaching) Trust, Birmingham B9 5SS, UK

INTRODUCTION: Multislice CT is a fast, accurate method for assessing patients admitted to casualty departments with body trauma. We have reviewed our experience of out-of-hours multislice CT in this patient group. MATERIALS AND METHODS: Patients with head trauma only were not included in this study. 39 patients with body trauma (32 male, 7 female) were evaluated on the Toshiba Multislice CT scanner at our institution over a 9-month period. 7 patients underwent a scan on one area (chest/abdomen/pelvis/neck/brain), 13 on two areas, 13 on three areas, 4 on four areas and 2 on five areas. RESULTS: Five patients had normal scans. The range of abnormal findings included cervical trauma/subluxation (3), lung contusion/rib fractures/diaphragmatic herniation (9), splenic/renal trauma (3), duodenal tear (1), fracture lumbar spine, pelvis, pubic bones (4) and intraperitoneal haematoma (6). Multiplanar reformats were performed on all neck trauma and were also helpful in cases of abdominal and pelvic trauma. Detailed examples of CT findings will be presented. CONCLUSION: Multislice CT is a fast accurate method of assessing body trauma, and multiplanar reformatting capabilities can be helpful for diagnosis in difficult cases.

1205 WIP: Ultrasound monitoring of soft tissue healing and physiotherapy management of soft tissue injuries

E Hancock, D T Graham, C Davidson, F W Smith and A Quirk
The Robert Gordon University, Grampian University Hospitals NHS Trust, Aberdeen AB25 1LD, UK

INTRODUCTION: Soft tissue injuries are the most commonly sustained pathology occurring as a result sporting or recreational activities or activities of daily living. 14% of these injuries are ankle injuries, and 85% of these are sprains of the lateral ligament. The main treatment provider for those who seek medical interventions is the physiotherapist. Therapeutic ultrasound is a commonly used treatment modality despite the absence of supporting clinical research. The aim of this study is to evaluate the effects of therapeutic ultrasound on the management of ankle injuries, with particular emphasis on sprains of the lateral ligament. METHOD: 30 suitable subjects were recruited from A&E and were scanned using a 10–16 MHz Diasus diagnostic ultrasound scanner within 2 days of injury. They were randomly allocated into one of three groups: the first group received therapeutic ultrasound and clinical and ultrasonic assessment at 2-day intervals until 22 days after the injury; the second group received therapeutic ultrasound as determined by their clinical symptoms and were finally reassessed at 22 days; the third group (control) were given the general advice for recovery from ankle sprain (this is normal current treatment) and were assessed and re-scanned at 22 days after their injury. When therapeutic ultrasound was used, the ligament was scanned prior to treatment and immediately after treatment. Each assessment of the patient involved joint range of motion, static and dynamic muscle strength, and visual analogue pain scale. The ultrasound images and other results are currently being analysed and will be reported.

1215–1315 Hall 9
Scientific Session
Image Interpretation and Radiographer Reporting

1215 WIP: The efficacy of radiographers' and radiologists' reporting of A&E and GP plain films: a quasi-randomized controlled trial

S Brealey, D G King, M T I Crowe and N G Warnock
Department of Health Sciences, University of York, Heslington, York YO10 5DD, UK

Two specially trained radiographers at York District Hospital have been reporting appendicular plain film X-ray examinations for accident and emergency (A&E) patients since February 1995. The aim of this study was to explore the potential for expanding their reporting role. The two radiographers as well as a group of consultant radiologists reported on a retrospectively selected random stratified sample of 400 A&E and GP plain film X-ray examinations for all body areas. The effect of the reports made by the radiographers and radiologists on the referring clinician's diagnosis and management plans as well as on subsequent patient outcome was also assessed. The findings will be presented using descriptive statistics, hypothesis tests and confidence intervals as appropriate.

1225 WIP: The effect of introducing trained radiographers to an A&E reporting service: a controlled interrupted time series

D G King, S Brealey, M T I Crowe and N G Warnock
Department of Health Sciences, University of York, Heslington, York YO10 5DD, UK

In February 1995, following a period of training, two radiographers at York District Hospital began to report appendicular X-ray examinations for accident and emergency (A&E) patients. The objective of this study was to assess the effect of introducing these trained radiographers on the quality of the reporting service. This involved assessing changes in the proportion of examinations reported and the timeliness of report availability, the proportion of examinations correctly reported and the effect on patient management and outcome. Whether different professionals found trained radiographers reporting acceptable was also investigated, as was the cost effectiveness of introducing radiographer reporting. The findings regarding changes in the proportion of A&E examinations (experimental group) and general practitioner examinations (control group) correctly reported will be presented. Furthermore, the effect of the reports of these examinations compared with the reference standard report on patient management and outcome shall be presented, as will the cost effectiveness of introducing radiographer reporting.

1235 WIP: Interprofessional education in image interpretation

B A Snaith and C M Ferris
Radiology Department, Pinderfields and Pontefract Hospitals NHS Trust, Wakefield WF1 4TU and School of Health and Social Care, Sheffield Hallam University, Sheffield S10 2BP, UK

Within the current health service, the roles of many healthcare professionals are changing rapidly. Many practitioners are extending their roles, and the boundaries between professions are blurring. In order that there is further development of roles, particularly where boundaries between professions are changing, it is important that there should be more interprofessional learning and teaching to ensure the systematic sharing and spreading of good practice. This also extends to the justification of practice in developing roles as well as assurance of competency. It is important that whoever takes responsibility for interpreting images and acting on the results should be educated to the highest standard. There is no specific reason why different professions should be educated in isolation. Indeed, to do so can only contribute to the multidisciplinary team approach to patient care and could develop a greater understanding of the role played by each profession in the care pathway. The rationale for the development of a postgraduate programme with opportunities for interprofessional learning in image interpretation will be discussed. Early findings will be presented, together with key issues identified from developing and delivering education in this format.

1245 WIP: Radiographer reporting of CT head scans

C M Craven, J A Guthrie, S E Swift and J A Spencer
CT Department, St James's University Hospital, Leeds LS9 7TF, UK

PURPOSE: To evaluate the diagnostic concordance of an experienced CT radiographer (CTR) with consultant radiologists (Cons. Rs) for acute head CT scans. METHODS: In phase I, concordance was established between senior trainee radiologists and the CTR on 81 consecutive general head CT examinations using an experienced Cons. R as the gold standard. In phase II, which is in progress, concordance will be evaluated for reporting of 200 consecutive head CT scans and in particular for hot reporting of acute cases. Validation of findings from clinical outcome, lumbar puncture, angiography/correlative imaging or surgery will be obtained for this subgroup. RESULTS: In phase I there was complete concordance between the CTR, the radiology trainees and the Cons. Rs in 71 (87%) cases. Compared with the Cons. Rs, the CTR had a sensitivity of 94% and a specificity of 100% for significant findings. Phase II results are to be presented. CONCLUSION: Recent audits of acute head CT services show widespread inability to meet Royal College of Physicians targets. Extending skill mix initiatives to this problem by utilizing the skills of highly trained, experienced and motivated CTRs offers a effective solution. Preliminary data are encouraging and offer a framework for training and validating skills.

1255 WIP: Visual conspicuity, detection and recognition: an eye tracking study

S C Ethell and D J Manning
Department of Radiography and Imaging Science, St Martin's College, Lancaster LA1 3JD, UK

BACKGROUND: Research has failed to demonstrate a significant linear correlation between target conspicuity and measures of observer performance. An explanation for this apparent lack of correlation may be found in the mechanisms of the visual interpretation task itself. Radiological errors may arise from a failure to detect a target; however, performance errors may also arise from misinterpretation of perceptual data during target recognition and decision-making. PURPOSE: Investigation of the influence of conspicuity on observer performance through the evaluation of radiologists' eye movements. MATERIALS AND METHODS: Six radiologists were requested to review 120 verified chest radiographs containing 81 pulmonary nodules. Observers recorded their decisions in accordance with AFROC methodology. Eye movements were recorded during a nested sequence of chest images containing 33 nodules. Cumulative dwell time and time to hit were computed from the fixation data. Conspicuity values for all nodules were ascertained. RESULTS: On the whole, there was a poor linear relationship between eye movement data and conspicuity values, but polynomial fitting showed some subtle findings concerning visual activities. Nodules with mid range conspicuity values (0.6–1.8) were detected rapidly, treated with the greatest visual interest and recognized with the greatest confidence. Nodules were also frequently fixated on, but remained unreported or misinterpreted as pathologically insignificant. CONCLUSION: The level of conspicuity of target features may influence visual activity. Cognitive elements of the interpretation task appear less dependent on target conspicuity.

1305 WIP: Chest radiograph interpretation by medical students

D R Jeffrey, M P Callaway, P R Goddard and R Greenwood
Department of Clinical Radiology, Bristol Royal Infirmary, Bristol BS2 8HW, UK

PURPOSE: To assess the ability of final year medical students to interpret conventional chest radiographs. METHODS AND MATERIALS: 10 conventional chest radiographs that were good radiological examples of common conditions were selected from a teaching hospital radiology department library. All were conditions that a medical student should be expected to recognize by the end of their training. One normal radiograph was included. The radiographs were shown to 52 final year medical students who were asked to describe their findings. RESULTS: The mean score achieved was 12.4 out of 20 (SD 2.77). There was no difference between the scores of male and female students (12.5 and 12.3, respectively; p=0.82), but males were more likely to be certain of their answers than females (mean certainty scores 20.0 and 15.9, respectively). The overall degree of certainty was low. On no radiograph were more than 25% of students definite about their answer. Students had received little formal radiology teaching (2–42 h, mean 20.6 h) and few expressed an interest in radiology as a career. Only 2 (3.8%) students thought they were good at interpreting chest radiographs; 17 (32.7%) thought they were bad or awful. CONCLUSION: Medical students reaching the end of their training do not perform well at interpreting simple chest radiographs. They lack confidence and have received little formal radiological tuition. Perhaps as a result, few are interested in radiology as a career, which is a matter for concern in view of the current shortage of radiologists in the UK.

1245–1330 Hall 11A

Keynote Lecture

Paediatric Imaging

1245 Invited review: Imaging of the compromised neonate

J Fairhurst
Southampton University Hospital NHST, Southampton, UK

Advances in technology and patient management in recent decades have seen great increases in the survival of very low birth weight babies. These infants, born as early as 23 weeks gestation, present many challenges. How these infants are compromised will be discussed. These babies are a population who develop disorders that are unique in their pathogenesis, radiological appearances and complications. A team approach is encouraged, with the Radiology and Medical teams

working together to provide continuous, on-going expertise in all branches of imaging. Although this is predominantly plain film imaging and ultrasound, CT and MRI are being used with increasing frequency, and these methods will be reviewed. This category of infant is particularly sensitive to the effects of radiation and, where possible, alternative methods of imaging should be used. However, it is imperative that when radiology does involve ionizing radiation, it provides maximum information with minimum radiation. Methods of reducing radiation exposure will be discussed and illustrated. All forms of imaging these babies require the infant to be disturbed and handled in some way, which can cause their condition to deteriorate. The imaging of these babies will be approached by body area: chest, abdomen, head and appendicular skeleton.

1315–1400 Olympian Suite 1
Keynote Lecture
Client Care and Counselling in Breast Screening and Assessment Units

1315 Invited review: Addressing familial breast cancer

S Hames
Derby City General Hospital, UK

It has been established that 5–10% of cancers may be due to an inherited genetic component. A heightened public and professional awareness of this resulted in the development of a team to address the emerging needs within a district general hospital. Historically, the only option available to individuals concerned about their genetic risk of cancer was to refer them to a regional genetics service. Therefore, as an alternative, a Familial Cancer Service was established within the developing cancer service network at Southern Derbyshire Acute Hospitals NHS Trust. The familial cancer specialist works to deliver a service to individuals with a family history of cancer as part of a multidisciplinary team including primary care, radiologists, surgeons, gynaecologists and geneticists. There is a move in the NHS toward skill mix and multiskilled staff working across professional boundaries. This is a unique post shared between a radiographer and a nurse, where the diverse skills and knowledge from both backgrounds can be utilized to maximum benefit.

1335 Invited review: Client counselling in breast assessment units

M Noblet
The Nightingale Centre, Withington Hospital, Breast Assessment Centre, Withington, Manchester M20 8LR, UK

No abstract provided.

1355 Discussion

1330–1415 Hall 10
British Institute of Radiology
Kodak Mayneord Memorial Lecture

1330 Eponymous Lecture: Imaging data explosion: how do we meet the challenge?

G D Rubin
Stanford University Medical Center, Stanford, CA, USA

Multidetector-row CT (MDCT) and MRI scanners are challenging radiologists with larger, higher resolution volumetric data sets. Whilst a typical CT scan of the chest may have contained 30 transverse sections 10 years ago, today we routinely acquire chest CT scans with over 350 transverse sections. Scan to identify a potential source for systemic atheroembolisation and to image the sequelae of peripheral arterial embolisation will require imaging of the chest through the feet, which can contain over 2000 cross-sections. Traditional film-based methods for image review and interpretation are no longer practical or cost effective. Whilst image review workstations allow "soft copy" reading, interpretation of CT and MR studies remain largely based in a review of 2D sections. With no end in sight to the rapid escalation in scanner capabilities, alternative volumetric analyses become necessary for the efficient assessment of volume data. These include 3D visualization, computer-assisted detection, automated geometric quantitation of anatomical structures, and alternative human–computer interfaces for effectively navigating through these large data sets. Using MDCT data as the paradigm, this lecture will present a variety of alternative approaches for the volumetric analysis of volume data.

1330–1400 Hall 11A
Scientific Session
Paediatric Imaging

1330 Ultrasound through the ages: a practical guide to paediatric renal ultrasound

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INTRODUCTION: Paediatric radiology involves imaging of all age groups from birth to late teens. With this in mind, it is important to be aware of the alterations in normal appearances owing to maturation and development that may lead to confusion of pathological processes for those unused to paediatrics. As renal tract ultrasound is one of the most common examinations performed in the paediatric age group, we present a pictorial review of ultrasound appearances of the renal tract from antenatal/premature infant to more familiar adult appearances, including a selection of the more common normal structural and developmental variants. METHOD: A retrospective review was carried out of normal renal tract ultrasound examinations performed at the Birmingham Children's Hospital between 1996 and 2001. The sample group consisted of all children aged between 26 weeks gestational age and 16 years having renal ultrasound. Normal developmental variants and relatively benign congenital variants were identified and reviewed. RESULTS: A development and aging map of the kidney was formed, with examples from late mid trimester to late teens. Some examples of normal variants have also been included. CONCLUSION: Recognition of normal renal appearances in different age groups is important. Familiarization with this will acclimatize the non-specialist sonographer/sonologist and allow recognition and differentiation of normal, congenital and pathological anatomy.

1340 Scoliosis radiography: conventional *vs* digital technique

E Franklin and A Stanley
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AIM: The Easy Spine Reconstruction application from Philips Medical Systems represents an innovative and relative method for the acquisition of whole spine images. The aim was to evaluate the Easy Spine application for whole spine imaging as an alternative to conventional imaging techniques. OBJECTIVES: To discuss the current conventional methods of acquisition; to describe an overview of the imaging systems involved with the new technique; to describe the technique; to evaluate the Easy Spine application by (a) ease of use, (b) user-friendliness and (c) dose/image quality/imaging techniques; and to evaluate the new technique as a replacement for conventional imaging techniques.

1350 Discussion

1415–1550 Olympian Suite 1
Keynote Lecture and Scientific Session
New Techniques in Breast Imaging

1415 Invited review: Computer-aided diagnosis in mammography: improving detection and improving decision-making

P Taylor
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Researchers have been looking at the use of computers for analysis and interpretation of digital mammograms since 1976. Much of this work is now aimed at the development of systems for computer-aided diagnosis (CAD). The term CAD serves to focus attention on the fact that systems are designed to enhance the accuracy of the human film readers' assessments. The defining feature of a CAD system is that it is the clinician who makes the decision; the computer is used in a secondary role, assisting with the process or with part of the process. Designers of CAD systems for mammography focus on two different roles for their systems. The first is in assisting radiologists in the

detection of abnormalities. The second is in making decisions about detected abnormalities. The current generation of CAD tools are marketed as aids for detection. They work by placing prompts on the mammogram, prompts that are supposed to direct the radiologist's attention to areas of the image that they might otherwise overlook. Most of the published evidence on the effectiveness of these tools relates to their capacity to detect abnormalities. There is currently very little evidence about the impact of the prompts on radiologists' decision-making. A review of the evidence suggests that more work needs to be done to establish what use film readers make of prompts. The question also arises of whether or not it is appropriate to focus on detection rather than decision-making.

1440 Invited review: Latest equipment and techniques in mammography

K C Young
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Developments in mammography can be considered in two parts. First, there have been changes in conventional imaging. Film–screen technology has continued to evolve with the introduction of faster screens coupled with more sophisticated emulsions. Dual emulsion films have changed the shape of characteristic curves. These have been used to enhance skin edges, increase contrast and improve the appearance of dense tissues. Automatic beam quality selection is now almost universal. This has moved practice away from standard factors (usually 28 kV Mo/Mo) to the use of different spectra for different types of breast. Although this has brought benefits in terms of radiation dose and image quality, such automatic systems must be appropriately adjusted. Improved designs of compression systems have been introduced. The second major area of development has been the gradual introduction of full-field digital mammography. There is now a remarkable variety of different designs. One of the oldest (photostimulable phosphors) has received a new lease of life with the introduction of dual reading technology at a 50 μm resolution. Systems using selenium detector plates with a 70 μm resolution are expected this year. Such systems have the advantage of converting X-ray energy directly to an electrical signal. A low dose system, which uses a scanning technique with a linear array of silicon detectors, has also been developed. Dual displays with 2000 x 2500 resolution are becoming standard. While such systems may be readily introduced into a symptomatic role, their use in screening remains problematic.

1500 Evaluation of image quality and dose on computed radiography systems for mammography

[1]C P Lawinski, [2]D A Goodman, [3]M A Whall, [1]A Mackenzie and [3]D S Evans
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Computed radiography (CR) in mammography was initially based on systems for general radiography and used a high resolution plate contained in a mammography cassette. The standard plate reader used specific algorithms for breast imaging. Dedicated mammography CR systems are now available with improved imaging capability, particularly in terms of spatial resolution. The phosphor is carried on a clear backing plate and the reader scans both sides of the phosphor simultaneously. Image quality data for both types of mammography CR system were obtained using standard test objects. All acquired images were printed on to film using a high resolution laser printer and were scored under typical film viewing conditions. Breast dose was also assessed. The results were compared with typical data for film–screen imaging and also with the recent guidance on the introduction of CR systems for mammography into the NHSBSP. In terms of low contrast sensitivity and small detail detectability, the performance of both designs of CR systems is very similar to that of a modern film–screen combination for mammography. The performance of the dedicated mammography CR system is slightly better than that of the general radiography based system. The high contrast resolution performance of both CR systems is significantly poorer than for film–screen imaging and the measured values are very close to the nominal values derived from the pixel size. Dose levels are similar to that for a modern film–screen combination. For both systems, the suggested NHSBSP image quality and dose standards are met.

1510 The performance of computer-aided detection in the assessment of interval breast cancer

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Duchess of Kent Breast Screening Unit, St George's Hospital, London, UK

PURPOSE: This study aimed to assess the performance of computer-aided detection (CAD) (Image Checker 2000) in the analysis of interval breast cancers. MATERIALS AND METHODS: Two-view screening and diagnostic mammograms of 95 patients with interval breast cancer were classified by a panel of five experienced film readers into four categories: true interval (T) (n=30); false negative (FN) (n=16); false negative minimal signs (FNS) (n=19); and occult (O) (n=30). The mammograms were digitized and subjected to CAD, which generated marks on suspicious calcification, asymmetry, or masses. Only the FN and FNS subgroups were considered further at this time. The CAD marks were reviewed by two radiologists to ascertain whether the cancers were correctly identified, and further data were collated on mammographic signs present and on tumour pathology. RESULTS: On the screening mammograms, CAD correctly identified 21/35 cases of interval cancer (60%). 8 (22%) of these 35 cancers had an emphasized mark indicating strong suspicion. CAD missed 14/35 cases (40%). Of these, the majority of the mammographic abnormalities were masses or asymmetry (87%) rather than calcification, which CAD discriminated well. CONCLUSION: Previous annual screening studies have shown that CAD marks between 80% and 90% of screen-detected cancers. The lower detection rate of 60% with interval tumours possibly reflects the more subtle nature of the lesions, but may also relate to the current longer screening interval of 3 years. However, this information may still aid in the identification of additional cancers, particularly as 22% received emphasized prompts. Further studies are needed on the influence this will have on recall rates, particularly in the FNS subgroup.

1520 Reproducibility of prompts in computer-aided detection of breast cancer

C Taylor, M Reddy, J Kelly, P Taylor and R Given-Wilson
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PURPOSE: We evaluated the reproducibility of prompts using the R2 Imagechecker M2000. MATERIALS AND METHODS: Selected 2-view screening mammograms were digitized on 10 separate occasions and the computer-aided detection (CAD) prompts were printed for analysis. The mammograms included were: 10 randomly selected screen-detected cancers; 10 screen-detected cancers not prompted by CAD on an initial evaluation; 10 minimal sign interval cancers; and 10 false negative interval cancers. Data analysed included type of mammographic abnormality, pathology and whether the cancer was not prompted, prompted or given an emphasized prompt. RESULTS: The detection rate of the randomly selected screen-detected cancers varied from 30% to 100%. Reproducibility was less in the other categories of more subtle cancers. However, prompts on cancers containing calcification were more reproducible and these cancers were more likely to be prompted in both views and to have an emphasized prompt. CONCLUSION: When a mammogram is digitized, the computer generates a large number of potential prompts. The number of prompts actually displayed depends upon a threshold pre-set to keep sensitivity high and false prompts low. Variability of prompts may result from a shift in film position during sequential digitizations. Consequently, subtle lesions that are only just above the threshold for display may not be prompted on repeat scanning. Users of CAD need to be aware that prompts on subtle cancers and false prompts are more variable, but that prompts on cancers with a higher correlation with the computer algorithm should be more reproducible.

1530 Non-medical readers for screening mammography

T Mistry, S M Astley, C R M Boggis and V Hillier
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PURPOSE: There is currently a shortage of mammographic film readers, which has been compounded by recent changes to the screening programme. One approach to solving this problem would be to use film readers who have no medical training, either to interpret the films as "second readers" or to exclude clearly normal cases from the radiologist's workload. We have performed a study to investigate the

feasibility of this approach. METHOD: Six non-medical readers were recruited and trained over a short period of time to identify signs of abnormality in screening mammograms. They then read six different randomized sets of mammograms, each comprising 135 normal cases and 15 randomly selected screen-detected cancers, and indicated their findings on report forms. A seventh and final test set was the same as the first, but re-randomized. At the end of each day, the readers were given feedback. The performance of the readers was compared with the ground truth in each case. RESULTS: The performance of individual readers varied from more than 95% sensitivity at the best to less than 80% sensitivity at the worst. The most sensitive reader was able to correctly identify 60% of normal cases. For some observers, their confidence declined during the period of the study. CONCLUSIONS: Non-medical readers could potentially be used to separate unequivocally normal mammograms from those cases that are possibly abnormal. Further research is necessary to determine the appropriate level of training and to identify methods of assessing aptitude for the task.

1540 A comparison of non-medical readers and a commercial prompting system for identifying normal screening mammograms

T Mistry, S M Astley, C R M Boggis and V Hillier
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PURPOSE: We have investigated the feasibility of using either a commercial prompting system (R2 ImageChecker) or trained non-medical readers to sort mammograms into those that are normal and those that may contain an abnormality, with a view to reducing the workload of the radiologist. METHOD: 810 normal screening cases and 90 randomly selected screening cases in which a cancer was detected were processed by the R2 ImageChecker, a commercial prompting system. Six non-medical readers were also recruited and trained to identify signs of abnormality in screening mammograms. Following training, they read the same films randomized into test sets. The cases in which the system did not place any prompts and the cases that the non-medical readers believed to be normal were compared with the ground truth. RESULTS: The R2 ImageChecker failed to detect only 3 of the 90 cancer cases. However, fewer than 30% of cases were unprompted by the system. The non-medical readers' sensitivity varied widely; they missed between 4 and 21 of the cancers, but they were better able than the computer to label normal cases correctly. CONCLUSIONS. The ability of the computer-based system to detect cancers is impressive, but the correct detections are currently overshadowed by many false positives. Whilst three of our non-medical readers performed well in terms of both sensitivity and specificity, the others did not achieve acceptable standards of performance in the time available.

1430–1545 Hall 11B
Scientific Session
Vascular

1430 Complications of collagen based vascular closure devices: results of a randomized trial

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AIM: To assess the efficacy and complications of three commercially available arterial closure devices in a randomized prospective trial after retrograde femoral artery catheterization. MATERIALS AND METHODS: 851 patients (77% male; mean age 63 ± 9.5 years) were prospectively randomized to one of three haemostatic closure devices to be placed following either coronary angiography (705 diagnostic procedures) or coronary angioplasty (146 therapeutic procedures). The devices used were Angioseal (243 angiography, 47 angioplasty), Duett (234 angiography, 47 angioplasty) and Vasoseal (228 angiography, 52 angioplasty). The times to achieve device deployment and haemostasis were recorded as well as recording complications. RESULTS: The primary success of deployment was Angioseal (93.4%), Vasoseal (89%) and Duett (88.5%). Minor bleeding and haematoma were more common with Angioseal and Vasoseal than with Duett in the angiography patients ($p<0.005$), with no overall difference between the devices for the angioplasty patients. Continued oozing occurred in 31% of Vasoseal patients. No significant differences were observed between the devices for major complications. The overall complication rate was 6.2%, with major complications occurring in 9 patients undergoing PTCA and 15 angiography patients. There were three plug embolisations and one retroperitoneal haemorrhage. 14 patients required transfusion for bleeding. CONCLUSIONS: This trial demonstrates no overall significant differences between the closure devices in terms of efficacy and complication rate but shows that the primary success rate is on average 90% and that major complications can be expected in 2% of angiography patients in routine use, with a higher level of 9% in anticoagulated patients.

1440 Endovascular stenting: 5-year follow-up of the "Symphony" stent and the use of non-invasive surveillance

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INTRODUCTION: Atheromatous lesions are commonly seen in the iliofemoral vessels of patients with symptomatic peripheral vascular disease. We present prospective follow-up data on the "Symphony" stent (Boston Scientific) placed for iliac arterial disease between December 1996 and October 1998. METHOD: 34 stents were placed in a cohort of 24 patients (14 male, 10 female; average age 63.6 years). Patients were grouped according to their Rutherford and Brewster classification. Clinical follow-up and non-invasive surveillance was performed at 2 years and 5 years post stent insertion. RESULTS: Stents were placed successfully in all patients, with no significant technical complications. Outcome was assessed by means of clinical surveillance, ABPIs and Doppler ultrasound. Over the period of follow-up there were six mortalities, predominantly in patients with high Rutherford and Brewster classifications. Of the remaining group of 10 patients, there has been 80% primary stent patency through 5 years. Stent placement has a range of 1095–1812 days, with a mean value of 1198 days. There was improvement both in reported clinical symptoms and in the mean ABPI, which rose from a mean of 0.50 prior to treatment to 0.87 following stent insertion. Doppler ultrasound showed that all individuals had triphasic waveforms, with only minor dampening in their iliofemoral segments. CONCLUSION: The "Symphony" stent technically appears to be an excellent endovascular stent, displaying beneficial primary and secondary patency rates at 5 years. Non-invasive stent surveillance through clinical follow-up, ABPIs and Doppler ultrasound are valuable, patient friendly and appear to be clinically effective in monitoring outcome.

1450 Venography, full duplex or limited compression ultrasound? A 6-year audit of changing practice in DVT imaging

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INTRODUCTION: Prior to 1996, suspected DVT was routinely imaged in our centre with venography. In 1996–1997, duplex imaging was introduced as the first line investigation, and in 1998 a policy of rapid access limited compression ultrasound without calf vein evaluation was adopted. Risk probability assessment and D-dimer estimation were subsequently introduced into the protocol. METHOD: All cases of DVT imaging from 1994–2000 have been reviewed. RESULTS: The number of studies performed per year has increased from 282 in 1994 to >1300 in 2000. Positive diagnoses of DVT almost doubled from 60–70 in 1994–1996 to 119 in 1997, the first year in which duplex imaging was routinely used as the first line test. A significant number of DVTs may have been undiagnosed previously, possibly owing to underinvestigation. Since then the number of DVTs diagnosed yearly has remained constant at about 120 per year despite the marked increase in demand for scans. Audit of figures since the introduction of limited compression ultrasound has shown that it is safe and accurate. Less than 2% of patients with negative scans present with DVT/PE within 6 months (comparable with venography). Less than 2% of second scans to detect extension of thrombus are positive, and routine second scans are no longer performed. DISCUSSION: The rationale for limited compression ultrasound, indications for further imaging with venography or full duplex, and changes to our initial protocol based on audit figures will be presented.

1500 Ongoing impact since the introduction of a contrast enhanced MRA service

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PURPOSE: Contrast enhanced magnetic resonance angiography (CE-MRA) is a proven alternative to conventional angiography, with comparable accuracy, and it is readily performed on an outpatient basis. The radiology department at Glasgow Royal Infirmary introduced a CE-MRA service in May 1998. We have assessed the impact since its introduction on the use of the angiography suite, including waiting times and a cost analysis. METHODS: A 4-year period from June 1997, to include activity prior to MRA, was reviewed. Vascular procedures were categorized as diagnostic or interventional as well as by body region. CE-MRA examinations were grouped by body region. The costs for the diagnostic procedures were calculated and waiting times were reviewed. RESULTS: A total of 2595 diagnostic catheter angiograms, 1179 interventional vascular procedures and 1502 CE-MRA studies were performed. There has been a 42% reduction in the number of catheter angiograms performed in the last year compared with prior to MRA. This includes a 96% reduction in radial punctures and a 68% reduction in carotid and arch arteriograms. The number of interventional procedures remains similar, although complexity has increased. CE-MRA is 44% cheaper than catheter angiography, excluding bed costs; when these are accounted for MRA is 71% cheaper. This translates into a saving of £84 000 depite performing 326 extra diagnostic angiograms with CE-MRA. Waiting times for angiography have also reduced. CONCLUSION: We have shown the impact of a CE-MRA service with significant cost savings over conventional diagnostic angiography. A secondary phenomenon is the freeing up of the angiography suite for more complex therapeutic interventions.

1510 Detection of the sinus node artery using electron beam CT of the heart

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INTRODUCTION: Stenosis or obstruction of the sinus node artery (SNA) of the heart can cause cardiac arrhythmia and even sudden death. The purpose of this study was to evaluate the detectability of the SNA using electron beam CT (EBCT). MATERIALS AND METHODS: 80 patients (61±10, 31–80a) were examined with ECG-triggered EBCT (exposure time 100 ms; slice thickness 1.5 mm), using two different detector systems (n=40, 9.5 lp cm^{-1}; n=40, 7 lp cm^{-1}) after administration of intravenous contrast medium. 24 of the 80 patients had supraventricular arrhythmia. RESULT: The SNA was detected in 60 (75%) of the 80 patients, with an average length of 16±7 mm (3–35.2 mm). One additional branch of the SNA was detectable in 17 (21%) of the 80 patients, and two branches in 6 (8%) of the 80. There was no significant difference between the two detector systems used (p<0.01) or between patients with or without supraventricular arrhythmia (71% *vs* 77%; p=ns). CONCLUSION: EBCT allows the detection of small coronary arteries such as the SNA of the heart.

1520 Comparison of artefacts in electron beam CT and retrospectively-gated multislice spiral CT

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PURPOSE: Electron beam computed tomography (EBCT) is the established technique for non-invasive cardiovascular scanning. Faster multislice spiral computed tomography (MSCT) scanners allow prospectively triggered and retrospectively ECG-gated cardiovascular scans. We compared the image quality of retrospectively-gated MSCT with prospectively triggered EBCT using a cardiac assist device. METHOD AND MATERIALS: A Novacor (Baxter, Dearfield, USA) cardiac assist device was scanned with prospectively triggered EBCT (Imatron, South San Francisco, CA) at 10–100 % of the RR interval. Temporal resolution was 100 ms with this method. Scanning was performed at rest and at 60, 80, 100 and 120 beats per min. In MSCT (Somatom Plus 4 Volume Zoom; Siemens, Erlangen, Germany), the cardiac assist device was investigated with a single spiral of 1 mm collimation and pitch 1.5. Retrospective ECG-gating at 10–100% of the RR interval was performed. Temporal resolution was 250 ms using a 0.5 s rotation time and a partial scan reconstruction algorithm. Unlabelled scans were evaluated by three independent investigators at the same window-centre setting and rated for absolute, parallel, orthogonal and oblique artefacts on a scale from 0 to 4, with 0 as the optimal/minimal artefact. In addition, imaging quality of the scanned aluminium plates and the water in the pump chamber was rated from 0 to 4. RESULTS: At rest, retrospectively ECG-gated MSCT and EBCT had equal artefacts (EBCT 0.7; MSCT 0.0). At a heart rate (HR) of 60, minimal artefacts could be achieved with 60–80% RR interval reconstruction in EBCT (0.3–0.7) and 60% or 80% RR interval in MSCT (0.7). The optimal RR interval setting was 80% in EBCT at a HR of 80 (0.0) and 90% in MSCT (1.3); at a HR of 100, minimal artefact showed in EBCT at 70% (1.3) and in MSCT at 80% (2.0). At a HR of 120, EBCT showed minimal artefacts with 80–100% (1.7) and MSCT with 50% (2.0) of the RR interval. The artefact analysis showed that MSCT had more problems with orthogonal artefacts than EBCT, and the image quality of the water between the aluminium plates was reduced in MSCT compared with EBCT. CONCLUSIONS: The severity of motion artefacts in MSCT is higher than in EBCT, even with retrospectively-gated reconstructions at an optimal delay relative to the RR interval. This effect is most likely caused by the limited temporal resolution in MSCT.

1530 Diabetes, coronary heart disease and the Bengali community of East London

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PURPOSE: Mortality due to coronary heart disease (CHD) is broadly linked to poor socioeconomic conditions. However, the East end of London, which has the highest CHD mortality in southern England, is also home to a large Bengali community, many of whom have Type 2 diabetes, an independent risk variable for CHD. Using myocardial perfusion SPECT scintigraphy (MPS), the incidence of transmural myocardial infarction (TMI) and regional myocardial ischemia (RMI) was compared between diabetics/non-diabetics, and was also related to racial (Bengali) origin. METHODS: 177 consecutive patients referred for MPS with symptoms suggestive of RMI were analysed. 62 patients (35%) were of identifiable Bengali origin, 32 (52%) of whom were diabetic, compared with 21 (20%) of all other racial groups. A 2-day Tc-MIBI protocol was employed using a dual-headed gamma camera with attenuation compensation. RESULTS: The total incidence of TMI and RMI was 0.36 and 0.29, respectively. For diabetics, the rates were 0.43 and 0.36 compared with 0.32 and 0.26 for non-diabetics. 93 patients were entirely normal on MPS (41% of the diabetic group and 57% of the non-diabetic group). However, compared with the general population, Bengali diabetics exhibited a lower incidence of TMI (31% *vs* 67%) and RMI (25% *vs* 59%). CONCLUSIONS: Diabetes, although common in Bengalis, appears to be a less significant risk factor for CHD than in other groups.

1540 Discussion

1430–1600 Hall 10
Scientific Session
Magnetic Resonance

1430 Image guided surgery for anal fistula in a 0.5 T interventional MRI unit

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INTRODUCTION: The aim of this study was to determine whether MR guided anorectal surgery was possible and to develop the necessary imaging and surgical techniques to perform image guided anal fistula surgery. MATERIALS AND METHODS: A total of 31 patients, 6 with pilonidal sinus and 25 with suspected anal fistulae, were recruited into the study. Pilonidal sinus surgery was done as a preliminary procedure prior to performing the more technically demanding fistula procedures. All the procedures were performed in the Signa SPIO 0.5 T interventional MRI unit. Intraoperative imaging, primarily STIR sequences, was used to identify the anatomy and extent of all fistula tracts and septic foci and to ensure the adequacy of the procedure. RESULTS: In all patients undergoing pilonidal sinus surgery, intraoperative imaging demonstrated the inflammatory changes

associated with the lesions and the adequacy of the operation. Imaging failed to demonstrate a fistula in two patients, which was confirmed by examination under anaesthesia. In the 22 patients in whom a fistula tract or abscess cavity was demonstrated, a post-procedural MRI was done to assess the adequacy of the procedure. Three patients required further surgery as the intraoperative MRI images demonstrated an incomplete procedure, which was not obvious on inspection of the surgical field. CONCLUSION: MRI guided surgery for anal fistulae is a feasible option. It demonstrates the exact anatomy of the primary and secondary tracts and abscesses during the procedure, and confirms that all of the pathology has been adequately addressed surgically. In the future it may be particularly useful in recurrent and complex anal fistulae.

1440 MRI of pilonidal sinus disease: distinction from fistula-in-ano

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PURPOSE: To describe the MRI features of pilonidal sinus disease and to compare these with fistula-in-ano to determine the accuracy with which MR can differentiate between the two. MATERIALS AND METHODS: Seven patients with surgically proven pilonidal sinus disease underwent MRI. The site and morphology of sepsis was noted and findings were compared with those from 14 age- and sex-matched patients with surgically proven fistula-in-ano to determine any MRI features able to reliably differentiate between the two states. RESULTS: All patients with pilonidal sinus had natal cleft sepsis, but 5 (71%) had sepsis at deep-seated sites more characteristic of fistula-in-ano. 8 patients with fistula-in-ano had natal cleft sepsis (57%), which is thought more characteristic of pilonidal sinus. However, no patient with pilonidal sinus had any MR evidence of intersphincteric sepsis or enteric communication, in contrast to all patients with fistula-in-ano. Using MRI, a blinded observer correctly classified six of seven patients with pilonidal sinus and all patients with fistula-in-ano. CONCLUSION: MR features of perianal and deep-seated sepsis, characteristics of fistula-in-ano, are also found in patients with pilonidal sinus but the absence of intersphincteric sepsis or an enteric opening allows reliable MR distinction between the two.

1450 Developing a functional MRI protocol

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INTRODUCTION: MRI is being increasingly used to map brain function non-invasively. Blood oxygenation level dependent (BOLD) contrast can reveal specific areas of brain activation via the haemodynamic response to stimuli. The local reduction in deoxyhaemoglobin that occurs in response to stimulation can be detected as a signal increase using gradient echo imaging. Signal intensity changes are typically of the order of a few per cent at 1.5 T, requiring stable systems. This work describes the development of functional MRI (fMRI) at our centre, including stability measurements and a comparison of results obtained on two separate 1.5 T scanners. METHODS: A total of 28 volunteer studies have been performed to establish and optimize an fMRI protocol. A standard protocol was adopted using a single shot EPI sequence (TE/TR/flip angle 50 ms/3000 ms/90°). After initial dummy images to establish a steady state, images were acquired during a rest period and subsequently during three alternate periods of stimulation and rest, with each epoch lasting 30 s. A series of high resolution FSE images were also acquired to provide an anatomical reference. The functional images were processed off-line using dedicated software, which correlated the stimulus paradigm with signal changes to produce pixel-by-pixel activation maps. These were then overlaid onto the structural images. Motor activation has been studied using simple finger–thumb opposition paradigms and also combined left–right tasks. Visual stimuli were produced using a projection system, which displayed a three-dimensional maze pursuit. CONCLUSION: Results demonstrate the importance of adopting a quality assurance procedure and the reproducibility and reliability of fMRI on two separate MR systems.

1500 Interleaved pulsed MAMBA: a multibeam MR system?

M Paley, K Lee, J Wild, E Whitby and P Griffiths
University of Sheffield, Sheffield S10 2JF, UK

INTRODUCTION: The Multiple Acquisition Micro B0 Array (MAMBA) MR technique can provide 1D or 2D encoding using multiple B0 regions within the main magnetic field. A new 1D technique using interleaved pulsed coils allows full slice coverage along the coil axis. METHODS: If a series of steps is created in the B0 field larger than the frequency encoding gradient, each step may be treated as an independent frequency encoded region. Coil sets to generate six stepped fields (12 with interleaving) were simulated using the Biot-Savart law and Matlab and a prototype was built and interfaced to a Niche MR system. A line phantom was imaged along the B0 (z) axis of the coil with and without the auxiliary field to verify the field. RESULTS: The phantom showed discrete steps that were in good agreement with the predicted results. Slices were acquired from each region showing the unique frequency bands. DISCUSSION: Stepped fields can encode multiple discrete frequency regions within the main field, which allows parallel slice images to be acquired simultaneously with the potential for much increased acquisition speeds.

1510 Long-term reproducibility of functional MRI data

A Papadaki, R Quest and D McRobbie
Radiological Sciences Unit, Charing Cross Hospital, London W6 8RF, UK

INTRODUCTION: Because the signal changes detected by blood oxygenation level-dependent (BOLD) contrast are small (in the range 1–5% for 1.5 T system), any system variations can contaminate the resultant activation patterns. Temporal scanner stability across the image set is therefore very important. The stability of the MRI system at Charing Cross has been examined using phantom data. The aim of this study is to investigate the results of analysis of a series of human data. METHODS: Images of a right-handed healthy volunteer were acquired on a Siemens Magnetom Vision 1.5 T MRI system using an echo planar imaging pulse sequence (TE 54 ms, 128 x 128 matrix, 240 mm FOV, 5 mm thickness, 10 slices). A simple right-hand thumb tapping was performed. Analysis of images was performed using SPM99. RESULTS: ROIs were defined based on the anatomy. The mean signal and the signal-to-noise ratio of the ROIs were measured for all images in each time series. The signal variation measured within a time series was around 0.6%. The number of activation pixels was counted for different p-values, range between 0.0001 and 0.01. To assess the accuracy, positive results were plotted against negative results. BOLD signal changes were investigated for each time series. Signal intensity values changed according to the haemodynamic response and changes varied around 3%. CONCLUSION: System stability was demonstrated in this study. The number of activation pixels was found to be independent of the statistical threshold.

1520 Use of partially parallel MRI to detect and reduce motion artefacts

J V Hajnal, M Bydder and D J Larkman
Robert Steiner Magnetic Resonance Unit, Imaging Sciences Department, Imperial College, Hammersmith Hospital, London W12 0HS, UK

PURPOSE: To use MR partially parallel imaging (PPI) methods such as SENSE and SMASH to detect and eliminate motion artefacts. MATERIALS AND METHODS: In PPI methods, the combination of coil data with phase encode data provides extra k-space coverage. We used this concept on fully phase-encoded data from array coils to detect and eliminate artefacts. The fully encoded data were first split into two subsampled copies (lines 1, 3, 5 etc. in one copy and lines 2, 4, 6 etc in the other) and then each was regenerated to a full data set using SENSE processing in the image domain. If the subject moved during the scan, these two full data sets would be inconsistent and comparing them in k-space could reveal where the inconsistencies were. The inconsistent data were then discarded and consistent data were regenerated from the remaining data using PPI techniques. An iterative scheme was developed that does not require separately acquired coil sensitivity information for the PPI reconstructions. Test data were acquired on a Philips 0.5 T scanner using a purpose-built 4-channel head coil, a 2-channel neck coil and 4-channel body coil arrays. Both phantoms and normal human subjects were scanned to test the methods. RESULT: The method has been found to reduce artefact levels in phantom and in *in vivo* test studies. In many cases the artefacts were dramatically reduced. There was a small decrease in signal-to-noise ratio consistent with the discarded lines. CONCLUSIONS: PPI methods can be used to detect and reduce motion artefacts.

1530 WIP: fMRI outside the magnet

I D Wilkinson, P W R Woodruff, A T Barker, Y Zheng and N G Papadakis
Academic Radiology, Psychiatry and Medical Physics, University of Sheffield, Sheffield S10 2JF, UK

INTRODUCTION: It is accepted practice in blood oxygen level dependent fMRI to provide stimuli to the subject whilst they remain within the imaging volume of the magnet. However, there are certain situations where it may be advantageous to apply a stimulus with the subject outside the magnet bore. This paper provides motor, auditory and transcranial magnetic stimulation fMRI data that support the feasibility of this scenario. METHODS: Six studies of modified boxcar design were performed at 1.5 T (Eclipse, Philips Medical Systems). Functional images were acquired using a gradient recalled, single-shot EPI technique. RESULTS: All studies produced statistically significant signal changes. Auditory activation occurred within the area of the middle temporal gyrus or superior temporal gyrus. Cerebral motor activation occurred adjacent to/within the pre-central gyrus. CONCLUSIONS: This method shows promise as a tool for the functional imaging of tasks undertaken outside the imaging volume of the magnet.

1540 WIP: Elliptic centric MRA: timing is everything!

N S Paul, I Cygan and N Merchant
Division of Cardiovascular MRI, Department of Medical Imaging, University Health Network, Mount Sinai Hospital, University of Toronto, Toronto M5G 2C4, Canada

BACKGROUND: Elliptic centric k-space filling improves magnetic resonance angiography (MRA) studies by reducing cross-contamination from adjacent venous segments. This preferential filling of central k-space contrast rich data takes 3 s of a typical breath-hold sequence. OBJECTIVE: To evaluate the effects of respiratory manoeuvres on peak enhancement during MRA. METHOD: 30 patients (17 female; 19–81 years, mean 42 years) referred for cardiovascular MRA received two timing boluses of intravenous gadolinium, 2 cc power injected at 2 cc s^{-1} with a 15 cc saline flush. One bolus was delivered during free breathing (NBH), the second during a breath-hold (BH) in inspiration. The time–attenuation curves (TACs) for peak enhancement were assessed and compared by two blinded workers. RESULTS: The time delay between bolus injection was 1–9.5 min (mean 4 min). 8 patients had no difference in the timing of the peak attenuation (PA), in 16 patients the BH PA was 1–8 s later (mean 2.6 s), and in 8 patients the BH PA was 1–4 s earlier (mean 1.9 s) than for NBH. The overall effect with BH was a delay in the PA by 1.9 s. The TACs were markedly different for the two groups, with a single peak for the NBH group and several peaks for the BH group, indicating a prolonged cardiac transit time. COMMENTS: Faster data acquisition sequences facilitate higher quality MRA studies. Stringent timing of the contrast medium is vital as the time alteration owing to respiratory excursions approaches that required to fill the centre of k-space.

1550 WIP: Ultrasound gel: the new rectal contrast agent in MR

I Renfrew, V Munikrishnan and C Hare
Departments of Radiology and Surgery, Middlesex Hospital, Mortimer Street, London W1T 3AA, UK

PURPOSE: To evaluate the benefits of ultrasound gel as a positive rectal contrast agent. MATERIAL AND METHODS: As supported by the weight of recent literature, MRI is advocated to evaluate rectal tumour staging. In our institution we have undertaken a study comparing the clinical stage *vs* the MR stage *vs* the histological stage (where available) in 20 sequential patients with rectal cancer. To facilitate intraluminal tumour identification, we distended the rectum with between 100 ml and 120 ml of ultrasound gel. RESULTS AND CONCLUSION: The ultrasound gel has several advantages over other agents used for rectal distension. The advantages included: easy availability; cost; distension up to the rectosigmoid junction without the necessity for prone imaging; fixation of the rectum within the pelvis; good T2 contrast; good T1 fat saturated post gadolinium contrast; and accurate measurement of tumour distance above the dentate line, which determines the operative approach to the tumour. We have had good correlation between MR staging and histopathological staging of the tumour, both with regards to the resection margins and the distance from the dentate line (anorectal junction) and the distal tumour margin, on those patients undergoing abdominoperineal resection for low tumours.

1425–1535 Olympian Suite 2
Keynote Lecture
The Diagnosis and Management of Osteoporosis: what you need to know for good practice

1425 Invited review: Using bone densitometry in clinical practice

J E Adams
Department of Clinical Radiology, University of Manchester, Stopford Building, Oxford Road, Manchester M13 9PT, UK

No abstract provided.

1500 Invited review: Technical principles: IR(ME)R regulations

G Blake
Department of Nuclear Medicine, Guy's & St Thomas NHS Trust, St Thomas' Street, London SE1 7EH, UK

No abstract provided.

1430–1615 Hall 9
Advances
Aspects of Trauma Imaging

1430 Invited review: Orthopaedic CT: "the bare bones"

P Heath
Northern General Hospital NHS Trust, Department of Diagnostic Imaging, Herries Road, Sheffield S5 7AU, UK

PURPOSE: Introduction of multislice systems has led to significant improvements in volume imaging of the skeleton and joints. The ability to generate multiple, high quality multiplanar reconstructions from a single irradiation of the patient allows more detailed assessment of bony injuries. This lecture examines the role of multislice CT (MSCT) in orthopaedic applications, discussing scanning protocols used in a busy CT department of a teaching hospital. METHOD, MATERIALS AND RESULTS: Scanning products for the axial skeleton and joints will be stated and illustrated with multiplanar and axial images. The phenomena of "autokabalesis", namely intentional vertical deceleration injuries, will be discussed and two case studies will be presented illustrating the role of MSCT in the assessment of such injuries. CONCLUSION: MSCT is revolutionizing orthopaedic trauma imaging, allowing rapid detailed assessment in many planes.

1500 Invited review: The radiographer's role(s) in managing minor injuries

C Davies
A&E Department, Royal London Hospital, London E1 1BB, UK

No abstract provided.

1530 Invited review: Imaging acute head and neck trauma

G Jefferson
Department of Clinical Radiology, Cumberland Infirmary, Carlisle, UK

No abstract provided.

1600 Discussion

1430–1545 Hall 11A
Refresher Course
Clinical Governance

1430 Invited review: Setting standards for clinical governance

I McCall
Department of Radiology, RJAH Orthopaedic Hospital, Oswestry SY10 7AG, UK

No abstract provided.

1450 Invited review: Self-regulation

A B Ayers
Guy's and St Thomas' Hospital NHS Trust, Guy's Hospital, St Thomas' Street, London SE1 9RT, UK

High standards of individual professional performance are an essential part of any professional service. In medicine, undergraduate education has formed an important part and has been the responsibility of the General Medical Council. Maintenance of high standards following basic qualification has relied on professional self-regulation. The mechanisms for this happening are not clear to the general public and some of the motivation for the proposal in the National Plan to create a Medical Education Standards Board is to bring together those bodies currently involved in this area—General Medical Council, Postgraduate Medical Federation, Royal Colleges and the universities—in a more integrated way to the benefit of the National Health Service. It is clear that a variety of standards and methodologies currently exist and some standardization is desired. Aspects of the government proposals for the Medical Education Standards Board will be discussed. Links with CCST, CME, annual appraisal, revalidation and other forms of self-regulation will also be addressed.

1510 Invited review: Consulting the user

R Moshy
Peterborough District Hospital, Peterborough, UK

Quality control is very much the "buzz word" in clinical practice at the moment. Part of quality control involves consulting those who use your services. The definition of a user depends, of course, on who you are and the context in which the question is being posed. For example, a consultant will have patient and GP users; a GP will have a patient population. The need to consult the user will also depend on the object of the consultation. For example, one may wish to expand one's service; or wish to have some feedback on a current service provision; or a personal feedback on a specific question; or even as part of a broader research project. This talk aims to give an overview on the methods that can be used to achieve a consultation exercise of this nature, with illustrations given from personal experience—I have been consulting the user systematically for at least the last 5 years of my personal practice.

1530 Discussion

1430–1545 Kingston Lecture Theatre Keynote Lecture and Scientific Session

Future Staffing Issues in Diagnostic Radiology Departments

1430 Ethics of skill mix

P Goddard, R Law, J Tonks, N Slack and R Ashcroft
Bristol Royal Infirmary, Bristol BS2 8HW, UK

Skill mix represents a major change in health care, and ethical considerations need to be addressed. The reasons for advocating skill mix may be many and varied. These include cost saving, lack of trained staff, excess of a different group of staff, improving the career prospects of a particular group and overall improved results. Effects on patients, staff doing skill mix, effects on staff who previously did the work and staff who are doing the work left by skill mixers must all be considered. Problems of medicolegal responsibility must be addressed. By casting off old prejudices and embracing multidisciplinary integration of staffing structures it is hoped that overall there will be considerable improvement in health care. Such improvement would not only justify skill mix but would make its adoption imperative. Relying on skill mix to provide cost savings or to replace staff shortages is more questionable and must be balanced against knock-on staff shortages and effects on other staff.

1440 Training of radiography department assistants in radiography: initial experiences

A Baker, F Mackenzie, C Loughran, L Connolly and L Wilkinson
Macclesfield District General Hospital, Macclesfield, Cheshire, UK

INTRODUCTION: Many departments struggle to provide prompt radiographic services because of recruitment difficulty, exacerbated by an increasingly extended role for those who remain. The NHS Plan highlighted the potential role of assistants, with particular emphasis on mammography. We have sought to establish an in-house training programme for two departmental assistants to undertake a range of general radiographic studies. Some initial findings are proffered. METHOD: Two experienced departmental assistants underwent a period of training to include fundamentals of anatomy, physics, radiation protection and technique. One-to-one tuition on practical aspects of radiography was later undertaken (and remains on-going). Time given to education and training extended over two and a half days per week. An electronic logbook of examinations performed, the degree of supervision and the degree of patient difficulty was maintained. RESULTS: Over the first 3 months, 336 examinations were conducted, 101 (30.3%) of which were unassisted. 127 of these were chest radiographs (27% of total). The examinations covered the appendicular skeleton and chest. Analysis shows a reject rate of 3%. The axial skeleton and abdomen have not been examined so far. A survey of qualified radiographers from the same department indicated that 92.5% of radiographers thought assistants could undertake some radiographic procedures, 25% thought them a positive influence on their working day and 75% thought such practitioners have a role in a modern radiology department. CONCLUSION: Radiographic assistants can undertake a range of radiographic tasks and are well accepted by radiographer colleagues.

1450 Occupational stress and job satisfaction: the radiographer's experience

[1]M J Lovegrove and [2]D Rutter
[1]Faculty of Health, South Bank University, London SE1 0AA and [2]Department of Psychology, University of Kent, Canterbury, Kent CT2 7NZ, UK

METHODS: A large-scale study commissioned by the National Health Service Breast Screening Programme was undertaken to compare occupational stress (malaise), job satisfaction and propensity to leave for matched samples of radiographers, mammographers, therapeutic radiographers, general diagnostic radiographers and radiographers working in ultrasound ante-screening departments. A total of 2975 postal questionnaires were sent to 750 mammographers, 750 general diagnostic radiographers, 725 radiotherapy radiographers and 750 sonographers. RESULTS: 1662 questionnaires were returned, a response rate of 56%. Quantitative analysis revealed that 35% of radiographers working in the breast screening services reported clinical levels of stress. The mean levels of stress reported in the other groups were significantly higher, with diagnostic radiographers reporting the highest level. Mammographers also reported significantly higher job satisfaction than the other groups. Diagnostic and therapeutic radiographers reported the lowest job satisfaction. Analysis of the propensity to leave data identified that, as a group, therapeutic radiographers are the most likely to leave their job, with mammography radiographers the least likely to leave. Pearson correlation of the three measures (malaise, job satisfaction and propensity to leave the job) noted that malaise and propensity to leave are positively related and that both of these measures are regularly related to job satisfaction. The correlation coefficient reliability is very high, with $p<0.001$ in all cases.

1500 Invited review: The four-tier structure

[1]A M Paterson and [2]R C Price
[1]Canterbury Christ Church University College and [2]University of Hertfordshire, UK

"Meeting the Challenge: a strategy for the allied health professions", published by the Department of Health in 2000, identified the potential and opportunities for new roles of consultant, advanced and assistant practitioners. These three new roles, together with that of practitioner, have provided the basis of the model that has become known as the "Four-Tier Structure". Within radiography, there are already national pilot studies focused on the introduction of assistant practitioners in mammography and radiotherapy. It is also known that a number of local initiatives are seeking to introduce assistant practitioners into general radiographic practice, despite professional body policy to the contrary. However, little attention has been paid to the introduction of radiographer consultants, nor to defining or re-defining the roles of practitioners and advanced practitioners, although the terms advanced and consultant practitioners have featured in re-grading claims and activity. This paper examines the degree to which the whole of the four-tier structure is being implemented, drawing on evidence gained from a sample of clinical radiology departments in two regions in England. In particular, this analysis concentrates on how current

implementation of the structure is helping to resolve chronic recruitment and retention problems and bringing about significant change in the way in which diagnostic imaging services are provided.

1515 Invited review: Agenda for change
W Town
The Society of Radiographers, c/o College of Radiographers, 207 Providence Square, Mill Street, London SE1 2EN, UK
No abstract provided.

1530 Invited review: The impact of the Health Professsions Council
A Yule
Chairman Radiographer Board, Cardiff, UK
No abstract provided.

1550–1635 Olympian Suite 1
Keynote Lecture
New Roles and Skills Mix in the Breast Screening Service

1550 Invited review: Advanced practice in breast ultrasound
R Tetlow
Castle Hill Hospital, Castle Road, Cottingham, HU16 5JQ, UK
No abstract provided.

1610 Invited review: New ways of working in breast screening
C Hopkins
Bolton Breast Screening Unit, Royal Bolton Hospital, Minerva Road, Bolton BL4 0JR, UK
No abstract provided.

1630 Discussion

1615–1700 Hall 11B
Keynote Lecture
Diagnostic Conventional Angiography

1615 Invited review: Diagnostic conventional angiography: is there still a role?
J F Reidy
Guy's & St Thomas' Hospital NHS Trust, 2nd Floor Guy's Tower, Guy's Hospital, London SE1 9RT, UK
With the exception of coronary artery disease, the role of conventional diagnostic angiography has been diminishing for many years now. For many radiologists, the role has changed markedly from a non-specialized angiographer to one where arteriography has become technically more demanding and is invariably a prelude to interventions that are becoming more invasive. In many situations, non-invasive techniques can now very effectively make the diagnosis. The role of arteriography is to confirm the diagnosis and then plan and proceed with vascular intervention. Arteriography has for some time had only a very limited role in non-occlusive arterial disease. In some vascular malformations and in rare cases of severe bleeding it can define the abnormality or pinpoint a bleeding site, so enabling very effective treatment to be performed by embolisation. The last area for non-invasive methods to make significant advances in has been in occlusive arterial disease. The biggest problem here is in defining when a stenosis is significant, when it needs treatment and in determining the best endovascular therapy. In certain situations, even with multiple detailed arteriographic views, this assessment can be difficult and sometimes the gold standard needs to be measurement of intraarterial pressure. The increasingly accurate non-invasive assessment of occlusive arterial disease compliments conventional areteriography. Currently, X-ray guided intraarterial procedures then follow together with the vascular intervention. The next big step in the future will be performance of intraarterial interventions without conventional arteriography and ionizing radiation utilizing duplex ultrasound or MRA.

1615–1700 Hall 10
Keynote Lecture
New MRI Techniques in Neurology

1615 Invited review: Brain connectivity mapping using diffusion tensor imaging
G J M Parker
Imaging Science and Biomedical Engineering, University of Manchester, Manchester M13 9PT, UK
Diffusion weighted imaging and diffusion tensor imaging are MR methods that provide information regarding the microscopic structural organization and integrity of tissues. Of particular interest is the study of white matter pathways to help understand structural alterations due to axonal loss, or differences in white matter organization between patient groups. Diffusion imaging provides MR images sensitized to the passive thermal motion of tissue water molecules. This motion is restricted by barriers such as cell walls. In tissues exhibiting widespread structural alignment, such as white matter fibre bundles, the restriction is anisotropically arranged, allowing diffusion sensitization to reveal the bulk orientation of the fibres. This information has been exploited by a number of recently developed methods to extract information about the interconnections of the central nervous system (CNS), effectively using the tissue water as a tracer of connectivity. Thus, diffusion imaging, and these associated tracing methods, show promise as a non-invasive tool for examining human CNS connectivity. In this presentation, the available diffusion-based tracking and connectivity mapping methods will be reviewed briefly. Examples of their application in normal tissues and in conditions such as cancer, stroke and epilepsy will be presented. Current problems and developments in this rapidly evolving field will also be outlined.

1535–1555 Olympian Suite 2
Scientific Session
Osteoporosis

1535 Integrated computerized data management and report generator for a multi-DXA based bone densitometry service
P S Ganney, B Stow and S A Steel
Medical Physics Service, Hull & East Yorkshire Hospitals NHS Trust, Hull HU3 2JZ, UK
PURPOSE: A direct access bone densitometry service was established in Hull in 1993. The service is based on three different dual energy X-ray absorptiometers located in one centre on a hospital site. The centre is also actively involved in clinical drug trials and other research studies. Currently, around 7000 patients attend each year for bone mineral densitometry by dual energy X-ray absorptiometry. Direct regular transfer of all bone mineral density results from each machine was required into one database to enable easy access to results, automated report generation and to facilitate the production of monthly activity records. MATERIALS AND METHODS: The three densitometers were enabled for networking, and data extraction, collation, viewing and reporting programs were written. Owing to the differences between the densitometers, this required three distinct programming languages (requiring the development of a signalling method) and two database access protocols. RESULTS: The LAN has proved a fast and reliable data transport system. The report letters have been well received, even praised, by referrers. In addition, the previously unreliable back-up and archiving has been replaced with a robust solution. User (staff and referrer) confidence in the system is high. Owing to the collated nature of the data, some areas of research are facilitated. CONCLUSION: Collation of data has provided the centre with a rapid results look-up facility, together with a clear graphical report letter for referrers.

1545 Prediction of distal forearm fracture by finite element analysis of DXA images
C M Langton and D K Langton
Centre for Metabolic Bone Disease, University of Hull and Hull & East Yorkshire Hospitals NHS Trust, Hull HU3 2RW, UK
INTRODUCTION: Bone mineral density (BMD) assessment by dual energy X-ray absorptiometry (DXA) is the current preferred method of assessing osteoporotic fracture risk. Other physical factors, however, contribute to the overall risk of fracture, including anatomical geometry and the spatial distribution of bone. Finite element analysis

(FEA) is a widely used technique for computer modelling of structures that is inherently sensitive to geometry and material distribution. METHODS: FEA has been applied to conventional DXA-derived spatial BMD images of the forearm (Lunar Expert fan beam densitometer) to calculate the mechanical stiffness of the radius. 10 female subjects who had previously suffered a distal radius fracture were compared with a control group of 10 non-fracture female subjects matched for handedness. BMD at the ultradistal radius (UDBMD) and lumbar spine (LSBMD) were not significantly different (Independent Sample Test) for the two cohorts, with p-values of 0.14 and 0.91, respectively, with FEA stiffness providing superior discrimination (p=0.057). Receiver operator characteristic (ROC) analysis was undertaken with area under curve (AUC) values (95% confidence interval) of 0.69 (0.437–0.943), 0.525 (0.236–0.814) and 0.770 (0.555–0.985) obtained for UDBMD, LSBMD and FEA stiffness, respectively. In this cross-sectional pilot study, finite element analysis of forearm DXA images (FEXI) appears to provide a superior means of identifying distal radius fracture risk than conventional BMD of the ultradistal radius and lumbar spine. The technique has the potential to be applied to other fracture scenarios, for example the proximal femur.

1615–1800 Olympian Suite 2
Keynote Lecture and Scientific Session
Osteoporosis

1615 Invited review: Establishing a bone densitometry service

P Ryan
Department of Nuclear Medicine, Medway Hospital, Windmill Road, Gillingham ME7 5NY, UK

No abstract provided.

1650 Should all low impact Colles' fracture patients be screened for osteoporosis?

[1]S E Green, [3]S J C Davies, [1]D A Collins, [2]J Tucker and [2]A Troughton
Departments of [1]Rheumatology and [2]Radiology, Princess Margaret Hospital, Swindon SN1 4JU and [3]Pyschopharmacology Unit, University of Bristol, UK

PURPOSE: To examine the advice given to, as well as the investigation of, patients with low impact Colles' fractures; to obtain bone density readings on this cohort; and to quantify ramifications for treatment. MATERIALS AND METHODS: All patients aged 40 years or above who attended with a distal radius (Colles') fracture within a 3-month period were identified. The manner of injury and subsequent management were assessed from patient questionnaires. Low impact fractures were defined as a fall from standing height or less, at walking speed or slower. Those who had not had bone density measured either 12 months prior to the fracture or subsequently were offered bone densitometry and were scanned using a Hologic QDR4500c dual energy scanner (DEXA). RESULTS: 91 (87%) of 105 patients identified returned the questionnaire, and 72 of these were judged to have sustained low energy fractures (60 female, 12 male). Only 8/72 (11%) had received advice regarding the possibility of osteoporosis at the time of fracture. 5 (7%) had been investigated within 10 months of fracture (4 DEXA, 1 bone ultrasound). A further 4 (6%) were already known to have osteoporosis. 59 patients were offered a DEXA scan. 44 attended, were counselled regarding osteoporosis risk factors and were given life-style advice during their scan. 34 (77%) patients, including 5 males, were found to have either osteoporosis (T-score greater than –2.5) or osteopaenia (T-score between –1.0 and –2.5). All 34 patients required a change in therapy. CONCLUSIONS: In our current practice, we fail to identify many patients with an increased risk of hip and vertebral fracture and who therefore require treatment. In planning densitometry services, the benefit of screening all low impact Colles' fracture patients should be considered.

1700 WIP: QUS in the investigation of osteoporosis: comparison of Sahara and DXA T-scores in an at-risk group

D P Montgomery, I M Stewart, H Veevers and C Sutton
Blackpool Osteoporosis Group and Medical Statistics Group at University of Central Lancashire, UK

QUS has been shown to have a place in assessing the risk of osteoporotic fractures, particularly in post-menopausal women. We have offered patients attending a fracture clinic who have suffered low trauma fractures a heel ultrasound examination using the Sahara system and followed this up with a DXA scan of spine and hip. The object of the study is to demonstrate whether QUS can identify the group who have suffered fractures but are not at-risk of developing osteoporosis and, at the other end of the spectrum, the group who are likely to have suffered a fracture due to osteoporosis and who should commence treatment. 168 patients aged between 40 years and 80 years had both examinations. 7.7% were under 50 years, 53.6% were aged between 50 years and 70 years and 38.7% were aged between 70 years and 80 years. Average age was 65 years. There were 5 (3%) male patients. The relationships between Sahara T-scores and each of the spine and hip DXA T-scores are only weakly positively linear. There is a lower spread of Sahara T-scores. There is some indication that the relationship between Sahara T-scores and each of the spine and hip DXA T-scores is stronger in the older age groups, with the bivariate correlation coefficients increasing from less than 0 under 50 years, to 0.2 between 50 years and 70 years, and approaching 0.5 between 70 years and 80 years. Using a Sahara T-score cut-off at –1 for DXA referral, 94.6% of patients would have a DXA scan; using a cut-off at –1.5, 84% of patients would have a DXA. With the Sahara T-score cut-off at –1, 4 (57.1%) of 7 patients were shown to have osteoporosis; with this cut-off at –1.5, 11 (50%) of 22 patients were shown to have osteoporosis. Using a Sahara cut-off at –2.5 or lower, 29.1% of patients would be considered for treatment; however, in this group of 35 patients, only 27 were confirmed to have osteoporosis on DXA. There were therefore eight false positive patients, which would result in over treatment. This study is on-going and further analysis of increased patient numbers will be reported in due course.

1710 Invited review: Bone health and cancer patients

R E Coleman and J E Brown
Cancer Research Centre, Weston Park Hospital, Sheffield S10 2SJ, UK

Survival after a diagnosis of malignancy has improved considerably over the past few decades. This is particularly true for patients with breast cancer, certain haematological malignancies, lymphoma and testicular cancers, many of whom have received aggressive combination chemotherapy. Naturally, attention has previously been focused on treatment of the malignancy, with little interest in the long-term effects of cancer treatments on the skeleton. The mechanisms by which chemotherapy leads to osteoporosis are not completely understood. Osteoporosis may occur secondary to hypogonadism. In men, chemotherapy is associated with decreased testosterone levels and raised levels of gonadotrophins. However, in a significant number of patients, sex hormone status is normal and osteoporosis appears to occur through direct effects of chemotherapy on the skeleton. Agents such as methotrexate and ifosfamide have been implicated in direct bone effects but, since most chemotherapy is given as a combination of several agents, it is difficult to delineate individual bone effects. For women, it is well known that chemotherapy can cause premature ovarian failure. This chemotherapy-induced early menopause can lead to significant bone loss of up to 8% a year. In quantitative terms this is the major factor affecting bone loss but, in addition, direct effects of cytotoxic agents on bone may occur. Hormonal therapies used in breast cancer, such as tamoxifen for pre-menopausal and aromatase inhibitors for post-menopausal women, may lead to accelerated bone loss. Monitoring of skeletal health is now recognized as important, and research is ongoing to identify simple treatment strategies to maintain bone mass.

1745 Discussion with Panel

1615–1700 Hall 11A
Keynote Lecture
Overview of Paediatric Neuroradiology

1615 Invited review: Overview of paediatric neuroradiology

W K Chong
Department of Radiology, Great Ormond Street Hospital, London WC1N 3JH, UK

The aim of this lecture is to illustrate the wide spectrum of conditions encountered in this evolving subspecialty. The increasing application of MR techniques has revolutionized understanding in the paediatric neurosciences and has had a major impact in the investigation and

management of paediatric neurological disorders. This lecture will concentrate on the clinical role of MR in the neuroimaging of a variety of disorders in this setting and, through illustration by example, will provide some clarification and guidance on the appropriate application of this technique.

1615–1715 Kingston Lecture Theatre Scientific Session

Clinical Governance and Audit

1615 CIRIS: the multidisciplinary approach to clinical governance

N Graham, S Kelly, S Bater and P Cavanagh
Taunton and Somerset NHS Trust, Musgrove Park, Taunton TA1 5DA, UK

The RCR and COR were quick to recognize the implications of clinical governance and responded positively by jointly devising a system to deliver the clinical governance remit in full whilst properly retaining professional control of clinical standards and best practice. CIRIS (Continuing Improvement in Radiology Imaging Services) is the result, ensuring continuous improvement of the over-arching systems that organize and deliver imaging services. This presentation explains the basic concepts of CIRIS as a tool for improving standards, for benchmarking against set standards and other departments, and for sharing best practice. To do this CIRIS uses the skills of the entire professional team to evaluate the way they deliver clinical services by an organized and internally performance managed approach. As one would expect from a clinical governance tool, it is patient-focused but also looks at the department's efficient uses of resources—human, capital and financial. A CIRIS-governed radiology department works to standards derived from the best practice of its peers. It shares its own successful strategies across the entire radiological community and gains from the CIRIS-circulated ideas of others. CIRIS services participate by the Governing Board in a continuous process of standard setting and development. In this way it is possible to keep disparate services operating in a similar way, matching their peers in terms of clinical and operational excellence. A benchmarking service, in-built in CIRIS software, provides the means to test this.

1625 CiRis—the first 9 months experience in a DGH: does it deliver on its promises?

S Messer, N Ridley, C Grist and A Troughton
Radiology Department, Princess Margaret Hospital, Swindon SN1 4JU, UK

CiRis is a computer-based programme developed jointly by the Royal College of Radiologists and the College of Radiographers to demonstrate and manage clinical governance within radiology. The programme was launched at UKRC 2001 and is supported by the Department of Health. In addition to providing a framework for scheduling improvement, CiRis contains other elements of quality management. These include benchmarking, good practice guidelines, sources of reference and knowledge sharing based on contributions supplied by other CiRis members to a central database. The Radiology Directorate of the Swindon & Marlborough NHS Trust has a well established clinical governance agenda and was the first department in the country to acquire CiRis when it was available in July 2001. We describe our experiences with CiRis, in particular the practicalities associated with its implementation and its impact on our existing clinical governance programme. Early results are mixed. For us, the change from a largely paper-driven culture to a computer-based one has taken time to establish, despite employing a radiographer specifically to lead the implementation. Additionally, although the CiRis philosophy aims to encourage wide ownership of quality management, the numbers of staff involved appear more limited than our own established regime. The benefits include more efficient scheduling of the clinical governance process, with improved evidence-based record keeping. The effectiveness of CiRis in benchmarking and knowledge sharing has as yet to be shown as it is largely dependent upon individual contributions and requires a large membership base. It will become ever more useful as take up increases.

1635 Clinical governance in radiography: how well are we doing?

D Adrian-Harris
Centre for Radiography Education, University of Portsmouth, Portsmouth PO1 2HY, UK

This paper explores the principles of clinical governance as they apply to diagnostic radiography. The majority of the presentation is an exploration and evaluation of the possible tensions between professional autonomy and clinical governance, with reference to examples drawn from medicine, nursing and radiography. A possible conclusion—but by no means the only one—might be that whilst we perform well at the mechanistic tasks, radiography is at the moment too immature as a profession to make a full contribution to the process of clinical governance.

1645 Comparing the performance of radiology departments

P Durham
Audit Commission, London, UK

In the past year, the audit commission has been carrying out local reviews of the performance of radiology departments in England and Wales. These reviews have used performance indicators to assess speed of service, quality and governance, and efficiency. This paper presents the main findings that have emerged from these local reviews and the issues that need to be considered nationally.

1655 An audit of colorectal radiology services in the North West

R Bramley and B M Carrington
Department of Radiology, Christie Hospital NHS Trust, Manchester M20 4BX, UK

PURPOSE: This audit was conducted to compare current oncoradiology services in the North West with the guidance on commissioning cancer services, "Improving Outcomes in Colorectal Cancer", issued by the Clinical Outcomes Group of the NHS executive. METHODS: Questionnaires were sent to 20 clinical directors of radiology within the region, to be forwarded to the lead GI radiologist in their department. The sequence of questions followed the main topic areas in the manual, with short extracts included to explain the relevance of each question. RESULTS: The audit showed considerable regional variation in oncoradiological practice, including access to radiology services, attendance at multidisciplinary team meetings, primary diagnosis and pre-operative evaluation, staging and follow-up procedures, and waiting times for investigations. Further evaluation revealed inequalities in referral practice according to the 2-week rule and mechanisms for ensuring combined colonic assessment with sigmoidoscopy and barium enema. DISCUSSION: The results have been presented at regional radiological and colorectal meetings. Recommendations to address some of the problems have included restricting access to barium enema investigation to colorectal clinicians, and closer integration of the radiology department with the colorectal multidisciplinary team.

1705 NHS Estates' further contribution to evidenced-based design of diagnostic imaging and interventional facilities

[1]J Britton, [1]N Tomlinson, [1]G Stone and [2]S Wolstenholme
[1]Engineering and Science, NHS Estates, Tunbridge Wells TN2 5NP and [2]Stanhope Wilkinson Architects, UK

PURPOSE: NHS Estates, led by its Engineering and Science Group, has now completed the first part of national guidance in support of the modernization programme for imaging services, entitled "The Design of Diagnostic Imaging & Interventional Radiology Facilities". The guidance has been generated using expertise from the NHS, learned bodies and private sector industry. The scientific challenges associated with the move from conventional imaging to digital solutions are addressed following an extensive review of the published literature. MATERIALS AND METHODS: The guidance is constructed on an evidence base. Care has been taken to research policy and development trends. This advice is supplemented by a number of example plans and engineering information, which focus on electrical supply and environmental requirements. The needs of the patient are recognized and emphasized, whilst attention is also devoted to installation of the imaging equipment and the provision of effective facilities for staff. Further advice to follow in a new part 2 will include dental radiology, interventional MRI and the special influence of PACS. This second part will be published in April of next year. The eventual target is to merge the advice into a single coherent volume. RESULTS AND CONCLUSIONS: The first part advice has now been published and is available through the World Wide Web at www.nhsestates.gov.uk or on the new CD-ROM, which is available free to the NHS. Diagnostic

imaging is a fast developing area with important design implications for modern healthcare buildings. This being the case, the guidance will be updated on a regular basis, with major changes being made in 2002/3.

1645–1745 Hall 9
Keynote Lecture and Scientific Session
Imaging of the Upper Limb: a comprehensive review

1645 Invited review: Imaging the upper limb—the elbow: a clinical and radiological review

A M K Thomas
Department of Clinical Radiology, Bromley Hospital, Bromley BR2 9AJ, UK

Injuries of the elbow are common and are seen in all ages, although they are more common in childhood. Radiographic examination remains invaluable following significant elbow trauma. The spectrum of injury includes dislocations, fractures, soft tissue injuries and cartilaginous injuries. This review will look at the anatomical basis of elbow trauma, and common anatomical variants will be discussed. The classification and radiographic appearances of injuries will be described with the common mechanisms of injury. The pathology of the elbow with radiographic features of arthritis will be discussed and illustrated.

1715 Invited review: Imaging the upper limb: a comprehensive review

W Ogufere
University Hospital Lewisham, High Street, London SE13 6LH, UK

No abstract provided.

1700–1830 Hall 11B
Refresher Course
Non-invasive Vascular Assessment

1700 Invited review: CT angiography: applications for the aorta and its branches

G D Rubin
Stanford University Medical Center, Stanford, CA, USA

Conventional angiography has been the mainstay of aortic imaging; however, the fluoroscopically acquired images are limited by poor tissue discrimination, which typically prevents visualization of aneurysm walls in the presence of mural thrombus and some regions of calcified plaque. Further, the constraints of C-arm geometry limit view angles. Because blood vessels are 3D structures, and stenoses, aneurysms and plaques are not symmetric, our view of these lesions is limited with angiography. CT angiography has become an important alternative to conventional angiography for the assessment of many vascular abnormalities. In fact, at our institution it has become the primary modality for vascular assessment, relegating conventional angiography to a problem-solving and interventional technique. Important routine clinical applications of CT angiography include aortic aneurysm, aortic dissection, renal vascular hypertension, peripheral arterial occlusive disease, pre-operative assessment of living renal and hepatic donors, planning of free flap transfer procedures, traumatic arterial injury, atheroembolism and pulmonary embolism. This lecture will provide a broad demonstration of the applicability of CT angiography for many of these applications, with emphasis on the added benefits of CT angiography relative to conventional angiography.

1725 Invited review: Thoracic stent-grafts

P A Gaines
Sheffield Vascular Institute, Northern General Hospital, Sheffield S5 7AU, UK

Covered stents (stents-grafts) have become relatively commonplace in the management of abdominal aortic aneurysms. More recently, with the availability of large devices, these devices have been used in the thoracic aorta. ANEURYSMS: The lecture will focus on patient selection, appropriate imaging modalities, stent-graft technique and outcomes for those patients with thoracic aortic aneurysms. AORTIC DISSECTION: Current wisdom indicates that the majority of type B (distal to the left subclavian) dissections are suitably managed by medical therapy. However, there remains a subgroup of patients with complication type B dissections (*e.g.* rupture, branch vessel ischaemia, persistent pain) who require active intervention. The lecture will focus on appropriate imaging, interpretation of the mechanism surrounding branch vessel ischaemia, the technique of stent-graft placement and patient outcomes. TRAUMA: Conventional surgery for traumatic disruption or dissection of the thoracic aorta has an associated high morbidity and mortality. The outcomes of endovascular treatment will be discussed.

1750 Invited review: Cardiac and great vessel MRI

P J Guest
Department of Radiology, Queen Elizabeth Hospital, Birmingham B13 9TP, UK

PURPOSE: To demonstrate the use of MRI in the evaluation of congenital and acquired disorders of the heart, thoracic aorta and pulmonary arteries. MATERIAL: Illustrative cases from an adult population will be used to show the assessment of pathologies of the aorta, including coarctation, dissection and aneurysm, as well as congenital anomalies. The role of MRI in follow-up of operated and non-operated cases will be discussed. Similarly, anomalies of the pulmonary circulation will be shown, including examples of pulmonary emboli, tumours and anatomical/congenital variants. Cardiac pathologies demonstrated will include effects of ischaemic heart disease, valvular dysfunction, tumours and congenital anomalies. Pericardial disorders will be demonstrated. The use of MRI in evaluating function, flow and haemodynamic disturbances of the cardiac chambers, valves and great vessels will be shown. RESULTS: MRI is the modality of choice in the evaluation of a number of disorders. It is complementary to echocardiography and invasive angiography and can be used to solve specific problems where these techniques are limited. Availability is currently a limiting factor. CONCLUSION: Cardiac MRI provides a valuable way of demonstrating cardiac and vascular anatomy and function.

1815 Discussion

1700–1830 Olympian Suite 1
Scientific Session
Breast Imaging Advances

1700 Human and computer detection of early breast cancer in prior mammograms

S Wallace, S M Astley and C R M Boggis
University of Manchester and The Nightingale Breast Screening Centre, Manchester M13 9PT, UK

PURPOSE: Computer-based prompting systems detect potential abnormalities in mammograms and indicate their locations to the radiologist. The aim of this study was to determine the ability of a commercial prompting system to detect very early signs of cancer in the screening mammograms prior to those in which the cancers were first identified in the screening programme. METHOD: A random sample of 90 incident-round screening cases in which cancer was detected and a similar control group of non-cancer cases were identified. The previous screening mammograms ("prior films") were processed through Secondlook, a commercial prompting system. The locations of prompts in the prior films were examined to determine whether they corresponded to the locations of the cancers that were subsequently identified. In addition, all the prior films were randomized and reviewed by an experienced breast radiologist, and the prior films of cancer cases were then reviewed again with the aid of the diagnostic films. RESULTS: In the cancer group, the radiologist detected very early signs of cancer in 10% of cases, rising to 14.4% with the benefit of the diagnostic films. The computer recorded a sensitivity of 27.8%, with an average of 1.32 false prompts per film in two-film cases and 1.56 per film in four-film cases. In the control group, there was an average of 1.25 false prompts per film, and 8.5% of cases had no prompts. CONCLUSION: The study demonstrates the potential of prompting, but the specificity of prompting systems must be increased for the technology to succeed.

1710 Effects of suboptimal viewing conditions on the detection of low contrast objects

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Regional Medical Physics Department, Newcastle General Hospital, UK

INTRODUCTION: Until recently, the establishment and maintenance

of satisfactory viewing conditions have been given a relatively low priority compared with the effort expended in optimizing the processes used to produce the radiographic image. However, poor viewing conditions can have a significant deleterious effect on the performance of an observer. Current trends in mammography, such as the use of high optical density films in the NHS Breast Screening Programme and the increase in the use of soft copy reporting from small field digital units, makes a study of this area overdue. METHOD: In this work, factors affecting the ability of an observer to discern low contrast objects are reviewed and the effects of poor viewing conditions are discussed. A model is presented that allows the effect of suboptimal viewing conditions on the detection of low contrast objects to be determined from a knowledge of basic photometric quantities and the observer's performance under ideal conditions. A protocol based on the model is proposed for the evaluation of viewing conditions.

1720 Does MRI have a role in the investigation of indeterminate microcalcification in the breast?

[2]P J Kneeshaw, [2]M Lowry, [1]P J Drew and [2]L W Turnbull
[1]Academic Surgical Unit, Castle Hill Hospital, Hull, UK and [2]The Centre for MR Investigations, Hull Royal Infirmary, Anlaby Road, Hull HU3 2JZ, UK

INTRODUCTION: Dynamic contrast enhanced MRI (DCE-MRI) is an effective diagnostic modality for symptomatic breast disease. However, its role in evaluating clinically occult disease associated with mammographically indeterminate microcalcification remains unclear. The aim of the study was to evaluate the efficacy of DCE-MRI in the investigation of indeterminate microcalcification in the breast. METHODS: Women with areas of indeterminate microcalcification demonstrated on X-ray mammography underwent DCE-MRI examination of the breast. The data were evaluated morphologically and by post-processing evaluating signal intensity parameters and two-compartment pharmacokinetic modelling to calculate the amplitude of contrast uptake and exchange rate in the whole region of interest and within the most enhancing 9-pixel square. RESULTS: 42 women were recruited. Histological diagnosis (n=37) revealed: invasive disease (n=2), DCIS (n=10), invasive + DCIS (n=12) and benign disease (n=13). The remaining patients (n=5) had benign FNAC followed by clinical and mammographic follow-up of at least 15 months (range15–43 months). Comparing malignant and benign lesions, the mean values in arbitrary units for the maximum intensity time ratio, exchange rate and amplitude of contrast uptake were 42.70 (range 1.66–312.65) *vs* 9.79 (range 1.55–19.66) (p=0.002), 5.47 (range 0.25–49.26) *vs* 1.18 (range 0.27–2.31) (p=0.003) and 8.61 (range 0.20–58.24) *vs* 1.19 (range 0.00–4.70) (p=0.007). CONCLUSIONS: DCE-MRI is able to distinguish benign from malignant clinically occult lesions associated with indeterminate microcalcification and is therefore a potentially useful investigation in this group of patients.

1730 Hormone replacement therapy-induced changes of parenchymal volume and Gd-DTPA pharmacokinetics in the breast

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Centre for MR Investigations & Centre for Metabolic Bone Disease, Hull Royal Infirmary, Hull HU3 2JZ, UK

INTRODUCTION: Mammographic studies have demonstrated variable increased tissue density in response to hormone replacement therapy (HRT). Comparative MR studies have been carried out, although the influence of drug formulation has not been reported. This study examines changes in parenchymal volume and Gd-DTPA pharmacokinetics following administration of four different HRT preparations. METHODS: 34 asymptomatic women randomized to receive either Premique (PR), Premique Cycle (PC), Livial (LV) or Evista (EV) had MRI performed at 0, 1, 3 and 6 months. Each investigation included a coronal 3D-FSPGR (TR/TE/flip = 12.9 ms/4.2 ms/30°) with 28 images of 512 x 196 pixels over 32 x 16 cm and a coronal multiphase FSPGR (TR/TE/flip = 8.8 ms/4.2 ms/30°) with 35 images at nine locations. After a neural network supervised B1-correction, parenchymal volume and Gd pharmacokinetics, respectively, were calculated. RESULTS: Significant time-dependent increases in parenchymal volume were observed for PR (16 ± 21% at 6 months, mean ± SD; p<0.05) and for PC (24 ± 6%, p<0.01) but not for LV (-1 ± 7%) or EV (0 ± 13%). Pharmacokinetic analysis at 3 months revealed increased maximum enhancement and permeability with PC and PR only. None of the formulations produced significant changes in exchange rate, thus leading to significantly increased Gd distribution volumes for PR and PC only. CONCLUSIONS: Only PR and PC promote increases in both total and interstitial breast parenchymal volume in a time-dependent manner with no apparent change in vessel characteristics, indicating a different mode of action compared with LV or EV. This increased parenchymal volume and contrast enhancement may mask lesions when only empirical measures are employed, suggesting that pharmacokinetic analysis to estimate exchange rate may be necessary to exclude pathology.

1740 Concordance of $^{99}Tc^{m}$ sestamibi and contrast enhanced MRI in the local assessment of breast cancer

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AIM: To review the concordance between $^{99}Tc^{m}$ sestamibi and dynamic contrast enhanced MRI in suspected breast cancer, to compare these results with pathological findings and to assess their accuracy in predicting multifocal *vs* unifocal disease. INTRODUCTION: There is now a greater need to ascertain local tumour burden and the possibility of multifocal or bilateral disease for breast conserving surgery. MRI and MIBI are useful modalities in the detection of suspected lesions, with high sensitivities and specificities. Tumour load may be greater than suspected and discovery of multifocal disease may lead to alterations in patient management. PATIENTS AND METHODS: We reviewed all patients who had undergone both MRI and MIBI since the introduction of a dedicated MRI breast coil. Comparison was made with pathological reports and patients were divided into multifocal and unifocal groups. RESULTS: 19 patients had both tests as well as available pathology results. There was a positive concordance between the imaging modalities in 16 cases (84%), negative concordance in 1 (5%) and discordance in 2 (11%). In all positively concordant results, pathology demonstrated carcinoma. In the discordant patients, both proved pathologically positive, agreeing with MRI in one case and MIBI in the other. In determining whether cancer was unifocal or multifocal in 13 of these patients, MRI was correct in 77% and MIBI in 69% (both were incorrect in 7%). CONCLUSION: Our results regarding the accuracy of MIBI and MRI in the detection of breast cancer compare favourably with those of other authors, and in addition are encouraging in the specific assessment of multifocal disease when this may otherwise be unsuspected.

1750 Dynamic contrast enhanced ultrasound examination of malignant breast tumours: comparison with dynamic breast MRI and histological features

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PURPOSE: The study characterizes the appearances of malignant breast tumours using dynamic contrast enhanced ultrasound (DCE-US) and compares them with breast MRI and histological features. A prospective study was performed using DCE-US and MRI on women with proven breast cancer. METHODS: Dynamic gadolinium enhanced MRI examination was performed, followed by dynamic levovist enhanced ultrasound examination. Time intensity curves were obtained on both US and MRI examinations and classified according to their shapes and correlated with histology. 37 women were recruited. Complete results are available for 33 women. RESULTS: There were 3 cases of *in situ* carcinoma and 30 infiltrating carcinomas (2 lobular, 2 mucinous and the rest ductal). Of the infiltrating carcinomas, there were six grade 1 tumours, 15 grade 2 and 10 grade 3 tumours. There was no US enhancement in two cases. Both grade 2 and grade 3 tumours show a mixed proportion of uniphasic and biphasic US time–intensity curves with a mean peak enhancement at 35.3 s (SD=15.6). All high grade tumours demonstrated a rapid wash-out of signal intensity, with a significant earlier peak at 23.7 s (SD=6; p=0.03). Enhancement was obtained on MRI in all lesions. No correlation was found between the MRI and US time–intensity curves. There was no correlation between MRI curves and histological grade. CONCLUSION: The shape of the time–intensity curve obtained using DCE-US appears to correlate with the grade of infiltrating breast carcinoma. A rapid wash-out of contrast with early peak enhancement is a strong predictor for high grade malignancy.

1800 An automated quantitative volumetric breast ultrasound data acquisition system

[1]J A Shipley, [1]F A Duck, [2]D A Goddard, [3]M R Hillman and [4]M Halliwell
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The aim of this project is to develop an automated ultrasound imaging technique to acquire quantitative volumetric breast data, the clinical objective being improved cancer diagnosis. Ultrasound scanning is highly operator dependent, requiring skilful probe manipulation and the mental ability to envisage 3D tissue structure. A novel mechanical scanner has been designed and constructed to facilitate automatic acquisition of an image data set using a conventional B-mode scanner. Mechanical issues included constraining the breast position without compromising the ultrasound image. Two major problems associated with reconstructing a volume are being addressed. First, attenuation of the ultrasound beam depends on tissue type and boundary morphology. Simple depth-dependent amplification does not account for this. Consequently, the tissue brightness in the image depends on the overlying structures. An algorithm to automatically correct for tissue-dependent attenuation is applied to the images, making the grey-scale values more quantitative. Second, differences in acoustic velocities in tissues result in refraction of the beam, so probe orientation provides only approximate beam position information. To correct for refraction errors, registration techniques are being investigated. The 3D data set provides extra volumetric information for the clinician. Attenuation correction improves visualization of, for example, the shadowed area behind the nipple. The automated scan reduces operator dependence and its repeatability suits it to monitoring cancer response to treatment. Since the technique uses conventional images, advances in commercial technology can easily be incorporated. [This work is funded under a Department of Health NEAT award.]

1810 Digital luminescence mammography: a phantom study before clinical use

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Institute of Diagnostic Radiology, Gynaecological Radiology, University of Erlangen-Nürnberg, 91054 Erlangen, Germany

PURPOSE: The objective of this phantom study was to determine whether the now available, high resolution digital phosphor storage plate system (18 cm x 24 cm) (Fuji/Siemens) can replace film–screen systems in diagnostic mammography. METHODS AND MATERIALS: RMI-mammography phantom X-rays were acquired. A set of digitally acquired images (Mammomat 3000N; Siemens), storage phosphor plate IP HRV (Fuji), image reader FFDM-CR (Fuji/Siemens) resolution 8–9 lp mm^{-1}, printer TM 8600 (Kodak) resolution 12.9 lp mm^{-1} (CR) were compared as hard copies with film–screen images (Mammomat 3000N; Siemens) resolution 12 lp mm^{-1}, UM mammo fine (screen) (Fuji), UM-MA (film) (Fuji), printer MF FPM 2100 (Fuji) (FS) of the same objects. Five radiologists experienced in mammography read the images with regard to recognition of details such as grains of aluminium oxide (200–740 mm), threads of nylon (0.4–1.6 mm) and round foci (0.5–4 mm diameter). RESULTS: It was possible to detect 225 true positive decisions for every system. We found 191 true positive decisions for the film–screen system (FS) and 193 for the digital phosphor storage plate system (CR). CONCLUSION: The results of this study indicate that the new, high resolution digital phosphor storage plate system (18 cm x 24 cm) (Fuji/Siemens) can be used in mammography at equal dose without loss of image quality and diagnostic security. Based on these results, in our department we routinely undertake only luminescence mammography on all patients.

1820 Digital luminescence mammography (CR) without magnification in clinical routine

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Institute of Diagnostic Radiology, Gynaecological Radiology, University of Erlangen-Nürnberg, 91054 Erlangen, Germany

PURPOSE: Digital mammography has a lower spatial resolution compared with film–screen systems but has the advantages of a large dynamic range, reduction in dose, post-processing and CAD. On the basis of our experimental phantom (RMI) examinations, we aimed to investigate the possibility of using digital luminescence mammography without magnification technique (CR) in clinical routine. METHODS AND MATERIALS: The pre-conditions for digital luminescence mammography (CR) are the "European guidelines on quality criteria for diagnostic radiographic images". They are fulfilled by the combination of Mammomat 3000N (Siemens), storage phosphor plate IP HRV (Fuji), image reader FFDM-CR (Fuji/Siemens) and printer TM 8600 (Kodak). We have demonstrated this by our experimental phantom (RMI) examinations in comparison with conventional film–screen mammography (FS). RESULTS: Between March 2001 and August 2001 we examined 1363 patients (preventive examination, screening, aftercare) in our department with digital luminescence mammography. Dose, contrast and noise were in accordance with the European Guidelines every time. The longer time needed for the development of digital compared with conventional analogue mammography hard copies could be compensated for by using eight cassettes. CONCLUSION: On the basis of the technical pre-conditions, the phantom (RMI) examinations and equivalent accuracy in diagnosis (lesions, microcalcifications), high resolution digital luminescence mammography (CR) (without magnification technique) can replace conventional analogue film–screen mammography (FS) and can be used in clinical routine.

1700–1830 · Hall 10
Refresher Course
Magnetic Resonance

1700 Invited review: Fetal MRI

S Chapman
Department of Radiology, Birmingham Children's Hospital, Steelhouse Lane, Birmingham B4 6NH, UK

No abstract provided.

1725 Invited review: MRI kidneys/urography

G P Krestin
Department of Radiology, University Hospital Rotterdam, Rotterdam 3000 CA, The Netherlands

Due to its high tissue contrast and multiplanar imaging capabilities, MRI provides a detailed display of renal anatomy. Technical developments overcoming the problem of respiration-induced motion artefacts as well as the use of paramagnetic contrast agents have improved the performance of MRI, which has now evolved as an alternative or complementary imaging modality to CT. Use of a fast (turbo) spoiled gradient echo sequence allows for detection as well as characterization of renal masses. Additionally, dynamic contrast enhancement offers semi-quantitative information on the excretory function of the kidneys. Repeated gadolinium enhanced 3D MR angiography can be used as an alternative, also providing a highly sensitive tool for assessment of renovascular hypertension. For tumour staging, the fat saturated imaging capabilities of MRI are advantageous. Perinephric extent is best detected using opposed-phase GRE images resulting in an artificial accentuation of renal contours. Extension into venous structures is best diagnosed using GRE sequences, allowing for distinction between flowing blood and tumour thrombus. MR urography can be used whenever involvement of the collecting system is suspected.

1750 Invited review: MRI of the chest

P Goddard and E Van Beek
Department of Radiology, Bristol Royal Infirmary, Marlborough Street, Bristol BS2 8HW, UK

MRI has been used in the assessment of pulmonary malignancy since the early 1980s. It has been well documented that MRI can demonstrate lesions in the mediastinum, apices, bases and chest wall more efficaciously than standard CT. 5-year follow-up of patients undergoing surgery for carcinoma of the bronchus shows clear advantages of MRI over surgical staging in predicting outcome. Comparison between the latest MRI scanners and multislice CT is, however, required. MRI is also useful in assessing chronic lung disease and in the assessment of airways abnormalities. New research is developing a role in the assessment of pulmonary embolism. This may be done by thrombus imaging, pulmonary MRA or MR ventilation (hyperpolarized noble gas MRI) and perfusion studies. The role of thoracic MR spectroscopy has been little studied and in the chest has only occasionally been used for studying the heart. There is potential for the use of MRS in thoracic malignancy.

1815 Discussion

1700–1830 Hall 11A
Keynote Lecture
Aspects of Paediatric Disease

1700 Invited review: Spinal ultrasound in infants

R De Bruyn
Department of Radiology, Great Ormond Street Hospital, Great Ormond Street, London WC1N 3JH, UK

Spinal ultrasound (SUS) in infants is primarily used in the screening for occult spinal dysraphism (SD). It is rarely used for the evaluation of spinal cord tumours, vascular malformations and in cases of birth-related trauma, and these conditions will not be discussed. SUS should be performed in patients suspected of occult SD. These include infants with associated syndromes (*e.g.* anorectal malformations, cloacal exstrophy), "atypical" dimples, haemangiomas, cutis aplasia, hairy patches, skin "tag" or tail and multiple cutaneous stigmata. SUS has been shown to be equal to spinal MRI in demonstrating occult and non-occult SD, therefore most agree that given the multiple advantages of SUS over MRI (including cost, speed and ease of examination), SUS should be a first line screening investigation for occult SD and only those with an abnormal SUS should go onto MRI. An exciting new development that will further improve the quality of SUS is the development of 3D US. This lecture will discuss technique of SUS in infants, the pathologies seen in occult spinal dysraphysm and the advantages of new ultrasound technology.

1725 Invited review: Imaging the paediatric chest

D Grier
Bristol Children's Hospital, Department of Radiology, Bristol, UK

An understanding of the normal variability and the changes of the appearance of normal chest radiographs in infancy and childhood is helpful in interpreting radiographs taken in sick children. Whilst chest radiographs are the most common investigation in children with respiratory symptoms, chest fluoroscopy, ultrasound, CT and MRI are important in certain clinical situations. This talk will provide an overview of the use of imaging in paediatric chest conditions, with emphasis on acute presentations such as stridor and infection, and the evaluation of antenatally diagnosed conditions and chest masses.

1750 Invited review: Imaging of paediatric TB

S Andronikou
Department of Radiology, Great Ormond Street Hospital, Great Ormond Street, London WC1N 3JH, UK

No abstract provided.

1815 Discussion

1715–1830 Kingston Lecture Theatre
Keynote Lecture
Funding and Procurement of Equipment

1715 Invited review: Leasing of radiology equipment: the way forward

D Rose
MEF, Thame, UK

It has long been recognized that acquisition of the latest technologically advanced equipment can promote dramatic benefits in hospital operating efficiency and quality of patient care. What is rarely appreciated, however, is that leasing new equipment can be a viable commercial alternative to capital purchase. With the recent clarification and relaxation of NHS private finance guidelines, more and more hospitals are recognizing the opportunities to procure much needed equipment through operating leasing, maximizing the advantages offered by this method of acquisition. Without the right information, however, the decision of whether to use leasing can appear to be a complex process, particularly for "non-financial" managers wishing to prepare a business case for this form of financing. The leasing option for radiology equipment is discussed in more detail at this presentation.

1740 Invited review: Managed technology services: opportunities and pitfalls

G Dombrowe
Siemens Medical Solutions, Bracknell RG12 8FZ, UK

Since the launch of the Private Finance Initiative, managed technology contracts have played a significant and increasing role in the provision of medical equipment and information technology, primarily in connection with new hospital builds. 3 years after the first projects have come online, it is possible to take stock of the success or otherwise of this approach and to discuss possible refinements for the future. In doing this, the author will be drawing on his experience and involvement with a number of high profile examples within the NHS.

1805 Invited review: Funding and procurement of equipment

S Dickinson
Galsworth Road, Kingston Hospital NHS Trust, Kingston-upon-Thames KT2 7QB, UK

No abstract provided.

0830–1000 Hall 10
Refresher Course
Gastrointestinal

0830 Invited review: CT liver: optimizing techniques

R L Baron
Department of Radiology, University of Pittsburgh Medical Center, Pittsburgh, PA 15238, USA

In daily practice, common indications for liver imaging include detection of liver malignancies, characterization of liver lesions suggested by other imaging tests and evaluation of chronic liver disease. The development of multidetector row helical CT has provided the ability to acquire volume data acquisition that (1) can rapidly obtain images with thin section techniques over large areas to optimally use contrast administration to aid detection and characterization of liver lesions, and (2) affords the ability to easily and rapidly retrospectively manipulate section thickness and interval as well as the plane of evaluation. The ability to optimize tumour detection and to provide detailed arterial anatomy is now possible during the same examination. This lecture will focus on CT contrast techniques to optimize tumour detection and characterization, as well as characterization of common benign lesions such as haemangiomas and focal nodular hyperplasia. An understanding of the principles in data acquisition with multidetector CT will be stressed to optimize CT examinations, including the use of common post-processing techniques. In staging and treating various tumours, knowledge of the arterial anatomy is essential, and techniques for depicting vascular anatomy with imaging studies of the liver will be presented.

0855 Invited review: Endoscopic ultrasound in the upper gastrointestinal tract

S A Roberts
Radiology Department, University Hospital of Wales, Cardiff, UK

PURPOSE: To discuss the role of endoscopic ultrasound (EUS) in the upper gastrointestinal tract. EUS is the marriage of ultrasound and endoscopy. It remains the most accurate method of locally staging oesophageal cancer, providing pre-operative T and N staging to determine the appropriate treatment pathway. In particular, oesophageal cancer invading adjacent organs can be diagnosed pre-operatively, preventing unnecessary surgery. Stenotic oesophageal cancer can be safely and reliably traversed and staged with narrow diameter EUS endoscopes. With the advent of EUS-guided fine needle aspiration (EUS-FNA), transoesophageal and transgastric biopsy of lymph nodes increases the specificity of the technique. Transoesophageal EUS-FNA of lymph nodes also has an increasingly important role in staging lung cancer. The impact of EUS in staging pancreatic cancer is diminishing owing to improved CT technology, but the technique still has a role in clarifying equivocal CT findings and in EUS-guided intervention. EUS-FNA of pancreatic masses is safe, with a sensitivity of 86% in a large, prospective multicentre evaluation. EUS-FNA of liver lesions provides additional staging information during the same procedure. EUS-guided coeliac plexus neurolysis is now established as a method of pain control in inoperable pancreatic cancer. Biliary microlithiasis as a cause of "idiopathic" acute pancreatitis is easily diagnosed with EUS, and endoscopic pseudocyst drainage can be guided by EUS. CONCLUSION: EUS and EUS-guided interventional procedures continue to play an important role in the staging and management of upper gastrointestinal tract and lung cancer, and in the investigation and management of acute pancreatitis.

0920 Invited review: CT of abdominal gas collections

R Nakielny
CT Body Scan Department, Royal Hallamshire Hospital, Glossop Road, Sheffield S10 2JF, UK

The progressively increasing use of spiral CT (sCT) in assessing the "acute abdomen" makes it imperative to be aware of the various manifestations on sCT of free or localized gas collections due to underlying pathology. Basic principles for reviewing sCT for gas collections in the acute abdomen include using wide windows and "soft copy". It is also important to be aware of normal variants and benign conditions that could mimic acute gas collections. A review of gas collections within organs, the peritoneal cavity and structures around the abdomen will be presented. Some of the technical difficulties (*e.g.* when intravenous and oral contrast media are not possible) and anatomically difficult areas (*e.g.* pre-sacral and psoas muscles) will also be discussed. The appearances of gas collections both around and remote from perforated bowel, together with the appearance of fistulae, will also be reviewed.

0945 Discussion

0830–1000 Olympian Suite 1
Refresher Course
Oncological Imaging

0830 Invited review: Is that pelvic mass really a bladder cancer?

R Nakielny
CT Body Scan Department, Royal Hallamshire Hospital, Glossop Road, Sheffield S10 2JF, UK

Specialist clinicians sometimes assume that any mass palpable in the region that they specialize in is automatically related to their speciality and refer for imaging on that basis. As imaging also becomes more and more subspecialized, it is essential that an awareness of the appearance of pathologies outside the individual's subspecialty is maintained to minimize "tunnel" vision. This lecture will commence with the MR appearances of bladder cancer. There will be a brief discussion of some of the difficulties in staging bladder cancer on MR. Other bladder masses will then be profiled, followed by the appearances of masses around the base of the bladder, including peri-urethral pathology. The MRI appearances of benign and malignant gynaecological and colorectal masses, which might present as palpable pelvic masses, will then be presented. A brief mention will also be made of the role of immunohistochemistry in distinguishing between ovarian primary and colorectal metastatic disease to the ovary. Finally, the imaging appearances of a small spectrum of other pelvic masses will be presented.

0855 Invited review: Bone metastases/marrow imaging

N R Moore
Department of Radiology, University of Oxford, Oxford OX3 9DU, UK

The bone marrow is the largest organ in the body. It is a very dynamic structure, which varies with age and stresses (such as anaemia). Haemopoietically active marrow is known as red marrow and has a much higher cellular content than yellow marrow. Yellow marrow is inactive and is dominated by fat. BENIGN: Haemangioma and focal fat are common benign marrow lesions that return high signal on T_1 and T_2 weighted images. Bone islands and marrow infarcts are characterized by low signal intensity on both T_1 and T_2 weighted sequences; when multiple, there is the potential for confusion with sclerotic metastases. MRI is the most sensitive imaging technique for the diagnosis of osteonecrosis and fractures when plain X-rays are negative (*e.g.* scaphoid and femoral neck). Bone infection is also readily demonstrated and the MRI features precede changes on plain radiographs. MALIGNANT: Most marrow metastases demonstrate low signal on T_1 and increased signal intensity on T_2 weighted sequences. The appearances on T_2 images may vary according to the degree of necrosis or sclerosis. MRI is more sensitive and specific than bone scintigrams and plain radiographs in the diagnosis of metastases. MRI gives greater confidence in the discrimination of a benign from a malignant cause for a vertebral compression fracture. Osteoporotic fractures tend to demonstrate a linear pattern of oedema and the fracture line may be visible. In contrast, a malignant fracture is often accompanied by signal changes in the pedicles and posterior elements as well as in the paravertebral soft tissues.

0920 Invited review: CT/MRI in staging renal cancer

R H Reznek
Academic Department of Radiology, St Bartholomew's Hospital, London EC1A 7BE, UK

The Robson staging classification of renal cancer remains the system most widely used. The accuracy of MRI and CT in distinguishing between Stages I and II (by identifying perinephric spread) is similar, although MR is probably more sensitive in detecting early perirenal invasion. Both CT and MRI have shown extremely high sensitivity in detecting invasion of the renal vein, IVC and right atrium (Robson Stage IIIA). Recently, MRI has also shown the potential to predict invasion of the wall of the IVC. As both CT and MRI rely on an increase in size to detect lymph node infiltration (Robson Stage IIIB), both techniques have similar limitations in sensitivity and specificity. Direct spread to adjacent viscera (Stage IVA) is accurately detected by both CT and MRI, although, as elsewhere, direct invasion of the spinal canal is better shown on MRI. Distant metastases (Stage IVB) occur most commonly to the lung (±18%) and are, as always, best shown on CT. Nevertheless, routine CT is not performed widely. Although the overall accuracy of both CT and MRI exceeds 92%, CT remains the most widely used technique for staging renal carcinoma for reasons of availability, cost and preference of the physician.

0945 Discussion

0830–1000 Hall 11B
Refresher Course
Neuroradiology

0830 Invited review: Diagnostic pathways: carotid disease

J Wardlaw
Western General Hospital NHST, Crewe Road, Edinburgh EH4 2XU, UK

No abstract provided.

0855 Invited review: Imaging for FESS

V Chong
Department of Diagnostic Radiology, Singapore General Hospital, Singapore

One of the prerequisites for successful functional endoscopic sinus surgery (FESS) is knowledge of the complex anatomy of the paranasal sinuses. The anatomy of the paranasal sinuses is variable and it is important to appreciate the clinical and surgical significance of these variations. This lecture will answer some commonly asked questions and clarify commonly used terminology such as agger nasi cells, frontal recess, ethmoid infundibulum, uncinate process, ethmoid bulla, basal lamella, sinus lateralis, sphenoethmoidal recess, Haller cells and Onodi cells. It also describes surgical correlation to help the radiologist appreciate the critical anatomy of the posterior ethmoid cell and the ethmoid roof. Our contribution as radiologists will be diminished if we cannot provide the information needed by surgeons. The ostiomeatal unit (OMU) comprises the maxillary sinus ostium, the ethmoid infundibulum, the anterior ethmoid cells and the frontal recess. It refers to the common drainage of the anterior sinuses. Diseased mucosa in the ethmoid infundibulum impairs ventilation and drainage of the frontal, anterior ethmoid and maxillary sinuses. FESS is based on the theory that the OMU is the key in the pathogenesis of chronic sinusitis. The aim of FESS is to re-establish normal ventilation and sinus drainage. The key sinus in FESS is the ethmoid sinus. It plays a central role in drainage of the anterior paranasal sinuses. Its close relationships with the orbit and anterior skull base make these structures vulnerable to trauma during surgery.

0920 Invited review: The radiologist and the gamma knife

P Butler
The Royal London Hospital, Neuroradiology, Whitechapel, London E11BB, UK

The gamma knife is a form of stereotactic radiosurgery for various craniocerebral abnormalities. It was conceived and introduced into clinical practice by the neurosurgeon, Professor Lars Leksell, and his team in Sweden. There are now x units worldwide, including three in the UK. The treatment consists of gamma irradiation using 201 individual sources of cobalt-60, distributed in a hemispheric arrangement and brought to a focus. Each of the sources alone gives a dose well below the threshold for cerebral injury but, at the focus, a "therapeutic" dose can be delivered. The initial experience was with cerebral arteriovenous malformations (AVMs), but the indications now include a variety of benign and malignant tumours such as acoustic neurinomas, meningiomas and cerebral metastases. The gamma knife has also been used to treat trigeminal neuralgia, Parkinsonian tremor and temporal lobe epilepsy. The mainstay of planning is MRI, with catheter angiography for AVMs. CT is a useful adjunct since, unlike MRI and DSA, there is no inherent image distortion. Each investigation is conducted with a Perspex "box" fitted to the frame, which is fixed tightly to the patient's head, on which are "fiducial" markers. These act as constant points of reference so that the target can be located accurately in 3D space. The gamma knife is a neurosurgical tool and the involvement of the radiologist may amount to little more than performing a cerebral angiogram. However, a greater contribution is possible depending on the radiologist's particular interest. This theme will be developed by the speaker.

0945 Discussion

0830–1000 Olympian Suite 2
Refresher Course
Musculoskeletal Upper Limb

0830 Invited review: Imaging the problem shoulder

P J O'Connor
Department of Musculoskeletal Radiology, Leeds General Infirmary, Leeds LS1 3EX, UK

Shoulder pain is a common cause of morbidity both in young and old patients. The literature regarding the clinical and radiological diagnosis of these conditions is controversial and even the most appropriate therapeutic options are somewhat unclear. This lecture places the imaging diagnosis of shoulder disorders in perspective by contrasting radiological diagnosis with the best evidence available regarding clinical diagnosis and therapy.

0855 Invited review: MRI and ultrasound of the wrist and hand

G Allen
Royal Orthopaedic Hospital, Bristol Road South, Woodlands, Birmingham BS31 2AP, UK

The complex anatomy of the hand and wrist is well demonstrated by MRI; however, there are sometimes problems in positioning the patient in the magnet. Ultrasound (US) has the advantages of showing structures at a higher resolution as well as observing them dynamically, particularly now that higher resolution US machines are available. On the other hand, US requires more experience for proper interpretation. MRI is the "easy" technique! Whilst US can detect small cortical breaks, MRI is the preferred method in detecting subtle fractures around the wrist as well as other bone marrow pathology. Tears of the triangular fibrocartilage can be seen on MRI, although there are arguments in favour of MR arthrography, especially in detection of intercarpal ligament injuries. US has little to offer in intercarpal ligament trauma. Both techniques will show the extent of ganglions and infiltrative disorders. US is especially useful in vascular lesions. Early synovitis may be detected by both techniques and we are not yet certain which is the most accurate. The principal strengths of US are to visualize tendons and nerves directly, to exclude or define mass lesions as cystic or solid, to detect and locate foreign bodies, and to direct injections and biopsies.

0920 Invited review: MRI and ultrasound imaging of the knee

A J Grainger
Department of Musculoskeletal Radiology, Leeds General Infirmary, Leeds, UK

The objective of this lecture is to outline the complementary roles of MRI and ultrasound in imaging the knee and to discuss the importance of some of the more subtle imaging findings encountered. The knee is the largest joint in the body and is anatomically and functionally one of the most complicated. Although conventional radiographs continue to play an important role in imaging the knee, particularly in the acute trauma setting, their limited demonstration of soft tissue structures has led to the development of major roles for both MRI and ultrasound. The complementary roles of ultrasound and MRI in knee imaging will be discussed. Ultrasound technique will be outlined. Ultrasound proves particularly useful in imaging tendons, superficial

ligamentous structures and soft tissue masses. Major advantages offered by ultrasound include its outstanding spatial resolution and real-time capabilities. However, MRI remains the modality of choice for imaging the deeper structures within the knee such as the menisci and cruciate ligaments. MRI of the knee is one of the most common MR investigations undertaken and provides exquisite demonstration of the relevant anatomy. The lecture will discuss the role of MRI in imaging knee pathology. Particular attention will be given to findings on MRI that the general radiologist may not encounter frequently but which are of importance to the clinician.

0945 Discussion

0830–1000 Kingston Lecture Theatre History Session

Radiology, Arts, Science and History

0830 Invited review: Wilhelm Conrad Roentgen and his contribution to physics in the 19th century

U Busch
German Roentgen-Museum, Schwelmer Str. 41, D-42897 Remscheid, Germany

In general, Roentgen became very famous to the public for his discovery of X-rays. Not everyone knows that he was well known as an excellent experimental physicist in the scientific world long before 1895. He entered his speciality of physics by accident in 1871 when he was asked by the famous physicist August Kundt to become his assistant. This very productive co-operation paved the way for Roentgen's career in physics. Both worked very successfully on topical physical problems such as the "electromagnetic rotation of the plane of polarisation in gases", later better known as the "Kerr Effect". In 1874 Roentgen first analysed discharge phenomena of electricity under various condition, and in 1878 he worked on the conductivity of heat in crystals. These papers very early on documented his great interest in crystals and their physical properties; to him crystals were the embodiment of the laws of nature. He kept his love for crystals until he died, and there seems to be a significant connection between this devotion and the valuable revelations on the real nature of the Roentgen rays that were yielded by a study with crystals by Max von Laue in 1912. In 1888 he made his famous investigations to prove that magnetic effects are produced in a dielectric, such as a glass plate, when it is moved between two electrically charged condenser plates. This work is one of his most important investigations based upon the theoretical reasoning of the Maxwell electromagnetic theory. The results that he obtained were the ideal co-ordination of the function of a theorist and those of a genius in experiment. Hendrik Lorenz later named the discovered phenomena as "Roentgen current". Another very important experiment Roentgen did in 1881 in Giessen when investigating "sounds produced by intermittent irradiation of a gas". Nowadays this photo-acoustic spectroscopy is been used to analyse the pollution of air.

0850 Invited review: Aspects of the history of medicine in Birmingham

R G Arnott
Centre for the History of Medicine, University of Birmingham Medical School, Birmingham B15 2TT, UK

The city of Birmingham has a long and distinguished place in the history of medicine. Early physicians included Erasmus Darwin and William Withering. This short paper traces the origins of medicine in Birmingham to the time of the discovery of X-rays and briefly discusses the role of radiology in the city and the work of early radiologists.

0910 Invited review: Rontgen and the 1914 affair

I Isherwood
University of Manchester, Oxford Road, Manchester, UK

In August 1914, the first month of the Great War of 1914–18, the University Library of Louvain (Leuven) was destroyed by the German occupying forces. In October 1914 an Appeal was addressed to "The Civilized World" by 93 German academics and artists disclaiming any German responsibility for this act of vandalism—"It is not true that our troops have brutally destroyed Louvain". The Appeal had a profound, though mainly negative, effect around the world, especially in the USA where it almost certainly influenced the decision to enter the conflict. The signatories to the Appeal included, amongst others, Max Planck, Liszt and Rontgen. Why did Rontgen sign such an extraordinary and untrue statement? He claimed that he had not read it, but both the personal and political background to his action were complex and worthy of further scrutiny. This presentation will explore the background to the issue and the reception of the notorious Appeal by British Radiology.

0930 Invited review: Lasting for a day: ephemera in radiology

A M K Thomas
Department of Clinical Radiology, Bromley Hospital, Bromley BR2 9AJ, UK

There is an increasing interest in the study of ephemera. The word ephemera is derived from Greek and refers to the "flies that live for a day". The value of transient material to illustrate and document social history is well known. In the words of Robert Opie, "it is becoming recognised that we are psychologically and socially rooted amongst the fragments of our daily living." The Ephemera Society was founded in 1975 as a non-profit-making body concerned with the preservation, study and educational uses of printed and hand-written ephemera, the "minor transient documents of everyday life." The term ephemera "covers a wide range of marginalia, from tickets to letterheads, from labels to proclamations." In the radiological world there is much of interest. Many images illustrate the popular perception of X-rays, from the charming early 20th century Belgian trade cards to the current image of an X-ray machine on a Penguin chocolate bar. Other significant material is the promotional material and advertisements produced by the X-ray industry. The presentation will be illustrated using material from my collection of radiological ephemera. Much of this material is unknown to the radiological community and deserves to be better recognized and explored. The X-ray has fascinated the public from the earliest days following the discovery by Wilhelm Röntgen in 1895, and the radiographic image is still widely used in popular culture.

0950 Discussion

0830–1000 Hall 11A Refresher Course

Body MR

0830 Invited review: Contrast agents for liver MRI

J Ward
Magnetic Resonance Imaging Unit, St James's University Hospital, Beckett Street, Leeds LS9 7TF, UK

There are three purposes of contrast agents in liver MRI: first, to improve the contrast between normal and abnormal tissues, thereby improving lesion detection; second, to demonstrate the perfusion characteristics of tissue to aid lesion characterization; and third, to identify and evaluate vascular structures, particularly in patients who are candidates for hepatic resection or transplantation. Several different contrast agents have been developed for liver MRI, which are classified as extracellular space (ECF) agents or liver-specific agents (Kuppfer cell or hepatocyte specific) on the basis of their biodistribution. All ECF agents contain gadolinium, which increases the T1 relaxation of the tissue in which it accumulates, resulting in a shortening of T1 and positive contrast enhancement. Immediately after injection, ECF agents are initially distributed within the intravascuar compartment, following which they rapidly distribute within the extracellular space. The advantages of ECF agents for liver imaging are most apparent during dynamic imaging (rapid sequential acquisitions during and after bolus injection). Arterial phase images demonstrate hypervascular lesions, whilst hypovascular lesions are best shown at the portal phase of enhancement. Delayed images are necessary to characterize lesions. Liver-specific contrast agents aim to prolong and increase the contrast between normal and abnormal tissues and further aid lesion characterization. Two types of agents have been developed: T1 agents, based on gadolinium or manganese chelates, which are taken up by the hepatocytes; and reticuloendothelial system agents that contain superparamagnetic iron oxide particles and cause signal loss on both T_1 and T_2 weighted images. This lecture will discuss the current status of all three types of agents and will focus on the choice of technique and appropriate clinical indications.

0900 Invited review: Aspects of oncological MRI

A D MacVicar
Academic Department of Diagnostic Radiology Hospital,

Royal Marsden NHS Trust, Downs Road, Sutton, Surrey SM2 5PT, UK

In recent years, MRI has assumed a central role in the diagnosis and staging of malignant disease. It has become the most important technique in the diagnosis of CNS tumours and has a firm place in the investigation of head and neck and orthopaedic tumours. MRI is the most accurate technique for staging uterine, cervical, prostate and rectal cancers in which the anatomy of these organs is demonstrable on high contrast sequences. The utility of MRI for investigation of some common solid tumours such as breast and lung carcinoma is more controversial. MRI also has an established place in the detection of recurrent tumour and complications of cancer, but has not become a routine multi-organ staging procedure. The place of MRI in current oncological practice will be discussed and possible future directions will be highlighted.

0930 Invited review: Cardiac MRI

T Jones
Radiology, Leeds General Infirmary, 3rd Floor Clarendon Wing, Great George Street, Leeds LS1 3EX, UK

No abstract provided.

0830–1000 Hall 9
Refresher Course
Imaging the Elderly Population

0830 Invited review: Orthopaedic imaging in the elderly population: trauma and abuse

J Rowe
Geriatric Department, Queen Elizabeth Hospital, Birmingham, UK

Abuse in older people was first recognized in 1975 with publications in Modern Geriatrics in the British Medical Journal. Although Authorities here initially turned a blind eye to this phenomenon, work in the USA investigated the epidemiology and developed Adult Protective Services to deal with the problem. More recently, studies from other countries have confirmed the prevalence of the phenomenon. It is common to all the societies so far studied (including a British survey). Some 3–5% of the older population will be being subjected to abuse. In Britain the 95% confidence limits for those being abused is 0.5 to one million people. Whilst abuse takes many forms—it may be physical, psychological, financial, sexual etc.—different forms of abuse present in different ways to different Services. All studies that have tried to generalize from the experience of a single Agency have been shown to be inadequate. The seminal Boston Study not only became the prototype for further studies but reversed the impressions gained by researchers who use their personal experience to generalize about the problem. This study revealed that spouses were the most likely abusers and that men were more likely to be abused than women. Since then, a persistent theme has come out that elder abuse is a specific form of domestic violence. This usually occurs on a background of conflict, especially a dysfunctional relationship with problems of communication between both parties. It does appear that the risk of abuse is defined more by the characteristics of the abuser than the dependency or frailty of the abused. Simplistic solutions such as offering more support do not heal dysfunctional relationships and do nothing to effect the likelihood of abuse. As in child abuse, there are some physical injuries that appear characteristic and perhaps even pathognomonic, but unfortunately these are great rarities. Practical difficulties with the legal system mean that these can virtually never be relied on to underpin successful prosecutions. Abuse is most likely to be discovered if one goes looking for it, and several units use a standardized questionnaire as part of their admission procedures. The severe physical injuries that may be recognized as almost certainly due to abuse may parallel those seen in damaged children: cigarette burns, whip marks, lesions from shackling etc. However, even in these cases a clear-cut outcome is difficult to obtain. There is increased sophistication in the way such problems are dealt with and a gradually increasing commitment by Authorities to deal with it. There is now a national organization, Action on Elder Abuse, that publishes much training material about recognition of the problem and how to deal with it. Furthermore, there is a national telephone line, Elder Abuse Response, modelled on the Childline system. More recently the Government has obliged Local Authorities and Health Authorities to sign up to policies intended to protect vulnerable adults in their "No Secrets" initiative.

0900 Invited review: Imaging of osteoporosis in the elderly: too little, too late?

S Barlow
Bone Densitometry, Nuffield Orthopaedic Centre, Oxford OX3 7LD, UK

This paper will attempt to show the difficulties that arise in the imaging of the elderly population in terms of risk of osteoporosis. It will outline the modalities best suited to accurate diagnosis of the elderly infirm and will show why the gold standard of DXA is sometimes unachievable and can be misleading if the results are not interpreted correctly.

0930 Invited review: The ageing brain

A Jackson
Imaging Science & Biomedical Engineering, University of Manchester, Stopford Building, Oxford Road, Manchester M13 9PT, UK

This presentation will focus on a number of aspects of novel imaging and image processing related to the ageing process. One major problem with the diagnosis of abnormalities within the ageing brain is the presence of normal age-related cerebral atrophy. A number of analysis techniques have now been described, some of which are sufficiently simple to be used in clinical practice. The relative values and clinical merits of these techniques will be discussed and the basic principles of cerebral atrophy assessment will be described together with an overview of the potential impact of these techniques on clinical diagnostic radiology. Another area of significant importance is the increasing recognition of vascular disease in the brain occurring as concomitant to neurodegenerative diseases or in isolation. The range of symptoms resulting from microvascular disorders within the brain is extensive and continues to grow. Despite this, classification of microvascular disorders is confused and is currently undergoing review. This will be discussed and an overview of the potential mechanisms for vascular injury, methods of imaging and quantifying, and potential implications for therapeutic strategies will also be discussed.

0830–1000 Lodge Room
Scientific Session
Recent Developments in CT

0830 Invited review: The new CT technology: what are the benefits?

J F Barrett
ImPACT, Medical Physics Department, St George's Hospital, London SW17 0QT, UK

Nearly all CT scanners currently being purchased for UK hospitals are sub-second multislice models. Most can acquire 4 slices simultaneously and may have the option of upgrading to 8, 16 or more slices in the future. Software packages are available that enable a variety of specialized scanning techniques to be performed, and some models incorporate dose reduction features. Patients undergoing CT scans in these hospitals can expect to benefit in a number of ways from the new technology. Greater diagnostic accuracy may result from improvements in image quality, and a greater range of diagnostic capabilities is now available. Better patient comfort can be expected with faster scanning speeds and the need for less contrast medium. The high quality 3D images reconstructed from multislice acquisitions have important applications in subsequent surgical procedures. In addition, the advances in specialized techniques such as CT angiography, virtual endoscopy and gated cardiac imaging should spare some patients from having to undergo more invasive procedures. This presentation explores the technological developments that have brought about these potential benefits, investigates how far the potential is currently being realized and examines the ways in which any drawbacks associated with the new technology are being addressed.

0900 The relationship between image noise and spatial resolution of CT scanners

S Edyvean, N Keat, M A Lewis, J F Barrett and S Sassi
ImPACT, Medical Physics Department, St George's Hospital, UK

The established relationships that link CT scanner image noise and high contrast spatial resolution are based on early theoretical studies and state that noise squared is proportional to spatial resolution cubed. This is interpreted and applied in a variety of ways in textbooks, including being used to normalize parameters in low contrast detectability studies. The ImPACT group also uses this relationship in

their Q value, combining noise, dose and spatial resolution data for standard resolution scans. An integral part of an ImPACT scanner assessment is investigation of the interrelationship of imaging performance indicators over a wide range of scanning and reconstruction parameters. In this paper, an empirical exploration of the relationship between image noise and spatial resolution is presented. These data demonstrate that the established power relationship is most closely followed in the range of standard resolution algorithms. When the full range of convolution kernels is considered, however, a higher power relationship exists.

0910 Assessment of the low contrast detectability of multislice CT scanners

N Keat, M A Lewis, J F Barrett and S Edyvean
ImPACT Group, Medical Physics Department, St George's Hospital, London SW17 0QT, UK

Assessment of parameters such as image noise, limiting spatial resolution, *z*-axis sensitivity and patient dose are well established, repeatable and objective methods of assessing and comparing CT scanner images. However, these techniques tell only part of the story, which also includes the uncertainties involved in human perception of images. As a large proportion of CT studies involve differentiation of low contrast structures, it is important to also cover subjective aspects of scanner performance when assessing image quality. This study used the Catphan 500 phantom, which includes low contrast details from 0.3–1.0% contrast relative to the surrounding medium, over a range of sizes from 2–15 mm diameter. The phantom was scanned on multislice CT scanners from four equipment manufacturers, using comparable acquisition and reconstruction parameters to enable comparison of results. The randomly presented images were assessed by a number of observers who scored the visibility of the low contrast objects. The results of these assessments will be presented. In addition, the interoperator and intraoperator variation of image quality scores was examined, and the influence of factors such as scanner mAs setting, criteria for visibility of objects and viewing conditions were investigated.

0920 Multislice CT: challenges of moving to 16 slices

Th Flohr, S Stierstorfer, H Bruder, J Simon, C Sueß, J Uebler, B Ohnesorge and S Schaller
Siemens Medical Solutions, Computed Tomography Division, Forchheim, Germany

Multislice spiral CT has made volumetric scanning and viewing a clinical and practical reality. On the way toward routine volumetric imaging at isotropic spatial resolution, the number of simultaneously acquired slices has to be increased, and submillimeter slices have to be introduced for clinical routine. Key challenges for the new generation of multislice CT systems are detector design, data transmission, image reconstruction, dose management and the need for a dedicated workflow to handle the increasing amount of images. The recently introduced 16 slice CT scanner, SOMATOM Sensation16 (Siemens AG, Forchheim), offers simultaneous acquisition of 16 slices with either 16 × 0.75 mm or 16 × 1.5 mm collimation. Optimized detector efficiency and advanced dose management and dose reduction tools, such as anatomical and ECG-triggered dose modulation, allow for a routine clinical use of submillimeter slices. With a newly developed spiral reconstruction approach, the cone beam geometry of the measurement rays is taken into account to avoid cone beam artefacts and image quality degradation, while the clinical benefits of free selection of the spiral pitch at full dose utilization are maintained. The spiral pitch is adjustable in the range 0.5–1.5 (table feed 6–36 mm rotation^{-1}). Reconstruction slice widths in the range 0.75–10 mm are available, which are independent of the pitch. Optimized examination protocols with integrated 3D evaluation help to avoid "image pollution". First clinical results are presented, which demonstrate the tremendous improvements in spatial resolution, scan speed and volume coverage.

0930 Systematic selection of technique factors in paediatric CT

C J Kotre and S P Willis
Regional Medical Physics Department, Newcastle General Hospital, UK

A method for the systematic selection of paediatric CT technique factors is described. The approach is based on the assumption that the level of image noise acceptable for a given adult CT image is also acceptable for the equivalent paediatric examination. A simple exponential attenuation model is proposed. Effective linear attenuation coefficients were initially established from a series of phantom measurements simulating head, chest and abdomen examinations at 120 kVp, then extended for a range of tube potentials and beam qualities using a beam spectral model. Application of the method is demonstrated using phantoms representing head, chest and abdomen sections for a neonate, a 1-, 5-, 10- and 15-year-old and an adult. Examples of the use of the method are given.

0940 Gamma-camera PET and functional anatomical mapping: experience in lung cancer patients

[1]W B Tindale, [1]E van Beek, [1]R Vaughan, [1]R Lawson, [1]A Connolly, [1]M Hanney, [1]P Hillel, [1]J Wrigglesworth and [2]M Buxton-Thomas
[1]Sheffield Teaching Hospitals NHS Trust and University of Sheffield, Sheffield S10 2JF and [2]King's College Hospital, London, UK

PURPOSE: To investigate the use of a gamma-camera (GC) PET system with integral CT facilities for combined functional–anatomical mapping (FAM) in patients with non-small cell lung cancer (NSCLC). MATERIALS AND METHODS: 11 patients with a diagnosis of NSCLC undergoing investigations for staging were studied. Each patient was administered 113–283 MBq (mean 192 MBq) ^{18}fluorodeoxyglucose. GC-PET images of the thorax and abdomen were acquired commencing 1 h post injection. CT images were acquired during the same examination for attenuation correction (AC) and FAM purposes. Images were reconstructed with AC and without AC (NAC). Images were randomized and reported separately and blind from results of other investigations. Reports indicated uptake in lung tumour, nodal involvement and operability status based on PET appearances. Reports were then reviewed with the addition of FAM. Results were compared with histology of samples taken at mediastinoscopy or thoracotomy. RESULTS: In 5/11 cases, reports differed between NAC and AC images; however, in no case was operability status changed. The addition of FAM clarified appearances or increased reporting confidence in 6/11 cases, had no effect in 4/11 and changed operability status in 1/11. PET images were true positive for the lung tumour in 10/11 cases and false positive in 1/11. Comparing PET with histology/surgical staging, there was agreement in nodal involvement in 6/8 cases and in operability status in 7/9 cases. CONCLUSIONS: These preliminary results support the use of GC-PET in the management of NSCLC and indicate that FAM can improve reporting confidence and aid interpretation in difficult cases.

0950 Initial experiences with a combined gamma-camera/CT imaging system for functional anatomic mapping

[1]P G Hillel, [1]W B Tindale, [2]E Van Beek, [1]M Hanney, [1]P Metherall, [1]C Taylor and [2]N Bax
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PURPOSE: To evaluate a combined gamma-camera/CT imaging system for functional anatomical mapping (FAM). MATERIALS AND METHODS: The IGE Hawkeye system is a dual-headed gamma-camera with an integral CT unit. It enables both nuclear medicine tomography and X-ray CT to be performed sequentially on the same system. The dual modality images obtained are inherently registered. Although Hawkeye yields only low quality CT images, they are sufficient for use in attenuation correction of the emission images and for mapping the functional information in SPECT and PET onto anatomy. Performing CT takes an additional 12 min per camera field-of-view and adds approximately 0.8 mSv dose. The practical aspects of performing the emission–transmission sequence will be discussed and results will be presented from the first 6 months of use. 43 patients have been investigated (12 with ^{111}In-Octreoscan SPECT, 21 with ^{18}FDG gamma-camera PET and 10 with SPECT using other tracers). All nuclear medicine scans were first reported in isolation and then re-reported with the addition of FAM to assess the additional benefit. RESULTS: 6/12 Octreoscan SPECT studies were judged to be abnormal, and in 5 (83%) of these FAM was found to either establish or change the location of at least one lesion. With PET, 4/11 positives

(36%) were affected by the addition of FAM. CONCLUSION: The initial results imply that FAM has the potential to significantly improve reporting of certain nuclear medicine scans, with important consequences for patient management.

1015–1115 Hall 9
Scientific Session
Radiography Education

1015 The National electronic Library for Health: radiographers' overview

N Rosen
National electronic Library for Health, Birmingham B6 5RQ, UK

Creation of the National electronic Library for Health (NeLH) was a specific policy target of the Government in order to provide healthcare professionals with the knowledge and know-how to support healthcare-related decisions. It was launched in November 2000 in pilot form and, in 2001 at the UK Radiological Congress, the Radiographer Portal of the NeLH was introduced. This paper discusses the development of the pilot NeLH and the Radiographer Professional Portal and describes the resources currently available. The Radiographer Portal offers a convenient and organized view of information available in the NeLH, tailored for radiographers needs. Over 70 electronic resources are available, including Anatomy.tv, which includes detailed annotated 3D rotating images as well as radiological images including MRI scans of normal and abnormal pathology. Radiographers are able to access the very latest versions of the Cochrane Library (2001/02), BMJ publishers Clinical Evidence (Issue 6), Clinical Guidelines & Care Pathway databases, and a database of Internet resources provided by NMAP (Nursing, Midwifery and Allied health Professions). NMAP is a gateway to evaluated, quality Internet resources aimed at students, researchers, academics and practitioners in the health and medical sciences. Professional bodies as content providers, including the Society of Radiographers, ensure that NMAP meets the needs of the professions. In addition to these resources, users are able to access National Service Frameworks, discussion groups and specialist Virtual Branch Libraries such as Cancer, Screening and Health Management. NeLH is available 24 h a day, 365 days a year at www.nelh.nhs/radiographer

1025 Integration of problem-based learning into a radiography programme: problems and successes

N A Thompson
School of Applied Medical Sciences and Sports Studies, University of Ulster at Jordanstown, Newtownabbey, Belfast BT37 0QB, UK

Problem-based learning has become increasingly popular since it was first introduced into medical education in the late 1960s. Since then, problem-based learning has gradually been implemented in many courses, and has proved to be particularly popular when considering clinical scenarios. Problem-based learning is a method of self-directed learning using small group discussion to solve a real-life problem. Students study the issues presented in the problem and endeavour to find a solution, with the lecturer acting as a facilitator. Therefore, the traditional roles of the student and teacher are changed and new skills are required to be developed by both parties. The students are encouraged to take responsibility for their own learning and so develop independent, self-reflective learning skills. The lecturer, rather than telling students what they should learn, should help students to determine on their own what they need to know. Following introduction of this method of teaching into the Medical Imaging modules of the radiography course 4 years ago, a number of problem areas were identified, mainly because of the change in the conventional roles of the student and lecturer. The aim of this paper is to detail these problems, to discuss how they were overcome and to outline the advantages and disadvantages of this method of course delivery.

1035 Return to radiography practice

R Chester
University of Derby, Derby DE1 2G7, UK

In response to recent Department of Health initiatives and following the publication of "Meeting the Challenge: a strategy for the allied health professions" [NHS, November 2000], the "Returnees to Radiography Programme" has been developed between the School of Health and Community Studies of the University of Derby, the North Trent Workforce Confederation and Service Managers within the Trent region. The aims of this programme for both diagnostic and therapeutic radiographers are to update the clinical skills and theoretical knowledge of the returnee, to re-establish competency in all aspects of general clinical work and to enable the returnee to feel confident in their role and contribution to a multiprofessional team. The programme is structured and clinically focused and requires the returnee to have the support of a local department for a minimum of 15 h clinical practice per week over a 6-month period. Mentor support from the department facilitates the clinical experience required. To enable the returnee to demonstrate their personal experience in returning to practice, they complete a clinical portfolio, which includes competency assessments, a record of experience and reflective writing. The portfolio enables the individual returnee to demonstrate their range of experiences and progression in returning to practice. There are currently a total of 19 returnees undertaking the programme, 5 of whom are therapeutic radiographers. The average career break of our returnees is approximately 15 years, with a range extending from 6 years to 23 years. This paper considers the programme structure, evaluates the feedback undertaken from the two pilot studies and identifies opportunities for extension of this programme into other professional areas.

1045 Treatment planning in radiotherapy radiography education

S J Walker
School of Radiography (Diagnostic & Radiotherapy), University of Central England, Birmingham B42 2SU, UK

Radiographers are required to have an understanding of the radiotherapy planning process and techniques in order for them to be able to evaluate the most appropriate radiotherapy treatment method for an individual patient. This presentation outlines the use of a treatment planning system in the education of student radiotherapy radiographers who undertake the BSc (Hons) Therapeutic Radiography programme at UCE. The course aims to develop basic skills and to raise the awareness of student radiotherapy radiographers to treatment planning requirements, mainly by self-study based on handbooks that the students use for guidance. These consist of a guide to using the computer, a workbook of 12 exercises, associated worksheets and body outlines for the exercises. The assessment will be discussed and is based upon the topics covered in the exercises carried out, which include an unseen case study. The student plans the most appropriate technique for this case in a time limit of 2 h, then work on the plan and data to provide a completed treatment sheet, which must be suitable for use to deliver the radiotherapy treatment correctly and accurately. Each aspect of the assessment is marked and contributes towards the student's degree award. The benefits and problems of planning course delivery are outlined and, to conclude, the value of this method of problem-based learning is considered.

1055 Development of a pre-registration postgraduate diploma in radiation oncology practice

E Gannon, N Sinclair and S Brown
Faculty of Health, South Bank University, London SE1 0AA, UK

The Postgraduate Diploma in Radiation Oncology Practice is a pre-registration programme leading to state registration as a Therapeutic Radiographer. It was developed in an attempt to reduce attrition in radiotherapy and to acknowledge prior learning of those who already had a first degree. The programme underwent a process validation, with involvement of the College of Radiographers and the Radiographers Board of the CPSM throughout. It is a 2-year course, with eight academic units being studied, all of which are assessed at Masters Level. The option of a Masters award was rejected by the course team and clinical colleagues, since 2 years was considered insufficient time in which to produce a dissertation that would have value for the clinical departments/profession, especially since this would be a new field of study for the students. The need to retain a significant amount of clinical contact time was a major player in the design of the programme, with the final document identifying clinical time equivalent to, if not more than, a 3-year undergraduate programme. Clinical competency assessment is based on occupational standards and requires students to consistently demonstrate that they have acquired the necessary clinical skills. A portfolio element requires students to evaluate current working practices related to specified pathologies, allowing them to assess the evidence base of the present radiotherapy techniques. Recruitment to the programme was slow in the initial stages but has improved significantly. The first cohort, be it small, has graduated and students have gained employment in radiotherapy.

1105 WIP: Teaching physics to Medical Radiation students

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[1]Medical Radiation Science, University of Newcastle, Newcastle, NSW 2308, Australia and [2]School of Radiography, University of Bangor, Wrexham, North Wales, UK

PURPOSE: The majority of incoming MRS students have a negative perception of physics. The phrases "I cannot do it" and "I don't like it" are often expressed. This negative perception presents lecturers with immediate difficulties not experienced with other academic subjects, and a lot of time is spent boosting the students' confidence. This experience by many lecturers teaching physics to MRS students instigated an investigation into the ways to reduce the students' negative perception. METHOD: The investigation assessed the thoughts of students before and after the first year of study. This was done using two questionnaires distributed to students at six Australian and eight British universities. Both questionnaires required the students to rank given responses to questions on their current feelings to physics and different learning and assessment styles. The student was able to explain their choices with a series of open-ended questions. RESULTS: When asked on the subject they thought they would enjoy most, the clinical subject was ranked as number 1; this was not an unexpected result given the professional nature of the course. The physics subject was ranked number 8 (last). They believed that they would learn most from group work and tutorials and least from researching the Internet and problem-based learning. In response to the style of examination questions, the use of short answers was the favoured response as it allowed a wider variety of questions to be asked.

1030–1115 Hall 10
Keynote Lecture
Biliary Tract Imaging

1030 Invited review: Biliary tract imaging: making subtle more obvious

R L Baron
Department of Radiology, University of Pittsburgh Medical Center, Pittsburgh, PA 15238, USA

Imaging the biliary tree should approach three basic questions. (1) Is biliary obstruction present? (2) If present, what is the level and aetiology of the obstruction? And (3) Stage the extent of the disease process present. Ultrasound remains a mainstay in the evaluation of biliary tract disease. Advances in MRI, and in particular MR cholangiography, have resulted in a prominent role for MRI in screening the biliary tract. MR contrast agents for liver evaluation are excreted through the bile ducts and allow for excellent physiological and anatomical depiction of the biliary tree and its integrity as a pre-operative tool or to detect post-operative complications. Multidetector CT has revolutionized the ability of CT to detect subtle details and, with volume data acquisition, to reformat images virtually instantly in any plane, adding to its key role as the first line of abdominal screening and evaluation. This lecture will focus on key anatomical and pathological bases for biliary tract disease that can be essential in making diagnoses based on subtle imaging changes. Techniques to maximize depiction of these pathological findings will be stressed, with an emphasis on biliary tract stone disease, bile duct malignancies, and pre- and post-operative biliary tract imaging. An awareness of these characteristics and correlative imaging findings combined with technique optimization should aid the course participant in diagnosing biliary tract disease.

1030–1115 Olympian Suite 1
Keynote Lecture
Vertebroplasty

1030 Invited review: Vertebroplasty

A Gangi
Department of Radiology B, University Hospital of Strasbourg, 1 Place de l'Hopital, BP 426 Strasbourg, Cedex F-67091, France

No abstract provided.

1030–1130 Hall 11B
Keynote Lecture
Spectroscopy

1030 Invited review: Clinical MR spectroscopy of the brain

A Waldman
Department of Imaging, Charing Cross Hospital, Fulham Palace Road, London W6 8RF, UK

Introduction. Basic principles. Single voxel and spectroscopic imaging techniques. Quantification and interpretation. Selected clinical applications, including degenerative disease, infection and brain tumours.

1100 Invited review: Spectroscopy in practice

S Halpin
Department of Radiology, Heath Park, University of Wales Cardiff, UK

No abstract provided.

1030–1115 Olympian Suite 2
Keynote Lecture
Spine: infections and tumour

1030 Invited review: Spine: infections and tumour

J J Rankine
Radiology Department, St James University Hospital, Beckett Street, Leeds LS9 7TF, UK

The intervertebral disc is the largest avascular structure in the body and is therefore a favoured site for blood-borne organisms to settle and proliferate in relative safety from the body's immune system. This accounts for the chronic, low grade nature of spinal osteomyelitis, and the non-specific nature of the symptoms often results in a delay in diagnosis of many months. *Staphylococcus aureus* accounts for 80% of cases, but there is a great variety of organisms that can cause spinal osteomyelitis. Imaging can never replace bacteriological isolation of an organism, but there are a number of features characteristic of spinal TB. TB is notoriously difficult to culture and imaging may be very important in determining when to commence anti-tuberculous chemotherapy. MRI is now the imaging investigation of choice in spinal infection and is helpful not only in establishing the diagnosis but also in determining when surgical decompression and spinal stabilization are required. As a consequence of a lack of a direct vascular supply to the intervertebral disc, the vertebral end plate is relatively thin to allow diffusion of nutrients to the metabolically active disc. Bone weakening conditions, such as osteoporosis, lead to collapse of the load-bearing portion of the vertebral body, resulting in end plate collapse. Such vertebral collapses are very common and must be distinguished from malignant infiltration. In most cases a confident diagnosis can be made from plain radiographs and MRI, with spinal biopsy required in only a small number of cases.

1030–1230 Kingston Lecture Theatre
Symposium
Planning for Digital Imaging

1030 Invited review: Digital imaging: where are we now?

L Beckmann
Lanmark, Beaconsfield, Bucks, UK

The topic of digital imaging encompasses both the acquisition of digital images and the elements of PACS, which enable these digital images to be viewed not only within the Radiology Department and throughout the hospital but also at other external sites. In reviewing where we are now we should look back at recent history to record key developments and milestones that have enabled the growth of digital imaging. We can also review what has actually been achieved to date, considering the limitations that may still exist. Then we can start looking forward to the areas that still present challenges and restrictions and consider those where solutions have been identified. To create a truly viable world of digital imaging we must look at those areas that pose outstanding questions and areas where challenges must still be overcome, such as the true integration of images into an EPR.

1050 Invited review: Preparing a specification

A R Davies
Princess Margaret Hospital, Swindon SN1 4JU, UK

The success or failure of a complex digital medical imaging system can be determined at a very early stage in the project. A carefully crafted specification for the components of such a system can prove to be an invaluable foundation on which to build. A range of approaches to the preparation of the specification can be taken, from a detail technical description of each component of the system through to a high level statement of the benefits that such a system should deliver. The choice of approach will depend on many factors, including the scope of the system to be procured, the limitations of existing systems on which it will depend, and restrictions imposed by systems with which it will need to interact. The relative merits of "output-based specifications" and the more traditional technical specification are discussed and illustrated using examples applied to the procurement of PACS and digital imaging systems.

1110 Invited review: Technical planning for a digital department: where to start

D Plummer
Department of Medical Physics & Bioengineering, UCL Hospitals NHS Trust, London WC1E 6JA, UK

The transition from a conventional department to one functioning digitally has many pitfalls. These can be avoided if sufficient effort is put into analysis of the existing equipment and working practices together with an understanding of the operational changes that it is hoped to achieve. The analysis needs to cover existing workflows and information systems in addition to imaging modalities. The time to start this analysis is when the possibility of a project is identified so that appropriate scope and resources can be determined and so that a realistic technical requirement can be prepared. A methodology for achieving this analysis is proposed. It involves developing an initial idea of project scope, identifying those who can provide useful information and making the objectives clear to them, and then developing a technical outline for the project. A simple description of how the desired configuration would function is then developed and tested against the outline. There is a need to strike a balance between output-based specifications, which presuppose no specific technical configuration, and specific system architectures, which assume a particular class of design. The presentation expands on all these areas and refers to current initiatives such as the BIR Scenarios, IHE and the NHS PACS Purchasing Guidance. The methodology is adaptable for all scales of development, whether part of a single department or organization-wide, and the presentation is directed at anyone who may find themselves taking a lead role in the introduction of networked digital technology.

1130 Invited review: What makes a good PACS solution?

D S Bhachu
PACSnet, Bence-Jones Offices, Perimeter Road, St George's Hospital, London SW17 0QT, UK

The answer to "What makes a good PACS solution?" is fitness for purpose and effective workflow! In an ideal world, a perfect PACS would be one where all information is digital, all system interfaces were seamless/transparent and all workflow processes were intuitive! However, this is not the case in a pragmatic world. So let us ask the question "What is a PACS?" Well, it is exactly what it says on the box: P, picture (digital radiological image); A, archiving (the means to "store", securely, the image); C, communicating (the means to "communicate" the image); S, system (the framework to do the above two things). Therefore, to make a "good" PACS solution, we need to look at all of the components of the system. Starting with the basics, such as: analysing the current radiological workflow processes; deciding how to digitize the information; type and speed of communications; type and size of archive. Then with the intermediates, such as: the imaging modality (or any other input) to the PACS interface; the PACS to storage interface; the PACS to workstations (or any other output) interface. To the finer and more crucial points, such as: the image management software (the right image, in the right place, at the right time); the RIS/HIS/PACS integration; the user ergonomics (user friendly, hanging protocols, speech recognition); the workflow, QA and expansion of the system. The presentation will address the problems and give guidance to achieving a good PACS.

1150 Invited review: Purchasing digital imaging systems

T S Malik
Diagnostic Medical Equipment, NHS Purchasing and Supply Agency, Chester CH2 3AD, UK

This presentation describes the procurement process, which has been recently developed with the DoH, PACSnet, NHS Trusts and major UK suppliers, for procuring digital imaging systems such as PACS (picture archiving and communications systems). This standardized process is designed to build purchasers knowledge to allow an effectively output-based specification to be developed whilst procuring in line with EU legislation and current best practice. In addition, the process ensures that potential suppliers are provided with the necessary information to allow the formulation of an appropriate solution whilst minimizing replication and reducing process costs. This process has been compiled into the IMPRESS guide (Image Management Procurement SyStem), which will be available on the NHS Purchasing and Supply Agency website.

1210 Invited review: Integrating Healthcare Enterprises

L J Jarvis
Royal Hospital Haslar, Gosport PO12 2AA, UK

Interoperability Conformance Standards have been set up to ensure that diagnostic imaging equipment can operate compatibly, established by DICOM, and standards are established for interoperability of information systems, presently at Health Level 7. As our technology advances, and there is an ever greater need for all imaging equipment to integrate, there is an evolving recognition of the need to establish conformance across all modes of equipment, particularly bearing in mind the integration with picture archiving and communication systems (PACS) and the wider integration of imaging departments both within hospitals and between organizations. The Radiological Society of North America (RSNA) and the Healthcare Information and Management Systems Society (HIMSS) launched the Integrating Healthcare Enterprises (IHE) in 1999, with the twin aims of increased efficiency of workflow and better patient management. IHE is a process, not a standard, and defines the use of established standards such as DICOM and HL7, bringing together users and developers of healthcare information and imaging systems to advance data integration. European countries are now participating within the IHE Europe Committee, led in the UK by the BIR IHE Working Group, which has Royal College of Radiologists representation. Now in Year 3, IHE is designed to grow incrementally by defining additional integration capabilities year by year. This brief presentation will outline the issues related to IHE, of general interest to the radiological profession, and describe the processes that are underway to ensure that integration proceeds smoothly between the participating groups in industry and the medical profession, and between countries.

1030–1245 Hall 11A
Refresher Course
Neuro MR

1030 Invited review: An overview of neuro MRI

A P Layt
Department of Neuroradiology, King's College Hospital NHS Trust, London SE5 9RS, UK

The importance of MRI in patients presenting with neurological conditions continues to grow. This presentation will provide an overview of current neuroscience use and look at how new techniques are being incorporated into clinical practice.

1100 Invited review: Perfusion and diffusion: the theory behind

C A Westbrook
Lodestone Patient Care Ltd, UK

Perfusion and diffusion are two relatively new MRI techniques used to assess brain function. Perfusion imaging relies on the change in T2* after administration of gadolinium to provide information on brain tissue perfusion characteristics. Diffusion techniques use additional gradients to sensitize image weighting towards apparent diffusion coefficient changes in the brain and spinal cord. Both techniques enable MRI to be used to characterize lesions. This lecture will outline the theory behind these techniques as a precursor to clinical applications.

1130 Neuro MR
T Lewis
Frenchay Healthcare NHS Trust, Frenchay Park Road, Bristol BS16 1LE, UK
No abstract provided.

1200 Invited review: Functional MRI of the brain: an overview
C Andrews
MRI Department, The National Hospital for Neurology and Neurosurgery, Queen Square, London WC1N 3BG, UK
For centuries, scientists and philosophers alike have sought to gain a better understanding of how the brain works, and more recently various methods have been used to localize and map brain function. MRI is a tool that has the potential to provide functional information in a non-invasive way. Technological advances have enabled the production of clinical MRI systems with ultrafast echo planar imaging capabilities. This in turn has led to functional MRI (fMRI) leaving the purely research arena and finding clinical application. The aim of this presentation is to give those new to fMRI an overview of both the theoretical and the practical aspects of the technique. The presentation will begin with a brief summary of other modalities used to examine brain function, and will then follow with a basic introduction to both echo planar imaging (EPI) and the blood oxygenation level dependent (BOLD) contrast mechanism. This section will discuss the imaging parameters used, the effects of field strength and the artefacts inherent in the technique. The second section will cover experimental design and practical implementation. Specific examples will be used to demonstrate the applications of fMRI and to highlight some of the inherent limitations. The final section will look at the steps used in the analysis and presentation of the data. The conclusion aims to summarize the advantages, limitations and future potential of fMRI.

1230 Patients with multiple sclerosis: their experiences and perceptions of the MRI investigation
A Laidlaw
Radiology Department, University Hospital, Lewisham, London SE13 6LH, UK
PURPOSE: This qualitative project investigated multiple sclerosis (MS) patients' holistic experience of the MRI scan, and identified any negative aspects of the experience. The project identified whether patients' experiences having had more than one scan improved and whether the information and support at the time of diagnosis was adequate. METHOD: Unstandardized tape-recorded interviews were undertaken on eight volunteers with the support of the MS Society of Great Britain and Northern Ireland. RESULTS: The holistic experience of the MRI scan by MS patients was overall a negative one. The most negative aspect was that the majority of interviewees felt that they had received little or no support at the time of diagnosis. The interviewees also felt that they had little or no control at certain stages of the experience and felt that they had to empower themselves because of the lack of support they received. CONCLUSIONS: The project concluded that, prior to having an MRI scan, patients should be given an information sheet about MRI scanners, and a consent form should be posted to them prior to attending the hospital. In addition, when a patient is diagnosed with MS, they should be given all the support and back up they need, such as being shown the results of the MRI scan, an overview of MS and, perhaps most importantly, being given information about their nearest MS Society branch. Improved communication between the NHS and the MS Society would achieve a stronger working partnership for the benefit of MS patients.

1240 Discussion

1030–1245 Lodge Room
Scientific Session and Keynote Lecture
Protection of Patients

1030 IR(ME)R 2000: views from the Department of Health
S Ebdon-Jackson
Department of Health, Rm 524 Wellington House, 133–155 Waterloo Road, London SE1 8UG, UK
No abstract provided.

1100 Invited review: Experiences of an IR(ME)R inspection
P J Marsden
Medical Physics and Bioengineering, UCL Hospitals NHS Trust, London WC1E 6JA, UK
The Department of Health has carried out a proactive inspection for IR(ME)R compliance at a specialist paediatric hospital with diagnostic radiology and nuclear medicine facilities. This presentation will describe the approach taken by the hospital in its implementation of IR(ME)R and how staff prepared for the inspection. To help others prepare for the experience, I will describe how the inspection proceeded, who was there, the types of questions put and the depth of detail one should be prepared to respond with. The outcome of the inspection will also be discussed.

1115 Invited review: Summary of the work of the IPEM Diagnostic Reference Levels Working Party
C J Kotre
Regional Medical Physics Department, Newcastle General Hospital, UK
The term diagnostic reference level (DRL) was introduced in the 1996 ICRP Publication 73, referring to reference patient doses for common radiological procedures used as an investigation level where doses are unusually high. This approach was adopted in the EC Medical Exposure Directive of 1997, and fed through to the UK Ionising Radiation (Medical Exposure) Regulations of 2000. In January 2000, the Department of Health convened a Working Party to consider the broad policies for the establishment and use of DRLs, where the requirements for both national and local DRLs were outlined. It was realized that more detailed guidance on the practicalities of establishing and using DRLs was urgently required, so the Institute of Physics and Engineering in Medicine (IPEM) took the lead in setting up a second DRL Working Party with representatives from the IPEM, the National Radiological Protection Board, the Royal College of Radiologists, the College of Radiographers and the British Institute of Radiology to provide authoritative guidance on these matters. This presentation summarizes the work of that group to date.

1145 A second review of the national patient dose database
D Hart, M C Hillier and B F Wall
Medical Dosimetry Group, NRPB, Chilton, Didcot, Oxon OX11 0RQ, UK
In 1992 the NRPB established a National Collation Centre for measurements of doses to patients made by X-ray departments throughout the UK. This paper analyses the data from 371 hospitals that were entered into the National Patient Dose Database during the period January 1996 to December 2000. The database contains information on the size, age and sex of the patient, and on the type of radiological equipment used. The dose data comprises 28 000 entrance surface dose measurements for single radiographs, 13 000 dose area product (DAP) measurements for single radiographs and 140 000 DAP measurements for complete examinations. This is a larger data set than that presented in the first 5-year review published in 1996. The present data set has more than four times the number of DAP measurements for complete examinations and 33% more entrance surface dose measurements for single radiographs. DAP measurements for single radiographs are analysed in this review, but they were not analysed in the previous review because there were insufficient data. Information will be presented on: (a) the geographical distribution of hospitals that have provided data; (b) the distribution of hospitals by size; (c) how data were selected to ensure that they were representative of the dose to a typical patient; (d) the distribution of room mean doses for common radiographs and examinations, including the mean and third quartile values; and (e) the level of compliance with current national reference doses.

1155 Invited review: Ultrasound safety: today and tomorrow
T A Whittingham
Regional Medical Physics Department, Newcastle General Hospital, Newcastle upon Tyne, UK
"Is it safe, Doctor?" The answer is still yes, but not an unqualified yes. Ultrasound scanners cannot be assumed to be unequivocally safe. The safety statements issued by The British Medical Ultrasound Society (BMUS) and The European Committee for Ultrasound Safety

(ECMUS) contain the proviso that equipment must be used prudently, by competent personnel who are trained in safety matters. Some machines are capable of elevating tissue temperature to levels that are known to produce teratological effects in animal embryos and fetuses. Non-thermal damage has been reported in the lungs of animal neonates. Although no epidemiological study has demonstrated any causal relationship between diagnostic ultrasound exposure and birth or developmental anomalies, no such study has been carried out with subjects exposed to today's unprecedented high output levels. The use of ultrasound contrast agents has added a new dimension to the question of safety, with reports of premature ventricular contractions in human subjects and capillary rupture in animal muscle. Until 1993, the Food and Drug Administration in the USA imposed limits on acoustic outputs that effectively gave umbrella protection against high ultrasound exposures. Since then, these limits have been substantially relaxed on the assumption that operators would make informed risk–benefit judgements using on-screen indices indicating the thermal and non-thermal hazard associated with the probe, mode and control settings in use. However, there is concern that, in general, operators are not adequately informed on the interpretation of these indices. This concern is heightened by the anticipation that machine outputs will continue to rise and the fact that there is currently a debate as to whether or not output limits should be removed altogether.

1225 Measurements of temperature rise from ultrasound exposure at soft tissue–air boundaries

[1]F A Duck, [2]G L Vella and [3]S B Barnett
[1]Medical Physics Department, Royal United Hospital, Bath BA1 3NG, UK, [2]School of Biomedical Sciences, Sydney University, Sydney, Australia and [3]CSIRO Telecommunications and Industrial Physics, Sydney, Australia

PURPOSE: Tissue heating is the most widely characterized hazard in diagnostic ultrasound. This study explored thermal effects that might occur at macroscopic tissue–gas interfaces, *e.g.* lung and intestinal gas. Three tissue-mimic targets were exposed within four ultrasound beams in pulsed Doppler conditions, frequency range 2.5–5 MHz, power range 100–200 mW. In two targets, including a modified NPL soft tissue Thermal Test Object (TTO), the temperature was measured at the plane interface between a soft tissue mimic and air. The third target consisted of two coupled slabs of tissue-equivalent gel, the lower one formed into a stabilized foam with bubbles of diameter approx. 2 mm. The interface temperatures were measured using miniature thermocouples and were compared with those in a simple tissue mimic under otherwise identical conditions. RESULTS: Within the simple tissue mimic, the greatest temperature rise at 3 min was 2.08 K. For the other targets, increases reached 2.56 K at the foamed gel interface, and 3.93 K at the tissue mimic air interface. The average (±1 SD) temperature enhancement ratios compared with tissue mimic were 1.15 (±0.076) for the foam interface and 1.68 (±0.117) for the air interface. The temperatures in the modified TTO were similar to those at the tissue–air target. CONCLUSION: It was concluded that temperatures at soft tissue–air interfaces may be expected to exceed those within uniform soft tissues, that the temperature rise will depend on the macroscopic character of the interface, and that simple, stable tissue models can be developed to characterize these conditions. [Part supported by a Wellcome Trust Travel Award.]

1235 Discussion

1115–1245 Hall 10
Scientific Session
Gastrointestinal

1115 Detecting hepatocellular carcinoma in cirrhosis: MRI with superparamagnetic iron oxide and dynamic gadolinium enhancement

B Bhartia, J Ward, J A Guthrie and P J Robinson
Clinical Radiology, St James's University Hospital, Beckett Street, Leeds LS9 7TF, UK

PURPOSE: To determine the accuracy of double contrast MRI (DCMRI) using a high resolution 3D T_1 weighted (T1W) GRE sequence in the detection of hepatocellular carcinoma (HCC) in the cirrhotic liver. MATERIALS AND METHOD: 28 patients underwent DCMRI prior to hepatic transplantation and imaging was subsequently correlated with explant histopathology. Breath-hold T1W and T2W images were obtained before and after superparamagnetic iron oxide (SPIO) and immediately followed by a bolus injection of gadolinium with 3D T1W GRE images obtained at 10 s, 40 s and 120 s. The effective slice thickness of these images was 2.5 mm. Lesions that failed to take up SPIO and were hypervascular were considered typical for HCC. Lesions that only demonstrated one of these features were considered highly suspicious. RESULTS: 30 HCCs were present in 12 of 28 patients. MRI showed 23/30 lesions (sensitivity 77%), 20/22 lesions >1 cm (sensitivity 91%) and 3/8 lesions <1 cm (sensitivity 38%). 17/23 (74%) had features considered typical of HCC; the remaining 6 had highly suspicious features. CONCLUSIONS: DCMRI is highly sensitive in the diagnosis of HCCs >1 cm in the cirrhotic patient. The detection of lesions <1 cm is still limited despite its combination with thin slice 3D T1W GRE imaging.

1125 Hepatic MRI: comparison of T_2 weighted breath-hold sequences using SPIO enhancement in patients with colorectal liver metastases

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PURPOSE: To determine the most appropriate T_2 weighted (T2W) breath-hold sequence for detecting colorectal liver metastases following SPIO enhancement. MATERIALS AND METHODS: 31 surgical patients with colorectal metastases were examined with unenhanced T1W and T2W images, and after SPIO, with four breath-hold sequences optimized for lesion detection: T2W GRE with TE 11 ms; T2W GRE with TE 15 ms; T2W FSE; and MEDIC. The images were reviewed by three independent observers and then correlated with surgery, intraoperative ultrasound and histology. The accuracy (using AFROC methodology) and sensitivity of each sequence was measured. RESULTS: The mean accuracies of post-SPIO sequences for lesions ≥1 cm and <1 cm, respectively, were: GRE (TE 15 ms), 0.97 and 0.82; GRE (TE 11 ms), 0.96 and 0.81; MEDIC, 0.95 and 0.77; and FSE, 0.90 and 0.63. For unenhanced images they were 0.88 and 0.62. Of 101 metastases, only 6 lesions were not detected by any observer on any sequence (5 lesions <1 cm, 1 lesion 1.2 cm). Irrespective of lesion size, the GRE T2W sequences were the most accurate and were significantly superior to unenhanced images and post-SPIO FSE T2. CONCLUSION: T2W GRE sequences using optimized parameters should be used for lesion detection with SPIO at 1.5 T.

1135 Influence of iodine concentration on the diagnostic efficacy of biphasic spiral CT in patients with hepatocellular carcinoma

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AIM: To assess whether using a highly concentrated contrast medium (Iomeron®-400) increases the diagnostic efficacy of biphasic spiral CT for tumour staging and indication of follow-up therapy in patients with hepatocellular carcinoma (HCC). MATERIALS AND METHODS: 22 patients with HCC confirmed by biopsy were studied with Iomeron® 400 and Iomeron® 300 in a randomized, comparative, double-blind, cross-over study. Each patient underwent two contrast enhanced spiral CT sessions (PQ6000, 120 kV, 250 mAs, 1 s rotation, 5 mm collimation, 1.5 pitch, 4 mm reconstruction interval) within 3–35 days. Contrast medium type, total grams of iodine and speed of injection were the same for each CT session (45 g I, 4 ml s^{-1}); however, contrast medium concentration was varied (400 mg I ml^{-1} *vs* 300 mg I ml^{-1}). Lesion contrast (HU lesion *vs* normal parenchyma) was examined separately in the arterial and portal venous phase for each lesion. Spiral CT sensitivity was determined in a subgroup of patients who underwent surgical resection/transplant. RESULTS: In the arterial phase, lesion contrast was significantly higher after administration of Iomeron® 400 compared with Iomeron® 300 (p=0.002, ANOVA test), whereas no difference was observed in the portal venous phase. Following the administration of Iomeron® 400, more lesions were detected in both in the arterial phase (43 *vs* 39) and in the portal venous phase (37 *vs* 34). CONCLUSIONS: In this study, a significantly higher lesion contrast was observed using a high concentration contrast medium (400 mg I ml^{-1}) in spiral CT of HCC. The qualitative evaluation for image quality and lesion detection supported the quantitative advantage afforded by Iomeron® 400.

1145 Correlative study of angiogenesis and dynamic enhancement MRI features of hepatocellular carcinoma

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PURPOSE: The aim was to study the correlation between contrast enhancement on MRI with tumour microvessel density (MVD), vascular endothelial growth factor (VEGF) and p53 protein expression. MATERIALS AND METHODS: MRI (GE Signa 1.5 T) was performed in 30 cases of hepatocellular carcinoma (HCC) (48 lesions) confirmed by histology. Cross-sectional SE T1 WI, PDWI, T2WI and FMPSPGR sequences were performed. Enhanced MRI was performed at the arterial, portal vein and delayed phases. Specimens were stained immunohistochemically for p53, VEGF and CD34. MVD was highlighted by anti-CD34. RESULTS: At the arterial phase, MVD was higher in the group with high enhancement (229.79 ± 80.96) than in the groups with medium enhancement (173.09 ± 61.38) or slight enhancement (153.00 ± 108.58) ($p<0.05$). VEGF expression was higher in the group with high enhancement (68.4%) than in the groups with medium enhancement (36.4%) or slight enhancement (38.9%) ($p<0.05$). At the portal vein phase, MVD was higher in the group of enhancement (259.80 ± 93.3) than in the group of non-enhancement (153.00 ± 108.58) ($p<0.05$). At the delayed phase, MVD was significantly higher in the group of ringed enhancement (269.06 ± 95.08) than in the group without ringed enhancement (144.10 ± 53.24) ($p<0.05$). There was a significant difference in VEGF express between the group with ringed enhancement (76.47%) and that without (42.86%) ($p<0.05$). CONCLUSION: Contrast medium enhancement patterns on MRI are influenced by tumour angiogenesis and are a valuable means to assess the angiogenesis activity and tumour neovasculaity *in vivo* for HCC patients.

1155 Double contrast MRI for pre-operative assessment of hilar cholangiocarcinomas

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PURPOSE: To assess the combined use of SPIO and gadolinium (Gd) enhancement in the evaluation of hilar cholangiocarcinomas by MRI. MATERIALS AND METHODS: 18 surgical candidates with histologically confirmed hilar cholangiocarcinoma were examined with unenhanced T_1 weighted (T1W) and T_2 weighted (T2W) sequences as well as T1W imaging at 15 s, 45 s, 90 s and 10 min after bolus injection of Gd-DTPA. 8/18 patients also underwent SPIO enhanced T2W GRE imaging immediately before the dynamic Gd enhanced series. Measurements were made of percentage enhancement of the liver and lesions after Gd in all patients. Liver/lesion contrast-to-noise ratios (CNRs) were calculated for all T1W sequences and for T2W images in the SPIO + Gd group. RESULTS: Lesion/liver CNR was substantially higher on T2W images after SPIO (mean = 20.2) than at any phase after Gd. On Gd enhanced images, lesion enhancement and CNR was greatest on 10-min images (mean CNR = 6 in both groups) in almost all cases. CONCLUSION: Double contrast MRI (DCMR) effectively combines SPIO enhanced T2W imaging for lesion detection with dynamic Gd enhancement for lesion characterization, delineating tumour from vessels and demonstrating vascular involvement.

1205 MR guided laser thermal ablation of primary and secondary liver tumours

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PURPOSE: To test the hypothesis that MR guided hepatic tumour ablation (i) is safe and feasible, (ii) improves patient survival and (iii) decreases viable tumour. MATERIALS AND METHODS: 125 MR guided laser thermal ablations (LTAs) were performed in 40 patients with hepatocellular carcinoma (HCC; $n=19$), metastases ($n=11$, mainly colorectal), carcinoid ($n=5$) and benign ($n=2$) tumours. RESULTS: Mean survival was 14.6 months for HCC and 15.2 months for metastases. For patients with Okuda Stage I HCC ($n=8$), mean survival was 17 months (expected survival 9.4 months). For Okuda Stage II ($n=9$), mean survival was 15.7 months (expected 3.5 months). For Stage III ($n=2$), mean survival was 10 months (expected 1.6 months). T_1 weighted colorized thermal maps correlated moderately well with follow-up gadolinium enhanced MRI in predicting the area of tumour ablated (Pearson correlation coefficient = 0.5). There was a significant difference in the percentage of tumour enhancing pre and post LTA (Wilcoxon signed ranks test = 0.0001). Pre- and post-ablation gadolinium enhanced MR images showed that an average of 50.7% of tumour was ablated. For multiple metastases, ablated tumours grew significantly less in size than untreated tumours over the same time period (108% *vs* 196% growth; Wilcoxon signed ranks test $p=0.07$). CONCLUSIONS: MR guided LTA of primary and secondary liver tumours is safe and feasible, and significantly decreased the amount of enhancing or viable tumour. MR guided LTA produces a better survival in patients with HCC than would be expected in untreated patients, and has a mean survival in patients with metastases at least equal to the longest median survival in untreated patients.

1215 Interventional MRI: interstitial thermotherapy with an MRI-compatible cooled laser microcatheter system

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PURPOSE: To evaluate the feasibility and safety of a new MRI-compatible cooled laser microcatheter system for thermoablation of liver metastasis. METHOD: The new microcatheter system consists of a titanium needle with a 1.5 mm diameter and surrounding Teflon catheter with a 1.80 mm (5.5 F) outer diameter. *In vitro* laser-induced ablations of liver tissue were performed to determine the optimal perfusion rate of cooling saline flow, maximum laser energy and ablation time. Laser-induced thermotherapy using the new microcatheter system, Nd:YAG laser (Dornier) and 3 cm laser applicator (Dornier) was performed in patients with liver metastasis of a colorectal carcinoma. Percutaneous introduction and positioning of multiple microcatheters in liver metastases and monitoring of therapy were performed with a 1.5 T MRI scanner (GE) using T_1 weighted gradient echo sequences in breath-holding technique. RESULTS: Perfusion rate of 0.75 ml min^{-1}, 15 W laser energy and 20 min ablation time were found suitable to perform a safe and sufficient ablation of metastatic tissue. Maximum size of induced coagulation *in vitro* was 6.5 x 4 x 4 cm^3. In all patients we were able to perform a technically and clinically successful complete ablation of all treated liver metastases. CONCLUSIONS: The new microcatheter system allows both application of the catheter and monitoring of therapy on only one imaging modality. This results in time saving and a more precise puncture and therapy of liver metastasis. Owing to the miniaturized design of the catheter and real-time monitoring, the procedure is minimally invasive and very well tolerated by patients. This new technique appears to be a safe and feasible alternative in the therapy of liver metastasis.

1225 Feasibility of abdominopelvic T_1 weighted thermal mapping of laser ablation

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PURPOSE: To prove the hypothesis that T_1 weighted thermal mapping is reliable and achievable in MR guided laser tumour ablation (LTA). METHODS AND MATERIALS: 110 MR guided LTAs of liver, kidney and uterine tumours were studied. After laser fibre placement, near real-time grey scale and colour thermal maps are produced. Previous work showed that T1 signal is inversely proportional to temperature below 55°C (the point of irreversible tissue necrosis). Measurements included: (i) percentage of cases in which the thermal map provided sufficient information to control the procedure; (ii) ability of grey scale and colour maps to demonstrate size (cm) and conspicuity (10-point scale) of thermal lesions; and (iii) factors causing thermal mapping failure. RESULTS: (i) Thermal mapping was successful in 84% of uterine ablations, 74% of hepatic ablations and 20% of renal ablations. (ii) For hepatorenal tumours, size and conspicuity of thermal lesions were significantly greater on the colour than the grey scale mapping. For uterine ablations, mean lesion size was 3.1 cm (colour) and 2.5 cm (grey; $p=0.001$, paired Student's t-test), while mean conspicuity was 7.3 (colour) and 1.7 (grey; $p=0.001$). For liver ablations, mean lesion size was 3.1 cm (colour) and 1.7 cm (grey; $p=0.001$), while conspicuity was 7.5 (colour) *vs* 3.7 (grey; $p=0.001$). (iii) Patient movement ($n=24$), fibre charring ($n=2$), magnetic field distortion and reconstruction errors ($n=2$) caused mapping failure.

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CONCLUSIONS: In hepatic and uterine thermal maps, the colour scale produced significantly greater sized lesions with significantly greater conspicuity than the grey scale. T_1 weighted signal thermal mapping was reliable and successfully achieved in 73.7% of procedures.

1235 Pre-emptive use of TBIDA hepatoscintigraphy to evaluate the biliary system following traumatic liver injury

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PURPOSE: The liver is the most commonly damaged organ in children following blunt abdominal trauma. CT is the primary imaging modality of choice and, if the patient is haemodynamically stable, a non-operative approach is now the recognized standard of care. Unfortunately, this approach can result in bile duct damage remaining undetected. We have evaluated the use of TBIDA hepatoscintigraphy acutely to detect bile leakage prior to the patient becoming symptomatic. METHODS: All patients who sustained significant trauma and who were haemodynamically stable underwent abdominal CT. Patients with a liver fracture that was greater than 4.0 cm or that involved the porta hepatis underwent TBIDA hepatoscintigraphy. RESULTS: 21 patients (13 boys, 8 girls; mean age 13.4 years) underwent abdominal CT. Nine patients had significant liver injury to warrant a TBIDA study. In three patients the TBIDA study demonstrated activity within the peritoneal cavity. These patients underwent intraoperative cholangiograms that confirmed biliary leak and were surgically stented. Neither patient showed evidence of biliary peritonitis at the time of the TBIDA study. In another patient, TBIDA imaging showed evidence of a biloma that on follow-up ultrasound was shown to be at the site of a portovenous fistula. All patients recovered well, back to normal lifestyle. CONCLUSIONS: Pre-emptive TBIDA can detect biliary damage prior to the development of symptoms. Early detection improves surgical outcome and reduces hospital stay. Combining CT and TBIDA examinations will improve detection of traumatic liver injuries.

1115–1145 Olympian Suite 1
Keynote Lecture
Cancer Services Collaborative: its importance in radiology

1115 Cancer Services Collaborative: its importance in radiology

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PURPOSE: To inform radiologists of the aims, principles and methodologies of the Cancer Services Collaborative and to indicate how these can be applied in a radiological setting. MATERIALS AND METHODS: The NHS Plan and the subsequent NHS Cancer Plan were published in 2000. Shortly afterwards, the Cancer Services Collaborative (CSC) was formed to introduce modern change principles aimed at improving cancer care. Over 250 CSC projects are currently being carried out looking at the major tumour areas. 13 radiology projects are underway, with more to follow. The CSC methodologies and principles are outlined. RESULTS: The CSC is increasingly being seen as an important vehicle for delivering the NHS Cancer Plan. The projects that are underway have shown how the methodology can be used to streamline patient care, placing the patient at the centre. The work being undertaken by the CSC in England is a major undertaking and is considered to be the largest healthcare redesign taking place anywhere in the world. The principles and methodologies used by the CSC are particularly relevant for radiology departments. Process mapping and capacity and demand studies are key elements in understanding the problems in overstretched radiology departments. They allow limited resources to be most efficiently targeted and form a powerful argument for additional resources. In the UK, the CSC principles are increasingly being accepted by the Government and it is likely that CSC methodologies will become an integral part of funding applications in the future. CONCLUSION: The CSC principles and methodologies are an important tool in improving patient care. They are widely applicable to radiology and cover all areas of practice, not just cancer. They are destined to become an important part of funding applications. It is important that radiologists understand these principles.

1115–1230 Olympian Suite 2
Scientific Session
Musculoskeletal

1115 Shoulder ultrasound: type and size of rotator cuff tears and influence on surgical management

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PURPOSE: To evaluate rotator cuff ultrasound within our centre. Does the size or type of cuff tear influence surgery? METHODS AND MATERIALS: A 2-year retrospective audit of 168 shoulder ultrasound scans was undertaken. Two orthopaedic surgeons referred all patients. All ultrasound scans were performed by a single musculoskeletal radiologist. 53 patients subsequently underwent surgery. Ultrasound and surgical findings were compared. The surgical findings were deemed the gold standard. RESULTS: Full thickness tears were diagnosed with a specificity of 87.5% and a sensitivity of 100%. Partial thickness tears were diagnosed with a specificity of 93% and a sensitivity of 85.7%. The average size of cuff tear at ultrasound was 2.7 cm. The average size at surgery was 3.23 cm. The discrepancy in size between ultrasound and surgery correlated with the delay between the two. All patients with tears greater than 4 cm, and most tears over 3 cm, required open operation. CONCLUSION: Ultrasound accurately diagnoses cuff pathology. Tears greater than 3 cm require open surgery. Size measurement should therefore be performed routinely in the shoulder ultrasound assessment. The type of surgery can be planned by determining the size of the cuff tear. Arthrotomy is associated with increased morbidity, and prolonged recovery period and hospital stay. In addition, rotator cuff tears appear to evolve and extend with time.

1125 MRI in clinical scaphoid fracture

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AIM: To determine the MRI-detected incidence of scaphoid and other wrist fractures in patients with suspected scaphoid injury and negative initial radiographs, and to examine the subsequent effect on patient management. MATERIALS AND METHODS: Patients attending Accident and Emergency over a 25-month period with suspected scaphoid fracture and normal scaphoid series plain radiographs were referred for MRI. Scans comprising T_1 SE and STIR coronal sequences were performed within 14 days of injury. Subsequent patient management was ascertained by a clinician-completed questionnaire. RESULTS: 195 patients were scanned. There were 37 scaphoid fractures (19%), 28 distal radius fractures (14%), 9 fractures of other carpal bones (5%) and 119 studies with no fracture (61%). The management of 180 patients (92%) was altered as a result of MRI. CONCLUSIONS: Occult fractures are present in two-fifths of patients with normal scaphoid plain radiographs and clinical suspicion of scaphoid fracture. Half of these are scaphoid fractures. MRI allows an early definitive diagnosis to be made, changing patient management in over 90% of cases, and should be regarded as the gold standard investigation in this population.

1135 MRI findings following acute wrist trauma in children

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PURPOSE: Accurate diagnosis of injuries to the wrist and forearm can be difficult in children. The purpose of this study is to evaluate the role of MRI of the wrist/forearm following acute trauma in children and to assess its correlation with plain radiography. MATERIAL AND METHOD: 101 MR examinations were performed in 99 children presenting to our hospital with acute trauma to the wrist and forearm between September 1998 and July 2000. Plain radiographs were obtained and all patients were clinically re-assessed 48–72 h later. In patients who had persisting equivocal clinical or radiological findings for injury, an MRI was performed. The MR investigation was considered the definite investigation. All examinations were reviewed by two consultant paediatric radiologists and agreement was reached by consensus. RESULTS: Of the 99 radiographic studies that preceded

an MRI examination, 48 were normal, 14 were equivocal and 37 were abnormal. In those with normal radiographs, 62% had abnormal MR examinations (34% of which were occult fractures). In those with equivocal radiographs, MR demonstrated an abnormality in all but one of the cases. In those with abnormal radiographs, MR was normal in 5% and showed additional pathology in 19%. CONCLUSION: MRI of the wrist/forearm should be routinely considered following acute trauma in those children where there is clinical doubt or discrepancy between clinical and radiological findings.

1145 Dedicated low field MRI for routine peripheral joint examination and visual quality

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PURPOSE: The purpose was to evaluate the visual diagnostic quality of examinations carried out on a low field (0.2 T) extremity MRI scanner (Artoscan, Esoate, Genova Italy) for routine orthopaedic and trauma indications. MATERIALS AND METHODS: Between October 1998 and May 1999 (8 months) a total of 445 extremity MRI examinations were carried out on 169 females (175 examinations) and 269 males (270 examinations) with an age range of 11–76 years. All examinations were scored retrospectively for general quality on the following scoring system: 1 = poor, not diagnostic; 2 = poor but diagnostic; 3 = good; and 4 = very good quality. The criteria for quality consisted of the visual diagnostic quality of anatomical parts. For the knee these were meniscus bone bruise, cruciate ligaments and joint fluid; for ankle, ATFL, syndesmosis bone bruise and joint fluid; and for wrists, TFCC, SL ligament and joint fluid detection. RESULTS: 316 knees, 55 ankles, 68 wrists and 6 elbows were examined on the extremity scanner. The results of quality scoring were as follows: Score 1 = 0; Score 2 = 55 (12%); Score 3 = 321 (72%); and Score 4 = 69 (16%). CONCLUSIONS: Retrospective evaluation has shown that 88% of low field MRI extremity examinations were of good quality (with 16% very good) and 12% were of poor quality although they were diagnostic for major abnormalities. Low field (0.2 T) extremity scanning is a feasible choice for routine indications for peripheral joint MRI examinations.

1155 Discriminatory ultrasound criteria for the diagnosis of carpal tunnel syndrome

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PURPOSE: Ultrasound examination of the median nerve has been suggested as a useful alternative to electrophysiological study in the diagnosis of carpal tunnel syndrome. To determine its usefulness and the best diagnostic criterion, ultrasound examination of patients with the disease were compared with ultrasound examination of normal subjects in a case-control study. MATERIALS AND METHODS: Patients with carpal tunnel syndrome and asymptomatic controls matched for age and sex were enrolled and underwent ultrasound examination of the wrists. Eight separate ultrasound criteria were analysed in each wrist. Data from the patient group and the control group were compared in order to establish optimal diagnostic criteria for carpal tunnel syndrome using receiver operating characteristic (ROC) analytical techniques. RESULTS: 35 carpal tunnel syndrome patients and 35 asymptomatic controls were examined. Increased cross-sectional area of the median nerve was found to be the most predictive of carpal tunnel syndrome proximal to the tunnel inlet, at the tunnel inlet and at the tunnel outlet, with significant differences between patients and controls. Using ROC curve, a cut-off value above 0.098 cm^2 at the tunnel inlet provided a sensitivity of 89% and a specificity of 83%. CONCLUSION: Measurement of median nerve cross-sectional area is both sensitive and specific for the diagnosis of carpal tunnel syndrome.

1205 MRI findings in soft tissue and muscle infection and inflammation: a systematic compartmental approach

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PURPOSE: MRI has become critical in the delineation of musculoskeletal infection. Evaluation of soft tissue infections, including cellulitis, myositis, fasciitis, abscess, osteomyelitis and septic arthritis, are often best evaluated by MRI owing to its excellent anatomic resolution and soft tissue contrast. The aim of this study was to describe and evaluate the MRI findings in soft tissue and muscle infection and inflammation. METHODS AND MATERIALS: A retrospective study was performed of the MRI findings of 74 patients (47 male, 27 female) presenting with soft tissue and muscle infection and inflammation over a 3-year period. Images were evaluated using a compartmentalized anatomical approach according to the location of signal abnormalities in the subcutaneous fat, deep fascia or muscle. The MRI results were correlated with the clinical outcome. RESULTS: The findings were as follows: 46% cellulitis, 1% necrotising fasciitis, 21% pyomyositis, 19% osteomyelitis, 6% septic arthritis, 1% tenosynovitis and 6% abscess. 86% of cases involved the lower limbs. Of the myositis group, 70% of the pathology occurred in the lower limb, 15% in the iliopsoas and gluteal region and 15% in the upper limb. CONCLUSION: MRI was highly sensitive for defining the pathological processes and for detecting subtle fascial and muscle changes. MRI is helpful for determining the depth of soft tissue involvement especially within the fasciae and muscle and can determine the need for surgical intervention.

1215 Discussion

1130–1250 Hall 11B
Scientific Session
Neuroradiology

1130 MRI and neuropsychological improvement in Huntington's disease following ethyl-EPA treatment

B K Puri, G M Bydder, S J Counsell, B J Corridan, A J Richardson, G Hamilton, J V Hajnal, C Appel, H M McKee, K S Vaddadi and D F Horrobin
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A 6-month randomized, placebo-controlled pilot study of the ethyl ester of eicosapentaenoic acid (ethyl-EPA) was carried out on seven inpatients with advanced (stage III) Huntington's disease (three treated with ethyl-EPA, four with placebo; no significant difference in age or sex between groups). After 6 months, all the patients treated with ethyl-EPA improved on the orofacial component of the Unified Huntington's Disease Rating Scale, while all the patients on placebo deteriorated on this scale ($p<0.03$). Following subvoxel registration of follow-up 3D MRI brain scans with baseline scans, subtraction images showed that while the placebo was associated with progressive cerebral atrophy, ethyl-EPA was associated with a reverse process. We conclude that treatment with ethyl-EPA is associated with beneficial motor and MRI changes.

1140 MRI demonstrates changes in tumoral capillary endothelial permeability in response to VEGF inhibition with HuMV833 anti-VEGF antibody

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PURPOSE: Growth of tumours is highly dependent on their ability to develop new blood vessels, a process known as angiogenesis. Many new therapeutic approaches are under development, which attempt to inhibit the angiogenic process. One potential strategy is inhibition of the cytokine mediator vascular endothelial growth factor (VEGF). We have used MRI to study the biological effects of a monoclonal anti-VEGF antibody (HuMV833) in a group of 20 patients with abdominal and pelvic tumours. The study was conducted as part of a Phase one trial. METHOD: The antibody was administered on days 1, 15, 22 and 29 at four dose levels ranging from 0.3 mg kg^{-1} $treatment^{-1}$ to 10 mg kg^{-1} $treatment^{-1}$. MRI was performed prior to drug administration, at 48 h following the first dose and at day 35. Since VEGF specifically inhibits capillary endothelial permeability over a short period of time, we have used MRI to calculate the capillary endothelial permeability surface area product (K^{TRANS}) and the regional blood volume (rBV) using a recently described breath-hold technique [1]. All patients showed a significant reduction in K^{TRANS} (median 44%, range 5–91%) following the first dose of antibody. In patients on the low dose regimen, changes in endothelial permeability were not associated with changes in rBV. At higher doses, concomitant changes occurred in both parameters. We conclude that breath-hold mapping of K^{TRANS} and rBV is able to demonstrate separate, dose-dependent

changes in these parameters in response to VEGF inhibition. ([1] Li K, Zhu X, Waterton J, Jackson A. Improved 3D quantitative mapping of blood volume and endothelial permeability in brain tumors. J Magn Reson Imaging 2000;12:347–57.)

1150 WIP: The ability of ultrasound to differentiate benign and malignant thyroid nodules using grey scale morphological features

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MATERIALS AND METHODS: Ultrasound (US) images of 102 patients who had undergone US guided fine needle aspiration biopsy (USGFNAB) were retrospectively reviewed. There were 16 males and 86 females, with a mean age of 55.5 years (range 15–86 years). Two reviewers, who were blinded to the cytology and histology reports, assessed the US appearances of biopsied nodules, with agreement by consensus. Features assessed included: nodular focality/multifocality; nodule size; marginal definition; heterogeneity or homogeneity of the internal architecture; internal echogenicity (hypoechoic, isoechoic or a combination) relative to the background of the thyroid; the presence or absence of calcification (focal, multifocal or diffuse, and coarse or fine); the presence or absence of cystic change and whether this was focal, multifocal or diffuse; and the presence of mural nodularity. RESULTS: 10 cancers were confirmed. Homogeneity was more common in follicular lesions. Hypoehoity was more common in malignant (77%) than benign (46%) lesions. Lesion size did not predict malignancy or benignity (both mean 2.9 cm). 60% of cancers presented as solitary focal lesions while 87% of benign lesions were part of a multifocal process. Fine calcification was more common in malignancy (40% *vs* 8%), whilst cystic changes were more common in benign lesions (70% *vs* 40%). CONCLUSIONS: The ability of US to more accurately differentiate nodules that are more likely suspicious may help to guide USGFNAB and improve its sensitivity, particularly in multifocal thyroid disease.

1200 WIP: Ultrafast MRI in paediatric neuroradiology

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PURPOSE: To compare the diagnostic information obtained from ultrafast MRI with standard MRI techniques in paediatric neuroradiology. The goal was to judge whether ultrafast methods can be used to replace standard methods and can reduce the need for sedation or general anaesthesia as a result of the considerably shorter scan times. PATIENTS AND METHODS: This was a prospective study over a 24-month period from January 1998 to December 2000, and involved 125 patients. Routine clinical imaging was performed along with two ultrafast methods. SSFSE was used to give T_2 weighted images and an EPI sequence to provide T_1 weighted images. The ultrafast images were presented to an experienced neuroradiologist who was also given the information present on the initial referral card. These reports based on the ultrafast images were then compared with the formal radiological report made solely on the basis of standard imaging. RESULTS: The overall sensitivity and specificity for ultrafast imaging compared with the reference standard were 78% and 98%, respectively, with positive and negative predictive values of 98% and 76%, respectively. Pathologies characterized by small areas of subtle T2 prolongation were difficult or impossible to see on the ultrafast images but they otherwise provided reliable information. CONCLUSION: This paper demonstrates that ultrafast MRI can diagnose many paediatric intracranial abnormalities equally as well as standard methods. Anatomical resolution limits its capacity to define subtle developmental anomalies, and contrast resolution limitations of the ultrafast methods reduce the detection of pathology characterized by subtle T2 prolongation. These findings begin to explore the possibility of replacing long MR scan procedures, which often require sedation or general anaesthesia. It appears that the ultrafast images contain sufficient information to make diagnoses in many cases and we discuss clinical situations that warrant further investigation.

1210 WIP: Immediate post-operative MRI in children following brain tumour resection

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PURPOSE: Post-operative enhanced MRI is the standard modality for assessing residual brain tumour. It may be impossible to differentiate residual tumour enhancement from surgically induced non-neoplastic enhancement. This includes enhancement of the surgical margin (demonstrated from 16 h post operatively), meninges (present from 9 h post operatively) and ischaemic parenchyma. Methaemoglobin also obscures residual tumour. The purpose of this project is to evaluate the role of immediate post-operative MRI in residual tumour assessment and patient management. METHOD: 24 children with brain tumours underwent pre-operative and immediate post-operative enhanced MRI. RESULTS: Immediate post-operative timing avoided benign surgically induced contrast enhancement. Residual tumour was clearly seen as enhancement corresponding to nodular enhancing areas present on the pre-operative scan. No diagnostic difficulties were encountered. Immediate post-operative images determined further management in patients with residual tumour as follows: (1) immediate re-exploration and further resection (under same GA); (2) referral to specialized chemotherapy centres; (3) stereotactically guided application of chemotherapeutic agents; or (4) coned down radiotherapy focused on clearly delineated residual tumour. Residual tumour was confirmed histologically in patients taken back to theatre for re-exploration or on follow-up imaging. The mean follow-up period is 27 months. CONCLUSIONS: Immediate post-operative MRI (1) minimizes interpretative difficulties, is more accurate in evaluating residual tumour and in serving as a baseline for subsequent studies; (2) influences and hastens further clinical management; (3) permits a single general anaesthetic for initial surgery, imaging and possible further resection; and (4) is practically possible in a busy radiology practice.

1220 WIP: Do clinically silent subdural haemorrhages occur in the newborn neonate?

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BACKGROUND: An isolated subdural haemorrhage in a case of suspected non-accidental injury may be defended in court by the possibility that it was birth-related. AIM: To establish whether clinically silent subdural haemorrhage occurs in the newborn neonate, if it is related to any variable in labour or delivery, and what the natural history is. METHODS: Babies were imaged within 48 h of delivery using a 0.2 T magnetic resonance (MR) scanner. Gestational age range was 38–42 weeks. All the labour details were collected. All neonates who had a subdural collection were followed-up clinically and by MR scanning. RESULTS: 62 babies have been scanned to date. The final delivery achieved was normal vaginal in 28 (45%), metal cup ventouse in 2 (3%), plastic cup ventouse in 5 (8%), emergency section in 6 (8%), elective section in 8 (12.9%) and forceps (keillands 1 (1.6%), Neville Barnes (NB) 12 (19.4%)). In 3 cases, silent subdural collections were identified: 2 supratentorial, 1 posterior fossa. All resolved fully within 4 weeks. All were delivered by NB forceps following attempted ventouse. In those delivered by forceps, 12 followed a previous attempt at a ventouse delivery. Comparing babies delivered by failed ventouse with forceps delivery with and without bleeds, using the Students *t*-test there was no significant difference in duration of second stage of labour, caput, or apgars at 1 min. (t= 0.18, 0.88, 0.94). CONCLUSION: The numbers are still small but the method of delivery may prove to be significant, as may the duration of second stage of labour.

1230 WIP: Non-invasive diagnosis and classification of dural arteriovenous fistulae with dynamic MR digital subtraction angiography

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PURPOSE: To assess the potential of dynamic MR digital subtraction angiography (MRDSA) to detect dural arteriovenous fistulae (DAVF) and to identify those at greatest risk of neurological complications. PATIENTS AND METHODS: Six patients with known or suspected DAVF were referred for MRI and catheter angiography. MRDSA was performed on a 1.5 T system (Eclipse, Philips Medical Systems) using a temporally dynamic, radiofrequency-spoiled, gradient echo technique that acquired a single thick slice prior to, during and after administration of a bolus of exogenous contrast agent. RESULTS: MRDSA

detected a total of 7 DAVF (type 1, n=2; type 2a, n=3; type 3, n=2) in the six patients. It was possible to identify the larger of the arterial pedicles, to locate the site of the shunt and to evaluate the pattern of venous drainage. Furthermore, we analysed time–intensity plots of the arterial and venous circulations in an attempt to identify those patients at greatest risk from intracranial hypertension. CONCLUSION: MRDSA is a non-invasive technique capable of detecting and characterizing DAVF.

1240 Correlation of spinal ultrasound with MRI in infants

J A Hughes, R de Bruyn, K Patel and D Thompson
Radiology and Neurosurgery Departments, Great Ormond Street Hospital for Children, London WC1 3JH, UK

PURPOSE: MRI represents the imaging method of choice for detecting spinal defects in infants. Ultrasound (US) is becoming more widely used, but has had little formal evaluation. To establish the accuracy of US for the detection of spinal defects in infants, US and MRI were compared. MATERIALS AND METHODS: 82 consecutive infants (age range 1 day–10 months; mean age 52 days) over 2 years had spinal US. 14 of these showed an abnormality on US and also underwent MRI. US and MRI findings were compared. RESULTS: MRI showed normal spinal anatomy in 2 of the 14 infants and abnormal anatomy in 12 of the 14. In 4 (29%) of 14 US showed full correlation with MRI, in 9 (64%) of 14 there was partial correlation and in 1 (7%) of 14 no correlation was seen. In 92% of cases with abnormal MRI, US identified an abnormality. US failed to visualize: 5/5 dermal sinuses, 2/2 fatty filums, 1/1 terminal lipoma, 2/3 partial sacral agenesis and 1/9 low lying conus. Of the two infants with normal MRI, one infant had cord tethering identified on US. CONCLUSION: There was a high degree of concordance between US and MRI, particularly for the detection of low lying cord. US detected an abnormality in 92% of abnormal spines detected on MRI. We therefore recommend US as a first line screening test for congenital spinal anomalies. If US is abnormal, MRI is advised for full assessment.

MONDAY

1130–1315 Hall 9

Advances

Radiographer Reporting

1130 Invited review: The plain film reading performance of radiographers: a systematic review

S Brealey, A J Scally and N B Thomas
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Introduction of the NHS and Community Care Act in 1990 provided radiographers with an opportunity to develop their reporting role. Subsequently over the last decade, the restrictions on who should report have been relaxed. This is reflected by the increase in radiographers reporting X-ray examinations for Accident and Emergency patients from 4 Trusts in 1995 to 32 trusts in 1999. The objectives of this systematic review were to synthesize the evidence of radiographers' and other healthcare professionals' plain film reading performance for different patient types, body areas and in different roles. Methods of locating studies included searching electronic databases and grey literature, hand-searching journals, personal communication and scanning reference lists. Studies were judged eligible for inclusion if they assessed radiographers' plain film reading performance compared with a reference standard and included appropriate statistics, *e.g.* sensitivity, specificity. The search of electronic databases yielded 20 such studies between 1971 to the end of June 1999, of which 7 were eligible. A total of 30 studies were judged eligible from all data sources. One independent reviewer extracted data from 10 studies and two of three independent reviewers for the other 20 studies. This paper will present the findings of the systematic review using both qualitative and quantitative analyses.

1150 Invited review: Image interpretation by radiographers: an analysis of visual search, eye movements and decision-making strategies

D Carr
University of Derby, UK

Image interpretation involves complex cognitive and perceptual processes. In analysing what an observer does in interpreting an image, the end point of the process (the decisions/observations made) are often solely used to quantify the efficacy of interpretation. Evaluating the eye movements (EMs) made by an observer and relating these to other factors associated with the outcome of interpretation can not only help us understand the nature of the process better but it can also effectively quantify the efficacy of individual observer performance. This presentation seeks to provide an overview of the methods that can be used to assess EMs and visual search strategies and how these can be related to factors associated with decisions/observations made. To contextualize the methods that can be used, the results of a recent study will be provided. The study aimed to compare and contrast the EM and decision-making strategies of radiographers and radiologists in the interpretation of a test set of 50 mediolateral oblique images. Data about eye fixations (duration and position) made by observers were recorded and correlated against decisions made about the outcome of observation (confidence in decision, position of abnormalities, overall decision of whether to return to screen or recall) as well as errors made against gold standard interpretations. Results show that film-reading radiographers had both higher sensitivity and specificity than non-film reading radiographers but lower sensitivity and specificity than radiologists.

1220 Interpreting chest radiographs: the effect of training and experience

M L Jones and A W Horrocks
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PURPOSE: This study investigates the accuracy of plain chest radiograph reporting in relation to level of training and experience. MATERIALS AND METHODS: There were 44 participants: 32 trainees (years 1–5 of the training scheme) and 12 consultant radiologists. Consultants were divided into two groups, those specializing in chest radiology and those not. The test set consisted of 50 chest radiographs with 30 abnormal and 20 normal films. Each examination was categorized as normal or showing significant abnormality. RESULTS: Chest consultants had the highest average sensitivity and specificity scores. From year 4 onwards there was no statistically significant difference in performance between the groups. Years 1 and 2 had average sensitivity scores of less than 50%, statistically significantly lower than all other groups. Specificity scores were generally higher. All groups scored lowest on mediastinal lesions and highest with chest wall/extrathoracic abnormalities. CONCLUSION: There is considerable variation in accuracy of plain chest radiograph reporting. A threshold level of performance is reached in year 4, coinciding with the final FRCR examination. Junior trainees had difficulty identifying abnormal films. A test set of films can be designed to identify a particular area of weakness.

1230 Introduction of digital radiography and its implications for radiographer clinical reporting

P Morris, A Grieve, J Hughes and A M K Thomas
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This paper reviews the practical issues and implications of reporting digital A&E radiographs on a PACS for a team of radiographers of varying experience. A Fuji digital radiography system and hospital-wide PACS was installed in our department in 2001. The images were initially reported on hard copy of the digital images before full soft copy reporting with the introduction of a hospital-wide PACS (supplied by Laser Lines). We have two radiographers who have been reporting for 4 years and two whose qualification in Clinical Reporting coincided with the introduction of the digital radiographic system. The implications of reporting digital radiographs are considerable. This paper will explore the practical implications of moving to soft copy reporting. In particular, the process of reporting, image manipulation, the viewing conditions required, the artefacts encountered in digital radiography and the acceptability of PACS will be considered.

1240 A 2-year prospective study of radiographers for unsupervised reporting of casualty trauma radiographs

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METHODS: Over a 2-year period, a total of 1050 casualty trauma films reported by specially trained radiographers were prospectively reviewed. Discrepancies were classified into three board categories:

(1) clinically important missed fracture that required issuing of an addendum to the original report; (2) major fault in the report issued but of minor clinical significance; and (3) minor fault in the report issued. For cases in category (1), the clinical outcome was reviewed retrospectively by studying the casualty record. RESULTS: There were 13 (1.2%) missed fractures in total that had an amended report issued. However, of these 13 cases, only 1 required referral to fracture clinic for treatment. In categories (2) and (3), common mistakes included missed old fracture (15 cases; 1.4%), no mentioning of significant soft tissue swelling especially over the ankle (12 cases; 1.1%), correct diagnosis but poor wording (11 cases; 1%) and missed degenerative changes in joints (8 cases; 0.8%). In addition, there were 5 cases (0.5%) of missed knee joint effusion, 4 cases (0.4%) of missed benign lesions and 3 cases (0.3%) of missed AC joint subluxation. CONCLUSION: We conclude that our current policy of allowing specially trained radiographers to report casualty trauma radiographs independently is safe.

1250 Reporting of non-A&E radiographic examinations by radiographers: a review of 6796 cases

K J Piper, R C Godfrey and A M Paterson
Department of Radiography, Canterbury Christ Church University College, Canterbury, Kent CT1 1QU, UK

PURPOSE: To analyse the results achieved in objective structured examinations (OSEs) by a number of radiographers (n=28) who successfully completed a postgraduate qualification in clinical reporting of the appendicular and axial skeleton. The purpose was to test for any significant differences in terms of sensitivity, specificity and/or accuracy between cases of patients referred from the accident and emergency (A&E) department compared with other referral sources. METHODS: The research examined the actual scores (n=6796) achieved by three cohorts of radiographers. Each radiographer reported on a bank of 200 plain film examinations of the musculoskeletal system and responses were scored using pre-determined expected answers. True negative/positive and false negative/positive fractions were allocated to allow sensitivity, specificity and accuracy to be calculated. Mean scores were calculated and multilevel modelling on the data enabled an estimation of underlying performance measures together with 95% confidence intervals (CIs). RESULTS: The mean values calculated from the actual OSE scores were very high: 91.6–96.7%, 92.1–94.0% and 91.8–93.7% in terms of sensitivity, specificity and accuracy, respectively. Mean scores for the A&E *vs* non-A&E examinations were 92.9% and 93.1%; 92.3% and 94.5%; and 92.5% and 93.9%, respectively. CONCLUSION: This study provides further evidence that radiographers are able to report on A&E plain film examinations of the musculoskeletal system to a very high standard. It also demonstrates that, in terms of overall accuracy between reports on A&E and non-A&E referrals, any differences are negligible. Implementation into clinical practice should be considered.

1300 Discussion

1145–1215 Olympian Suite 1
Keynote Lecture
Diagnostic and Staging Procedures in Gastric and Oesophageal Cancer in Scotland

1145 Invited review: Diagnosis and management in gastric and oesophageal cancer: a Scotland-wide survey (SAGOC)

F J Gilbert, on behalf of the Steering Group of SAGOC
Department of Radiology, University of Aberdeen, Aberdeen AB25 2ZD, UK

INTRODUCTION: The aims of the SAGOC project were to identify variations in diagnosis and management of gastric and oesophageal cancer in Scotland; to identify good and inappropriate practice based on clinical outcomes; and to identify areas requiring further investigation and research. METHOD: Prospective data on all patients with gastric and oesophageal cancer were collected. Data on patient symptoms, diagnostic procedures and staging investigations were collected. Data on surgical and oncological treatment together with palliative procedures were collected in detail, together with survival results. RESULTS: 3293 patients were identified from August 1997–1999. The median age was 72 years. 40% of patients had severe co-morbid disease limiting treatment options and 30% had symptoms for over 4 months. Dysphagia and weight loss were the two most common symptoms. Endoscopy and biopsy were performed in 94% of cases, with barium meal performed in 45%, 37% and 21%, respectively. Staging was predominantly performed using CT (69%), ultrasound (30%) and laparoscopy (20%). Survival curves show that endoscopic ultrasound is best able to differentiate outcome. 1302 (39.5%) patients were treated surgically, 6.5% anastomotic leak rate and 12.9% post-operative mortality. There were no statistically significant differences in operation rates or mortality with size of hospital. 22.9% of patients received chemotherapy or radiotherapy, or a combination of both. Overall, the survival for gastric and oesophageal cancer was 32% (1 year) and 17% (2 years); patients undergoing surgery had 54% and 33% survival, respectively. Age, co-morbidity, level of physical activity, degree of dysphagia, pre-treatment aim of therapy and resection margin involvement were the major factors affecting survival.

1205 Discussion

1330–1415 Hall 10
Royal College of Radiologists
Tesla Lecture

1330 Eponymous Lecture: Imaging liver cirrhosis: opportunities and pitfalls

R Baron
University of Pittsburg, 200 Lothrop Street, Pittsburg, PA 15213, USA

No abstract provided.

1345–1515 Lodge Room
Scientific Session
Radiation Protection and Image Quality

1345 UK population exposure from medical X-rays

B F Wall and D Hart
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The results of a recent survey of the frequency of medical and dental X-ray examinations in the UK have been combined with contemporary data on the radiation doses typically received by patients in order to assess trends in the extent and pattern of this major source of population exposure. Individual patient doses, expressed in terms of the effective dose, range from a few microsieverts for simple radiographic examinations of the teeth, limbs or chest to tens of millisieverts for prolonged fluoroscopic procedures or some CT examinations. A total of 41.5 million medical and dental X-ray examinations are now conducted each year in the UK (0.70 examinations per head of population), resulting in an annual per caput effective dose of 330 μSv. This is not significantly different from the previous rough estimate of 350 μSv for 1991. However, over the last 10 years CT has more than doubled its contribution and is now responsible for 40% of the total dose to the population from medical X-rays. In contrast, the contribution from conventional radiographic and fluoroscopic examinations has nearly halved to about 44%. Interventional and angiographic procedures together contribute the remaining 16%. The much increased contributions of CT, angiography and interventional procedures to the UK population dose will be discussed and indicate an urgent need to develop radiation protection and optimization initiatives for these high dose procedures to the same level as has been achieved for conventional radiology.

1355 Ethics in radiation protection

R H Corbett
Radiology Department, Hairmyres Hospital, East Kilbride G75 8RG, UK

Ethics is a branch of philosophy. Its object is the study of both moral and immoral behaviour in order to make well founded judgements and to arrive at adequate recommendations. The International Radiation Protection Association (IRPA) has responded to an increasing interest worldwide in the creation of a code or codes of ethics in radiation protection. It has sponsored sessions at various national and international meetings with a view to reaching an international consensus at its next Congress in Madrid, 2004. To assist those interested in contributing to the debate, this presentation will discuss some of

the basic issues. An IRPA-sponsored Internet chat room exists to allow anyone to contribute. It can be found at www.srp-uk.org/irpaethics. There are perhaps eight major issues that have to be considered: (1) equity *vs* efficiency: the justification principle; (2) health *vs* economics: the optimization principle; (3) individual rights *vs* societal benefits: the dose limitation principle; (4) due process *vs* necessary sacrifice: liability principles; (5) stakeholder consent *vs* management decisions: controlling exposures; (6) psychology: fear of radiation more harmful than radiation; (7) psychology: fear of radiation as a contribution to genocide; and (8) science: the question of truth. These and other aspects will be discussed, principally in relation to radiation protection, but they could just as easily apply to any branch of science.

1405 Implementing IR(ME)R: providing "adequate" training

[1]A Hemingway and [2]M Myers
[1]Department of Imaging and [2]Radiological Sciences Unit, Hammersmith Hospital, DuCane Road, London W12 0HS, UK

The Ionising Radiation (Medical Exposure) Regulations 2000 (IR(ME)R) came into force in May 2000 and January 2001. The day-to-day responsibility for implementing these regulations was delegated to the Trust Ionising Radiation Protection Committee, the Radiological Sciences Unit and the Clinical Risk Lead for Imaging. The Group focused attention on a number of areas within the regulations, including, for example, training, protocols, referral criteria and establishing the equipment inventory. Training represented a significant challenge. Regulation 4(4) stipulates that employers will ensure that every practitioner and operator is "adequately" trained. Schedule 2 provides a comprehensive syllabus for both theoretical and practical training. The tasks involved in fulfilling this duty include: determining who within the Trust requires training; deciding who will provide the training; developing the course programme; obtaining external recognition for the programme; delivering the theoretical training; delivering the practical training; auditing the programme; establishing a continuing education programme; establishing a register of "adequately" trained personnel; and deciding how to deal with potential problem areas such as locum staff, staff on rotation etc. The first cycle in this process has been undertaken, with 49 staff from outside the radiological disciplines successfully completing the course. We wish to report on the areas outlined above and on future initiatives.

1415 Evaluation of mA modulation in CT

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INTRODUCTION: A number of manufacturers have introduced on-line tube current modulation with respect to patient anatomy in CT. This attempts to reduce patient dose without detriment to image quality. This work aimed to assess the operation of mA modulation on an IGE Zx/i CT scanner and to determine the impact of mA modulation on patient dose. METHODS AND RESULTS: There are four mA modulation functions (NORMAL, LOW DOSE, IMAGE QUALITY and MAX). Operation of each function was assessed by scanning a 33 cm diameter cylindrical water phantom positioned to present a continuously varying thickness along the *z*-axis. The mA and noise per slice were recorded. Results demonstrated that one of two mA ranges were selected (10–190 mA, small focal spot; 200–440 mA, large focal spot) depending on phantom thickness and function. To assess patient doses, 10 patient scans were evaluated, including chest, abdomen, pelvis and brain. The mAs values and the length of the patient were scaled to the NRPB SR250 model using definable complete organs that were visible in the axial images. The effective doses were compared with calculated doses for the local fixed mA protocols. The difference in dose between mA modulation and fixed mA protocols was found to be between –61% and +30% depending on the area scanned and patient size. The main dose saving was found to be in the chest area, with mA being reduced by up to 65% compared with the fixed mA protocol.

1425 Patient and operator doses during uterine artery embolisation

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PURPOSE: Uterine artery embolisation (UAE) is a minimally invasive technique used to shrink uterine fibroids. It is performed under fluoroscopic guidance, thus overcoming the risk associated with invasive procedures. Current literature reports that UAE has the potential to deliver high doses to patients as well as operators. This raises the need for justification of the fact that the gonads of women of reproductive capacity are being irradiated. The purpose of this study was to calculate the absorbed dose to the uterus and ovaries of patients as well as the effective doses, which can lead to an estimation of the overall detriment due to the irradiation of the patient. In addition, the extremity absorbed dose to the operator's hands has been measured and compared with the limits recommended in IR(ME)R2000. MATERIALS AND METHODS: Thermoluminescent dosemeters have been used to assess the extremity doses as well as the entrance surface doses. A Monte Carlo algorithm has been employed to calculate organ doses and the effective dose to the patients. RESULTS: The organ doses varied in the range 10–200 mGy, leading to an average effective dose of 19 mSv to the patients. The average extremity operator dose was 0.3 mSv. CONCLUSION: A linear relationship has been observed between the DAP value and the effective dose to the patient. Observed doses were lower than those reported in literature. Patient and operator doses are demonstrated to be heavily dependent on examination technique.

1435 Paediatric angiography: justification of patient dose reduction using clinical audit

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Department of Cardiology, Royal Brompton and Harefield Hospital and Department of Physics, The Royal Marsden Hospital, London, UK

PURPOSE: In children with congenital heart disease, angiography is used to delineate intracardiac, coronary and branch pulmonary anatomy. The risk of radiation-induced detriment for such procedures is relatively high. A clinical audit of various imaging strategies has been undertaken to establish whether the radiation dose can be reduced without loss of material clinical information. MATERIALS AND METHODS: 17 cases of Tetralogy of fallot (TOF) and 19 cases of closure of persistent ductus arteriosus (PDA) were selected. The angiographic images from each case were modified by computer to simulate four dose reduction strategies: reduction of the frame rate by 50%; reduction of the dose per frame by 50%; reduction of the frame rate and the dose per frame by 50%; and omission of selected views. The modified angiographic images and the original images were viewed by three paediatric cardiologists. An audit form designed to evaluate clinically relevant information rather than physical image quality was completed for each case and strategy. RESULTS: Contingency tables were produced for each key question in the audit to enable comparison between the clinical assessment of the original and modified data. For the TOF and PDA key questions, the audit demonstrated no significant difference (at the 95% confidence level) in clinical utility between the original angiographic images and the modified images. CONCLUSION: For both TOF and PDA, important dose savings can be achieved without loss of key clinical information. This is achieved by halving the frame rate and the dose per frame and by omitting particular angiographic projections.

1445 How does procedural complexity affect patient dose at interventional cardiology?

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PURPOSE: Quantifying procedure complexity gives another powerful tool for dose audit and optimization. METHODS: Dose–area product (DAP) distributions for angiocardiography, angioplasty, and angioplasty with stent implantation were compared with other centres, and differences in DAPs between cardiologists at Nottingham City Hospital were investigated. Dose distributions were compared using Cox analysis. The medical physics dose database was then merged with the cardiology stenting database and the correlations of a wide range of procedure variables with patient DAP were considered to identify possible procedure complexity indicators. Nottingham City Hospital DAPs for interventional cardiology procedures with 95% and +95% confidence intervals were as follows; angiocardiography 46.6 (43.4, 50.1) Gycm^2; angioplasty 83 (67.0, 102.8) Gycm^2; angioplasty with stent 108.2 (97.3, 120.3) Gycm^2. These values were in the middle or lower half of the range of DAPs quoted in the literature

by other centres. No significant differences were identified between DAPs for different consultants. Procedure time, screening time, number of wires and number of stents all demonstrated correlations with patient DAP that were significant at the 1% level. Use of procedure time, screening time, number of wires or number of stents as indicators of procedure complexity will help to identify true areas for improvement in interventional cardiology patient dose audits.

1455 Effective dose: how accurate are our calculations?

J Reay and C J Kotre
Regional Medical Physics Department, Newcastle General Hospital, UK

Effective doses following diagnostic radiographic examinations are often calculated using NRPB conversion factors from entrance surface dose (ESD) or dose–area product (DAP). However, these factors were calculated for a simple phantom originally designed to estimate effective doses from intakes of radioactive materials and, although the NRPB document advises against their use to calculate doses for specific individuals, it does describe the procedure for doing just that. One of the major differences between the phantom used and actual people is body shape and size, particularly the amount of body fat (or subcutaneous adipose) carried by an individual. Fat is the only tissue not assigned a weighting factor by the ICRP or included in the remainder organs. As a result it may be considered radio-insensitive and energy deposited in it during radiography need not be included in any subsequent dose estimation. This paper describes a method for estimating the amount of body fat an individual has and shows the effect this has on the effective dose estimation for that individual following simple radiographic examinations.

1505 Influence of patient age on normalized effective doses for CT examinations

A Khursheed
Medical Dosimetry Group, National Radiological Protection Board, Chilton, Didcot OX11 0RQ, UK

Monte Carlo simulations of CT examinations have been performed to estimate effective doses normalized to axial air kerma for six mathematical phantoms representing ages from newborn to adult and for three CT scanner models covering a range of designs (Siemens DRH, GE 9800 and Philips LX). Organ doses calculated for CT exposures of contiguous, 1 cm wide, transverse slices in each phantom have been tabulated and summed to give normalized effective doses for scans of four regions of the trunk and head. In all cases, an inverse trend is observed between normalized effective dose and phantom age, with the dose to the newborn from "head and neck" scans being 2.2–2.5 times higher than that to the adult, depending on the scanner model. Corresponding increases for scans of the "trunk" region are more variable between scanners and range from a factor of 1.3 to 2.4. If typical clinical exposure conditions for adults are also utilized for children, then, for example, the effective dose to the newborn from a chest scan could be above 15 mSv. CT therefore has the potential to deliver significantly greater radiation doses to children than to adults and, in view of their greater susceptibility to radiation effects, special efforts should be made in clinical practice to reduce doses to children by the use of size-specific scan protocols. The full set of normalized organ doses calculated in the study will be available as a software report. This may be used to estimate doses received by paediatric patients from user-specified CT scan information.

1400–1445 Hall 11A
College of Radiographers
William Stripp Memorial Lecture

1400 Eponymous Lecture: The art and soul of orthopaedic radiography

T H Thorne
Radiology Department, Airedale General Hospital, Keighley BD20 6TD, UK

See page 48 for abstract.

1400–1500 Multipurpose Rooms 1 & 2
Workshop
Musculoskeletal Reporting

1400 Musculoskeletal Reporting Workshop

Q C Field-Bowden
X-Ray Department, Wansbeck General Hospital, Woodhorn Lane, Ashington, Northumberland NE63 9JJ, UK

No abstract provided.

1415–1530 Olympian Suite 2
Scientific Session
Musculoskeletal

1415 Invited review: Assessment of trabecular bone structure using micro CT and MR

H K Genant
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Non-invasive and/or non-destructive techniques are capable of providing microstructural information about bone beyond simple bone densitometry. While the latter provides important information about osteoporotic fracture risk, numerous studies indicate that bone strength is only partially explained by BMD. Quantitative assessment of microstructural features such as relative trabecular volume, trabecular spacing and connectivity may improve our ability to estimate bone strength. The methods available for quantitatively assessing the microstructure of trabecular bone non-invasively and/or non-destructively include high resolution (HRCT), micro CT (μCT), high resolution magnetic resonance (HRMR), and micro magnetic resonance (μMR). HRCT and HRMR are generally applicable *in vivo*, and μCT and μMR are principally applicable *in vitro*. While considerable progress has been made in CT and MRI of bone microstructure, some challenges and dilemmas remain. From a technical perspective, the balance between spatial resolution *vs* sampling size, or between signal-to-noise ratio *vs* radiation dose or acquisition time need further consideration, as do the trade-offs between the complexity and expense of equipment *vs* the availability and accessibility of the methods. The relative merits of *in vitro* imaging and its ultrahigh resolution but invasiveness *vs in vivo* imaging and its modest resolution but non-invasiveness also deserve careful attention. From a clinical perspective, the challenges for bone imaging include balancing the relative advantages of simple bone densitometry *vs* the more complex architectural features of bone, or similarly the deeper research requirements *vs* the broader clinical needs. The considerable potential biological differences between the peripheral appendicular skeleton *vs* the central axial skeleton have to be further addressed. Finally, the relative merits of these sophisticated imaging techniques have to be weighed with respect to their applications as diagnostic procedures requiring high accuracy or reliability *vs* their monitoring applications requiring high precision or reproducibility.

1445 Audit of the application of a loading device (Dynawell) for imaging of spinal compression device

U Amendy, R Watura, I Watt, P Goddard, B Khoudi, K Foreman, S Waddington, B Danielson and J Willer
Department of Radiology, Bristol Royal Infirmary, Bristol BS2 8HW, Bristol Oncology Centre, Bristol BS2 8ED, Frenchay Hospital, Bristol BS16 1LE and University of the West of England, Bristol BS16 1DD, UK

PURPOSE: MRI of the lumbar spine is routinely carried out with the patient in the supine position. In this position the spine is not subject to the normal axial loading that occurs in the erect position. As a result, some spinal disorders may be missed or underestimated. The study was designed to examine patients with suspected spinal stenosis or patients with symptoms and signs of lumbar pathology but with normal scans. MATERIALS AND METHODS: Examinations were carried out before and after axial loading. A Dynawell loading device was used. The Dynawell device is constructed of hard plastic with a neoprene and nylon harness, and allows for axial loading of the lumbar spine. The device simulates the axial loading that the spinal canal is subjected to in the normal erect position. RESULTS: In greater than 50% of cases the post-loading scan provided new or additional diagnostic information. In most cases this was demonstration of stenosis. In one case a right-sided L5/S1 facet joint synovial cyst became

distended and clearly visualized after axial loading, occupying 40% of the central canal and impressing on the S1 nerve root. Appearances corresponded to the clinical findings. DISCUSSION: Axial loading of the lumbar spine is potentially a useful additional diagnostic tool for the examination of patients with suspected spinal stenosis or symptoms of back pain with normal or inconclusive routine MRI scans. Patient acceptance of the device is being investigated. More patients will be added to the study before presentation.

1455 Cortical bone volume and structure in CT images: a non-invasive predictor for vertebral fracture risk?

R Andresen and M A Haidekker
Güstrow Municipal Hospital, Academic Teaching Hospital, University of Rostock, D-18273 Güstrow, Germany

PURPOSE: To assess the value of cortical volume and cortical structure in CT images as a non-invasive predictor of vertebral fracture load. MATERIALS AND METHODS: 40 patients were divided into groups with and without fractures. Mid-vertebral CT slices were obtained from lumbar vertebrae L1–L3. Cortical bone volume was determined by counting voxels (0.2 x 0.2 x 2 mm) in the segmented corticalis. Quantitative parameters to describe cortical structure were obtained through the methods of low BMD cluster counting (PC) and by analysing the grey-value profile of the cortical ridge (PR). All values were related to age and were compared between groups. RESULTS: Both structural parameters were significantly correlated with age (PC, $r = 0.46$; PR, $r = 0.56$; $p<0.005$ in all cases), while no significant correlation between cortical volume and age was found. BMD and cortical structure differ significantly between patients with and without fractures as well as between patients with one *vs* multiple fractures. Cortical volume is 8.5% lower in patients with fractures, but the level of statistical significance is not reached. DISCUSSION: When spongy bone deteriorates in osteoporosis, the cortical shell takes up an increasing part of the vertebral load. The load-bearing role of the cortical shell and the importance of including cortical properties in the diagnosis of osteoporosis are increasingly recognized. We found the hypothesis that cortical volume significantly changes with age and differs between osteoporotic and non-osteoporotic groups not to be true. Two structural parameters, independent of BMD and volume, significantly change with age and the number of fractures, thus allowing a prediction of fracture risk.

1505 Ultrasound *vs* MRI in detecting local recurrence of malignant bone and soft tissue sarcomas

W H Ng, J F Griffith, S M Kumta, L T C Chow and C Metreweli
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PURPOSE: This study was undertaken to compare the accuracy of ultrasound with MRI in the detection of local recurrence of bone and soft tissue sarcomas following surgery. MATERIALS AND METHODS: Ultrasound and MRI examinations were performed in 104 cases to assess local recurrence. Examinations were performed independently, with a time interval of 19.7 days (range 0–52 days), ultrasound usually pre-dating MRI. Findings were classified as showing either definitely no recurrence; low, moderate or high probability of recurrence; or definitely recurrence. "No recurrence" was diagnosed by serial follow-up imaging. "Definite recurrence" was diagnosed histologically. RESULTS: Definite recurrence was diagnosed in 17/104 cases (16%) by both modalities. No recurrence was diagnosed in 72/104 cases (69%) by both modalities. Possible recurrence was seen in 6/104 cases (5%) by both modalities. Complete concordance with respect to the presence or absence of recurrence was present between ultrasound and MRI in 95/104 cases (91%). Non-concordance was present in nine cases. Ultrasound yielded two false negative cases (one patient) and one false positive case, while MRI yielded seven false positive cases. CONCLUSION: Ultrasound can replace MRI for the detection of local recurrence of malignant bone and soft tissue sarcomas, enabling earlier follow-up, where the pressure on MRI is high.

1515 Does analysis of vascularity by ultrasound help predict the aggressiveness of soft tissue tumours?

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PURPOSE: This study investigates the discriminatory values of several vascular parameters in predicting aggressiveness of musculoskeletal soft tissue tumours. MATERIALS AND METHODS: Vascular tumours were defined as soft tissue tumours with three of more vessels demonstrable on colour Doppler imaging. Over a 3-year period, 101 vascular tumours in 109 patients (55 females, 54 males; age range 1–87 years) were studied. In all tumours, seven separate features of tumour vascularity were assessed, namely: (1) degree of vascularity (high, intermediate, low); (2) location of vascularity (central, peripheral, mixed); (3) organization of vascularity (chaotic, organized, indeterminate pattern); (4) average peak systolic velocity; (5) end-diastolic velocity; (6) resistive index; and (7) pulsatility index. Three descriptive features (delineation, intrinsic calcification, intrinsic cystic spaces) were also assessed. Final diagnosis was defined histologically (73%) or by characteristic clinical and imaging appearances on serial follow-up (27%). Tumours were arbitrarily divided into aggressive (n=42), intermediate (n=18) or non-aggressive (n=49) according to the final diagnosis. RESULTS: An ill defined margin ($p<0.05$), a high resistive index ($p<0.05$), a high peak systolic velocity ($p<0.1$) and a chaotic vascular pattern ($p<0.1$) were the most helpful positive discriminatory criteria in distinguishing between aggressive and non-aggressive tumours. CONCLUSION: Prediction of soft tissue tumour aggressiveness can be helped by analysing various aspects of tumour vascularity on ultrasound, in particular the resistive index.

1525 Discussion

1430–1530 Hall 10
Scientific Session
Gastrointestinal

1430 Imaging the ileoanal pouch

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PURPOSE: The purpose of our study was to review the imaging characteristics of the normal and abnormal ileoanal pouch procedure. METHODS: 72 procedures were performed by a single surgeon over a 13-year period. The majority were for ulcerative colitis (57 patients), but a significant number were for familial polyposis syndromes (15 patients). The majority of patients then had a defunctioning ileostomy for a 3-month period to allow adequate healing of the pouch. Before the ileostomy was reversed, a "pouchogram" was performed to exclude a pouch leak, which is regarded as the gold standard complication. RESULTS: We quote a leak rate of 4% (3 patients), which compares favourably with recent North American data where a series from Philadelphia [1] quotes an 8% leak rate. Our series is, however, larger and we describe other complications such as megapouch, micropouch and pouch–anal stenosis. We also present some small bowel series, CT and evacuating pouchographic images of the various problems unique to this interesting procedure. ([1] Hrung JM, Levine MS, Rombeau JL, Rubesin SE, Laufer I. Total proctocolectomy and ileoanal pouch: the role of contrast studies for evaluating postoperative leaks. Abdom Imaging 1998;23:375–9.)

1440 Role of defecography in the diagnosis of enterocele

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PURPOSE: An enterocele may be difficult to diagnose on clinical examination. The purpose of this study was to define the role of defecography in the diagnosis of enterocele and other pelvic floor abnormalities commonly found in association with enterocele. METHOD And MATERIALS: Of the 1080 patients undergoing defecography in a 7-year period for various anorectal symptoms and rectal evacuation difficulties, 110 women (age range 30–92 years) were found to have an enterocele. 66 had large, grade 3 or 4 enterocele and 44 had small grade 1 or 2 enterocele. 31 age-matched control patients undergoing defecography for various anorectal symptoms but without

an enterocele were selected. The defecography parameters measured in all patients were: anorectal angle in resting and during straining; perineal descent; presence and size of 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 groups. Clinically, enterocele was either not diagnosed or was underdiagnosed as to its grade in almost half of the patients (49%). In the enterocele group, 63 (57%) patients had had a previous hysterectomy whereas only 1 (0.03%) of 31 patients in the control group had had a previous hysterectomy. Intussception and rectal prolapse were found in 73% in the enterocele group but in only 42% in the control group. Pelvic floor descent was increased significantly in the enterocele group compared with the control group. Recotcele was found more commonly with small enteroceles compared with large enteroceles. CONCLUSIONS: Defecography plays a vital role in objective demonstration of enterocele and associated pelvic floor abnormalities. This is important for the correct choice of surgery. 60% of the patients have already undergone an entereoceleplasty.

1450 Optimization of CT colonography technique: is a rectal balloon catheter necessary?

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PURPOSE: One of the largest sources of non-perceptual error in CT colonography (CTC) is inadequate colonic distension. We hypothesized that a self-retaining rectal balloon catheter improves colonic distension compared with a thin rectal tube and tested this hypothesis prospectively. MATERIALS AND METHODS: 63 consecutive patients examined with CTC were randomized to either an inflated rectal balloon catheter or a thin rectal tube for colonic distension with CO_2. Prone and supine CTC was performed using a multislice scanner (Lightspeed-Plus, GE Medical systems). On subsequent analysis, the colon was divided into six segments and distension was then graded (0 = fully distended, 1 = predominately distended, 2 = predominately collapsed, 3 = completely collapsed). The least distended section in a particular segment was used to assign the overall grade. RESULTS: The mean segment distension score for patients with the rectal balloon catheter (n=32) was 0.99; it was also 0.99 for patients with the thin rectal tube (n=31). However, when individual segments were compared, there was significantly better rectal distension with the balloon catheter (mean = 0.65) than with the rectal tube (mean = 1.06) (p=0.03). CONCLUSION: The use of a self-retaining rectal balloon catheter conveys significantly better rectal distension than a thin rectal tube but this beneficial effect does not extend to the proximal colon.

1500 Prognostic value of FDG-PET for predicting outcome in patients with oesophageal cancer: a pilot study

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OBJECTIVE: Positron emission tomography (PET) is being increasingly used in the staging and post-therapy assessment of patients with oesophageal cancer. The aim of this pilot study is to examine whether the uptake of ^{18}F-fluorodeoxyglucose (FDG) is of prognostic value in patients with primary oesophageal cancer. METHODS: 27 patients (mean age 61 years; female/male ratio 0.2) with primary oesophageal cancer were retrospectively analysed. FDG-PET was performed on a Siemens ECAT Exact camera after injection of 350 MBq FDG. All patients underwent whole body and localized thoracic scanning at least 1 h post injection. The maximum and mean SUV at the primary sites were measured and patients were accordingly divided into three groups: Group I, SUV (max.) 1–10; Group II, SUV (max.) 10–15; Group III, SUV (max.) ≥15. Correlation of the SUV (max.) with the survival time was performed using Kaplan–Meier survival estimates. RESULTS: The median survival time for Group I was 6 months, group II was 5 months and group III was 11 months. 3 of the 27 patients are still alive 26 months, 36 months and 37 months post treatment, respectively; 2 of those had SUV (max.) greater than 15. CONCLUSION: Assessment of SUV (max.) with FDG-PET may have a prognostic value in predicting outcome of therapy in patients with oesophageal cancer.

1510 Prognostic value of CT-determined tumour volumes in oesophageal cancer

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PURPOSE: This study aims to study the significance of tumour volume (TV) on overall TNM staging, survival and changes of tumour stage after chemoirradiation in oesophageal cancer (OC). MATERIALS AND METHODS: 45 consecutive patients (39 male; median age 64 years) with biopsy-proven OC and clearly discernible tumours on CT were recruited. All underwent baseline and post-chemoirradiation volumetric CT examinations of the thorax and abdomen. TV in each axial CT section was determined by placing operator-defined cursors around the tumour multiplied by slice thickness. Baseline TNM staging, post-chemoirradiation pathological staging and survival data were obtained. 42 patients underwent resection. All received neoadjuvant chemoirradiation. RESULTS: Median baseline TV, post-treatment TV and % TV reduction were 31.13 cm^3, 19.63 cm^3 and 28.10%, respectively. Baseline TV correlated with post-treatment TV (r = 0.858, p <0.001), with no significant associations between baseline TV and % TV reduction. Both baseline TV and post-treatment TV were significantly smaller in T2 than T3 (p = 0.001 and 0.004), and in N0 than N1 (p = 0.002 and 0.004) patients. T-score changes after chemoirradiation were not related to either baseline TV or post-treatment TV or % TV reduction. N score changes were related to both baseline TV and post-treatment TV (p = 0.009, 0.033). A higher risk of death was associated with baseline stage III, post-treatment TV <20 cm^3 and enlarged regional lymph nodes (p = 0.01, 0.03 and 0.03). CONCLUSION: Post-treatment TV rather than baseline TV may be more important as a prognostic indicator. Baseline TV does not influence treatment response measured in terms of % TV reduction. TVs may play a significant role in determining N scores after chemoirradiation.

1520 Discussion

1430–1515 Olympian Suite 1
Keynote Lecture
Staging of Upper Gastrointestinal Cancer

1430 Invited review: Staging and follow-up of upper gastrointestinal tumours

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The prevalence of oesophageal carcinoma has increased dramatically in the last 30 years. Adenocarcinoma is now the commonest cell type in the USA and the overall 5-year survival is 25%, increasing to 85% if the nodes are disease-free at presentation. Appropriate staging is important for assessment of prognosis and for deciding the most appropriate therapy. Treatment options include curative and palliative surgery, chemoradiotherapy and stent insertion. Staging is based on depth of tumour invasion (T stage), regional node involvement (N stage) and the presence of metastases (M stage). Non-invasive methods of staging include CT, endoscopic ultrasound (EUS) and positron emission tomography (PET). MRI has no real advantage over CT. EUS is the best method for T staging (overall accuracy 84%). CT is readily available and is best for advanced disease to preclude surgery. FDG-PET is best for distant metastases (accuracy 84%) and may the best method to assess response to chemotherapy. The overall incidence of gastric cancer is declining, with a rising incidence of proximal third tumours. Most patients present late with advanced disease and are staged in a similar fashion to those with oesophageal cancer. Preoperative staging is used to identify unresectable disease and EUS is increasingly being used as the T staging is superior to CT and it appears to reliably predict resectability.

1510 Discussion

1430–1530 Hall 11B
Scientific Session
Neuroradiology

1430 A new method for quantitative measurement of cerebral blood flow

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PURPOSE: Conventional approaches to the measurement of cerebral blood flow (CBF) with non-diffusible tracers rely on estimates of mean time to transit (MTT) indirectly derived from the tissue residue function, since accurate measurement of input and output functions for individual voxels is not possible. We describe a novel technique to produce quantitative parametric images of CBF using a direct application of the original central volume theorem. METHOD: We assume that bulk (directional) flow will be seen within all voxels and our model does not address the presence of any truly non-directional flow. We measure rBV in the conventional way using the area under the tissue residue function. The MTT is directly measured for each voxel by estimation of the time to mean contrast concentration (TTM) in each of the six surrounding voxels. The mean difference between these values is a direct estimate of the MTT voxel. Using this more rigorous definition of MTT we are able to calculate CBF directly for each voxel. No calibration factors are required in the calculation and CBF can be displayed as ml 100 g^{-1} min^{-1}. Values in normal grey and white matter conform closely to those of observed with diffusible tracer techniques (grey matter 70–105 ml 100 g^{-1} min^{-1}; white matter 25–37 ml 100 g^{-1} min^{-1}) whilst values in arteries and veins show expected decreases in MTT in keeping with increased flow rates. We conclude that direct estimation of MTT for each voxel is feasible and provides direct estimates of CBF in close agreement with those using diffusible tracer techniques.

1440 Endothelial permeability measurements fail to distinguish between tumour grade in enhancing glioma

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Imaging Science, University of Manchester, Manchester, UK

Characterization of angiogenic tissues in tumours and inflammatory disease has been the topic of considerable research in recent years. MR- and CT-based methods allow non-invasive assessment of regional blood volume (rBV), endothelial permeability (k^{trans}), blood flow and vascular tortuosity. As indicators of angiogenic activity, both blood volume and tortuosity have been shown to relate to tumour grade, and rBV has been shown to relate to tumour prognosis in a number of tumour types. Changes in endothelial permeability are believed to reflect local variations in the activity of angiogenic cytokines such as VEGF, and previous workers have shown a relationship between k^{trans} and tumour grade in cerebral gliomas [1]. However, measurement of k^{trans} is dependent on the pharmacokinetic model used to interpret the changes in contrast concentration, and this original work failed to allow for errors due to the presence of intravascular contrast medium within the tumour. We have repeated this study using a modified technique that removes this dependence of k^{trans} measurements on rBV [2]. Using this technique in a group of patients with glioma, we have been unable to demonstrate any difference in the values of k^{trans} in enhancing gliomas, although there was a clear difference in rBV as previously reported. We conclude that it is possible to measure k^{trans} independently of local variations in rBV and that these parameters provide distinct biological information about tumoral angiogenesis in gliomas. ([1] Roberts HC, Roberts TP, Brasch RC, Dillon WP. Quantitative measurement of microvascular permeability in human brain tumors achieved using dynamic contrast-enhanced MR imaging: correlation with histologic grade. Am J Neuroradiol 2000;21:891–9. [2] Li KL,Zhu XP, Waterton J, Jackson A. Improved 3D quantitative mapping of blood volume and endothelial permeability in brain tumors. J Magn Reson Imaging 2000:12;347–57.)

1450 Sestamibi parathyroid scanning: a 4-year experience

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INTRODUCTION: Surgical exploration remains the investigation of choice in assessing primary hyperparathyroidism and as such is highly sensitive. Parathyroid adenomas can be located and excised at surgery. Sestamibi scanning of the parathyroid glands is a well recognized investigation for cases of hyperparathyroidism of patients prior to re-exploration after failed parathyroid surgery. However, its role in the routine investigation of hyperparathyroidism is dubious. METHODS: We examined 49 consecutive sestamibi scans in 46 patients at our hospital. Each patient had prolonged hypercalcaemia, with suspicion of or biochemical evidence of primary hyperparathyroidism. Case notes were available in 34 cases. A parathyroid adenoma was detected by scanning in only six cases and, of these, only three cases were submitted for surgery. Of the 34 cases available for review, a total of 7 cases were submitted for surgery. Four of these seven cases had negative scans, but in all seven cases surgical exploration disclosed parathyroid adenomas. CONCLUSIONS: Surgical candidates are equally likely to have positive or negative sestamibi scans. The result of the scan does not seem to influence the decision to carry out surgery. The sensitivity of surgical exploration is 100%. In those patients subjected to surgery, there was a high false negative rate in sestamibi scanning of 57%. There were no false positives. Sestamibi scanning cannot therefore be relied upon as a routine diagnostic test in the investigation of primary hyperparathyroidism. It has a role in cases of suspected ectopic parathyroid adenoma or in cases where previous neck surgery has been carried out. We discuss these results with illustrations and provide an algorithm for imaging these patients.

1500 Intracanalicular optic nerve meningioma: a serious diagnostic pitfall

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We present six cases where the diagnosis of optic nerve meningioma has been missed (14–49 months) despite extensive investigation. In all cases, serious visual deterioration was seen between presentation and eventual diagnosis. All six cases were young adult females aged 24–38 years, and all presented with sudden (2/6) or progressive (4/6) visual loss. Ophthalmologic or neurological examination demonstrated loss of visual acuity leading to a presumptive diagnosis of optic neuritis. CT (1/6) and MRI (2/6) at diagnosis were reported as normal and all patients were treated with high dose steroids, which resulted in some degree of improvement in visual function. In all cases there was progressive episodic deterioration in vision over the following months/years, leading to complete visual loss in two cases. In two cases, transient or permanent palsies of the III and/or IV nerves occurred. All patients underwent multiple MRI during the period of deterioration (12–49 months), with between two and six scans in total. Formal orbital MRI was commonly omitted and only brain sequences obtained. In two cases there was mention of enhancement of the basal meninges and in one case this led to a diagnosis of sarcoidosis (biopsy negative), which was treated with methotrexate and high dose steroids. All cases were eventually proven to have intracanalicular meningioma compressing the optic nerve. The tumour was best seen on high resolution, 3D, contrast enhanced, fat suppressed MRI. Extension was to the apical optic nerve sheath (5/6), tuberculum sellae (5/6), sulcus chiasmaticus (6/6) and lateral wall of the cavernous sinus (2/6).

1510 WIP: Temporal evolution of changes in cerebral perfusion following carotid stenting

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INTRODUCTION: This study monitored the effects of intracarotid stent insertion on cerebral haemodynamics at four time points over a 1-month time span. METHODS: Seven patients with symptomatic ICA stenosis were assessed by exogenous MR perfusion mapping at 1.5 T (Eclipse, Philips Medical Systems), 24 h pre, and 3 h, 24 h and 1 month post procedure. A multi time point, single shot T2* weighted EPI technique acquired 12 slices over the cerebrum every 1.4 s for a total imaging time of 98 s. A 20 ml bolus of gadolinium diethylenetriamine pentaacetic acid acted as the perfusion agent. Post-acquisition processing consisted of baseline subtraction, inversion, gamma-variate fitting and calculation of time-to-peak (TTP) signal change and relative cerebral blood volume (rCBV). RESULTS: Changes in hemispheric asymmetry of both TTP and rCBV were evident. Pre-treatment TTP hemispheric asymmetry within middle cerebral artery (MCA) territory was >2% in 4/7 cases, which resolved to <0.5% asymmetry in 3

MONDAY

of these 4 cases. In the 3/7 remaining cases, initial asymmetry in TTP was <0.5% despite the degree of their symptomatic ICA stenoses being >70%. Changes in rCBV within the same territory were >10% in all patients. DISCUSSION: These data aid our understanding and suggest that several other factors have to be considered when assessing alterations in cerebral haemodynamics due to direct intervention in carotid stenosis.

1520 WIP: Image quality and dose considerations in CT for 3D maxillofacial imaging

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OBJECTIVE: To explore the potential for dose reduction in multislice spiral CT used to collect data for 3D reconstructions in maxillofacial surgery. MATERIALS AND METHODS: An anthropomorphic head phantom underwent CT using a multislice spiral system (Lightspeed QXi, GE Medical Systems). The imaging volume extended from the superior orbital border to the body of the mandible using a 1.25 mm exposure collimation at a pitch of 3; FOV was 21 cm, reconstruction matrix 512 x 512, standard reconstruction algorithm. Sections were reconstructed at 1 mm intervals, giving 100 images per series. Multiple series were obtained using incremental decreases in tube current and kilovoltage. 3D images were constructed by surface rendering using a stand-alone system and in-house developed software. 3D images were viewed by a panel to evaluate differences in definition dependent on exposure factors. RESULTS: The study indicates that potential for significant dose reduction exists when image data are acquired for 3D alone, without significant deterioration in the 3D image despite detectable changes in slice signal-to-noise ratio. In this series, a dose reduction of about 40% can be obtained without deleterious effect. CONCLUSION: Dose reduction measures should be practiced in 3D CT. The study is ongoing and updated data will be available.

1430–1615 Kingston Lecture Theatre

Case Studies: Digital imaging installation at your hospital

1430 Invited review: The impact of digital imaging at Royal Glamorgan Hospital

S G Davies
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A PACS was introduced into a newly built district general hospital 2.5 years ago. Initially a Radiology Department system with full A&E Department integration, this project has extended incrementally to encompass the whole hospital. This presentation describes the implementation of PACS and focuses on the impact that PACS has had upon the working practices of all groups within radiology, as well as budgetary issues and, importantly, the impact upon the clinical process. Future perspectives of this project are outlined.

1445 Invited review: To be confimed.

1500 Invited review: The successes and problems encountered in a whole hospital PACS installation

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Installation of a whole hospital PACS allowing a 900+ bed hospital to be filmless met with both successes and problems. The successes included the choice of a reliable and experienced PACS supplier and careful planning of the project to reflect the detailed design of the department that had been undertaken with PACS in mind. The needs of clinicians for image review were paramount and 474 image review workstations were provided as part of the IT installation. Inclusion of dental imaging, nuclear medicine and mammography was innovative. Pivotal to success was the successful interfacing with other hospital IT systems, namely RIS, HIS and results reporting. There were problems of co-ordination with the move of IT to the new hospital, which delayed the installation of some of the clinicians' workstations. Exciting the interest of clinicians and inducing them to undergo training proved challenging. The continuing need for digitization of radiographs and provision of hard copy was underestimated. Provision of images in theatre was resolved late in the project. Lack of an electronic requesting system has limited the full use of PACS within radiology to a minor degree.

1515 Invited review: Digital imaging at Bromley Hospital

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A stand-alone digital imaging system was installed at Bromley Hospital NHS Trust in 2001. The Trust comprises four sites, with the main acute services at Bromley Hospital. The digital imaging system is networked to all four sites. There is now all soft copy reporting, and a minimal number of hard copies are produced. The setting up of the system has proved complex and not without difficulties. The departments have an established Radiology Information System (RIS). At present, there is a plan to link the digital imaging system with the RIS, however, this has yet to occur. This has resulted in several difficulties. Each patient attendance is filed as a separate examination. The CT images are filed separately from other images on the database. It is difficult when looking at the list of examinations to be sure which images are located in the particular examination. As the size of the archive increases, the difficulties of locating images increases. There are further difficulties related to multiple input of data. The images are viewed on workstations in the radiology department and on conventional monitors using Web browsers throughout the hospitals. There is concern from our clinicians over a number of issues. These include difficulties in retrieving images, image retrieval times and difficulty in image interpretation on small images. Further concerns relate to the increased time taken for ward rounds. Overall, the radiology service has been enhanced. Communication with clinicians has improved and there has been a marked improvement in image availability.

1530 Invited review: Conquest! A timeline of digital imaging and PACS in East Sussex

K D Foord
Radiology Department, Conquest Hospital, St Leonards on Sea TN377RD, UK

1991: Hastings to act as a test bed for PACS ideas; SE Thames RHA leads—as a Regional development project. **1992:** Conquest Hospital opens; "iLAN" PACS installed—all UNIX – "SUN" servers and workstations; linked to fluoro, CT, digitizer, basic NM images. **1993:** Added computed radiography unit; image review stations in A&E and Fracture Clinics; **1994:** New RIS installed late in year. **1995:** ODs damaged, recovered by specialists; RAID to small for future use. New RAID installed. **1996:** New RAID fails, images lost. RAID manufacturers bankrupt; stop using iLAN for new work; "Continue if possible in safe incremental steps". **1997:** Decide to lease 3 x CR, with DICOM workstations linked to fluoro and angio. **1998:** Tender for new PACS; choose preferred supplier. **1999:** Preferred supplier taken over; long hiatus; Region say "too long since tendered", deny permission to finalize. **2000:** Start to think about re-tendering; Eastbourne Hospital installs single CR mini-PACS system, links with RIS. **2001:** Trust announces planned "management merger" with Eastbourne; joint IT department formed; joint PACS Project Board; Eastbourne obtain trust fund money and tender for their half of PACS plus 2 additional CR units. **2002:** New CR installed at Bexhill (Hastings satellite); 36 Mbs microwave wireless linkage between Hastings and Eastbourne; Hastings extends CR lease at Conquest—with 4th CR unit for mammography; Hastings installs Web Server; Hastings contracts for DICOM printing and new A&E room with 5th CR; Eastbourne place full DICOM/Web PACS and 2 additional CR units contract; "East Sussex Hospitals NHS Trust" formally established; Hastings goes to PACS tender soon.

1545 Panel Discussion

1515–1730 Hall 11A

Advances

Musculoskeletal MRI

1515 Invited review: The role of MRI in scoliosis

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Scoliosis is a lateral curvature of the spine greater than 10°, which at present is diagnosed with plain radiography. An initial X-ray of the

whole spine and pelvis, taken with the patient erect, enables the curve to be measured and vertebral anomalies to be detected. Any progression of the curve is monitored by imaging at regular intervals either with X-rays using a low dose technique or with integrated shape imaging scans. The present role of MRI is to assess patients who either have abnormal neurological findings, who present with pain or who have a rapid progression of their curve. It can also be used to detect intraspinal pathology such as syringomyelia, tethered cord, Chiari malformations and tumours prior to any surgical correction of the curve. MRI scanners that allow patients to be imaged erect could potentially in the future allow both the initial diagnosis of scoliosis and further monitoring to be undertaken without the use of ionizing radiation. MRI could also be useful to assist with the design of braces used to correct scoliosis, to monitor brace treatment and to make sagittal Cobb-angle measurements.

1545 Invited review: To be confirmed.

1615 Invited review: Stability of the knee

C W Heron
Department of Radiology, St George's Healthcare NHST, Blackshaw Road, Tooting, London SW17 0QT, UK

No abstract provided.

1645 Invited review: New approaches in lumbar spine imaging

K Griffin
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For investigating the low back, MRI is the investigation choice. Advances in both equipment and sequences have led to fast, high quality diagnostic images and shorter examination times. An increasing awareness of the lack of diagnostic information available from a conventional lumbar spine X-ray has led to a number of centres questioning whether MRI could provide quality diagnostic information more quickly. Patient pathways have involved patients being referred by their GP for plain X-rays, waiting for results, then a second visit to their GP to be referred to outpatients who, in turn, refer the patient for MRI. The need to shorten the patient pathway to treatment is clear. Furthermore, this would allow radiographers to comply better with their obligations under the IR(ME)R regulations. Direct GP access to MRI, controlled by tight guidelines, could significantly shorten the patient pathway but would have significant impact on scanner throughput along with increased radiologist reporting workload. Medway is piloting a scheme for radiographer-led lumbar spine restricted sequence blitz sessions. This includes the report being made by the scanning radiographer. This role extension enhances the role of the radiographer whilst preventing radiologists becoming overwhelmed by an additional source of referrals.

1715 An audit of MRI in the diagnosis of occult hip pathology

J C Lee and J Healy
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PURPOSE: Fractures of the pelvis and neck of femur in the elderly population following a traumatic episode are common. They are responsible for a significant proportion of healthcare costs today. Diagnosis of hip fractures is not always clear-cut as the initial radiograph may be negative in undisplaced fractures. Subsequent displacement of an unrecognized fracture affects prognosis, morbidity, length of hospital stay and costs. MATERIALS AND METHODS: A 4-year retrospective audit of all patients undergoing MRI of the pelvis for undiagnosed hip pain at the Chelsea and Westminster hospital was performed. The notes and radiographs were reviewed, and the treatment received and patient outcome were documented. RESULTS: A total of 36 patients were identified, 12 male and 24 female. The mean age was 69 years (range 11–98 years, median 74 years). 23 patients (64%) were shown to have sustained fractures, 3 showed evidence of avascular necrosis of the femoral head, 1 patient had septic arthritis, 3 had soft tissue injuries, 3 had myeloma and only 3 scans were reported as normal. CONCLUSION: 64% of patients were found to have sustained a fracture, 70% of which involved the femoral neck. All patients between 71 years old and 90 years old who underwent MRI for undiagnosed hip pain and difficulty weight bearing were shown to have a fracture of the femoral neck. The implications of missing such fractures are grave. The main benefit of MRI is to direct early operative intervention in patients with undisplaced neck of femur fractures.

1725 Discussion

1515–1645 Hall 9
Advances
Advances in Radiotherapy Practice: new roles

1515 Invited review: Radiotherapy practice: an overview of national strategy and local implementation

K Fell
City Hospital Nottingham, Hucknal Road, Nottingham NG5 1PB, UK

No abstract provided.

1545 Invited review: Clinical experience of employing trainee assistant practitioners in an oncology centre

C Richards
Radiotherapy Department, Maidstone Hospital, Hermitage Lane, Maidstone, Kent ME16 9QQ, UK

This paper will give a background to the initial skill mix exercise and will discuss the practical aspects of employing trainee assistant practitioners in the oncology setting, taking into account the political and professional issues. Kent Oncology Centre is in close proximity to London but without the additional financial rewards and this has led to a deficit of qualified radiographers. Radiographers within the centre have been undertaking role development for many years and the trend is for this to develop further within the four-tier structure. It became evident that a formalized system needed to be in place to enable suitable staff to be employed to assist the radiographers and to put in place an educational framework to enable them to develop. As part of the national "therapy skill mix" pilot project, for the past year the centre has been working with trainee assistants in the radiotherapy department. The paper will discuss the issues regarding setting up educational links and the various options that might be available. The roles, responsibilities and future aspirations of these staff will also be discussed. Results of some staff surveys undertaken within the pilot sites will be presented and relevant features will be discussed. Results of interviews with the trainee assistants will be presented. It is hoped that at the end of the presentation that all staff within the oncology setting will feel more confident about the positive effect that these key workers can have in the work place.

1615 Invited review: Matching education to service needs

A M Duxbury
School of Health and Social Care, Sheffield Hallam University, Collegiate Crescent Campus, Sheffield S10 2BP, UK

As different educational and professional strategies emerge to support the changing needs of the oncology service, there is a greater need for education providers to work in partnership with the service to match education to service needs. This paper will outline the challenges for educational and service providers for both pre-registration and post-experience education. There will be an outline of some of the radical changes being made to programme delivery and we will raise and debate some of the current and future challenges.

1515–1615 Multipurpose Rooms 1 & 2
Workshop
Musculoskeletal Reporting

1515 Musculoskeletal Reporting Workshop

Q C Field-Bowden
X-Ray Department, Wansbeck General Hospital, Woodhorn Lane, Ashington, Northumberland NE63 9JJ, UK

No abstract provided.

1530–1600 Hall 10
Keynote Lecture
Abdominal and Liver Doppler

1530 Invited review: Abdominal and liver Doppler

S T Elliott
Freeman Hospital, Newcastle, UK

Ultrasound practitioners may be discouraged from using Doppler techniques owing to the perception that detailed and often difficult measurements need to be made. Although abdominal Doppler ultrasound is now an essential component in many clinical services, such as liver and kidney transplantation, it is also an increasingly useful modality in more routine abdominal ultrasound examinations. This talk will focus on the interpretation of the common waveforms encountered in abdominal Doppler, both physiological and pathological. The inherent errors in quantitative abdominal Doppler studies will be discussed as well as how to incorporate quick and easy assessments into everyday scanning.

1530–1600 Olympian Suite 1
Keynote Lecture
Imaging Neck Nodes

1530 Invited review: Imaging neck nodes: what the radiologist needs to know

V Chong
Department of Diagnostic Radiology, Singapore General Hospital, Singapore

Appropriate management of the cervical lymph nodes requires a good understanding of the incidence, patterns and prognostic implications of nodal metastasis. The propensity of head and neck squamous cell carcinoma (SCC) to metastasize depends on site of the lesion and the tumour size. Patterns of nodal spread are also predictable. This lecture correlates the anatomical and simplified level classification systems of cervical lymph nodes, and examines the criteria for nodal metastasis and the clinical significance of nodal metastasis. Rouviere classified cervical nodes into collar of nodes surrounding the upper aerodigestive tract (submental, facial, submandibular, parotid, mastoid, occipital and retropharyngeal) and two bands along the long axis of the neck (anterior cervical and lateral cervical). Surgeons, however, make use of the simplified level system. Nodal metastasis is the single most important prognostic factor in SCC of the head and neck. In general, it decreases the overall survival by half. Extracapsular spread worsens prognosis by another half. The level of nodal metastasis is also significant and correlates with distant metastasis. The existing criteria for diagnosing nodal metastasis have serious shortcomings. 50% of nodes harbouring malignant cells measure less than 5 mm and 25% of nodes with extracapsular spread are less than 10 mm. In clinical practice, therefore, tumours with more than 20% probability of occult nodal metastasis warrant elective node dissection. The main roles of imaging include: (1) to confirm N0 status of the neck; (2) to exclude adenopathy contralateral to clinically palpable disease; (3) to document the regional extent of disease especially in relationship to neurovascular structures; and (4) nodal surveillance.

1530–1600 Hall 11B
Keynote Lecture
Imaging for Strokes

1530 Invited review: Imaging for strokes

R Jager
Radiology Department, National Hospital for Neurology & Neurosurgery, Queen Square, London WC1N 3BG, UK

No abstract provided.

1530–1600 Olympian Suite 2
Keynote Lecture
CT in Trauma

1530 Invited review: CT of musculoskeletal trauma

D Wilson
Nuffield Orthopaedic Centre NHS Trust, Headington, Oxford OX3 7LD, UK

Since the early days of CT it was apparent that it would have a major role in the imaging of skeletal trauma. The major limitation is the risk of radiation if the method were to be used extensively as a screening tool. When a patient presents after an injury, the clinical radiologist will need to answer the following questions. Which part of the body is injured? Is there are fracture of bone? If there is a fracture, does it need treating? If it does need treating, how should this be done? Has the treatment been successful? Are there any complications? It is my view that the imaging protocols should be designed to address these questions. They are different, will be asked on separate occasions and are not necessarily formally communicated to the radiologist. It is the role of a clinical radiologist to not only know how to image and be competent at interpretation but perhaps more importantly to understand what question is being asked. In this lecture I will explore the role of CT and discuss its place in practical clinical management of bony injury.

1545–1715 Lodge Room
Scientific Session
Radiation Protection and Image Quality

1545 Radiation dose to the lens and thyroid gland in paranasal sinus multislice CT

[1]I Zammit-Maempel, [1]C L Chadwick and [2]S Willis
[1]Department of Radiology, Freeman Hospital, Newcastle NE7 7DN and [2]Regional Medical Physics Department, Newcastle General Hospital, UK

INTRODUCTION: CT has become an established examination in the evaluation of the paranasal sinuses. Until recently this was achieved by the direct coronal technique on conventional and single slice helical scanners. With the advent of multislice technology, thin slice axial CT with excellent coronal and sagittal reconstructions is now possible. We describe a study evaluating the radiation dose to the lens and thyroid gland on a Siemens Volume Zoom quad slice scanner at 140 kV and effective mAs of 100 mAs using 1 mm collimation. METHODS: Thermoluminescent dosemeters were positioned on the right eyelid and right lobe of the thyroid gland of 29 patients scanned axially in the supine position and a further 28 patients scanned coronally in the prone position with gantry tilt. RESULTS: The results show mean doses of 35.1 mGy (lens) and 2.9 mGy (thyroid gland) in the coronal plane compared with doses of 24.5 mGy (lens) and 1.4 mGy (thyroid gland) in the axial plane. Results obtained from a head phantom will also be discussed. DISCUSSION: The results are higher than an earlier study performed in our institution using a direct coronal technique on a conventional scanner. The eye dose on a multislice scanner is, however, still substantially less than the threshold dose of 0.5–2 Gy for detectable lens opacities. These results indicate that decreased radiation dose to both the eye lens and the thyroid gland should be added the established perceived advantages of multislice axial sinus CT, *i.e.* patient comfort, no artefact from dental amalgam and reproducible true coronal images.

1555 Comparison of X-ray dose in standard 2D digital subtraction angiography and 3D rotational angiography examinations

[1]E Murphy, [1]P Flynn, [2]R Bridcut, [2]A Workman and [2]J Winder
[1]Department of Neuroradiology, The Royal Group of Hospitals Trust and [2]Northern Ireland Regional Medical Physics Agency, Belfast, UK

3D rotational angiography (3D-RA) has gained increasing interest in the pre-operative diagnosis and assessment of intracranial aneurysms. It is important in neuroradiology for the visualization and measurement of cerebral aneurysms and the determination of the optimum projection for intervention. PURPOSE: To determine the effective dose received by patients with proven subarachnoid haemorrhage who underwent 2D digital subtraction angiography (2D-DSA) and 3D-RA examinations, allowing a comparison to be made. MATERIALS AND METHODS: A Philips Integris BV 5000 biplanar neurovascular system was used to examine 50 patients, half of whom were examined using standard 2D-DSA and half using both 2D-DSA and 3D-RA. Radiographic factors were recorded for each examination. The output characteristics of each tube were measured. These data were used to calculate the entrance exposure to the patient for each projection using the kV, mAs and focus-to-skin distance. Interactions between X-ray photons and a mathematical patient phantom were simulated for each projection using PCXMC, a Monte Carlo computer simulation program. Using the entrance exposure for each projection, PCXMC

allowed an effective dose to be determined. RESULTS: Dosimetry calculation results will be presented. Preliminary results indicate the effective dose from a 3D-RA examination to be of the order of 0.2 Sv. 3D-RA results in a relatively low dose and provides additional clinical information not always available from standard 2D-DSA.

1605 Comparison of methods for calculating radiation shielding requirements

L J Sawyer and H C Starritt
Medical Physics Department, Royal United Hospital, Bath BA1 3NG, UK

METHOD: This paper explores the use of the BIR Report "*Radiation Shielding for Diagnostic X-rays*" (2000) to calculate shielding in a specific situation. The area used to demonstrate the shielding calculations involved a temporary ward in the Accident and Emergency department, where a variety of emergency examinations were expected to take place. This area consisted of three cubicles, with a nurses' station at one end and a corridor running along the side of the cubicles. Shielding requirements were assessed for each area, taking into account occupancy and use factors in both calculation methods. Comparison is made with different methods of carrying out the calculation, for example based on NCRP 49 and ICRP 33. These methods use the estimated weekly workload and tube output data to find the shielding required for reducing the dose rate to within recognized limits. The method published more recently by the BIR/IPEM Working Party uses DAP measurements to estimate output and also considers secondary dose rates. The lead equivalence required between each examination area was found to be similar using each of the methods described. The adequacy of shielding resulting from the calculations was assessed by monitoring and using transmission measurements. The issues raised by a change in calculation method, including the availability and accuracy of DAP data, approximations involving types and numbers of examinations and the significance of scattered radiation, will be discussed.

1615 Designation of radiation areas on the basis of dose rate

A G Brennan, S Evans and P J Allisy-Roberts
Western Infirmary, Glasgow G11 6NT, UK, Royal Marsden, London SW3 6JJ, UK and BIPM, Paris F-92312, France

Guidance on the designation of controlled and supervised areas is presented in "Work with Radiation" (L121) and in the revised "Medical and Dental Guidance Notes". The latter uses instantaneous dose rate (IDR) and time-average dose rate (TADR) and introduces a new concept, time-average dose rate 2000 (TADR 2000; time averaged over 200 h) to present a structured approach to the designation that takes account of workload, use and occupancy that is consistent with the requirements of dose limitation and risk assessment and is easily auditable. The basis of this structured approach is explained and is explored using examples of area designation in diagnostic radiology and radiotherapy.

1625 Practical methods of assessing extremity doses in interventional radiology

M Whitby and C Martin
Health Physics, Department of Clinical Physics, Western Infirmary, Glasgow, UK

INTRODUCTION: Interventional radiologists can receive significant radiation doses to their extremities. Such doses may be high enough to warrant that they be classified as radiation workers. Dose to the hands is routinely monitored using TLD rings located at the base of the fingers. This allows an average dose across the hand to be monitored. Under IRR99, if there is a potential for localized areas of the skin to receive a high radiation dose, then monitoring of the most exposed 1 cm^2 is required. METHOD: This paper reports the results of a comprehensive 2-year study of extremity dose in interventional radiology in Scotland. The study measured the dose across the hands of radiologists, covering a range of both diagnostic and therapeutic procedures across a wide range of hospitals throughout Scotland. The dose was measured over complete procedures using LiF:Mg, Ti TLD100 chips. RESULTS: Results show that the magnitude and distribution of dose to the hand was dependent primarily upon the procedure undertaken. However, this was influenced by the complexity of the procedure, room layout and clinical protocol. In general, a gradient of dose existed across the hand from the wrist to the fingertips in both dorsum and palmer aspects, with the wrist receiving the lowest dose. This could lead to an underestimation of dose to the most exposed 1 cm^2 by 20–30%. DISCUSSION: In some circumstances, the position of a TLD ring would be the most appropriate one to measure the highest dose. The practicality of showing compliance with IRR99 will be discussed.

1635 Evaluation of ALVIM phantom for use in radiographic optimization

R Morrell, A Rogers and B Waters
Medical Physics, Nottingham City Hospital NHS Trust, Nottingham NG5 1PB, UK

PURPOSE: To evaluate a new statistical phantom with moveable test elements for use in radiographic optimization. Key factors considered were reproducibility of results, sensitivity to changes in image quality and usability. METHOD: The phantom was imaged under various clinical conditions. Images were scored by multiple observers, and intraobserver and interobserver variability were estimated. Small changes in exposure factors were made to test sensitivity to the imaging technique. Binary and 5-point scoring systems were compared. RESULTS: The phantom allows straightforward comparison of imaging techniques. It is sensitive to small changes in image quality, with a change in beam energy of 5 kV corresponding to a change in mean observer accuracy of up to 20%. The quantity of interest, detection accuracy, is independent of operator bias, giving the ALVIM an advantage over phantoms with contrast objects in fixed positions. However, the results depend on the observer's level of confidence in the test element positions, with intraobserver and interobserver standard deviations of up to 10%. Observer accuracy was found to increase following training. Individual re-positioning of test elements is time consuming, and manipulating them in blocks proves more practical. The phantom is more sensitive if used with the 5-point scoring system, but it is quicker and simpler to use with the binary system. CONCLUSION: The phantom provides a practical alternative to ROC analysis for assessment of image quality. It is a useful tool for optimization of radiographic technique. Accuracy may be improved by repeated imaging with different element positions or by use of multiple observers. Appropriate operator training is essential.

1645 Determination of an image quality index from threshold contrast detail diagrams

I A J Fife and I R Pitkin
Medical Physics, Royal Free Hospital, London NW3 2QG, UK

PURPOSE: A novel image quality (IQ) index using threshold contrast detail diagram data is presented. METHOD AND MATERIALS: A threshold contrast detail test object has been used to obtain data on 15 fluoroscopy units. The data recorded have been plotted as threshold contrast *vs* object size and fitted to a rectangular hyperbola. The distance c from the origin to the curve apex has been calculated and used to form a measure of IQ. Threshold contrast detail diagrams (TCDDs) and threshold detection index diagrams (TDIDs) have been compared with c-2, a proposed IQ index. RESULTS: Use of c-2 as an IQ indicator agrees well with the established methods for IQ assessment, such as the area under a TDID curve and the reciprocal area under a TCDD curve. CONCLUSION: When the Pearson correlation coefficient of contrast *vs* reciprocal object size is >95%, the TCDD can be accurately plotted as a rectangular hyperbola. When this is the case, c-2 is a useful IQ indicator, correlating well with the area under a TDID curve and the reciprocal area under a TCDD curve.

1655 WIP: An index of conspicuity for pulmonary nodules

D J Manning and S C Ethell
Department of Radiography and Imaging Science, St Martin's College, Lancaster LA1 3JD, UK

BACKGROUND: Chest radiology is subject to error, but the sources of observer error are poorly understood. Pulmonary nodules are a common pathological feature and their clinical significance can be substantial. Investigating observer performance in the task of pulmonary nodule detection requires detailed knowledge of the physical features of the targets. OBJECTIVES: To measure the physical image characteristics of natural pulmonary nodules; to simulate natural nodules with computer generated lesions; to form a test bank of chest images; and to investigate observer performance. RESEARCH QUESTION: How does the physical conspicuity of a lung nodule influence its detection? MATERIALS AND METHODS: Nodules were simulated from data from natural lesions using the Photoshop® program by

reducing local optical image density with the "dodge-tool". An "index of conspicuity" was developed from physical measures of contrast and edge gradient for all the lesions. 81 nodules (46 natural and 35 artificial) were presented in a bank of 120 PA chest images to four experiences radiologists. Nodule location and observer confidence ratings were determined by the method of Alternative Free Response Operating Characteristics (AFROC). RESULTS: Edge gradient was the most influential parameter in the value of lesion conspicuity. Observers were unable to distinguish the real from the artificial nodules. Conspicuity values were generally lower for missed lesions compared with detected ones, although the correlation was weak. CONCLUSION: The simulation technique is a reliable method of generating realistic lesions for observer studies. Detection was poorly correlated with conspicuity and we suspect our results show errors of recognition.

1705 Discussion

1630–1800 Hall 10
Refresher Course
Gastrointestinal

1630 Invited review: CT of the pancreas

J C Healy
Department of Radiology, Chelsea & Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK

CT of the pancreas affords high resolution imaging, which is quickly and easily acquired. It is the modality of choice for staging pancreatic cancer and for assessing the severity of acute pancreatitis. I will discuss the value of CT in the context of pancreatic adenocarcinoma: in detection, evaluation of local extent including vascular involvement, and its performance in overall staging. I will also discuss the imaging features of cystic pancreatic tumours and the value of CT in the detection of neuroendocrine tumours. I will discuss the value of CT in the context of acute and chronic pancreatitis, confirming uncertain diagnosis and evaluating complications, which in severe acute pancreatitis contribute to prediction of outcome.

1655 Invited review: Characterization of liver lesions

P Kane
Kings College Hospital, London, UK

This presentation will review the physical and cellular properties of normal and pathological liver tissue that allow liver lesion characterization. A review of current techniques, including ultrasound, CT and MRI, and their use of contrast media will be presented with reference to the role of arteriography in a proportion of patients. A diagnostic algorithm will be developed to allow a methodical approach to liver lesion investigation in the adult population.

1720 Invited review: PET in the gastrointestinal tract

M Maisey
King's College, St Thomas Street, London SE1 5RT, UK

No abstract provided.

1745 Discussion

1630–1800 Olympian Suite 1
Refresher Course
Oncological Imaging

1630 Invited review: Tumours of the face and neck

P Anslow
Neuroradiology Department, Radcliffe Infirmary NHS Trust, Woodstock Road, Oxford OX2 6HE, UK

No abstract provided.

1655 Invited review: Colorectal cancer: staging and diagnosis of recurrence

J A Guthrie
Department of Radiology, Lincoln Wing St James's University Hospital, Leeds LS9 7TF, UK

Once a diagnosis of colorectal cancer is established, imaging is potentially of value in the pre-operative staging and the diagnosis of residual or recurrent disease following surgery in either the symptomatic population or, more contentiously, as part of a post-operative surveillance programme. The justification for pre-operative staging is that the therapeutic approach will be modified by demonstration of locally advanced or distant metastases. In rectal cancer, radiotherapy is more effective in the pre-operative setting. The best outcomes should be achieved if this is applied selectively rather than universally. Imaging, particularly MRI, has a potential role in aiding selection. The combination of sagittal T_2 and high resolution axial T_2 weighted images is of greatest value in assessing the extent of transmural spread of rectal cancers. The liver is the commonest extranodal site of spread, and the demonstration of liver metastases may modify surgery. Either palliation or additional hepatic surgery may be performed. CT enables the liver to be examined for this purpose and can also assess the peritoneal cavity and the local extent of colonic neoplasms proximal to the rectum. CT can be used to identify locally recurrent and metastatic disease, with MR having advantage in the pelvis. Extending the use of imaging techniques to the asymptomatic population is contentious. To be of value, identification of patients prior to presentation with symptoms needs to confer an improved outcome. There is some evidence to support this, although the role of imaging is far from clear.

1720 Invited review: Paediatric oncology: protocols and dilemmas

K McHugh
Radiology Department, Great Ormond Street Hospital, Great Ormond Street, London WC1N 3JH, UK

Survival after childhood cancer has improved significantly over the past 25–30 years. At least some of this improvement is due to advances in imaging with consequent better staging at diagnosis and often earlier detection of relapsed disease. Paediatric oncologists rely heavily on radiological examinations to monitor response of tumours to treatment. Protocols for radiological assessment and follow-up are designed by national and international paediatric oncology groups. Unfortunately, however, there are many unaccountable differences in strategy between the groups, *e.g.* do renal tumours in young children merit a biopsy prior to commencing chemotherapy? In addition, there are gaps in our knowledge pertaining to the optimal imaging of childhood malignancies. The role of positron emission tomography in childhood cancer needs to be properly evaluated. Is abdominal CT sufficiently reliable in detecting lymphadenopathy in boys with paratesticular rhabdomyosarcoma or should nodal sampling be reintroduced? A number of controversies regarding the interpretation of findings on radiological studies also exist, *e.g.* do patients with Wilms' tumour and pulmonary nodules visible on CT but not evident on a chest radiograph have a higher rate of metastatic relapse? Should they be treated as stage IV disease? Could performing routine chest CT at diagnosis now be unethical in paediatric Wilms' patients? Finally, new response evaluation criteria in solid tumours (RECIST criteria) are gaining acceptance in adult oncology. However, these criteria are not, in their present form, applicable to paediatric cancers (there is too much reliance on CT advocated; cystic or necrotic tumours are supposedly non-measurable).

1745 Discussion

1630–1800 Hall 11B
Refresher Course
Neuroradiology

1630 Invited review: Imaging the middle ear

V Chong
Department of Diagnostic Radiology, Singapore General Hospital, Singapore

A good knowledge of the anatomy of the middle ear is crucial in formulating a differential diagnosis and mapping disease extent. Differential diagnosis based on attenuation seen in fine section CT is difficult because most lesions share the same range of densities. However, the location of the lesion, the morphology and clinical information can help narrow down the differential diagnosis considerably. It is important to recognize two vascular variants: aberrant carotid artery and a dehiscent jugular bulb. These variants should be recognized for what they are. Glomus tympanicum are localized vascular tumours in the region of the cochlear promontory. In contrast, glomus jugulotympanicum tumours originate in the jugular foramen and extend into the middle ear. Granulation tissues are common in the middle ear and can be categorized into three forms: soft tissue mass indistinguishable from early cholesteatoma; linear strands; and cholesterol

granuloma. Congenital cholesteatomas are aberrant epithelial rests and occur in children or young adults without a history of infection, while acquired cholesteatomas are more common in adults. Congenital and acquired cholesteatomas are indistinguishable on CT and MRI. On CT it is important to document the erosion of ossicles, tegmen tympani, lateral semicircular canal and involvement of the facial canal. Facial nerve schwannoma usually presents as conductive hearing loss as a result of pressure effect on the ossicles. Facial nerve palsy is seldom an important presenting symptom. Typically, facial schwannomas on CT have a tubular appearance enlarging the facial canal. The lesion enhances well on MRI.

1655 Invited review: Approaches to orbital imaging

A Jackson
Imaging Science & Biomedical Engineering, University of Manchester, Manchester M13 9PT, UK

Requests for imaging of orbital disease are relatively infrequent in general radiological practice and the majority of radiologists have little experience of the interpretation of orbital abnormalities. Combined with the wide range of pathologies that occur within the orbit, this can lead to uncertainty in the selection of imaging protocols and interpretation of findings. The standard classification of orbital lesions as intraconal or extraconal has little or no practical value and this talk will present an alternative approach to the classification of orbital abnormalities based on the identification of their tissue of origin. We will specifically address lesions of the optic nerve/optic nerve sheath, extraoccular muscles, lachrymal gland, orbital wall and orbital apex. We will discuss the selection of imaging protocols for suspected orbital lesions using both CT and MRI. The lecture is intended to provide the attendees with a structured diagnostic framework around which to base both the design of imaging protocols and the diagnostic differential diagnoses.

1720 Invited review: Imaging the pituitary

J B Bingham
Department of Radiology, Guy's and St Thomas' Hospital, 2nd GT, Guy's Hospital, London Bridge, London SE1 9RT, UK

MR has almost completely displaced CT for imaging the pituitary, mainly because of its superior contrast resolution and multiplanar capability. None the less, for most acute problems CT is adequate for showing pituitary tumours, the presence of haemorrhage and invasion of adjacent structures. T_1 weighted images are appropriate for most pituitary disease and although contrast medium is frequently used, for most conditions it contributes very little. The normal anterior pituitary is isointense with brain but the posterior pituitary is hyperintense because of its pituicyte content. The pituitary stalk lies in the midline and enhances after contrast medium, as does the anterior pituitary. Most microadenomas are hypointense and enhance less than the surrounding anterior pituitary. The majority are visible prior to contrast medium, although in Cushing's disease they are often small and less conspicuous than prolactin-secreting adenomas. The underlying histology makes little difference to the appearance of microadenomas. Macroadenomas often enhance after contrast medium. Invasion into the adjacent structures is frequent, with infiltration into the cavernous sinuses, invasion of the sphenoid sinus and displacement of the optic chiasm. Following surgery there is often little decrease in size but there may be haemorrhage into the gland. Most are treated with radiotherapy to reduce their size and to prevent re-growth. Other tumours include dermoids (which contain fat) and craniopharyngiomas, although precise histological classification by MR is difficult. In hypopituitary patients it is important to obtain sagittal images to assess both the posterior lobe and the thickness of the pituitary stalk, particularly if there is posterior lobe dysfunction. There may be thickening of the stalk in association with meningeal disease in conditions such as sarcoidosis. Growth hormone deficiency is usually due to pituitary disease and there may be accompanying changes such as a small anterior lobe and ectopia of the posterior lobe, which lies close to the floor of the third ventricle, but tumours such as dysgerminoma may also be seen.

1745 Discussion

1630–1800 Olympian Suite 2
Refresher Course
Musculoskeletal Lower Limb

1630 Invited review: Chronic low back pain in the athlete

J J Rankine
Radiology Department, St James University Hospital, Beckett Street, Leeds LS9 7TF, UK

A spondylolysis is a stress fracture of the pars interarticularis. It is a common cause of chronic low back pain in the elite athlete, particularly those involved in sports that involve repetitive twisting forces such as cricket bowlers. A spondylolysis occurs in approximately 5% of the general population and can occur as an asymptomatic finding. Detection of a lysis by plain radiographs or CT may therefore be an incidental finding. Isotope bone scanning has been used in an attempt to distinguish an asymptomatic lytic non-union from a symptomatic lysis. Using reverse angle and 3D sequences, MRI can be used to detect the lysis. Detection of bone oedema using fat suppressed T_2 weighted sequences may correlate with symptoms and may help distinguish a symptomatic from an asymptomatic lysis. In difficult cases, direct injection of the lysis with local anaesthetic can be used to determine the significance of the lysis, and this is also used to predict the likely benefit of a spinal fusion.

1655 Invited review: Soft tissue sarcoma and mimics

R Nakielny
CT Body Scan Department, Royal Hallamshire Hospital, Glossop Road, Sheffield S10 2JF, UK

Soft tissue sarcoma is a rare tumour. There are several well recognized predisposing factors (*e.g.* neurofibromatosis type 1 and previous radiotherapy). The histological diagnosis of soft tissue sarcoma is obtained by percutaneous biopsy with a Tru-cut needle. However, it can be difficult to make the diagnosis even in the hands of a specialist pathologist, so referral to a soft tissue sarcoma unit is recommended. Suggested guidelines for referral are if the mass is greater than 5 cm, deep or fixed. The surgeon needs to know the grade of the sarcoma, whether it is invading neurovascular structures, and (if previous surgery has been performed) whether all the tumour has been removed. The medical oncologist will need to know the cell subtype of the tumour, as some of the sarcomas are chemosensitive. Pre-operative imaging involves X-rays and ultrasound of the primary mass together with cross-sectional imaging using MR to characterize the size, depth and proximity to vessels. Basic sequences in two planes usually suffice. Chest X-ray and CT thorax is also performed, as the incidence of lung metastases is high. A variety of soft tissue sarcomas will be demonstrated, followed by examples of trauma, inflammation, benign tumours and a few miscellaneous conditions that can mimic soft tissue sarcomas.

1720 Invited review: MRI of the foot and ankle

R S D Campbell
Department of Radiology, James Cook University Hospital, Middlesbrough TS4 3BW, UK

MRI is often utilized as a supplement to radiography for diagnosis of bone and joint related abnormalities of the foot and ankle. Indications include osteochondral injuries, stress lesions of bone, ankle impingement, inflammatory arthritis and other arthropathies, and osteomyelitis. MRI is also frequently regarded as the primary imaging modality for investigating soft tissue disorders of the foot and ankle, such as tendon disease and soft tissue masses. The diagnostic capabilities of MRI can also be improved in some circumstances by the use of intravenous contrast agents and MR arthrography. However, other imaging modalities such as ultrasound and CT may provide an alternative means to investigate many of these conditions, with equal or greater diagnostic confidence. Utilization of alternative techniques may prove more cost effective or may be more readily available to the radiologist. This lecture will review the MR techniques of foot and ankle imaging and will discuss the main pathological processes that may be encountered. The applications of contrast agents and arthrography will be included, and where appropriate a critical analysis of alternative methods of investigation will be made.

1745 Discussion

1645–1715 Kingston Lecture Theatre
Keynote Lecture
Review of Future Developments

1645 Invited review: Review of future developments in digital imaging and their impact on service provision

M Vannier
Department of Radiology, University of Iowa, 200 Hawkins Drive, 3966 JPP, Iowa City, IA 52246, USA

No abstract provided.

1645–1745 Multipurpose Rooms 1 & 2
Workshop
Musculoskeletal Reporting

1645 Musculoskeletal Reporting Workshop

Q C Field-Bowden
X-Ray Department, Wansbeck General Hospital, Woodhorn Lane, Ashington, Northumberland NE63 9JJ, UK

No abstract provided.

1700–1800 Hall 9
Advances
Advances in Radiotherapy Practice: new practices

1700 Invited review: Spiral CT sim

S Kingston
Weston Park Hospital, Sheffield, UK

Since the spiral CT sim became clerical at Weston Park Hospital, Sheffield, almost 5 years ago, we have coordinated to develop our working practices and the CT sim is now an integral part of the radiotherapy planning process within the radiotherapy department. The technology offers an opportunity to customize and modernize the planning and delivery of radiography, facilitating complex planning and the move towards IMRT. We are currently evaluating the role of CT simulation within the radiotherapy process and within that context, also assessing the future of the conventional simulation service. The future of conventional simulation therefore depends upon acceptability of the "virtual" CT simulation process.

1730 Invited review: Radiographer-led prostrate brachytherapy service

K Wilkinson
Christie Hospital NHS Trust, Wilsmlow Road, Withington, Manchester M20 4BX, UK

No abstract provided.

1715–1800 Kingston Lecture Theatre
Scientific Session
Digital Imaging

1715 A PACS view of the EPR universe

H Hatzakis
31 Ferry Street, Isle of Dogs, Docklands, London E14 3DT, UK

The healthcare computing and PACS market has matured and is no longer in an embryonic state. Companies have learned from old mistakes, and new designs utilizing new algorithms and hardware can better address the new emerging requirements. Hospitals, on the other hand, have realized the numerous benefits from filmless operations and how they can add value to their health provision and their strategic planning. Inevitably, the quest for development of the integrated clinical desktop becomes the strategic focus of healthcare enterprises. A clinical desktop is needed that will provide a uniform single point of entry for access to patient-related, administrative and research information focused on the new incarnations of the medical record: electronic, accessible, confidential, secure, acceptable to clinicians and patients, and integrated with other, non-patient-specific information. It is within this technical framework that modern PACS is required to operate. The author believes that clinical image archiving and communication, with their diversity of models and architectures, are established clinical practices and no longer an issue; but the paramount question that PACS needs to address is that of clinical data utilization: how the imagery data can be semantically presented in such a way as to maximize the decision-making process to the benefit of the patient. We believe that the final success of modern PACS within an EPR universe will depend on the ability to implement the institutional and national directives for integrated care pathways, user expectations and proposed technologies.

1725 Our approach towards an Integrated Healthcare Enterprise (IHE): early implementations

N Shastry, P Richardson, S King and I Watt
Bristol Royal Infirmary, United Bristol Healthcare NHS Trust, Bristol BS2 8HW, UK

The prime requirement of an integrated healthcare enterprise is to provide all the relevant patient-centred data securely and reliably across the patient care pathway. We have used the "ICARAS Agenda" (Interoperability, Compatibility, Accessibility, Reliability, Affordability, Scalability) to address the dictates of the current and future requirements at remote hospitals, wards and GP clinics. We have used digital radiography systems, film digitizers, PACS brokers and hospital-wide intranet entities to facilitate this IHE implementation. The importance of a clinical champion who can describe the needs of such a system cannot be overemphasized. The implementations have to be needs-based, with enough time spent in training and working with the clinical users to imbibe confidence whilst also addressing the fears of the technophobes. From a remote radiographer-led facility, the Bristol General Hospital, comprising ultrasound scanners, digital radiography systems and general X-ray rooms, we are now transmitting GP-requested outpatient and other inpatient images to the Bristol Royal Infirmary for diagnosis and reporting. We have also extended the digital link to send chest images to the chest physicians in their OPDs. This complements our earlier lung cancer care image and reports links to the cardiothoracic surgeon. We are now in the process of implementing a further five image workstations to cover the current requirements of the consultant chest physicians. This work has been possible only owing to the fact that this a collaborative effort with a team mix of clinicians, radiographers, IM&T/IT, NHSIA, DOH, telecommunications companies and imaging systems vendors.

1735 Digital dictation in the radiology department

S G Davies
Royal Glamorgan Hospital, Wales, UK

This presentation explores the benefits that have been realized following the introduction of a centralized digital dictation system into the radiology department. The system is widely used in the directorate and remotely within and outside the Trust. There have been improvements in report turnaround time and better access to urgent reports. There has been more efficient use of the secretarial resource. Unexpected benefits such as reduced report enquiries and remote access are described. Future developments and their anticipated benefits are outlined.

1745 Advantages of Web technology for distribution of information and medical images

G Venturi, A Fiumicelli and S Simonetti
LifeImaging Division, Ferrania Imaging Technologies, Italy

Most of the RIS/PACS systems on the market are based on the client/server model. Communications between server and client and the visual interface with the operator are developed according to proprietary protocols. Server and client are strictly related and any change in the server implies that changes must be made with the client. In addition, the configuration is rigid. If one client machine is added, special software must also be installed. Finally, the client/server model is designed to operate in a local network and is difficult to implement on a geographic network or on the Internet. Because Web technology is based on international standards, it gets around all these problems. With this technology, a server machine also handles the complex processing operations, but the communication to clients is carried out using a standard protocol while the data display interface is standardized and incorporated within the client machine operating system (Web browser). Therefore, client management is no longer tied to the server and can be managed independently by the user. Since it is standard, the transmission is managed at the operating system level, thus offering greater guarantees in terms of efficiency and stability. In addition,

Web technology does not make any distinction between local network, geographic network or the Internet, ensuring that the operating model remains the same in all three environments.

1755 Discussion

1400–1445 Hall 11A (from page 37)

College of Radiographers

William Stripp Memorial Lecture

1400 Eponymous Lecture: The art and soul of orthopaedic radiography

T H Thorne

Radiology Department, Airedale General Hospital, Keighley BD20 6TD, UK

PURPOSE: The orthopaedic radiographer is highly skilled in demonstrating the pathology and/or trauma of the presenting patient. A unique combination of radiography and an in-depth knowledge of pathology and the mechanisms of trauma make this healthcare professional an indispensable member of the orthopaedic team. With the advent of radiographer reporting in the last few years, the knowledge base of the radiographer with an interest in orthopaedics and trauma is enhanced still further and results in a deeper understanding of the clinical setting. METHOD: Excellence in orthopaedic radiography is crucial to orthopaedic radiology, and the first line of the imaging investigation. It is the radiographer's skill and knowledge in producing quality images and using optimal projections that aids correct patient management. Illustrated throughout by real case studies. CONCLUSION: Although radiography has its roots in science, it may be argued that there is an art to producing that definitive image. The dedication, search for perfection, answering the question posed by the case are etched on the very soul of the specialist orthopaedic radiographer—working in a radiology department near you!

0830–1000 Hall 10
Refresher Course
Oncological Imaging

0830 Invited review: Extranodal lymphoma in the abdomen and pelvis

S J Vinnicombe
Department of Radiology, St Bartholomew's Hospital, West Smithfield, London EC1A 7BE, UK

The incidence of non-Hodgkin's lymphoma (NHL) is increasing steadily, only partly as a result of the increased incidence of lymphoma in association with immunocompromise. As extranodal disease is far more common in NHL than in Hodgkin's disease, radiologists can expect to recognize extranodal manifestations with increasing frequency, particularly with the routine use of cross-sectional imaging in staging. Extranodal involvement usually occurs in the setting of widespread disease (secondary involvement), but in 30–40% of cases there is primary extranodal involvement, most commonly in the gastrointestinal tract. Certain pathological subtypes of NHL are more often associated with extranodal disease, which is also more likely to occur during the course of childhood lymphomas. Identification of extranodal disease is important, since it carries a poorer prognosis, as recognized in the international prognostic index (IPI). CT remains the mainstay of imaging in lymphoma. It has a crucial role in staging, assessment of response to treatment and diagnosis of relapse. Occasionally the overall pattern of CT abnormality will suggest a diagnosis of lymphoma, but visceral lymphoma can mimic many other diseases. This lecture will aim to illustrate the most common CT manifestations of extranodal lymphoma in the abdomen and pelvis. Where appropriate, the role of other imaging modalities in problem-solving and staging will be discussed. Finally, difficulties in the assessment of response to treatment and possible imaging strategies will be reviewed.

0855 Invited review: PET in the staging and follow-up of lymphoma

G J R Cook
Department of Nuclear Medicine, The Royal Marsden Hospital, Downs Road, Sutton, Surrey SM2 5PT, UK

Nearly all types of lymphoma show avid uptake of ^{18}F-fluorodeoxyglucose (^{18}FDG) owing to enhanced glycolysis and overexpression of glucose membrane transporter proteins. Exceptions include the very low-grade lymphomas such as MALT tumours. ^{18}FDG PET does not usually have a role in the diagnosis of lymphoma, except in rare instances where biopsies are inappropriate or difficult. For example, it has been demonstrated that the degree of uptake in CNS space-occupying lesions in HIV patients may help differentiate lymphoma from infectious causes. Many studies have confirmed the sensitivity of ^{18}FDG PET, showing that it upstages disease in a number of patients compared with CT or gallium scintigraphy in Hodgkin's disease and non-Hodgkin's lymphoma. It is superior to CT in detecting both nodal and extranodal disease and has also demonstrated better sensitivity for detecting skeletal disease compared with bone scintigraphy. Less commonly, ^{18}FDG correctly down-stages disease by showing low or absent uptake in reactive nodes. Overall, ^{18}FDG PET leads to a change in management in approximately 20% of patients. ^{18}FDG PET may also be of value in assessing persistent tumour in residual lymph node masses. In this situation the positive predictive value approaches 100%, with remnant uptake predicting relapse, but PET may not be able to exclude minimal residual disease that may eventually lead to relapse. When assessing response to treatment, a metabolic response may be seen as early as 7 days after a course of chemotherapy, but delaying scanning until 6 weeks after treatment may lead to a better prediction of long-term outcome.

0920 Invited review: Tumours of the peritoneum

J C Healy
Department of Radiology, Chelsea & Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK

The peritoneum is the largest and most complexly arranged serous membrane in the body, producing a system of spaces and peritoneal reflections that can both prevent the spread of and act as conduits for disease. An understanding of this anatomy is key to understanding tumours of the peritoneum. Tumours of the peritoneum are most frequently malignant, peritoneal metastases being more common than primary peritoneal malignancies. Metastatic disease disseminates through the peritoneum via direct spread along peritoneal reflections, intraperitoneal seeding, lymphatic spread and embolic haematogenous spread. Primary peritoneal tumours are rare, involving mesenchymal elements. They are most commonly malignant. Benign tumours can be solid or cystic and may have characteristic appearances.

0945 Discussion

0830–1000 Olympian Suite 1
Refresher Course
Genitourinary

0830 Invited review: Management of haematuria

J H Newhouse
Department of Radiology, Columbia-Presbyterian Medical Center, New York, NY 10032, USA

Imaging evaluation of patients with haematuia is evolving as new techniques such as CT urography are being investigated, but there continues to be a lack of consensus regarding the proper approach. Haematuria is extremely common, occurring to some degree to nearly everyone at some time; therefore, to work-up every case of microhaematuria would be expensive and would yield little. The stratification of risk for important diseases therefore becomes important. Certain carefully defined clinical circumstances may obviate the need to work-up an episode of haematuria; in others, evaluation is clearly necessary. Investigation often requires both imaging and cystoscopy. Until recently, radiography, excretory urography and ultrasound have been the studies most frequently promoted to investigate haematuria; it is the author's prejudice that urography has been the best single examination. Increasing utilization of CT urinary tract examinations, commonly termed "CT urography", has been promoted and has been found to be effective, but controlled studies comparing it with more traditional examinations are lacking. This presentation will review indications for imaging, the array of diseases important to discover, the limitations of imaging and choice of modality.

0855 Invited review: Ultrasound of the scrotum

K Dewbury
Radiology Department, Southampton General Hospital, Tremone Road, Southampton SO16 6YD, UK

No abstract provided.

0920 Invited review: Radiology of urinary tract inflammatory disease

J H Newhouse
Department of Radiology, Columbia-Presbyterian Medical Center, New York, NY 10032, USA

No abstract provided.

0945 Discussion

0830–1000 Olympian Suite 2
Refresher Course
Chest

0830 Invited review: Multislice CT in the chest: techniques and protocols

F V Gleeson
Department of Radiology, Churchill Hospital, Old Road, Headington, Oxford OX3 7LJ, UK

No abstract provided.

0855 Invited review: ARDS: what can we learn from imaging?

S Desai
Department of Radiology, King's Healthcare NHS Trust, Denmark Hill, London SE5 9RS, UK

No abstract provided.

0920 Invited review: Imaging the chest wall and pleura

S P G Padley
Chelsea and Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK

The range of benign and malignant chest wall and pleural diseases encountered during clinical practice is wide and the role of imaging varies accordingly. Primary chest wall and pleural tumours may arise from all elements of the pleura, extrapleural space and chest wall. Frequently, chest wall disease represents metastatic spread to the thoracic cage from a distant primary, underlying lung tumour or local recurrence of a lymphoma or breast malignancy. Limited chest wall invasion by a lung primary is no longer a contraindication to surgery, with survival of up to 50% at 5 years being possible when nodal disease is not present at thoracotomy. Chest wall disease may also be due to infection, especially if the patient is immunocompromised, diabetic or has undergone recent thoracic surgery. This talk will briefly review the commoner pathologies encountered as well as the radiographic evaluation of chest wall disease.

0945 Discussion

0830–1000 Hall 11B
Scientific Session
Radiotherapy

0830 Clinical implementation of dynamic intensity modulated radiotherapy: radiographers' perspectives

[1]H McNair, [2]G Francis and [1]J Balyckyi
[1]Radiotherapy Department, Royal Marsden Hospital, Sutton and [2]Kingston University, Surrey, UK

PURPOSE: To explore radiographers' beliefs regarding technology and their perceptions of the clinical introduction of intensity modulated radiotherapy (IMRT). Also to identify factors that influence trust and confidence in the human–machine interface. METHODS: This was a qualitative study based on semi-structured interviews with 16 radiographers. Data were analysed using a framework analysis to identify themes and categories. RESULTS: Positive attitudes regarding technology were demonstrated by 13/16 radiographers (81%). The introduction of IMRT was seen to be stimulating and motivating. Negative aspects were associated with increased stress from learning new skills, concerns regarding loss of control of radiotherapy delivery when using IMRT, and the additional pressure of increased workload. Although there were contradictory views regarding the effect of increased use of technology on the patient–radiographer relationship, the use of technology and caring skills were not felt to be mutually exclusive. Trust in machines was influenced by the recognition of teamwork with the physicists. CONCLUSION: Radiographers perceptions regarding the clinical use of IMRT appeared to be influenced by their mainly positive beliefs regarding technology. With the current problems of recruitment and retention of therapy radiographers, full exploitation of modern technology could be used to reduce attrition. However, careful integration is required to allow for the increased training and workload.

0840 CHART in non-small cell lung cancer: experience in Nottingham

K L Foweraker, J K Berridge and S A Morgan
Department of Clinical Oncology, Nottingham City Hospital, Nottingham NG5 1PB, UK

BACKGROUND: In a multicentre study, CHART demonstrated a major advance in the treatment of non-small cell lung cancer (NSCLC). Since July 1997, all Nottingham NSCLC patients receiving radical radiotherapy have been treated with CHART. We present the results, with a minimum 1-year follow-up. METHODS: All patients presenting to multidisciplinary lung oncology meetings with NSCLC deemed inoperable (tumour status, patient status or choice) were considered. Additional selection criteria were WHO performance status 0–2, malignancy confined to the chest and adequate lung function. Radiotherapy was given thrice daily over 12 days, with a minimum interfraction interval of 6 h and total dose of 54 Gy. Side effects and tumour response were scored at 2 weeks and 4 weeks, and 3–4 monthly thereafter. RESULTS: 68 patients were treated, 7 after chemotherapy. Histology was available in 65 (95.6%); 51.5% were squamous carcinoma. Stages were: T1 17.6%, T2 41.2%, T3 19.1% and T4 17.6%. 28 patients (41.2%) were N1 or N2. 24 patients (35.3%) had no dysphagia; 11 (16.2%) grade 1; 17 (25%) grade 2; 10 (14.7%) grade 3; and 2 (2.9%) grade 4 (severe difficulty). Myelitis and pneumonitis requiring hospitalization were not seen. Dysphagia was maximal at the first visit and pneumonitis at 4–6 months. Mean survival was 627 days (95% CI 514–741 days) and median 532 days (95% CI 421–642 days) with KM analysis. Analysis by age, nodal status, tumour size and histology showed significant improvement in outcome with node negativity (p=0.004). CONCLUSION: Treating unselected patients, we demonstrate results comparable in survival and side effect profile to the CHART study group. CHART is feasible, tolerable and effective.

0850 Rapid Access Lung Cancer Clinic: the Liverpool experience

R F Magennis, C Sampson, S McDonald, M J Ledson and M J Walshaw
Department of Radiology, Cardiothoracic Centre, Liverpool, UK

PURPOSE: To review the diagnostic process of patients referred with suspected lung cancer. METHOD: The Rapid Access Lung Cancer Clinic (RALCC) was introduced in order to comply with the Government's mandatory maximum 2 week waiting time. Strict referral criteria were defined. 12 patients attend a morning clinic, undergoing clinical assessment, chest radiography and multislice CT. Bronchoscopy is performed the same day. The results are reviewed and management is planned 1 week later by the multidisciplinary team. CT biopsies are performed the following week if appropriate. RESULTS: During the first year (April 2000–March 2001), 431 patients (45% female) with a median age of 66.7 years (range 17–90 years) were seen, all within the mandatory 2 weeks. A diagnosis of cancer was made within 4 weeks in 96%. Of those patients diagnosed with cancer, all patients had a CT and 95% underwent bronchoscopy. Non-small cell lung cancer accounted for 77% of cases of cancer, 14% were small cell lung cancer and 2% were metastatic. CONCLUSION: Improved time to diagnosis of lung cancer has been achieved by a multidisciplinary approach with same day attendance for clinical and radiological assessment.

0900 Results of radiotherapy for recurrent rectal cancer following surgery ± chemotherapy for the primary tumour

[1]M Niewald, [1]R Hielscher, [1]L Wisser, [2]K W Ecker and [1]Ch Rübe
Departments of [1]Radiotherapy and [2]Surgery, University Hospital of the Saarland, D-66421 Homburg/Saar, Germany

PURPOSE: To review the results and side effects of radiotherapy for recurrent rectal cancer and to evaluate the prognostic factors for outcome. PATIENTS AND METHODS: Between 1983 and 2000, 128 patients were irradiated for recurrent rectal cancer. Primary cancer (mainly stages II–IV UICC) had been treated by surgery; in addition, 8% had received chemotherapy. There had been no radiotherapy. For recurrence, 36 patients underwent surgery and 20 received additional simultaneous/sequential chemotherapy. The mean age was 61 years and the mean Karnofsky performance index was 7.4. In 90 patients the recurrence was located in the pre-sacral region and in 15 patients it was in the rectosigmoid region. Radiotherapy was performed using a box technique and arc therapy as a boost, with total doses mainly between 50 Gy and 60 Gy within 5–6 weeks (daily single dose 1.8–2.0 Gy). RESULTS: Local tumour response (CT) was seen in 12%, whereas there was a progression in 56%. During follow-up, regional lymph node metastases were diagnosed in 21% and distant metastases in 41%. Overall survival was 8% within 5 years. The risk of distant metastases within 5 years was 70%. Prognostic factors were Karnofsky status and metastases during follow-up. Total dose, chemotherapy and surgery were of no prognostic significance. Side effects were tolerable. CONCLUSIONS: In our collective study, rectal cancer patients having recurrence after surgery ± chemotherapy had a very unfavourable prognosis. Nowadays, in the majority of these patients, radiochemotherapy according to the NCI recommendations would have been performed.

0910 An evidenced-based practice of image matching in radiotherapy

J Penman and D M Flinton
The Middlesex Hospital, City University, London EC1M 6PA, UK

PURPOSE: Technological advances and increased demands on diminishing staff resources in radiotherapy have promoted the question as to whether radiotherapy radiographers should expand their role by assuming one that has been historically held by clinical oncologists, that of reviewing verification images and, more specifically, portal images. This study, which took place at the Middlesex Hospital, compared the matching ability and accuracy of 10 clinical oncologists with that of 10 radiotherapy radiographers in an attempt to demonstrate each group's accuracy skills. METHODS: Each participant was trained by the researcher in the use of Vision 6.1 and was then was asked to match simulator reference images to portal images for two anatomical sites (the pelvis and the larynx). RESULTS: Results showed that the two groups compared favourably when matching images. The mean lateral and longitudinal shifts detected by both the groups were accurate to within 1 mm, and the mean rotational shifts for both groups were found to be accurate to within 1°. The evidence demonstrated equal proficiency between the clinical oncologists and the radiotherapy radiographers at matching reference images and detecting the movement shifts required.

0920 The ethical and legal implications of the use of complementary therapies by therapy radiographers

E White
Department of Radiography Education, University of Wales College of Medicine, Cardiff CF14 4XN, UK

An increasing number of Clinical Oncology and Radiotherapy Departments offer complementary therapies to their patients. These therapies may be offered by therapy radiographers as part of their continued professional development. Complementary therapies are, for the most part, not based in evidence gathered by established research techniques and so do not adhere to the principles of clinical governance. For patients to be able to make an autonomous decision regarding the acceptance or refusal of complementary therapies, they need to be informed of the risks and benefits of the proposed therapy. With current levels of knowledge, this may not be possible and so a patient is not able to give informed consent. There are many forms of regulation of practice in current use. The Health Act 1999 is a statute that regulates the professional activities of a number of health care professionals and seeks to raise the standard of care offered to the patient. For those complementary therapies that are interventional and have the capacity to do harm, it is suggested that statutory regulation under the 1999 Health Act may be an appropriate safeguard for the patient. The practice of therapy radiographers who offer complementary therapies to patient as part of their planned management may be regulated by their existing regulatory body as long as the radiographer undertakes additional training in complementary therapy on an accredited education course.

0930 The Newcastle technique for 3D planning of craniospinal radiotherapy: improved efficiency and treatment accuracy

[1]J M Wilkinson, [1]H H Lucraft, [2]R Kermode, [1]S Dickson and [1]E Murphy
[1]Northern Centre for Cancer Treatment and [2]Regional Medical Physics Department, General Hospital, Newcastle-upon-Tyne NE4 6BE, UK

Craniospinal irradiation is a complex technique used to treat brain tumours at risk of dissemination within the CSF, most commonly medulloblastoma in children. Accurate treatment planning is essential to maximize cure and to minimize late effects. Conventional simulation requires the patient (often a child) to remain in an immobile prone position for up to 1 h. A spinal compensator, which is time consuming to construct, is usually required to achieve acceptable homogeneity of spine dose. A new craniospinal technique developed in Newcastle, which utilizes 3D planning, is presented. 3D data have allowed the dose distribution at, and the effect of moving matches between, the spine and the skull fields to be visualized and evaluated. Segmented fields replace customized compensators. The new technique has improved accuracy; and has reduced planning time and the time the patient must lie immobile during the planning process.

0940 CT-planned supine craniospinal radiotherapy for medulloblastoma on a quadriplegic patient

[1]M A Mosleh-Shirazi, [2]F H Saran, [2]R S Soomal, [3]C Knowles, [3]H Taylor, [1]P J Childs, [3]H McNair and [1]V N Hansen
Departments of [1]Physics and [3]Radiotherapy, and [2]Neuro-oncology Unit and the Academic Unit of Radiotherapy and Oncology, Institute of Cancer Research and Royal Marsden NHS Trust, Downs Road, Sutton Surrey SM2 5PT, UK

PURPOSE: To describe the planning and treatment method for a quadriplegic young adult with a primitive neuroectodermal tumour of the posterior fossa (medulloblastoma) requiring craniospinal irradiation. MATERIALS AND METHODS: Owing to the patient's physical constraints, the standard prone position was impractical and not well tolerated. A simple supine set-up method was devised. Information from both CT and simulator were utilized. CT-based treatment planning was performed on an ADAC Pinnacle® system. Couch height limitation and spine length necessitated the use of two spine fields. Moving gaps were used to reduce dose inhomogeneity at the field junctions. The use of a top-up spine field ensured 95% isodose coverage of the entire spinal canal and obviated the need for a physical spinal compensator. Multiple dose prescriptions within the Pinnacle® plan provided a semi-automatic method of beam weight optimization. The cranial field blocks were designed from simulator films and were delivered by a combination of multileaf collimator (MLC) and divergent blocks to reduce block weight. Parallel opposed MLC fields were used for the posterior cranial fossa boost. Set-up verification was performed by portal imaging. RESULTS: The patient's simulation and treatment were uncomplicated. The top-up spine field provided a good alternative to a physical compensator. The CT plan revealed excessive dose to the posterior neck soft tissues requiring shielding of this area in the lateral fields. A lower than expected acute skin reaction was observed in this region. CONCLUSION: CT-planned supine craniospinal irradiation is practical and can be used in circumstances where a supine position is preferable.

0950 Discussion

0830–1000 Hall 11A
Refresher Course
Radiographer-performed Gastrointestinal Studies

0830 Invited review: The extended role of the radiographer in fluoroscopy

R L Law
Department of Radiology, Frenchay Hospital, Bristol BS16 1LE, UK

Role extension in fluoroscopy has been performed at this hospital since 1982, and GI fluoroscopy has been radiographer-led since 1996. Since computerization of department records in 1992, radiographers have performed over 26 000 fluoroscopic examinations. Radiographer final reporting in fluoroscopy is being performed at Frenchay. This talk is to discuss the extent of reporting, some of the audits performed and our considerations for current best practice in relation to GI radiographer final reporting.

0915 Invited review: Radiographer reporting of gastrointestinal examinations: meeting the challenges of the modern NHS

J M Nightingale
Directorate of Radiography, University of Salford, Salford M6 6PU, UK

Colorectal cancer is the second most common cancer in the UK, accounting for over 19 000 deaths per annum. The prognosis is dependent upon timely and accurate diagnosis, with the double contrast barium enema forming an integral part of diagnostic algorithms for suspected bowel disease. The potential impact of colorectal cancer screening and government cancer targets, coupled with an ageing population, will put increasing demands on gastrointestinal (GI) radiology services. The UK shortage of radiologists may result in an overstretched GI reporting service, with fewer examinations reported quickly or achieving dual reporting gold standards. Many NHS Trusts have successfully delegated the management of a range of GI examinations to radiographers, many of whom currently offer an informal description

of findings. In light of recent government initiatives, there is now a significant opportunity for these practitioners to further develop their reporting role. Selected radiographers working in other branches of radiology have already achieved high standards of independent reporting and, with appropriate education and clinical support, experienced GI radiographers should also embark upon formal reporting. This presentation identifies the potential benefits and barriers for radiographer reporting of GI studies. It considers associated issues, including government and professional body policy, standard setting and accountability. The key elements of an innovative GI reporting programme will be outlined. The presentation will also assess how the development of the reporting role may assist GI radiographers in striving for Advanced practitioner/Consultant practitioner status.

0830–1030 Hall 9
Advances
Radiation Protection and IR(ME)R

0830 Invited review: IR(ME)R and beyond: searching for the Holy Grail?
J Lynch
IRS Ltd, Unit 188, Century Building, Tower Street, Brunswick Business Park, Liverpool L3 4BJ, UK
No abstract provided.

0900 Invited review: Controversies in dose reduction
S Field
Department of Radiology and Physiotherapy, Blackpool Victoria Hospital NHS Trust, 36 Primrose Avenue, Blackpool, Lancashire FY4 2LL, UK
The Radiology Department at Blackpool Victoria Hospital formulated an IR(ME)R2000 steering group in September 1999. The lead was taken jointly by Consultant Radiologist Dr G M Hoadley and Directorate Manager Mr A S Whitley. The radiographers represented imaging modalities requiring procedures and protocols, including cardiology and CT scanning. The group met for weekly lunchtime meetings for 12 months and continues to meet twice monthly. Two national study days were organized in 2000, which were very well attended. The procedures and protocols introduced into the department were made available in a bound reference manual for purchase at the study day. The process of training and monitoring continues to be a dynamic process and provides the group with many controversial topics for discussion. Some of these have involved: referrers; justification of request cards; optimization issues involving techniques, equipment usage design and the impact of PACS; dose reference levels (DRLs); training issues; and availability of resources. Clinical audits have been undertaken on some of the procedures introduced. As an active member of the steering group and clinical audit, I continue to be involved in the controversies surrounding dose reduction. The introduction of IR(ME)R2000 and the compliance required in law has given us an overdue lesson in good housekeeping and best clinical practice. It has also forged closer working relationships with other health professionals within the Trust and Primary Care Sector.

0930 Invited review: The contribution of scatter to radiation dose in clinical practice
A C Eyden
Department of Allied Health Professions, Faculty of Health, Canterbury Christ Church University College, Canterbury CT1 1QU, UK
Scattered radiation is produced in every X-ray examination and is therefore a contributory factor to patient dose. This presentation will include new data related to the scattered radiation produced during radiographic examinations of the ankle, foot, knee, shoulder, elbow, wrist and hand. Sattered radiation was measured using a Passivated Implanted Planar Silicon (PIPS) detector, which is able to measure doses in the nGy region. This detector system has proved reliable in previous work and is a powerful tool in measuring scattered radiation in many different scenarios. The detector was placed at various sites within a Rando phantom. Limbs were manufactured from real bone, cast material and water (as a tissue substitute). The experiments were conducted in the practical X-ray room of a Higher Education Institution. Radiation dose was measured at the testes, mid pelvis (ovaries), mid abdomen, breast and thyroid. Entrance surface dose to the area under examination was measured using TLDs and relative ratios were estimated. Further work was undertaken to investigate the effect of lead protection on the radiation dose to the gonads. Different methods of lead protection were used and the most effective method for each examination was identified.

1000 Invited review: Implementation of IR(ME)R in cardiac angiography
C L Skinner
Physics Department, The Royal Marsden Hospital, London SW3 6JJ, UK
IR(ME)R2000 legislation states that special attention should be given to the optimization of procedures involving high patient doses as well asthose involving children. Some of the highest radiation doses encountered in X-ray imaging involve patients undergoing cardiac catheterization, and children are of particular concern. The cardiologist's role as an operator under IR(ME)R is often limited and the radiographer may play a key role in ensuring that dose is optimized. Factors affecting patient dose will be addressed, including equipment specification, operator technique and equipment performance. Optimum selection of dose-saving equipment features by the radiographer during a procedure is essential for compliance with IR(ME)R, and written protocols can help facilitate this. The requirement for comprehensive equipment quality assurance programmes will be emphasized. IR(ME)R requires that referrers are supplied with typical values of effective dose for different procedures. The quantity dose–area product provides a good starting point for dose assessment, but gives no information on the contribution to the total dose from different projections. Effective dose is thus difficult to assess. The estimation of effective dose will be discussed and typical values will be presented for different cardiac procedures. In cardiac angiography, doses may approach levels that result in deterministic effects such as skin erythema and it is therefore also necessary to consider entrance skin dose. The importance of defining dose action levels above which an investigation is carried out will be emphasized and the use of diagnostic reference levels in cardiac angiography will be discussed.

0830–1000 Kingston Lecture Theatre
Refresher Course
External Beam Dosimetry

0830 Invited review: Dosimetry traceable to air kerma standards
T Williams
National Physical Laboratory, B56/ 107 A, Queens Road, Teddington, Richmond TW11 OLW, UK
No abstract provided.

0900 Invited review: Dosimetry traceable to absorbed dose standards
S Duane
National Physical Laboratory, B56/ 107 A, Queens Road, Teddington, Richmond TW11 OLW, UK
No abstract provided.

0930 Invited review: Clinical applications
T J Jordan
North Wales Medical Physics, Glan Clywd Hospital, Bodelwyddan LL18 5UJ, UK
Transfer of primary standards to the hospital environment requires the use of suitable dosimetry protocols. The current status of IPEM protocols is reviewed and their practical implementation is considered. For megavoltage photons, the absorbed dose to water (calorimeter based) standard has been in use for over 10 years (IPSM 1990). The relatively simple approach based on a tissue phantom ratio of 20 to 10 cm deep, a single ion chamber model, together with national/interdepartmental audit has produced a very high degree of dosimetry consistency in the UK. However, the original secondary standard instrumentation is ageing and alternatives are considered. For kilovoltage photons, the protocol (IPEMB 1996a) is based on air kerma standards and is divided into three energy ranges. Medium energy (0.5–4 mm Cu HVL), where ion chamber calibrations are performed at 2 cm deep in water; low energy (1 8 mm Al HVL), where calibrations are performed in air and appropriate backscatter correction factors are given to calculate the dose at the surface of a phantom; and very low energy (0.035–1 mm Al HVL), where calibrations are performed at the surface of a phantom with a parallel plate chamber. The

principal limitation is that chamber replacement correction factors were not well known at the time and this will be the subject of a planned addendum. For electrons, traceability with the current air kerma based protocol (IPEMB 1996b) is achieved via the intercomparison of a Farmer chamber with the secondary standard in low energy megavoltage photons. The Farmer is then compared with a recommended parallel plate electron chamber in a high energy electron beam in water. There are a number of basic limitations on accuracy with this approach and a new protocol based on absorbed dose to water (calorimetric standard) is planned for this year (IPEM 2002). The essential elements of this will be reviewed, suitable ion chambers will be considered and the measurement of correction factors, including polarity and recombination, will be described. ([1] IPSM 1990. Code of practice for high energy photon therapy dosimetry based on the NPL absorbed dose calibration service. Phys Med Biol 35:1355–60. [2] IPEMB 1996a. The IPEMB code of practice for the determination of absorbed dose for x-rays below 300 kV generating potential. Phys Med Biol 41:2605–25. [3] IPEMB 1996b. The IPEMB code of practice for electron dosimetry for radiotherapy beams of initial energy from 2 to 50 MeV based on an air kerma calibration. Phys Med Biol 41:2557–603. [4] IPEM 2002. The IPEM code of practice for electron dosimetry for radiotherapy beams of initial energy from 2 to 25 MeV based on an absorbed dose to water calibration. In preparation.)

0830–0945 Lodge Room Symposium

CARS Symposium: Regional PACS and EPR

0830 Invited review: Effects of RIS/PACS on process parameters in hospitals of different sizes

K J Klose
Department of Radiology, University Hospital, Philipps University, Rudolf-Bullmann Str. P, Marburg D 35033, Germany
No abstract provided.

0845 Invited review: Experiences with the regional PACS project SAX/Tele/Med by example in Dresden

W Niederlag
Central Hospitals Services Department, Dresden-Friedrichstadt General Hospital, Friedrichstrafe 41, Dresden D-01067, Germany
No abstract provided.

0900 Invited review: PACS as a base technology for the institutional and personal medical record

H U Lemke and S Märkle
Technical University Berlin, FR 3-3, Computer Graphics & Computer Assisted Medicine, Franklinstr. 28-29, D-10587 Berlin, Germany
The SaxTeleMed project was initiated by the Ministry of Social Welfare, Health, Youth and Family of the Free State of Saxony, Germany. The reference model programme on "Digital imaging and image communication between hospitals in the Free State of Saxony" (SaxTeleMed) covers seven regional projects distributed throughout Saxony. The aim of this programme is to test the technical, organizational, legal and economic problems in the area of digitization and networking within the Free State of Saxony. A number of innovative projects within the context of PACS implementation, which has been initiated, are development of a quality function deployment (QFD) method for PACS specification and selection, introduction of a health professional card (HPC) with digital signature as well as the conceptual organization of an electronic health record. A structural approach was seen to be particularly helpful in preparing the RFP, and subsequently in the product and system evaluations. A suitable approach for creating a RFP can be derived from QFD techniques. The QFD methodology is based on a strong involvement of the user in determining product/system requirements with clearly stated importance ratings. After successful implementation in the SaxTeleMed project, this methodology has been used for PACS planning in other hospitals, *i.e.* the Zurich University Hospital in Switzerland. The decision to use a digital signature was facilitated by the availability of a specification for a digital signature card in the healthcare environment, the so-called "Health Professional Card" (HPC). In its basic directive, the signature law requires each user to contact a Trust Center for requesting a HPC. According to the new signature law, one of its main uses is the so-called "qualified" digital signature. The conceptual design and implementation of an EHR is an ongoing process in SaxTeleMed and requires close interaction with a number of existing projects on a European and worldwide basis, as well as with standard bodies. Within this framework, some of the EHR activities that have been considered are: GEHR, EHCR, Synapsis, EHTO, CHIN, PROREC, ERDIP, IHE, and openEHR. An evaluation of the above activities, with recommendations for future actions, will be given in the lecture.

0915 Invited review: From clinical management system to EPR to image distribution

H K Huang
Children's Hospital LA, University of Southern California, Los Angeles, CA, USA
No abstract provided.

0930 Panel Discussion

0900–1000 Multipurpose Rooms 1 & 2 Workshop

Musculoskeletal Ultrasound

0930 Musculoskeletal Ultrasound Workshop

D Chapman-Jones
Canterbury Christ Church University, North Holmes Road, Canterbury CT1 1QU, UK
No abstract provided.

1015–1145 Hall 11B Keynote Lecture

Radiotherapy Planning Update: targeting the tumour

1015 Invited review: Gross tumour volume determination

M Robinson
YCR Department of Clinical Oncology, Weston Park Hospital Trust, Whitham Road, Sheffield S10 2SJ, UK
No abstract provided.

1045 Invited review: Enhancing tumour volume determination and targeting

J Logue, *Christie Hospital, Manchester*. No abstract provided.

1115 Invited review: Clinical tumour volumes: margins and errors

M van Herk
Radiotherapy Department, The Netherlands Cancer Institute/ Antoni van Leeuwenhoek Hospital, Plesmanlaan 121, 1066 CX Amsterdam, The Netherlands
Conformal radiotherapy aims at maximizing tumour control whilst minimizing damage to the surrounding tissues. To increase the therapeutic range, smaller and smaller margins are being used between the gross target volume (GTV), the clinical target volume (CTV) and the planning target volume (PTV). To achieve a high precision, each step in the conformal radiotherapy procedure is image guided. The most important errors are: (1) organ motion: movement of the tumour with respect to the bone. This error occurs during treatment planning and treatment execution. Although no movement occurs as such in the CT scan, organ movement is frozen by the action of taking the CT image. (2) Delineation errors: misplacement of the delineated contour with respect to the tumour. Recent data have shown that the error in target volume delineation may be single biggest error in the entire radiotherapy chain. In addition, the GTV to CTV expansion assumes knowledge of microscopic tumour spread, which often is hardly available. (3) Set-up error: deviation between the CT room coordinate system or the treatment room coordinate system and the patient's bone. Each of the errors should be made as small as possible, for instance by measuring and correcting set-up errors. However, it will never be possible to exclude all errors. To determine which margin is adequate, the statistics of each of the residual errors should be known. Through physics and biological modelling, formulae are being developed for the margin. Using these formulae, the limits of safe margin reduction can be explored.

1015–1145 Lodge Room
Symposium
CARS Symposium: Imaging for Intervention

1015 Invited review: Image guided magnetic surgery

M Vannier
Department of Radiology, University of Iowa, 200 Hawkins Drive K, 3966 JPP, Iowa City, IA 52246, USA

Catheters, magnetic seeds, untethered endoscopes and slurries of ferromagnetic particles may be moved, guided and/or steered in living tissue by the shaped field of a repositionable external magnet for minimally invasive surgical procedures. A magnetic surgery system (MSS) consists of a control processor, a pointing device, a magnet assembly generating a magnetic field, a display and a 3D medical imaging system. Biplane fluoroscopic images of the patient in which the magnetic delivery vehicle is implanted are shown on a screen, each image representing a projection in space of the operating region. The pointing device is operated to move a cursor from a projection of a present location of the magnetic delivery vehicle to a projection of a desired future location. When the locations are completely specified, the currents applied to multiple magnets in the MSS produce a magnetic field and move or orient the magnetic delivery vehicle. Multiple superconducting magnetic coils are activated simultaneously to move a magnetic object to precisely specified locations within the body under command of a physician-operator observing the motion with live fluoroscopic imaging fused with a more detailed pre-operative image. A workstation contains the pre-operative images and the fluoroscopic images as well as the means to effect changes in the coil currents and to position the magnetic object motion as desired. The control method operates the coils in pairs on opposite sides of the body to minimize the necessary current changes, thus avoiding quenching of the superconducting coils. Combinations of these pairs can execute motion of the magnetic object in any direction in an impulsive manner and with high precision. The display provides real-time imaging of the implanted magnetic object in comparison with the desired path as the object is moved. This system has applications in neurosurgery, cardiac electrophysiology mapping and ablation, brachytherapy and endoscopy that are currently under development. The technical features of an MSS and examples of its applications will be presented.

1045 Invited review: Image guided surgery in Germany

G Strauss
Department of ORL/Plastic Surgery, University of Leipzig, IGSN, Liebigstrasse, Leipzig 04103, Germany

No abstract provided.

1100 Invited review: Navigation in liver surgery: from vision to reality

[1]H-P Meinzer, [1]M Vetter, [1]P Hassenpflug, [1]G da Silva Jr, [1]M Thorn, [1]C Cárdenas, [2]G M Richter, [3]W Lamadé and [3]M Büchler
[1]Deutsches Krebsforschungszentrum, Division of Medical and Biological Informatics, Im Neuenheimer Feld 280, 69120 Heidelberg, and Departments of [2]Radiology and [3]Surgery, University Hospital Heidelberg, Im Neuenheimer Feld 110, 69120 Heidelberg, Germany

Ever since the first surgical interventions, surgeons had to compensate the for lack of transparency of human organs. They learned to orientate themselves by means of their visual and tactile senses, and their actions were limited by their motor skilfulness. Nowadays, augmented reality (AR) allows for enhanced perception of the surgical site by superimposing stereoscopic projections over the field of operation. This has already been demonstrated for computer-assisted neurosurgery. Although the brain is surrounded by the skull, it deforms when the skull has been opened, and even further as resection continues. AR systems for neurosurgery can cope with this brain shift by deformation modelling and intraoperative imaging. However, the problem of deformation is much greater in liver surgery where no adjacent bone fixes the deformable organ. Not only surgical manipulation but also breathing and blood supply have a major impact on the deformation of the liver during surgery. This is why up to now the vision of seeing intraoperatively inside the liver has remained unfulfilled. For the same reasons, active constraints have not yet been implemented for liver surgery. The concept of active constraints has been developed by the medical robots community to control the power of surgical tools and instruments. When the surgeon violates a pre-operatively given constraint, such as a security margin surrouding a tumour, the instrument's power is automatically turned down. We are building a prototype named ARION™ (Augmented Reality for Intra-Operative Navigation) to demonstrate the feasibility of image-guided liver surgery. New technologies and methods implemented in ARION™ will enable image-guided liver surgery.

1115 Invited review: Trends in PACS-based information

H K Huang
Children's Hospital LA, University of Southern California, Los Angeles, CA, USA

No abstract provided.

1130 Panel Discussion

1030–1130 Hall 10
Keynote Lecture
Screening for Lung Cancer

1030 Invited review: Screening for lung cancer

P Armstrong and J E Husband
P Armstrong
Academic Department of Radiology, St Bartholomew's Hospital London, UK

Several trials, most notably the Early Lung Cancer Action Project in New York, have shown that low dose CT, *e.g.* using 40 mAs per section, can diagnose lung cancer at an early stage. Although many of the nodules shown on screening CT turn out to be benign, a non-invasive scheme of assessment was devised whereby virtually all the nodules removed by thoracotomy were primary lung carcinomas. The results and methodology of some of the existing lung cancer screening programmes will be reviewed. A key question in all population screening programmes is whether the screening programme will do more good than harm at an affordable cost. This talk will concentrate on the issues that need to be considered when trying to answer this question.

J E Husband
Department of Diagnostic Radiology, Royal Marsden Hospital, Downs Road, Sutton, Surrey SM2 5PT, UK

Lung cancer is the leading cause of cancer death in the western world. Non-small cell lung cancer may benefit from screening, as surgery for stage I disease results in 5-year survival rates in excess of 50%. Results of non-randomized trials of spiral CT in the USA, Japan and Germany have shown that spiral CT can detect approximately four times as many cancers as chest radiography, and most are stage I. Currently no randomized controlled trials (RCT) are being conducted. The National Cancer Research Institute (NCRI) proposals for a RCT in the UK have been submitted to the Medical Research Council. A RCT of spiral CT vs no screening in smokers aged 60 years and over is proposed, with lung cancer mortality as the primary end-point. Smoking cessation will be offered to both groups. A pilot trial of 2000 individuals is aimed to determine the feasibility, compliance and costs of a large RCT. A mobile multichannel CT scanner will be used. Nodules detected will be assessed to determine lesion growth using 3D volume software. Approximately 40 000 individuals would be required in the full trial conducted over 5 years to demonstrate a reduction in lung cancer mortality of 25%. Several RCTs are also being planned in Europe and the USA. International collaboration would be beneficial to all countries seeking funding and is being actively pursued by the European Early Lung Cancer Detection group, the NCI and the American Cancer Society.

1030–1115 Olympian Suite 1
Keynote Lecture
Indeterminate Adrenal Mass

1030 Invited review: Indeterminate adrenal mass

R H Reznek
Academic Department of Radiology, St Bartholomew's Hospital, London EC1A 7BE, UK

Adrenal masses >1 cm will be detected incidentally on 2–4% of

abdominal CT scans. The majority of these will be benign cortical adenomas, although other masses such as phaeochromocytomas, carcinomas and myelolipomas may also be incidentally discovered. In patients with known primary cancer, therefore, care must be exercised in distinguishing between benign cortical adenomas and metastases. A test with an extremely high specificity for the identification of benign cortical adenoma is essential. Almost all modalities rely on the presence of intracellular lipid to confirm the presence of an adenoma. On review of 11 studies on unenhanced CT, attenuation values of <0 HU, <10 HU and <18 HU have specificities of 100%, 98% and 88%, respectively. However, lipid-poor adenomas will not show this feature and will not be correctly characterized. Nowadays, most scans are performed following intravenous injection of contrast medium, and various formulae calculating the washout characteristics have been devised and will be elaborated on. Chemical shift (in- and out-of-phase) MRI has also been shown to have a high specificity. This too relies on the presence of intracellular lipid. Significant loss of signal between the in-phase and out-of-phase sequence has been shown to have a specificity of >95% for the presence of an adenoma. Only rarely are adrenal biopsies necessary nowadays.

1030–1115 Olympian Suite 2
Keynote Lecture
Pulmonary Embolism

1030 Invited review: Effective investigation of pulmonary embolism: the role of CT

S Padley
Chelsea and Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK

Whilst the most common radiological investigation for pulmonary embolism in the UK remains perfusion scintigraphy, there has been marked increase in the application of contrast enhanced spiral CT for the diagnosis of this clinical problem. Many departments are now routinely undertaking this investigation on a daily basis. Numerous studies have demonstrated the impressive sensitivity and specificity of spiral CT in this setting. However, there are important considerations in regard to CT, including radiation dose and availability of CT. Perfusion scintigraphy remains the most appropriate investigation in a significant number of patients. This talk will briefly review the evidence supporting CT for the diagnosis of pulmonary embolism and will place the use of CT within a diagnostic algorithm. Current CT technique, including multichannel CT, will also be reviewed.

1030–1200 Hall 11A
Refresher Course and Scientific Session
Developments in Endoscopy

1030 Invited review: Radiographer-led endoscopy

C Bloor
Department of Clinical Imaging, Royal Cornwall Hospital, Truro TR1 3LJ, UK

Radiographers have been performing barium enemas and other gastrointestinal contrast studies to a high standard for many years. At the Royal Cornwall Hospital, a radiographer who specializes in gastrointestinal work has successfully completed a training and assessment programme to perform flexible sigmoidoscopy and now performs regular endoscopy lists. This paper will describe the training and assessment programme undertaken by the radiographer and the methods used to audit quality. It will explore the professional issues related to this innovative approach to practice and role development, and the resultant benefits to the multidisciplinary team. An outline will be given of service improvements, including a radiographer-led one-stop flexible sigmoidoscopy and barium enema clinic. There will also be a discussion of future plans for the radiographer to progress to perform colonoscopy.

1100 Invited review: Virtual colonoscopy: a review

D A Nicholson
Department of Radiology, Hope Hospital, Stott Lane, Salford M6 8HD, UK

Colorectal cancer (CRC) is the second commonest cause of cancer deaths in the UK, with over 30 000 new cases and almost 20 000 deaths per year. It is now generally accepted that adenomatous polyps are the pre-cursor of most CRC, with adenomas under 1 cm in size requiring about 10 years dwelling time before the development of invasive cancer. A decrease in both incidence and mortality from CRC can be achieved by early diagnosis and preventative removal of pre-malignant adenomatous polyps. Currently there are numerous diagnostic techniques for investigation of patients suspected of having polyps. Virtual colonoscopy (VC) is a recent development allowing non-invasive large bowel imaging and is being increasingly used for colonic examination. In 1999 we were awarded a grant (NHS North West Executive R&D grant - Reactive funding Ref. No. RDO/18/91) to compare the detection rates and complications of VC and conventional fibre optic colonoscopy in 200 patients with suspected colonic polyps and cancer. This lecture will present the results of this clinical trial, including patients' response/preference to VC and the health economic comparison of the two methods. Additionally, current technique, scanning parameters, clinical use of VC and organization of the service will described, considering the impact of multislice CT and new visualization techniques.

1130 WIP: Evaluation of the role of CT colonography and virtual colonoscopy in imaging colorectal cancer

D M Allen and I J McCafferty
University of Central England, University Hospital Birmingham, Birmingham B42 2SU, UK

The Government's capital investment programme aims to increase and modernize CT scanning provision in the UK. The consequent arrival of multislice scanners is making sophisticated imaging techniques such as virtual colonoscopy (VC) more generally available. The purpose of this study, involving University Hospital Birmingham and the University of Central England, is to evaluate the clinical usefulness of this new imaging option. The method used is based upon an ongoing retrospective audit of radiological reports gathered over the past 2 years. It is interesting that in Birmingham we have had access to a Philips Easyvision system, which, together with a GE Prospeed single slice scanner, has allowed us to explore this area ahead of the current national position. Our findings lead on to a qualitative consideration of the differing expectations of where this imaging could lead. For example, could CT colonography realistically act as a screening test for early detection of colorectal cancer, and to what extent does 3D modelling such as VC add to axial image interpretation? Furthermore, in 2002, as we in turn receive the new multislice system, we will be well placed to conduct comparative prospective research into the way that new technology influences the radiological response to clinical need. In conclusion, it is exciting that new scanners are offering the opportunity to visualize real life pathology from the diagnostic image more easily, and this has important implications for the confidence with which a practitioner intervenes in a patient's treatment. This study attempts to quantify this opportunity.

1140 WIP: Variations in patient dose for barium enema and barium meal examinations in Ireland

E M Carroll and P C Brennan
UCD School of Diagnostic Imaging, St Anthony's, Herbert Avenue, Dublin 4, Ireland

PURPOSE: Wide variations in patient dose exist for the same examinations within and between countries. These variations may be due to operator, technique or equipment factors. Doses should be kept as low as reasonably achievable, therefore an effort must be made by all countries to be aware of the doses imparted to patients for a particular examination. It is only when patient doses are monitored that departments can begin optimizing their radiation protection methods. METHODS AND MATERIALS: This study aimed to establish a national diagnostic reference level for barium enema and barium meal examinations. These examinations are among the highest contributors to the collective population dose and it is therefore worthwhile establishing their reference levels. National studies have been performed in other countries, but this study is the first Irish nationwide study aimed at investigating barium enemas and barium meals. The study examined 38% of Irish hospitals providing these investigations. Dose–area product (DAP) meters were used as they are the recommended dosemeter for fluoroscopic examinations. The DAP meters were installed and calibrated *in situ*. Patient, examination, equipment and dose data were recorded for each examination. Up to 43 patients per examination per hospital were obtained. RESULTS: The data analysed have demonstrated average DAP values differing by up to a factor of three, with an overall mean for barium meals and barium enemas of 11.55 Gy cm^2 and 20.21 Gy cm^2, respectively. Individual patient doses

differ by up to a factor of 185, suggesting high variation within hospitals. CONCLUSION: These data demonstrate the importance of standardizing protocols for fluoroscopic procedures to eliminate unacceptable intrahospital and interhospital dose variation.

1150 WIP: Radiographers' work practices and perceptions of performing barium enemas

S Mathers
Grampian University Hospitals NHS Trust, UK

BACKGROUND: Nationally, radiographer-performed barium enemas (BEs) are described as the norm in imaging departments. Little research exists relating to their work practices or identifying areas of concern. These results are part of a larger study including qualitative data, the analysis of which is ongoing. METHOD: A convenience sample of Gastrointestinal Special Interest Group (GIRSIG) members who perform BEs was identified (n=68). A questionnaire was developed to collect quantitative data and included open questions to allow other issues to be described. RESULTS: A 70.6% (48/68) response rate was achieved, with 93.8% (45/48) completed and usable. 51% (23/45) of participants performed all the enemas in their departments, and the practice of radiographer-performed BEs had been in place for 1–18 years (mean 7.3 years). 33% (15/43) never attended BE reporting sessions, but 7 (15.5%) radiographers described issuing reports on enemas they had performed. The main reasons for training were "increased job satisfaction" (86%; 37/43) and "a new challenge" (86%; 37/43), with 81% (35/43) indicating expectations had been fulfilled. The reason given for non-fulfilment was "lack of progression to independent practitioner". The benefits were "increased job satisfaction" (66%; 29/45) and "providing a better service to patients" (64%; 28/45), but the drawbacks were "radiologist attitude" (30%; 11/37) and "lack of recognition and remuneration for added responsibilities" (24%; 9/37). CONCLUSION: This exploratory study indicated that radiographers' expectations of performing BEs had been fulfilled but concerns did exist. These will have implications for future service delivery, as radiographers take on further duties previously performed by radiologists.

1030–1130 Kingston Lecture Theatre
Keynote Lecture and Scientific Session
Quality Management and Patient Dosimetry

1030 Invited review: Quality management: is it "fit for purpose" in radiotherapy today?

C S Hall
Radiotherapy Physics Unit, Bristol Haematology and Oncology Centre, Bristol BS2 8ED, UK

The Quality Assurance in Radiotherapy (QART) standard has been an integral part of the management and organization of radiotherapy departments for the last decade. The Quality Management System (QMS) series of standards on which it was based has evolved during that time, addressing some drawbacks of previous versions. The latest version, ISO9000 (2000), is currently being implemented by many departments in the UK. Alongside this, a number of new initiatives have been adopted by departments, for example the Cancer Standards, Clinical Governance and the ionizing radiations legislations (IRR99 and IR(ME)R2000). This presentation will examine the ability of a QMS to address some of these initiatives and to support the needs of a modern radiotherapy department. To answer the question "Is quality management fit for purpose in radiotherapy today", this lecture will seek to examine whether a QMS can be an effective tool in changing practice for the better.

1100 Optical imaging of the patient surface quantifies set-up variations and movement

[1]V Sauret, [1]P J Sharrock, [1]C J Moore and [2]C M Wood
[1]*Department of North Western Medical Physics and*
[2]*Department of Radiotherapy, Christie Hospital, Manchester M20 4BX, UK*

PURPOSE: Customization of the radiation dose volume to the exact shape of the tumour in radiotherapy means that any patient movement becomes critically important. This paper investigates set-up variations from one treatment session to another as well as movement during treatment using interferometric, optical sensor height maps of the patient surface. MATERIALS AND METHODS: The study is of a patient receiving 5-week rectal conformal treatment lying prone. Patient daily set-up was performed by the radiographers based on three body marks (two lateral and one on the back). Once a week the patient's surface was imaged at random times in the breathing cycle. The FOV was 20 cm x 20 cm, with 440 x 440 height measurements taken in 20 ms, covering the treated area. The absolute differences between height map pairs from the same and different sessions were classified and represented in colour-coded images (0–1 mm, 1–2 mm, 2–5 mm, 5–10 mm and 10–20 mm). The respective position in space of any two surfaces was viewed interactively by the user. RESULTS: In all movement studies, 60–100% of the pixels in the 2D displays were found to be within 0–2 mm, whereas in the set-up studies 6–35% were found to be within 0–2 mm and 60–80% within 2–10 mm. The interactive displays stimulated the user to adjust the patient position. CONCLUSION: Breathing did not cause unacceptable movement of the treated surface but the variations in set-up showed manual positioning procedures require care for reproducibility. Systematic use of optical sensing for monitoring and correcting patient positions when displacements are critical may well be of value in guaranteeing correctly delivered radiation dose.

1110 Contralateral breast dose using the Siemens virtual wedge

S A Whittle, H M Morgan and J T Shakeshaft
Department of Medical Physics, Royal United Hospital Bath, Bath BA1 3NG, UK

There has been interest in the contralateral breast dose with the increase in delivery of radiotherapy to both mastectomy and lumpectomy patients. Although most studies do not show a statistically significant increase in breast cancer risk, it is recognized that a small group of patients may be at special risk for scatter-related second tumours, which may be for environmental or genetic reasons. Treatment plans for mastectomy patients generally use a higher wedge angle than for lumpectomy patients and a higher contralateral breast dose might be expected owing to the longer beam-on time and greater scatter from the wedge if a physical wedge is used. The treatment technique used at the Royal United Hospital, Bath is for two isocentric tangential fields with the 50% back edges aligned. An allowance of 15 mm on the beam width is made for patient movement. The aim of this work is to quantify the relative dose to the contralateral breast for both mastectomy and lumpectomy patients using the Siemens virtual wedge from a series of patient measurements using both TLDs and diodes. A comparison of measured doses on a phantom between the physical wedge and the virtual wedge for the Siemens linear accelerator will also be given.

1120 Discussion

1030–1130 Multipurpose Rooms 1 & 2
Workshop
Musculoskeletal Ultrasound

1030 Musculoskeletal Ultrasound Workshop

D Chapman-Jones
Canterbury Christ Church University, North Holmes Road, Canterbury CT1 1QU, UK

No abstract provided.

1100–1215 Hall 9
Scientific Session
Role and Education Developments

1100 WIP: What is specialism in diagnostic radiography?

C M Ferris
School of Health & Social Care, Sheffield Hallam University, Sheffield S10 2BP, UK

What is specialism in diagnostic radiography? A specialism may be defined in ways denoting an exceptional or restrictive nature; therefore, to what extent is this notion of specialism applicable to radiography? When considering the exceptional nature of a practice, a practice specialism may be perceived as such when considered in relation to the usual. As the generalized concept of specialism tends to be based on relative values, all radiographic practice may be considered special when considered by those people who are unfamiliar with the

subject or practice of radiography. When considering radiographic theory and practice from this perspective, all radiographers are seen to have specialist knowledge and skills. However, the amount of diversity in radiographic practice is increasing and the baseline for what is usual from a professional perspective is neither static nor even. Changes to boundaries of labour division, the use of a variety of medical imaging modalities, service provision, professional education provision and patient expectations have increased the range and diversity of medical imaging practices. Using medical specialism as a model, this paper examines specialism, specialization and the specialist in diagnostic radiography.

1110 WIP: Changing diagnostic imaging service delivery: will this be the effect of the Critical Care Programme?

C A Davies
Accident & Orthopaedic X-Ray Department, The Royal London Hospital, London E1 1BB, UK

In April 1999, the Department of Health established a review of adult critical care services and appointed an expert group to develop a framework for the future organization and delivery of critical care. The "Comprehensive Critical Care" paper, a review of adult critical care services, was published in May 2000. This paper examines the role that radiographers have within critical care services. Comprehensive Critical Care is the complete process of care for the critically ill, focused on the level of care for individual patients. It is a "whole systems" approach, which encompasses the needs of those at-risk of a critical illness, those who have recovered from such illnesses, as well as the needs of patients during the critical illness itself. The proposals in the Comprehensive Critical Care Report set out a new way of thinking about critical care, not only impacting on intensive care and high dependency units but acute care as a whole. A key component of care for all levels of critically ill patients is diagnosis then monitoring of their condition. By utilizing a combination of patient-focused and complex technical skills, radiographers provide this front-line care. Diagnostic radiographers are integral to the critical care patient, from initial diagnosis through treatment to eventual discharge. The role encompasses a range of imaging modalities, but does the career structure based on specialization within one modality help or hinder patient care? Will the critical care agenda change the way diagnostic imaging services are delivered?

1120 WIP: Shifting care boundaries: a new type of radiographer treatment practitioner

D M Stelmach
St James's University Hospital, Leeds LS9 7TF, UK

The NHS Plan specifies UK Government aims for modernization of the NHS. The paper expresses a desire that health professionals devise new care models that: are patient centred; reduce waiting and access times; cross traditional professional boundaries; utilize fully the expertise of health professionals; are based on protocols founded by best evidence; and utilize the skills of multidisciplinary teams. This paper examines the role of the radiographer in the assessment, radiography, diagnosis and treatment of minor injuries, proposing a care plan that reduces the care pathway from a five-stage process to a two-stage care pathway with reduced waiting times and "fast-tracking" of minor injury patients in a system that usually affords them a low priority. The proposed model meets the needs of the patient and the Government and offers a challenging new role to radiographers, with greater responsibility for the outcomes of their decisions. It is hoped that this paper will stimulate debate in the healthcare arena, motivating radiographers to proactively seek new roles that fully utilize their skills and knowledge.

1130 WIP: Learning to manage health information: incorporation into radiography and other allied health professions undergraduate curricula

[1]H A Best, [1]K Booth, [1]J Cleak, [1]A Garth and [2]S Ward
[1]School of Health and Social Care, Sheffield Hallam University, Sheffield S10 2BP and [2]Medical Imaging Department, Doncaster Royal Infirmary, UK

Funding was gained from the NHS Information Authority through the Society of Radiographers to explore the extent to which the curriculum elements outlined in "Learning to Manage Health Information" (LtM) 1999 were incorporated into undergraduate radiography curricula and a sample of curricula from other allied health professions. For diagnostic and therapeutic undergraduate curricula across the 24 UK validated and approved courses, the project identifies the following: (i) the elements of LtM that have been incorporated into the radiographic curricula nationally; (ii) where these elements exist within the curricula; (iii) whether they are delivered and if so how they are delivered; (iv) whether they are assessed and if so how they are assessed; and (v) what curriculum development plans exist to embed LtM or those sections that are not already included. The same outcomes are identified across a range of allied health professions and using a smaller sample size. This paper discusses the methods used in carrying out this project and presents the findings of the research. Initial results indicate that LtM is relatively well embedded within curricula across all professions and that the majority of elements are felt to be relevant. Evidence-based practice is a strong theme firmly embedded within the courses. It is identified as a strand through all levels and is underpinned by use of information technology. Most respondents provided some examples from their programmes. These comments were used to provide insight into the meaning of the statistical data collected. Overall conclusions of the research will be presented.

1140 WIP: Supporting student learning in the complexities of skull radiography: from electronic workbook to multimedia CD-ROM

J R Pirrie, C V Dawson, R Mather and H A Best
Radiography School of Health and Social Care Collegiate Crescent Campus, Sheffield Hallam University, Sheffield S10 2BP, UK

Radiography of the skull and facial bones is identified by student radiographers as being complex and challenging. Academic and experiential learning are essential in student development in this area. The number of examinations of the skull and face has diminished over recent years as a result of improved CT provision and changes in clinical decision-making processes. Students therefore find it difficult to gain mastery of techniques; however, skull radiography remains an essential skill. To support limited clinical opportunities, it was decided to develop a workbook for students to refer to at the time of need, *i.e.* when examinations are conducted and later on to consolidate learning. This idea coincided with Sheffield Hallam University's commitment to the virtual learning environment, Blackboard 5.5. It was decided that the proposed workbook would be placed on Blackboard, allowing student access at University, on practice placement and from home. Students were involved during the initial developmental stages. The workbook contains written, photographic, radiographic and electronic resource links focusing on anatomy, pathology, equipment and techniques. Initial outcomes indicate that students view the workbook as a positive learning resource; however, they prefer to download the workbook onto their own PC, which is problematic owing to the file size. Moving to CD-ROM will reduce this problem. This presentation will demonstrate the structure of the electronic workbook, present student perceptions of the resource to date and justify future planned developments to create a multimedia CD-ROM.

1150 WIP: Implementation of computer-based assessment in pre-registration radiography education: an evaluation

H A Best
Department of Radiography, School of Health and Social Care, Sheffield Hallam University, Collegiate Crescent Campus, Sheffield S10 2BP, UK

Summative computer-based assessments (CBAs) with associated formative feedback have been introduced this year into the BSc (Hons) Diagnostic Radiography at Sheffield Hallam University (SHU). CBA has been introduced in five discipline-specific, 20 credit modules of study that are delivered in years 1 and 2 prior to student placement. CBA was selected for a number of reasons: it is a natural progression of the current use of information technology (IT) in learning and teaching; it develops essential IT skills; it helps students become accustomed to viewing images on a monitor; it allows real medical images to be viewed (as opposed to line diagrams in written exams); it tests students prior to placement therefore helping to ensure appropriate levels of knowledge and understanding and consequently reducing the burden on supervising radiographers; students requiring additional tutor support will be identified at this stage; it is thought to be an efficient use of lecturer time; it is anticipated that there will be a reduction in potential biases surrounding the marking process; an "easy"

to use CBA system is readily available in SHU's adopted virtual learning environment, Blackboard 5.5; SHU's IT infrastructure is more robust than ever before. Although CBA is only one method within a diverse overall learning teaching and assessment strategy, it is new and innovative and is therefore being evaluated to highlight the effectiveness of implementation. The aim of this paper is to present the initial findings following both summative and formative evaluation and to make recommendations for future practice.

1200 WIP: Practicing radiography in a rural hospital, Ghana: achievements, problems and the way forward

M Aowusu-Adjei
X-Ray, Holy Family Hospital, Nkawkaw, Ghana

Ghana has a total radiological technical population of not more than 1000 and the concentration of these professionals is in the urban centres. Because technology is not well developed in terms of training facilities, equipment and a university to administer the programme, all except a few are trained in Ghana, therefore we find it difficult to enrol in schools abroad, for example schools in the UK. The only training centre is in Korle-Bu Teaching Hospital, Accra, which is run by the Ministry of Health under the Department of Radiology in Korle-Bu. The practice in rural Ghana is very difficult, but exciting and challenging because most people are ignorant of the profession and unaware of the dangers of ionizing radiation and its immediate and future effects. The practice involves both X-raying and teaching, which has helped many of our rural folks to understand and appreciate the profession more. We hope that in the near future we will get the opportunity to come to the UK to continue our profession to be better able to serve our people in this part of the world, thereby contributing to the expansion of radiography in Ghana.

1210 Discussion

1115–1300 Olympian Suite 1 Scientific Session
Genitourinary

1115 Adrenocortical carcinomas and pheochromocytomas: assessment of wash-out on delayed contrast enhanced CT

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PURPOSE: To measure the changes in wash-out of contrast material on contrast enhanced CT in patients with adrenocortical carcinomas and pheochromocytomas. MATERIALS AND METHODS: 15 patients with proven adrenocortical carcinomas and 17 patients with pheochromocytomas underwent helical CT. Unenhanced CT was followed by enhanced CT at 60 s and 10 min. 121 adrenal masses (74 adenomas and 47 metastases) in 108 patients served as reference data. RESULTS: The adrenocortical carcinomas and the pheochromocytomas enhanced significantly less than the adenomas at 60 s ($p<0.001$). At 10 min, both the absolute and relative percentage loss of enhancement were significantly greater for the adenomas than for the adrenocortical carcinomas and the pheochromocytomas ($p<0.001$). Delayed enhanced CT at 10 min (sensitivity 92%; specificity 95%) was more accurate for differentiation of adenomas and adrenocortical carcinomas and pheochromocytomas than unenhanced CT (sensitivity 82%; specificity 95%). CONCLUSION: Adrenocortical carcinomas and pheochromocytomas exhibit similar wash-out to adrenal metastases, but significantly less than adrenal adenomas. The percentage change in wash-out of contrast material is a useful adjunct to absolute CT attenuation values in the differentiation of adrenal adenomas and adrenocortical carcinomas and pheochromocytomas.

1125 Filling defect artefacts in magnetic resonance urography

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PURPOSE: To assess the prevalence of filling defect artefacts (FDAs) in magnetic resonance urography (MRU) and to present the characteristic features of FDAs that can differentiate them from true filling defects (TFDs). METHOD AND MATERIALS: MRU examinations of 45 patients with neurogenic bladder dysfunction were reviewed to assess the prevalence of filling defects within the pelvicalycyal system (PCS) and ureter. Heavily T_2 weighted fast spin echo techniques with fat saturation were used. These included axial images (5 mm thick, 2 mm gap), slab images (75 mm thick) of the retroperitoneum and volume coronal imaging of the kidneys and retroperitoneum with 3D and maximum intensity projections (MIPs). Dilatation of the PCS was graded and features of filling defects (central, eccentric, complete) were noted. The clinical course and plain films were reviewed to determine the significance of filling defects. RESULTS: Filling defects were present in 27 patients (60%). The prevalence of FDAs was 22/45 (49%) and that of TFDs was 11%. The characteristic features of FDA that differentiate them from true filling defects are: (1) the vast majority of FDAs occurred in axial T_2 weighted images and very rarely in slab and MIP images; (2) FDAs were usually small, centrally placed (94%) and noted mostly in the PCS (41.8%) and upper third of the ureters (39.5%); and (3) TFDs were larger in size and seen in two or more image sequences. CONCLUSIONS: Awareness of these artefacts will avoid misinterpretation and prevent unnecessary further investigations or interventions. When in doubt, correlation is suggested with other MRI sequences, plain abdominal radiography and clinical presentation.

1135 Diagnosing renal colic: who should have access to CTKUB?

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INTRODUCTION: CTKUB, an unenhanced helical CT examination of the urinary tract, is an alternative approach to radiodiagnosis in patients thought to have symptomatic renal calculi. Some advocate the adoption of CTKUB as the first line investigation for renal colic. There is concern that allowing non-urologists access to CTKUB will result in wasted resources and extra population radiation dose, because non-specialists will refer patients inappropriately (*i.e.* non-specialists will have a lower rate of positive examinations). At our hospital we have been performing CTKUB since 1997. CTKUB is taken to be the gold standard test and access was initially restricted to urologists. Referrals were also taken direct from the admitting emergency physicians after mid 1999. We were thus able to audit the rate of positive examinations with respect to the different referring specialities and, by inference, their diagnostic abilities. METHODS: The RIS reports of 491 CTKUB examinations performed over 3 years were retrospectively coded for the presence of renal stone disease. RESULTS: Over the introductory 2 years, 59% of CTKUB examinations were positive for the presence of renal stone disease. 170 CTKUBs were performed in the final year. Urologists requested 65 of the examinations (48% positive). Emergency physicians requested 97 examinations (58% positive). Significant extra renal pathology was found in 7.3%. CONCLUSION: Emergency physicians achieved a higher rate of positive examinations than specialist urologists over 1 year. The rate of positive examinations did not deteriorate compared with the introductory period. CTKUB should be accepted as a first line investigation for renal colic.

1145 Identifying lymph node metastases from vulval carcinoma by MRI

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PURPOSE: Metastasis to inguinal nodes is of major prognostic importance in vulval cancer. Inguinal lymphadenectomy is necessary to stage the groins because clinical palpation is unreliable. This exploratory surgery carries significant morbidity, but is often negative in superficial tumours, fewer than 20% of which metastasize. The aim of this study was to assess the ability of MRI to identify inguinal lymph node metastases from vulval cancer. PATIENTS AND METHODS: 13 women underwent MRI of the inguinal regions prior to surgery for vulval cancer. Surface coil T_1 weighted and fat suppressed T_2 weighted MRI was performed, assessing nodal size, shape, contour, architecture and cystic changes to prospectively identify metastases. Lymph nodes were removed *en bloc* and orientated to allow

size and location of lymph nodes on histopathology to be related to the MRI findings. RESULTS: 10 women had groin dissections, providing histopathological correlation with MRI in 20 groins. In three, the outcome measure was clinical follow-up extending for at least a year after local excision. The positive predictive value of MRI for metastatic inguinal lymphadenopathy was 90%, the negative predictive value (NPV) was 94%, the sensitivity 90%, the specificity 94% and the accuracy 96%. The most useful MRI signs of metastatic lymphadenopathy were those of contour irregularity, asymmetry of soft tissue in a fatty lymph node, focal cystic areas and a short axis diameter >10 mm. CONCLUSION: The NPV of 94% for MRI suggests a potential role in the selection of women with a low risk of nodal metastasis from vulval cancer for conservative surgery.

1155 Dynamic contrast enhanced MRI in prostate cancer pre and post treatment

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PURPOSE: To compare the changes in prostate cancer pre and post treatment with Zoladex and/or external beam radiotherapy using dynamic contrast enhanced MRI (DCE-MRI). MATERIAL AND METHODS: 14 patients with biopsy-proven adenocarcinoma of the prostate underwent MRI using a 1.5 T GE Signa Echo-speed and phased array pelvic coil, before and after treatment. T_2 weighted FSE images of the pelvis were acquired with further thin-slice sections through the prostate for staging and localization. DCE-MRI was performed at four or five pre-selected slice locations through the prostate using a FMPSPGR sequence following an initial PD-weighted acquisition. Gd-DTPA was administered intravenously by bolus injection (0.1 mmol kg^{-1} body weight). A two compartment pharmacokinetic model was used to quantify amplitude and exchange rate (ER) between plasma and tissues. The maximum enhancement index (MEI) was obtained empirically. RESULTS: 3 patients were stage T2a, 10 were T3 and 1 was T3N1, with Gleason grade ranging from 4 to 9 (median 5). The second MR was performed after treatment at 1 month to 38 months (mean 8.4 months). The mean PSA value dropped from 42.3 ng ml^{-1} to 16.2 ng ml^{-1} (p=0.026). The maximum tumour diameter and total volume, and the total prostate volume decreased dramatically (p=0.001, 0.002 and 0.005, respectively). MEI reduced from 1.29 pre-treatment to 1.14 post-treatment (p>0.05), amplitude from 5.02 to 2.56 (p=0.068), and ER from 3.63 to 2.26 (p=0.017). The decrease in PSA was significantly correlated with change in amplitude (p=0.008). CONCLUSION: Reduction in pharmacokinetic parameters that parallel PSA changes may allow assessment of residual and/or recurrent tumour.

1205 Transjugular renal biopsy using the "Quick-core" needle: single centre experience in 11 cases

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PURPOSE: A retrospective analysis of 11 cases of transjugular (TJ) renal biopsy performed at a single institution. MATERIALS AND METHODS: Case notes were examined in 11 cases of TJ renal biopsy performed for abnormal clotting (INR > 1.3, or platelets <100) or in patients with suspected vasculitides where there is the likelihood of renal artery aneurysms (such as polyarteritis nodosum). The technique involves cannulation of the renal vein (preferably right) with a 7 F Arrows sheath and advancement of the "Quick-Core" (Cook, UK) biopsy needle in a protective catheter. A range of 2–7 biopsy samples was taken (median 4 samples). Elective track embolisation can be performed immediately with a single coil. RESULTS: Tissue samples are assessed immediately by a histopathologist using light microscopy, and further samples are taken as necessary. We have technical success in 100% of cases, with a range of 2–20 intact glomeruli per biopsy specimen. COMPLICATIONS: We report 1 complication in 11 cases, in a patient who presented with haematuria following biopsy and was shown to have developed an arteriorenal collecting system fistula. This was successfully treated with arterial embolisation via a right femoral artery approach. CONCLUSIONS: Our extensive experience of TJ liver biopsies in >1000 cases has allowed the technique to be extended to TJ renal biopsy with a high technical and diagnostic success rate. Our series has a low complication rate in a difficult patient group with abnormal clotting.

1215 The safety and efficacy of subcapsular infiltration of local anaesthetic during transrectal prostatic biopsy

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AIM: We prospectively evaluated the safety and efficacy of pericapsular prostatic injection of local anaesthetic during ultrasound guided transrectal prostatic biopsy. MATERIAL AND METHOD: 58 patients undergoing transrectal biopsy received either 10 ml of 1% lignocaine or 10 ml of 0.5% bupivacaine. The local anaesthetic was administered transrectally around the prostatic capsule under ultrasound guidance. Six 18 G biopsies were then taken after an interval of 3 min. Pain during and 24 h following the biopsy was assessed using a 10-point visual analogue pain scale. Patients were also asked to record any other symptoms following biopsy. RESULTS: 29 patients recieved lignocaine and 29 recieved bupivacaine. The average mean pain score immediately following biopsy was 1.66 (range 0–10).The mean pain score 24 h following biopsy was 1.03. One of the patients required hospital re-attendance following the procedure owing to acute urinary retention. Overall, the most common complications were urethral bleeding, which occurred in 56% of patients, and rectal bleeding, which occurred in 34% of patients. Complications were more common with bupivacaine than with lignocaine. CONCLUSION: Transrectal biopsy of the prostate following local anaesthetic infiltration is a well tolerated procedure with a low pain score. The incidence of serious complications following biopsy requiring hospital re-attendance was low. We propose that it should be widespread practice to administer subcapsular local anaesthetic prior to transrectal biopsy.

1225 Radiological management of urethral strictures

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INTRODUCTION: Urethral strictures are a common management problem in urological practice. The aetiology includes infection, trauma and iatrogenic causes. There are a few options available for managing these strictures. Non-surgical options include serial rigid dilatation and balloon dilatation. There are various surgical techniques to treat the stricture, including urethrotomy and urethroplasty. We report our experience using fluoroscopically guided urethral balloon dilatation in the management of these strictures. METHODS: A total of 20 male patients (12 patients following radical prostatectomy, 2 patients following TUPR, 2 post trauma, 2 following inflammatory disease and 2 unknown) were referred for management of symptomatic urethral stricture dilation. One patient had an occluding bladder carcinoma. Technical success was 100%. Our protocol included performing the procedure as an outpatient, with follow-up by the urologist. 19 patients had 24 procedures to treat 16 posterior and 3 anterior strictures. We used an 8–10 mm diameter balloon and aimed to place a 24 Fr catheter transurethrally at the end of the procedure. Follow-up was available for 1–16 months. RESULTS: No further management was required in 11 patients. Five patients had a delayed urethrotomy, one had a TUPR, one had a retained suture removaed and two patients were intermittently self-catheterizing. CONCLUSION: We conclude that balloon dilation of urethral strictures is a safe outpatient procedure, with a high success rate. It can be repeated if needed and replaces the need for suprapubic catheters by re-establishing urethral patency. It is especially useful in post-surgical strictures.

1235 Percutaneous nephrostomy 2001: a prospective pilot study

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AIM: To analyse the indications, methods, results and complications in a consecutive series of patients with ureteric obstruction or fistulae undergoing percutaneous nephrostomy (PCN) with a view to defining standards. MATERIALS AND METHOD: 65 PCN-related parameters were recorded in a purpose-designed database. 56 procedures were performed in 40 adult patients (mean age 65.8 years, range 43–90 years) over a 10-month period. Follow-up was at 48 h. RESULTS: The most common diagnosis was malignant obstruction in 71.4% (40/56). Mean pre-procedure serum creatinine was 493 µmol l^{-1} (range 78–1129 µmol l^{-1}). Mean 48 h post-nephrostomy creatinine was

363 μmol l^{-1} (range 74–970 μmol l^{-1}). Operators were four consultants (n=42), two fellows (n=2) and five registrars (n=12). Mean screening time was 2.6 min (range 0.3–10.0 min). Mean procedure time was 18.2 min (range 5.0–65.0 min). Single puncture technique was used in 88% (49/56) of cases with ultrasound and C-arm digital fluoroscopic guidance. Double puncture technique was used in 11% (6/56) of cases. One-stage nephrostomy and stent placement was done in 19.6% (11) of cases. Technical success rate was 98.2% (n=55). Complications included renal pelvis perforation (n=2), septicaemia (n=1), catheter dislodgement (n=3) and blockage secondary to haemorrhage (n=2). There were three deaths within 48 h of the procedure. A one-stage nephrostomy and stent placement was carried out in two of these cases. CONCLUSION: Percutaneous nephrostomy has a high technical success rate with significant associated morbidity and associated mortality. A multicentre study using this methodology is suggested for determination of modern standards.

1245 Role of embolisation in the management of uncontrollable gynaecological haemorrhage

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PURPOSE: To determine whether selective pelvic embolisation is an effective treatment for uncontrolled gynaecological bleeding. MATERIAL AND METHODS: A retrospective review of the case notes and imaging of all patients who underwent pelvic embolisation for active gynaecological haemorrhage over the past 5 years was performed. Note was made of demographic factors, the underlying or precipitating cause, angiographic appearances, embolisation method and outcome. RESULTS: 15 patients were identified and 12 had complete medical records. The median age of the patients was 32 years (range 26–73 years). Uncontrolled vaginal haemorrhage had occurred in 11 patients and intrapelvic haemorrhage in 1 patient. The causes of haemorrhage were: lower segment Caesarean section (n=3); termination of pregnancy (n=3); cervical carcinoma (n=2); vaginal metastatic disease (n=1); and uterine arteriovenous malformation following a previous molar pregnancy (n=1). On diagnostic angiography, active bleeding was demonstrated in one case, a uterine artery pseudoaneurysm was seen in one case, and a uterine arteriovenous malformation was demonstrated in two cases. No abnormality was seen in the remaining eight cases. All patients underwent selective embolisation of the uterine artery or divisional branch of the internal iliac artery. Bleeding was successfully controlled in 11 (91%) patients. Self-limiting recurrent haemorrhage occurred in two patients with malignant disease, at 2 days and 4 weeks, respectively. Haemorrhage continued despite embolisation in one patient who underwent surgery. CONCLUSION: Selective pelvic embolisation is an effective treatment for acute gynaecological haemorrhage and also as a palliative procedure in patients with gynaecological malignancy.

1255 Discussion

1115–1245 Olympian Suite 2 Scientific Session

Chest

1115 Correlation between histological features and CT morphology in idiopathic pulmonary fibrosis

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PURPOSE: There is increasing evidence that the profusion of fibroblastic foci seen at histology in idiopathic pulmonary fibrosis (IPF) is predictive of mortality. The aim was to determine whether high resolution CT (HRCT) appearances correlate with prognostically important histological features. MATERIALS AND METHODS: The HRCT scans of 34 histologically confirmed cases of IPF were scored by two observers according to the proportion of macrocystic (>4 mm) and microcystic (<4 mm) honeycombing, fine reticulation and ground-glass opacity. Their relationships to histological scores of fibroblastic foci and macrophages were examined. RESULTS: There was a positive correlation between the proportion of combined HRCT score of macrocystic and microcystic honeycombing and the number of fibroblastic foci on histology (p=0.04). A further positive correlation was found between the extent of ground-glass opacity and the macrophage score (p<0.01). There was no correlation between any histological feature and the extent of fine reticulation on HRCT. CONCLUSION: The extent of honeycombing on HRCT is linked to the number of fibroblastic foci found on histology. Therefore, it is likely that prognostic inferences can be made from HRCT features alone.

1125 Comparison of high resolution CT morphology with histology: prognostic significance in usual and non-specific interstitial pneumonia

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PURPOSE: Both histological and CT features are known to predict outcome in idiopathic pulmonary fibrosis (IPF). The aim of this study was to compare the prognostic significance of the histological diagnosis (usual interstitial pneumonia (UIP) *vs* non-specific interstitial pneumonia (NSIP)) with CT findings. MATERIALS AND METHODS: 53 biopsy-proven cases of UIP and NSIP were diagnosed by consensus by two histopathologists. The high resolution CT (HRCT) scans were scored semi-quantitatively by four observers with regard to the proportion of ground-glass opacity to reticulation (1 = predominantly ground-glass, 2 = mixed ground-glass and reticulation, 3 = predominantly reticulation). In addition, the exact proportion of ground-glass opacity was recorded. RESULTS: 32/53 cases were classified as UIP, 21/53 cases were classified as NSIP, 5/21 of which were cellular and 16/21 were fibrotic. At follow-up (median 33 months) there were 22/53 deaths. Both an increasing extent of ground-glass opacity and a lower semi-quantitative CT score were associated with a better outcome (p=0.02 and p=0.01, respectively). The histological diagnosis of NSIP was also associated with lower mortality (p=0.05). On bivariate analysis, HRCT provided the more powerful prognostic information. CONCLUSION: In terms of prognosis, HRCT features in IPF provide much information, with little added value from the histological diagnosis.

1135 The complication rate of percutaneous image-guided drain insertion

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PURPOSE: The aim of this study was to assess prospectively the success and complication rate associated with image-guided placement of a percutaneous pigtail drain into the pleural cavity. MATERIALS AND METHODS: A prospective, single institution study of all image-guided chest drains placed over a 28-month period was carried out. All drains were inserted using the Seldinger technique. Data collected included indication for drain insertion, drain size, type of image guidance used (CT or ultrasound), demographic data, nature of fluid aspirated, and success rate and complications. RESULTS: 248 drains were inserted into 248 patients (112 male, 136 female). The median age was 63 years. 100 drains were inserted on the left and 148 on the right. The majority of drains were 12 Fr (193), although drain size varied from 8 Fr (52) to 14 Fr (3). 231 drains were placed under ultrasound guidance and 17 under CT. Indications included 148 malignant effusions, 84 empyemas and 16 other effusions. 248 drains were successfully inserted. Two patients suffered significant immediate complication of intercostal artery laceration. One of these patients underwent successful artery embolisation. The other died of intrathoracic haemorrhage within 24 h of the procedure. Both of these patients had chronic renal failure and the drains were inserted via a posterior approach. There were no other significant immediate complications. CONCLUSION: Image-guided insertion of percutaneous pigtail drains into the pleural space has a much lower complication rate than blind insertion of chest drains. Posteriorly inserted drains may have a higher and significant complication rate compared with other drain position. Patients with renal impairment appear to be at greater risk.

1145 Undiagnosed exudative pleural effusions: a comparison of blind percutaneous pleural biopsy with CT guided biopsy

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PURPOSE: To prospectively compare the diagnostic yield of blind percutaneous pleural biopsy with image guided biopsy in patients with suspected malignancy and pleural effusions. MATERIALS AND METHODS: 40 consecutive patients with non-diagnostic cytology from an exudative pleural effusion each initially underwent contrast enhanced thoracic CT. The pleural surfaces were characterized as less than or greater than 5 mm. The patients were then randomized to either an Abrams needle biopsy or a CT guided biopsy of the pleura. Of the 40 patients randomized, 1 refused further investigations, in 1 the pleural effusion resolved spontaneously and 1 patient died prior to investigation. Final diagnoses were based on histopathological or cytological analysis, either percutaneously or at thoracoscopy (n=31), autopsy findings (n=1) or clinical follow-up (n=5). RESULTS: 19 patients were randomized to an Abrams biopsy (group A) and 18 patients to a CT guided biopsy (group B). The pleural thickness was less than 5 mm in 9 patients in group A and in 10 patients in group B. Correct histological diagnosis was made in 10 of the 18 patients who underwent a CT guided biopsy (sensitivity 91%) and in 6 of the19 patients who underwent an Abrams biopsy (sensitivity 50%). The only complication in the study was a local haematoma in the Abrams group. CONCLUSION: The diagnostic yield from CT guided pleural biopsy is far greater than that from blind percutaneous pleural biopsy and is independent of pleural thickness.

1155 ECG gating in high resolution CT of the thorax

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PURPOSE: To evaluate the degree of motion artefact attributable to cardiac motion on thoracic high resolution CT (HRCT) with and without ECG gating. METHODS: 60 HRCT studies were randomly numbered, with patient and technical detail omitted. All patients had been scanned on a Siemens Volume Zoom Somatom Plus 4 Scanner with typical exposure factors of 120 mAs and 140 kV. ECG gating was used in only 50% of the scans. Cardiac motion artefact was assessed on all the scans by two independent thoracic radiologists, using a clearly defined scoring system of 0–3. Common indications for scanning included bronchiectasis, pleural disease and fibrosis. RESULTS: The percentage of scans considered to have minimal or no cardiac motion artefact (score 0–1) was significantly higher with ECG gating (87–97%) than without ECG gating (27–40%). 5% of the non-gated scans were thought to be of limited diagnostic value (score 3). Interobserver variability was reduced following review and agreement by consensus. Both sets of scans were comparable in terms of pathology and normality. CONCLUSION: ECG gating of thoracic HRCT improves image quality by reducing artefact attributable to cardiac motion without increasing radiation dose. Reduced respiratory motion artefact proved an additional but unexpected benefit on the ECG-gated scans.

1205 Thoracic high resolution CT and clinical outcomes in patients with isolated reduced transfer coefficient

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PURPOSE: The transfer coefficient for carbon monoxide (KCO) is commonly measured during pulmonary function tests (PFTs). Patients in whom a reduced KCO is the only demonstrable PFT abnormality may represent a diagnostic challenge. We have retrospectively investigated thoracic high resolution CT (HRCT) findings and clinical outcomes in this patient group. METHODS: Patients in whom KCO was significantly reduced but whose dynamic and static lung volumes were within normal limits were identified. HRCT films and chest radiographs were reviewed, and case records were retrospectively assessed. RESULTS: 40 patients were identified, all symptomatic. All had been referred for HRCT after PFTs because of diagnostic difficulty. Chest radiographs were normal in 9 patients (22%), demonstrated non-specific increased lung markings in 11 (27%), reduced lung markings in 3 (7%) and interstitial or reticular/nodular opacities in 11. HRCT demonstrated emphysema in 28 patients (70%), emphysema being the sole or predominant abnormality in 11 (27%) and coexisting with interstitial disease in 11. Established pulmonary fibrosis in a pattern typical of UIP was found in 11, and other interstitial disease in 7 (17%). Ground-glass opacities were demonstrated in 9 (22%) and bronchiectasis in 9. 4 (10%) were found to have a previously unsuspected bronchial carcinoma. Only 3 scans (7%) were normal. HRCT revealed an unsuspected or additional diagnosis in 32 patients (80%); this resulted in a change in management in 19 (47%) and was the diagnostic investigation in 29 (72%). CONCLUSION: HRCT appears to be a valuable investigation in this patient group.

1215 Use of objective CT measures of emphysema to develop a composite functional index

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PURPOSE: No single lung function test index correlates well with the severity of emphysema. The aim was to develop a composite pulmonary function score that better reflects the CT quantification of emphysema. MATERIAL AND METHODS: The high resolution CT (HRCT) scans of 97 cases of emphysema were scored objectively using a density mask. The following standard pulmonary function tests (PFTs) were recorded: DL_{co}, K_{co}, FEV1, total lung capacity (TLC) and residual volume (RV). Stepwise regression was used to identify the combination of PFTs that best fitted the HRCT score. RESULTS: Significant negative correlations were found between the HRCT emphysema scores and DL_{co}, K_{co} and FEV1 (R^2=0.39, R^2=0.36 and R^2=0.42, respectively), and positive correlations were found with TLC and RV (R^2=0.29 and R^2=0.37, respectively). A composite score representing the best fit combination of PFTs against CT emphysema score was: 24.5 [0.16 x DL_{co}] [0.19 x FEV1] + [0.15 x TLC] (R^2=0.50). CONCLUSION: A simple composite score based on readily available PFTs more accurately reflects the morphologic extent of emphysema on CT than any single functional measure.

1225 Clinical implications of chest wall fracture detection by ultrasound

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PURPOSE: This study compares the accuracy of clinical, radiographic and ultrasound examination in the detection of rib and sternal fractures and investigates whether patients with fractures (detected by ultrasound) have a more complicated recovery than those with no fractures. MATERIALS AND METHODS: 115 patients with blunt chest injury of mild to moderate force presenting to the Emergency Department were studied. Primary outcome measure was the presence of a rib or sternal fracture detected by ultrasound. Secondary outcomes were pain score (visual analogue score), respiratory complications and days off work. A second ultrasound at 3 weeks was used as the final arbiter as to the presence of a fracture. RESULTS: 87 (76%) patients had a fracture detected on second ultrasound examination. The accuracy of clinical, radiographic and ultrasound examination at presentation in the detection of a chest wall fracture was 41%, 39% and 85%, respectively. Pain on coughing, age >40 years and duration of pain >24 h were the best clinical discriminators of a fracture. There was no statistical difference in the level of pain or respiratory complications experienced in those with or without rib fractures. Median time off work was statistically greater in those with fractures (26.2 days) than in those with no fractures (7.1 days) (p=0.0007). CONCLUSION: Early ultrasound is more accurate than clinical or radiographic assessment of chest wall fractures. The presence (and knowledge) of a fracture appears to have little bearing on the level of pain or respiratory complications experienced, but has a major bearing on the duration of sick leave.

1235 Discussion

1130–1300 Hall 10
Scientific Session
Interventional

1130 WIP: Magnetic resonance guided focused ultrasound therapy for the treatment of uterine fibroids: a feasibility study

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PURPOSE: To demonstrate that magnetic resonance guided focused ultrasound (MRGFUS) thermal ablation of uterine fibroids is a safe and feasible procedure, and to show there is correlation between the MRGFUS treatment and pathological specimens. MATERIALS AND METHODS: Women undergoing hysterectomy for symptomatic fibroids were recruited from the gynaecological outpatient clinic. The patients were placed prone into the MRI scanner and axial and sagittal T_2 images used with the focused ultrasound system (ExAblateä 2000; InSightec-TxSonics Inc, Haifa, Israel) to plan the treatment area. A close loop system of treatment pulses and thermal mapping by phase shift in T1 ensures that the heat is applied to the target volume. Following treatment, T_2 weighted axial and sagittal images and gadolinium enhanced T_1 images were taken immediately and on day 4. A hysterectomy was performed within 30 days. RESULTS: Four patients have been treated. No devise-related adverse events were seen. The treatment was well tolerated as an outpatient procedure. The first two women were treated suboptimally, one owing to unsatisfactory thermal mapping and one owing to a scar in the path of the ultrasound beam causing pain with sonication. The latest two treatments were uneventful and successful. Pathological correlation with the treatment area was good. The lesion increased in size over the first few post-treatment days. Two patients withdrew consent following the screening MRI and one was not treated owing to an equipment failure on the day of treatment. CONCLUSIONS: MRGFUS is a safe and feasible minimally invasive treatment for fibroids.

1140 WIP: Gastrostomy insertion: endoscopy or fluoroscopy?

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PURPOSE: To assess the difference in success and complication rates between percutaneous endoscopic gastrostomy (PEG) and radiologically inserted gastrostomy (RIG) and the additional information gained using an endoscope. MATERIALS AND METHODS: Prospective multicentre comparison aiming at 50 consecutive PEGs and 50 RIGs. Antibiotics were not used at the time. In addition, the endoscopic detection rate of significant abnormalities was evaluated in 200 consecutive PEGs. RESULTS: 50 PEGs (20–24 Fr) and 48 RIGs (10–15 Fr) have been placed to date. Technical success was 100% and 98%, respectively. There were no procedure-related complications. Wound infection occurred in 9 PEGs (18%) and 1 RIG (2%). Accidental tube dislodgement occurred in 6 PEGs (12%) and 2 RIGs (4%). None of the PEGs, but 10 RIGs (21%), blocked and 2 leaked. Replacement tubes were required in 6 PEGs (12%) and 10 RIGs (21%). Conversion to gastrojejunostomy because of aspiration was performed in 5 PEGs (10%). Significant endoscopic abnormalities were found in 42/200 patients (21%), all related to inflammation or ulceration. Insignificant pathology was found in 8.5%. No unexpected strictures or malignant tumours were found. CONCLUSION: PEG has a higher patency and lower replacement rate than RIG. Relevant pathology found by endoscopy was limited to inflammation and/or ulceration of the upper gastrointestinal tract; a course of acid-suppressing therapy should be considered for patients awaiting gastrostomy. On the basis of excluding pathology alone, use of the endoscopic route is not justified. The current method of using small-bore tubes for RIG needs re-assessing.

1150 WIP: Gastrostomy insertion: hybrid PIG—best of both worlds

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PURPOSE: Percutaneous endoscopic gastrostomy (PEG) is relatively expensive and requires access to an endoscopy service. Radiologically inserted gastrostomies (RIGs) block more frequently owing to the smaller lumen and are more time consuming to insert, especially if multiple anchor stitches are used. We describe a hybrid technique using fluoroscopic guidance for insertion of a large endoscopic gastrostomy tube without the need for gastropexy. MATERIALS AND METHODS: 30 percutaneous image guided gastrostomies (PIGs) have been placed to date. Initially the technique was reserved for patients where endoscopic placement had failed or was deemed inappropriate (*i.e.* after neck surgery), but was then used as a routine alternative to PEG. After air insufflation via a peroral catheter or NG-tube, the stomach was punctured and a 4 Fr vascular sheath was inserted. The oesophagus was cannulated retrogradely with catheter and guidewire, which were brought out through the mouth. A 20 Fr endoscopic "MIC-PEG" push gastrostomy (Vygon UK Ltd.) was then inserted antegradely over a long wire and pulled through the abdominal wall. RESULTS: All tubes were placed successfully in the stomach. There were no procedure-related complications. One patient died from aspiration of feed after 4 days. None of the tubes has blocked, and there have been no wound infections so far or accidental removal. CONCLUSION: This technique is a useful alternative to conventional PEG and RIG methods. It combines the safety aspects of fluoroscopic guidance with the advantages of a large bore gastrostomy tube and it removes the need for gastropexy.

1200 WIP: Comparison of capillary action and suction aspiration techniques for head and neck tissue sampling

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PURPOSE: Fine needle biopsy is an integral part of the investigation of mass lesions in the head and neck. Two well described and commonly used methods of ultrasound guided tissue sampling are capillary action and suction aspiration techniques, both of which are currently used in our department. This study has been designed to directly compare the tissue quality obtained with both techniques in head and neck sampling. The study will initially be performed over a period of 1 year. MATERIALS AND METHODS: A randomised controlled trial of all adult (over 18 years old) patient referrals for head and neck biopsy is being performed. Patients are randomly allocated to sampling via either technique. Two passes are performed. The tissue is then transferred to microscope slides and immediately fixed in alcohol. The resultant tissue is then sent to the cytopathology laboratory for analysis. Any complications at the time of biopsy are recorded. RESULTS: The results of sample analysis are categorized as follows for each sampling technique: (i) sample suitable for diagnosis; (ii) sample unsuitable for diagnosis; (iii) reason for unsuitability of sample (*e.g.* blood stained or inadequate material or poor fixation). Separate record is made of data regarding complications. The results will be subjected to statistical analysis using the Student's *t*-test. CONCLUSION: Discussion of the results to analyse whether one or both techniques should be used to obtain tissue samples of head and neck lesions.

1210 WIP: Comparison of intervention with no treatment in duplex-detected residual stenoses following balloon angioplasty

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INTRODUCTION: Quality control of peripheral arterial percutaneous transluminal angioplasty (PTA) is not universally accepted. Some centres rely on angiographic findings alone, while others perform

pressure measurements. We have compared the results of intervention with no intervention in duplex-detected residual stenosis after iliac, femoral and graft PTA. PATIENTS AND METHODS: 103 lesions in 81 patients had PTA of lower limb stenoses. Residual stenosis was defined as >50% based on conventional duplex criteria. Group A (n=63) had no stenosis detected and had no further treatment, Group B (n=18) had immediate re-intervention based on duplex criteria, and Group C (n=22) had duplex-detected stenosis with no re-intervention. Duplex was repeated 6 weeks post PTA to determine persistent stenosis. RESULTS: At 6 weeks, stenoses were detected in 25% (16) of Group A, 44% (8) of Group B and 73% (16) of Group C. The increase in stenosis in Group C patients approached significance (x^2 = 3.3, p=0.069). In Group B, 13 stenoses were abolished by repeat PTA, but 6 recurred at 6 weeks, and in the 5 with residual stenosis after repeat PTA, 3 had resolved at 6 weeks. In Group C, 6 stenoses had resolved at 6 weeks. CONCLUSIONS: The use of completion duplex identified a significant proportion of patients who required further immediate dilatation. When this was performed it reduced the incidence of persistent stenosis at 6 weeks. Remodelling does occur but only in a minority of patients. Completion duplex imaging has a useful role in peripheral PTA.

1220 WIP: Virtual cystoscopy in the diagnosis of new and recurrent carcinoma of the bladder

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PURPOSE: To evaluate the application of virtual CT cystoscopy in the detection of undiagnosed and recurrent bladder carcinoma and to correlate findings with conventional cystoscopy. METHODS: An initial prospective study of 20 patients presenting with suspected new or recurrent bladder neoplasm has been performed. There were 14 males and 6 females, with ages ranging from 47 years to 83 years (median 67.5 years). Patients underwent virtual cystoscopy prior to conventional cystoscopy. Technique consisted of air insufflation, via a 14 F Foley catheter, of between 100 ml and 500 ml depending on patient tolerance. An AP scout view of the region was obtained prior to a single breath-hold helical CT scan (Toshiba Xvision/GX) of the air-filled bladder. A further scan was performed in the prone position. Volume rendering algorithms allowed intraluminal views of the bladder to be generated, and interactive scroll through the virtual bladder could be undertaken. Examinations were read by one radiologist blinded to conventional cystoscopy findings. RESULTS: Virtual cystoscopy detected tumour in all 20 patients and correlated with findings at conventional cystoscopy. Virtual cystoscopy accurately detected all superficial tumour recurrences. In combination with axial images of the air-filled bladder, invasion of tumour through the bladder wall could be detected. In addition, virtual cystoscopy detected a number of bladder diverticulae not seen on conventional studies. CONCLUSION: In this ongoing study, virtual cystoscopy has detected all intrinsic bladder neoplasms, including superficial tumour recurrence. It has also detected bladder diverticulae. This may represent a non-invasive bladder imaging technique, especially in patients attending for check cystoscopy for recurrent bladder tumour.

1230 WIP: Non-surgical treatment of epiphora: balloon dacryocystoplasty

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Epiphora, the imperfect drainage of tears through the lacrimal passages, can be caused by irritation, anatomical origin or by obstruction of the nasolcarimal duct system. In recent years, balloon dacryocystoplasty has been advocated as an alternative therapy to dacryocystorhinostomy. 46 patients underwent dacryocystoplasty for the treatment of troublesome epiphora, 42 of these procedures being performed as day cases. A fine bore cannula is inserted into the visible opening of the duct, with a Twohig–Borst adaptor attached to facilitate the injection of contrast medium. The guidewire is removed and the balloon angioplasty catheter is threaded into position. The balloon is inflated for 3–5 min and is usually 2.5 mm (at max. inflation) and measures 2 cm long. A post-PTA dacrycystogram is done after balloon deflation. A technical success rate of 94% was discovered.

1240 WIP: Multislice CT angiography of coronary artery bypass grafts: comparison with catheter angiography

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PURPOSE: To evaluate multislice CT (MSCT) angiography as a non-invasive method of determining the patency of coronary artery bypass grafts. METHOD: 19 patients (age range 57–78 years) who underwent catheter angiography for investigation of recurrent symptoms following coronary artery bypass graft surgery volunteered to have MSCT angiography within the following 3 weeks. The number of grafts per patient varied from 1 to 5, giving a total of 61 grafts studied. CT images were obtained with a quad spiral 0.5 s rotation scanner during intravenous injection of 120 ml of contrast medium (300 mg ml^{-1} of iodine) given at 3 ml s^{-1}. Image slice thickness was 1.25 mm reconstructed to 0.8 mm with a pitch of 1.5. Following retrospective cardiac gating, the axial images, MIPs and MPRs were reviewed. The grafts were assessed for patency and diameters were measured. The findings were then compared with those of catheter angiography. RESULTS: On catheter angiography, 54 grafts were reported as patent. Only one of these was not seen on CT angiography. Of the 7 grafts found to be occluded on catheter angiography, 4 were seen on CT angiography as severely narrowed grafts. Three severe proximal stenoses seen on catheter studies were also identified on CT angiography. CONCLUSION: These preliminary results indicate that MSCT angiography could have a role in the imaging of coronary artery bypass grafts and could reduce the number of catheter angiograms performed. [This work is supported by a Royal College of Radiologists grant.]

1250 WIP: Estimation of differential renal plasma flow in optimized models of unilateral obstructed renograms

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OBJECTIVE: In acute unilateral renal obstruction, calculated divided renal uptake of tracer at 2–3 min following tracer injection may be normal. Divided renal function may therefore be insensitive to falls in effective renal plasma flow (ERPF) to the obstructed kidney. This study analyses the arterial flow rate parameters of optimized computed models of obstructed renogram time–activity curves (TACs). METHOD: 25 background-corrected renograms (MAG3) with unilateral obstructive patterns and 5 bilateral normal control renograms were studied. Optimized computed models of each renogram were constructed using specialized software (Modelmaker, Cherwell Scientific) and optimization was performed using the Marquadt least-squares method. Three compartments (blood, renal and bladder), linked by flow rate parameters, comprised each model template forming a linked series of first order differential equations. Following optimization to numerical data from the TAC of each target renogram, the arterial flow rate parameters of the model were calculated. RESULTS: Optimization of all models was successful, with correlations of 0.65 to 0.98 (model weighted sum of squares/total weighted sum of squares). Arterial flow parameters, representing ERPF, in acutely obstructed kidneys were typically 20–25% of the contralateral normal kidney in the presence of equal divided renal uptake at 3 min. Linear correlation between simulated ERPF and divided renal uptake for both obstructed and normal kidneys was demonstrated (r= 0.9). CONCLUSION: Optimized models of TACs permit estimation of differential ERPF and may provide a more sensitive index of parenchymal dysfunction in early obstruction than comparing divided renal uptake.

1200–1245 Kingston Lecture Theatre
Institute of Physics and Engineering in Medicine
Douglas Lea Lecture

1200 Eponymous Lecture: Functional imaging in oncology

R J Ott
Department of Physics, Royal Marsden, Downs Road, Sutton, UK

Until recently, diagnostic imaging in oncology has been dominated

by morphological imaging techniques such as planar/digital X-ray, X-ray CT, ultrasound and MRI. These modalities provide exquisite, high resolution anatomical detail relating to the body tissues but, in general, are unable to differentiate between benign and malignant disease and may well not be able to detect disease at its earliest stages. On the other hand, functional imaging techniques have poorer spatial accuracy but provide physiological imaging information that may help to differentiate malignancy from benign conditions, allow early detection of functional abnormalities and provide real specificity related to disease status. In particular, as genetic abnormalities probably underlie the development of most cancers, measurement of gene expression and related molecular processes may identify abnormal gene function leading to improved early cancer diagnosis. In turn this may allow a prediction of tumour response to particular therapies and may provide generic markers of response to treatments, especially those therapies directed at specific molecular mechanisms such as cellular proliferation, apoptosis and other important cell signalling processes. Imaging methods that are sensitive to tissue molecular processes include single photon emission computed tomography (SPECT), positron emission tomography (PET), MRI and magnetic resonance spectroscopy (MRS), and new optical imaging methods. There are future prospects of using functional imaging techniques registered with anatomical information to detect disease at the very earliest stage and to specify the most appropriate treatment for each patient. This methodology will have far reaching consequences for both diagnosis and treatment of cancer.

1200–1300 Multipurpose Rooms 1 & 2 Workshop

Musculoskeletal Ultrasound

1200 Musculoskeletal Ultrasound Workshop

D Chapman-Jones
Canterbury Christ Church University, North Holmes Road, Canterbury CT1 1QU, UK

No abstract provided.

1300–1415 Lodge Room Scientific Session

Digital Imaging

1300 Computer-assisted diagnosis and pre-operative planning for brain tumour

P Diamantopoulos and J D Richardson
Biomedical Modelling Unit, School of Engineering, University of Sussex, Brighton BN1 9QT, UK

INTRODUCTION: This work describes the application of computer techniques in the diagnosis of a complex brain tumour case. A patient with a rare clinical condition of multiple brain tumours was presented. The application of clinical MRI was complemented by further image processing and tissue segmentation. The generated computer visualization presented an accurate picture of the clinical condition and assisted in appropriate planning of treatment. METHOD: A set of 188 MR images of the skull in a DICOM format was transferred by available computer network to a PC workstation for processing. The image data were manually segmented at a 2D level and the skull tissues of interest were distinguished. Skin, bone, brain and tumour tissues were reconstructed in three dimensions and represented by different volumetric entities. A virtual osteotomy was performed to isolate the problematic areas and to provide a clear picture of the tumour position. RESULT: An accurate 3D computer model of the patient's skull with selective colouring of the healthy and pathological tissues was developed from MR images. The surgeon was able to obtain multiple views of the reconstructed anatomy, to obtain accurate measurements regarding the position and the size of the tumour, and to evaluate access routes for surgical intervention. CONCLUSION: The generated computer model provided an essential diagnostic and planning tool for the medical team. It was proved that computer techniques and image processing methods can often complement traditional scanning techniques in complex clinical cases.

1310 A novel method for determining the accuracy of automated feature detection in medical images

M Board and S Astley
Imaging Science, University of Manchester, Manchester M13 9PT, UK

PURPOSE: Many computer-based aids for radiologists automatically detect features of interest, but the methods used to determine the accuracy of detection vary. An example is the accuracy of detection of mammographic abnormalities, in which a variety of criteria have been used. We have developed a new method for measuring the usefulness of computer-based detection, which outputs a cost derived from the transportation algorithm. METHOD: In the case where the detection image is a grey scale image and the truth is represented as a grey scale map, we successively threshold the detection image and normalize its grey levels to total those of the truth image. The cost of transporting the normalized grey levels to the truth values is computed at each threshold, and the resulting costs are again normalized to take into account the size of the truth regions. The method has been tested on a set of 20 images of mammographic microcalcifications, using standard detection algorithms. RESULTS: The behaviour of the method is such that an optimum threshold can be identified on the basis of cost. The main advantage of this technique over other published methods is that it deals well with the case of multiple detections around the edge of a feature, giving an appropriate cost, rather than recording multiple false positive detections. CONCLUSION: The method has been shown to work effectively, and provides a simple way of measuring and comparing the performance of different detection techniques.

1320 Evaluation of video display systems for radiological soft copy reporting

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PURPOSE: As long as image quality is maintained, soft copy reporting has the potential to improve workflow efficiencies in radiology. The aims of this study were to evaluate soft copy display systems for primary reporting of CR images and to test a method of routine quality control. METHODS: A range of CRT video display systems was evaluated. All video cards accepted on-board correction in conformance with DICOM part 14 Grayscale Standard Display Function. Two commercial software packages were used for calibration and were compared for monitor assessment and routine quality control. Perceptual linearization was investigated with an SMPTE phantom. CR images of X-ray phantoms were used to assess low contrast detectability and spatial resolution. Three observers evaluated CR images on soft copy and hard copy. Where possible, comparisons were made with a conventional screen–film system. RESULTS: Only high quality monochrome video display systems were able to match the image quality of CR hard copy. In comparison with screen–film, spatial resolution of these video display systems was decreased, although there was a marked improvement in low contrast detectability. A low cost commercial software package provides both calibration and simple quality control of soft copy systems for primary reporting and for secondary viewing. CONCLUSION: The correct choice of video display system, along with routine quality control, makes it possible to maintain soft copy image quality and compares well with conventional X-ray film–screen technology.

1330 Film reject analysis in a hardcopy CR environment: a departmental QC project

M Ong, A Gapay, M Roopesh, A Lau, H W Tung, J Jackson, Z Bi, F F Luo and L M Kew
Department of Diagnostic Imaging, National University Hospital, Singapore

Valid quality indicators are necessary in any quality assurance system. This is also true in the field of diagnostic radiography as departments strive to achieve recognized quality standards such as the ISO 9000 series. Film reject analysis is one such indicator that forms an important part of the departmental audit and an invaluable tool for the improvement of a radiology service. The Department of Diagnostic Imaging of the National University Hospital, Singapore, performed this project as part of the hospital's quality circle (QC) initiative. PURPOSE: The aims were: to determine the overall reject rate of the department as a baseline for future studies; to investigate the primary factors contributing to the reject rate; and to suggest solutions to reduce the reject rate. METHOD: Study data were collected over a 2-month period (January through February 2001), after which solutions were suggested to reduce the reject rate. Data were again collected for April and May 2001, a period of 2 months after implementation of the

solutions. RESULTS AND CONCLUSIONS: The department's overall reject rate was 7.52% before and 6.52% (13.3% reduction) after implementing the suggested solutions. The primary factors found to be contributing to the overall reject rate were radiographic positioning and incorrect exposure. The suggested solutions proved to be effective in reducing the department's reject rate. The results achieved were purely within the context of the local department.

1340 Image quality comparison between a flat panel detector and image intensifiers in cardiac imaging

A Mackenzie and C P Lawinski
KCARE, King's College Hospital, London SE22 8PT, UK

PURPOSE: To evaluate the image quality of the GE Innova 2000 with flat panel detector compared with five cardiac systems using image intensifiers. METHODS: Image quality was measured using the threshold contrast detail detectability (TCDD) test objects TO10 and TO20. A quality index (QI) was calculated using exposure and TCDD. High contrast resolution was measured using a line pair (lp) phantom. RESULTS: The average fluoroscopy QI for an image intensifier was 1.02 while for the Innova it was 1.37 and 0.98 on the "low" and "normal" dose rates, respectively. The average acquisition QI was 1.11 for image intensifiers and 1.74 for the Innova on both "normal" and "high" dose rates. The average high contrast resolution for the image intensifier is 1.7 7 lp mm^{-1} and 2.7 lp mm^{-1} for the largest and smallest fields, respectively, and 2.8 lp mm^{-1} and 3.2 lp mm^{-1} for the Innova. CONCLUSION: The fluoroscopy QI for "low" dose rate for the Innova was higher than the "normal", indicating some temporal averaging may have been used. The "normal" fluoroscopy QI is similar to that of the other systems. The large dynamic range of the photodiode/TFT array compared with the image intensifier camera helps the acquisition QI to be much better than the image intensifier. The high contrast resolution was best for the Innova, although the difference reduces for smaller field sizes. The resolution would be same for all field sizes on the Innova if a digital magnifying glass was available.

1350 WIP: Teleradiology in rural health centre environments

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[1]EuroteleRad, [2]Alfandega da Fé Health Center and [3]NovaBase, Trigueira, P4605-171 Mancelos, Amarante, Portugal

With the advent of the digital age of radiology, its pivotal role in diagnostic work-up and patient management is penetrating medical practice, often in remote geographical areas. The contribution of teleradiology to the upgrading of Health Centers sited in rural communities of the mountains of Northern Portugal is summarized. Teleradiology is the more technologically complex and costly expression of a wider project of telemedicine being implemented in three such Health Centers that concomitantly also run telecardiology and teledermatology. It is planned to add teleultrasound and telemammography as the appropriated and price wise apparatus come into the market. The cultural, medical, social and cost benefits that have been derived so far from this project are discussed.

1400 WIP: DR *vs* CR systems: evaluation of workflow and time utilization in a clinical setting

G Goff and S Phillips
Department of Diagnostic Radiology, Princess of Wales Hospital, Coity Road, Bridgend CF31 1RQ, UK

PURPOSE: With the advent of DR (digital radiography), the anticipated productivity of such a system within a radiology department is claimed to be greater than that of a CR (computed radiography) system. The purpose of this study was to evaluate this hypothesis in a clinical setting. METHOD: The workflow patterns were identified and mapped in rooms within the same department using a DR and CR system. The time for the following steps within the process was established for both DR and CR systems: time from commencement to completion of examination; time from commencement of examination to patient exiting the examination room; and time from commencement of examination to exiting the radiology department. Examinations were matched for type and patient condition. The study was carried out in a department with a fully functional department-wide PACS. RESULTS: The number of workflow steps with the DR system is three steps less than that with the CR system. The time from commencement to completion of examination was 39% quicker in the DR than the CR system. The time from commencement to patient exiting the examination room and patient exiting the radiology department was 41% and 50%, respectively, quicker with the DR system than the CR system. CONCLUSION: The workflow pattern and throughput of a DR equipped room were found to be more efficient than those of a CR equipped room. With ever increasing demands on radiology services, the installation of DR is advantageous in already over stretched and under staffed radiology departments.

1410 Discussion

1330–1500 Hall 9
Keynote Lecture
CT Imaging: technological developments

1330 Invited review: Techniques and radiation dose: the challenge of multislice CT

S Golding
Department of Radiology, John Radcliffe Hospital, University of Oxford, Headington, Oxford OX3 9DU, UK

No abstract provided.

1400 Invited review: CT unsliced

A J Scally
School of Health Studies, University of Bradford, 25 Trinity Road, Bradford BD5 0BB, UK

The very first CT scan comprised a series of transaxial slices, and CT images have predominantly been viewed in this way ever since. In recent years, various image processing techniques (MPRs, MIPs, virtual endoscopy, surface and volume rendering) have been additionally used for a wide range of clinical applications, but their utilization has not been widespread. With the advent of multislice (and soon cone beam) CT, is it now time to make better use of these techniques and consign the simple slice to history? This talk will briefly review the principles of 3D image processing, identify clinical problems they have been useful in addressing and discuss the potential for their more widespread use.

1430 Invited review: Micro CT

E Morton
Department of Physics, School of Physics and Chemistry, University of Surrey, Guilford, Surrey GU2 7XH, UK

No abstract provided.

1345–1430 Hall 10
Keynote Lecture
Lung Cancer Staging

1345 Invited review: Lung cancer staging: CT/MRI

F V Gleeson
Department of Radiology, Churchill Hospital, Old Road, Headington, Oxford OX3 7LJ, UK

No abstract provided.

1405 Invited review: Use of ^{18}FDG PET in lung cancer

G J R Cook
Department of Nuclear Medicine, The Royal Marsden Hospital, Downs Road, Sutton, Surrey SM2 5PT, UK

Most malignant lung tumours show avid uptake of ^{18}F-fluorodeoxyglucose (^{18}FDG). However, low uptake may be seen with broncheoalveolar carcinomas and carcinoids, and active granulomatous processes may occasionally show moderate to high uptake. In the investigation of indeterminate pulmonary nodules, ^{18}FDG PET shows sensitivities in excess of 90% and specificities in excess of 80%. Specificity is reduced in US studies by the relatively high prevalence of histoplasmosis and granulomatous disorders. ^{18}FDG PET is clearly superior to CT in the pre-operative staging of lung cancer, upstaging approximately 40% and down-staging 20% of patients, both in the mediastinum and for distal metastases. The British Thoracic Society guidelines recommend the use of PET in all patients before surgery, and it has been shown to be cost saving when used in this way. Primary tumours with SUV >20 are associated with a poorer prognosis. Whilst a metabolic ^{18}FDG response to radiotherapy predicts overall survival, a metabolic response to neoadjuvant

chemotherapy does not necessarily predict complete pathological response. However, a poor metabolic response has a high specificity for residual active tumour. ^{18}FDG PET is accurate in differentiating recurrent thoracic disease from post-operative and post-radiotherapy changes. It is possible that the emergence of PET/CT will improve patient management further in some specific situations.

1425 Discussion

1345–1430 Olympian Suite 1
Keynote Lecture
Implications of Imaging in Prostate Cancer

1345 Invited review: Implications of imaging in prostate cancer

J H Newhouse
Department of Radiology, Columbia-Presbyterian Medical Centre, New York, NY 10032, USA

Radiological imaging plays a variety of roles in the evaluation and management of patients with prostate cancer; these will be reviewed in this presentation. Despite attempts to improve the accuracy of transrectal ultrasound, screening is still performed primarily with digital rectal examination and PSA; transrectal ultrasound remains in use as a biopsy guide. Staging recently diagnosed patients relies upon skeletal scintigraphy and abdominal pelvic CT to detect metastatic disease, and MRI to delineate local invasion. These are not needed for all patients, however; stratification of risk for advanced stage disease using PSA and Gleason scores, together with the implications for choosing imaging procedures, will be presented. The accuracies, limitations and pitfalls of these techniques will be discussed, along with their implications for choices of therapy. Following initial treatment, follow-up is not initially an imaging task but is PSA-driven; the roles and interpretation of imaging techniques, including newer radionuclide tests, will be reviewed. Throughout the talk, the basic clinical issues regarding the disease (demographics, histological evaluation, treatment choices etc.) will be described in order to link radiographic procedure choice and interpretations with clinical impact.

1345–1430 Olympian Suite 2
Keynote Lecture
HRCT of the Lungs

1345 Invited review: High resolution CT of the lungs: the basics

S P G Padley
Department of Radiology, Chelsea and Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK

This is the first of three lectures on high resolution CT (HRCT) of the lung (including "HRCT of the lung: the pitfalls", Sujal Desai, and "HRCT of the lung: a simplified approach", Professor D M Hansell). This talk will cover the basic structure of the secondary pulmonary lobules and the common radiological patterns revealed by HRCT. This initial lecture will also discuss technique, including the implications of multidetector CT scanners, dose lowering strategies and the necessity for ancillary sections (prones, expiratory images etc.).

1405 Invited review: High resolution CT of the lungs: the pitfalls

S Desai
Department of Radiology, King's Healthcare NHS Trust, Denmark Hill, London SE5 9RS, UK

No abstract provided.

1425 Discussion

1345–1545 Kingston Lecture Theatre
Keynote Lecture and Scientific Session
Conformal Therapy and Treatment Planning

1345 Invited review: Helical tomotherapy: the marriage of a linac with a CT scanner

R Mackie
Department of Medical Physics, University of Wisconsin, 1300 University Avenue, Madison, WI 53706, USA

No abstract provided.

1415 Invited review: Practical experience with IMRT

A J Poynter
Suffolk Oncology Centre, Ipswich IP4 5PD, UK

A number of centres in the UK have recently acquired the ability to plan and deliver intensity modulated radiotherapy (IMRT), and it is expected that this technique will be brought into more widespread use across the country during the next few years. Clinical implementation has been delayed in some areas owing to concerns over the selection of suitable patient groups and the possible impact upon departmental resources. The Suffolk Oncology Centre commenced its IMRT programme in June 2001 and has extended the use of the technique to the treatment of lung, breast, head & neck and pancreatic tumours. The technique has been found to be appropriate and practical to deliver in a non-academic general hospital setting. The impact upon resources, particularly oncologists and radiotherapy physics, has been significant but manageable, and fully justifiable given the benefit to the patients.

1445 Invited review: Should planning margins be added to organs-at-risk in radiotherapy?

A L McKenzie, M van Herk and B Mijnheer
Bristol Oncology Centre, Bristol BS2 8ED, UK

In ICRU Report Number 62 it is stated that "an integrated margin must be added to the Organ at Risk (OR)" to compensate for geometric uncertainties including organ motion and set-up error. Such a margin would produce a planning at-risk volume (PRV), in analogy with the way that adding a margin to the clinical target volume (CTV) produces a planning target volume (PTV). The question is, should margins be added to all such ORs, and how large should the margins be? In some instances, for example large, parallel organs, the judgement may be that such margins are unnecessary. In all other cases, provided that it is not already the practice to delineate the OR with a margin (*e.g.* delineating the spinal canal rather than the cord), it is recommended that a margin should be drawn around the OR. Derivation of the margin follows a similar philosophy to that employed for determining CTV to PTV margins. Systematic errors that are introduced at the treatment preparation stage may be accommodated by a margin of width 1.3Σ, where Σ is the standard deviation of the combined systematic uncertainties. Blurring caused by daily treatment uncertainties should be considered in addition to the systematic uncertainties. How this blurring is incorporated into the OR to PRV margins depends upon the size of the tolerance dose in relation to the overall dose distribution.

1515 Calibrating radiation dose using MRI

G P Liney, A Beavis, A Jenner and L W Turnbull
Hull & East Yorkshire NHS Trust and University of Hull, Hull HU3 2JZ, UK

PURPOSE: Intensity modulated radiotherapy (IMRT) offers an advanced conformal approach to treatment, but conventional methods of verifying treatment plans are no longer practical. MRI of irradiated polyacrylamide gels has been shown to demonstrate dose distributions. This work extends previous preliminary results by calibrating the dose response. METHODS: Batches of a BANG-type gel were manufactured using either 3% or 3.3% bis-acrylamide, and the gels were irradiated over a range of doses from 0 Gy to 10 Gy. MR studies were performed on a 1.5 T GE Signa system using a conventional head coil. A variety of imaging sequences were acquired for subsequent post processing, including two dual echo FSE sequences (TE/TR = 30,105 and 60,180/4000 ms, ETL = 12) to produce pixel-by-pixel R2 maps of the gels. R2 values for each gel sample were determined to establish calibration plots. RESULTS: Results demonstrate the linear relationship between R2 and dose below 10 Gy. The dose dependence was influenced by concentration, with the 3% composition providing a better fit compared with the 3.3% composition. CONCLUSIONS: These results demonstrate the use of polyacrlyamide gels and MRI in providing high resolution dose verification of IMRT plans. The variability of the response necessitates that a calibration be performed each time the gel is used, but this can be done by imaging small samples in the manner described here at the same time as scanning a larger sample that has been exposed to the IMRT plan.

1525 Monte Carlo calculation of the photon beams produced by a linear accelerator with multileaf collimators using MCNP

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The photon beam produced by the linear accelerator is inhomogeneous both in energy and intensity, especially when additional beam shaping tools such as the physical wedge are employed. Accurate non-Monte Carlo computation of radiation penetration and dose deposition therefore requires comprehensive information about the beam incident on the patient. The required information may be difficult if not impossible to obtain by measurement. Although Monte Carlo calculations are still considered to be too slow for routine treatment planning of photon beams, they are used to generate the necessary spectral input for faster alternative algorithms such as the convolution/superposition methods of dose calculation. This study has used the Monte Carlo N-Particle radiation transport code MCNP (version c) on a PC to simulate the open and wedged 6 MV photon fields produced by a MLC. The depth–dose distributions and dose profiles at constant depth for various field sizes have been simulated and found to be within acceptable limits. The code has also been applied to the simulation of asymmetric fields as well as for characterization of MLC produced irregular fields. The accuracy of the model for generation of comprehensive off-axis asymmetric to symmetric field ratio data for asymmetric field calculations as well as leaf response functions for MLC produced fields has been demonstrated.

1535 Discussion

1400–1530 Hall 11B
Symposium
Radiotherapy Planning Update: planning treatment delivery

1400 Invited review: Planning the tumour volume: when and how to use MLCs

A M Bidmead
Physics, The Royal Marsden Hospital, London SW3 6JJ, UK

Conformation of the dose distribution necessary for conformal therapy can be achieved by using an MLC, either as a shielding device or to modulate the intensity of the treatment beam, as in IMRT. However, consideration has to be given to the size and shape of the volume to be treated because, for small, irregularly shaped volumes, conformal blocks may be preferable. A knowledge of the different margins involved in conformal therapy is required before planning with MLCs. The magnitude of the MLC penumbra, the distance between the 50% isodose curve and the MLC leaf edge, and the 50–95% distance should all be known before conformal shielding is undertaken. Increasing the number of fields, avoiding opposing fields and using non-coplanar fields all decrease the margin needed for tight conformation of dose. When using an MLC, there are various criteria that should be taken into account. The orientation of the MLC with respect to the wedge is often non-optimal and collimator rotations to "best fit" shapes are sometimes difficult to achieve practically. The penumbra from the MLC increases with leaf stepping angle, so a limit is placed on the angle that the leaf ends make with the volume. There are different methods of leaf fitting dependent on the use made of the MLC, whether for shielding critical organs or conforming to target volumes. When using MLCs for IMRT delivery, other technical and dosimetric constraints will apply and the specific design and performance of the MLC needs to be thoroughly understood before clinical use.

1430 Invited review: Dose distributions and dose–volume histograms: interpretation and pitfalls

A E Nahum
Physics, Royal Marsden, Sutton SM2 5PT, UK

Today's 3D treatment planning systems produce a great deal of data; how can we handle this? Dose distributions, as isodoses or colourwash, on many CT slices are virtually impossible to assimilate. Thus, the dose–volume histogram (DVH) was born. Generally, DVHs both for tumour volumes (GTV, CTV or PTV) and for organs-at-risk (OARs) are plotted in cumulative form (cDVH), *i.e.* percentage of tumour/organ volume receiving at least a certain dose *vs* dose (Gy or percentage). For tumours, a uniform dose distribution transforms into a rectangular cDVH and it is easy to spot any deviations from this; cDVHs are excellent for judging whether the dose is acceptably uniform. For OARs there is no ideal shape, except zero dose of course, and interpretation is less straightforward. However, one can read off from a cDVH the percentage volume receiving, say, 90% of the prescription dose. DVHs are not the whole story, however. They cannot tell us WHERE the problem, *e.g.* a cold spot in a tumour, lies. And if two DVHs cross over for an OAR, which is "best"? Going beyond DVHs, models of tumour control probability (TCP) and normal tissue complication probability (NTCP) are being developed using DVHs as input. These may prove to be very useful once the parameters involved in these inevitably oversimplified "biological models" are better known, *e.g.* tumour cell radiosensitivity, exponent of OAR volume effect. Furthermore, surface dose maps for hollow organs, *e.g.* rectum, may enable us to "put back" the spatial information "removed" by the DVH.

1500 Invited review: Practical problems in delivering planned tumour volumes

D Routsis
Oncology Centre, Addenbrooke's Hospital NHS Trust, Cambridge CB2 2QQ, UK

No abstract provided.

1400–1530 Hall 11A
Refresher Course
Abdominal Ultrasound

1400 Invited review: Transabdominal abdominal scanning techniques

M Stocksley
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Radiographers educated in clinical ultrasound at postgraduate level have participated in the delivery of general medical ultrasound services for several years as a result of an acknowledged radiologist shortage combined with an increase in interventional procedures and new imaging modalities. Radiographer involvement in abdominal scanning appears to range between undertaking limited studies of the gall bladder, aorta or bladder volume and producing images for radiologists to report to performing full abdominal surveys with free text self-reporting. Whilst the majority of radiologists support radiographers' contribution to the service, some have commented that radiographers are worse at lateral thinking and lack the medical knowledge required to undertake and report on an abdominal scan. To demonstrate that radiographers can think laterally and have some insight into the clinical background of the patient, they have to look to their scanning techniques and approach to the scan as well as to their knowledge of anatomy and pathology. This refresher course session will revisit the basic techniques and approaches that radiographers have traditionally used when scanning some common areas encountered during a general medical ultrasound scan. It will then look at alternative ways of approaching the scan and at any changes or updates in technique that radiographers might find useful.

1430 Invited review: Intraoperative ultrasound in the abdomen: a review

J Bates
Ultrasound Department, St James's University Hospital Trust, Lincoln Wing, Beckett Street, Leeds LS9 7TF, UK

The trend towards organ-preserving surgical treatment, such as hepatic resection of colorectal metastases, has emphasized the need for the highest quality of pre-operative radiology for staging purposes to plan the most effective course of surgery. Intraoperative ultrasound (IOUS) continues to be a gold standard by which pre-operative imaging is measured. The direct impact of IOUS on surgery depends, to a large extent, upon the quality of the pre-operative imaging. Current literature supports the view that IOUS adds significantly to the pre-operative information in around 30% of cases (ranging from 0.7% to 48%) and that the surgical procedure may be altered in up to 18% of these, but this figure will continue to reduce as the accuracy of pre-operative diagnosis improves. IOUS, however, continues to maintain its place as a useful tool. Its value has been demonstrated in the localization of pancreatic tumours, and renal and gastrointestinal disease. Surgical techniques for the resection of liver metastases continue to develop,

with a wider range of referrals and increasingly complex disease now being considered potentially curative. The trend towards laparoscopic ultrasound in the field of hepatobiliary surgery continues, with clear benefits to replacing operative cholangiography in the identification of ductal stones. Laparoscopic ultrasound also optimizes patient selection for liver and pancreatic surgery with curative intent, and has been used to great effect in the resection of renal tumours.

1500 Invited review: Endoscopic ultrasound: a review

K M Harris
Department of Radiology, Leeds General Infirmary, Great George Street, Leeds LS1 3EX, UK

Endoscopic ultrasound (EUS), combining endoscopy and high frequency ultrasound, provides a unique opportunity to visualize the bowel wall and adjacent structures. EUS has been in use since the early 1980s but has been slow to gain acceptance in certain countries, including the UK. There are two basic types of echoendoscope commercially available, with either radial or curved/linear array technology. EUS has evolved to become an essential imaging modality in the investigation of patients with a wide range of suspected pathologies. Accurate staging of gastro-oesophageal tumours is essential to allow a well informed decision to be made to plan appropriate treatment. EUS is superior to CT for the local staging of gastro-oesophageal tumours and is more accurate in predicting resectability, although the complementary nature of these imaging techniques must be emphasized. The gall bladder, extrahepatic biliary tree and the whole of the pancreas can be examined in most cases, and pancreaticobiliary EUS has been shown to be superior to other imaging techniques for a range of conditions. Submucosal or extrinsic indentations into the bowel lumen can be elegantly characterized with EUS and, whilst not histology, it often adds useful information to assist management. Using the curved/linear array echoendocspoes, image guided EUS intervention has become a reality. The principal indication for interventional EUS at present is fine needle aspiration of masses or lymph nodes. Recent improvements in instrument and accessory design have opened up many potential new roles including coeliac plexus neurolysis and drainage/stenting of pancreatic pseudocysts.

1430–1600 Hall 10
Refresher Course
Female Malignancy

1430 Invited review: MR in the management of cervical and endometrial cancer

R H Reznek
Academic Department of Radiology, St Bartholomew's Hospital, London EC1A 7BE, UK

MRI has been shown to have an impact on several aspects of the management of patients with cervical cancer, including staging the disease, monitoring response, detecting complications and planning radiotherapy. The key question in staging cervical cancer is detecting parametrial invasion. The NPV for parametrial invasion is 95%. Identification of nodal disease on MRI is poor. In those patients treated with radiotherapy, MRI is extremely useful to monitor change and to detect early recurrent disease. MRI has also been shown to be reliable in delineating post-operative or post-radiotherapy vaginal fistulae. Increasingly, uterus-conserving surgery is being carried out in early stage cervical cancer and in these patients MRI has become extremely important in deciding on the anatomical feasibility of this procedure. MRI has been shown to be remarkably accurate in delineating the extent of the tumour and has therefore become indispensable in local planning of radiotherapy. The role of MRI in endometrial cancer is less clear cut, but it is becoming important in staging the disease. The single most important decision is to be able to identify the presence of myometrial invasion, as this is an important factor in predicting lymph node invasion.

1455 Invited review: Evaluation of adnexal masses: ultrasound

J A W Webb
Diagnostic Radiology, Barts and the London NHS Trust, St Bartholomew's Hospital, West Smithfield, London EC1A 7BE, UK

Ultrasound (US) is the first imaging method of choice for suspected adnexal masses. Using transvaginal US, supplemented with transabdominal US for larger masses, it is usually possible to show whether the mass originates in the ovary, tube or uterus (*e.g.* pedunculated fibroid) or outside these structures. For ovarian masses, US can accurately characterize simple cysts and may suggest a variety of other benign diagnoses (*e.g.* haemorrhagic cyst, endometriona, dermoid). Features that suggest malignancy include mixed solid/cystic consistency, the presence of multiple or thickened septa or the presence of solid nodules in cystic masses, large masses and the presence of ascites. Doppler indices (PI, RI) alone tend not to be particularly helpful. However, the presence of vessels, especially arteries with low resistance flow, in the solid areas of masses increases the suspicion of malignancy, particularly in post-menopausal patients. In pre-menopausal patients however, low resistance arterial flow is normal in relation to the corpus luteum. When US is used in a way that provides high sensitivity for ovarian malignancy, its specificity is considerably lower and a significant number of masses remain indeterminate even when US is combined with CA125. In such patients, MR may be helpful for further characterization.

1520 Invited review: Evaluation of the adnexal mass

R H Reznek
Academic Department of Radiology, St Bartholomew's Hospital, London EC1A 7BE, UK

In practice, ultrasound is the initial imaging modality used for the investigation of adnexal masses. However, a significant number of masses remain indeterminate on ultrasound. MRI now has a role in characterizing these indeterminate lesions. On MRI, the features most indicative of malignancy include: vegatations within a cystic lesion; a solid mass with or without necrosis; irregular thickening of the wall; or of an interstitial septum. The signal characteristics on MRI may also be extremely valuable in confirming that an indeterminate cystic mass on ultrasound is benign: the presence of blood almost always indicates an endometriotic cyst; uniformly low signal intensity on a T_2 weighted sequence often indicates the presence of a fibroid. Once characterized as a malignant lesion, MRI has a similar accuracy to CT in staging malignant ovarian neoplasms. Evidence of peritoneal involvement, such as ascites, omental infiltration and peritoneal nodules, should always be sought, together with evidence of lymph node enlargement and liver or spleen deposits.

1545 Discussion

1430–1600 Olympian Suite 1
Refresher Course
Female Benign Disease

1430 Invited review: MRI female pelvis: benign disease

N R Moore
Department of Radiology, University of Oxford, Oxford OX3 9DU, UK

MRI is ideally suited to the diagnosis of benign disease of the female pelvis; it has excellent soft tissue discrimination, is able to obtain images in any plane, has a wide field of view and does not use ionizing radiation. CONGENITAL ANOMALIES: MRI is more accurate than hysterosalpingography in the assessment of uterine anomalies. Non-visualization of the uterus or vagina on a technically adequate study indicates agenesis or hypoplasia. BENIGN DISEASE OF THE UTERUS: MRI is the best technique for the diagnosis of leiomyomas and adenomyosis. Leiomyomas are well defined and usually of low signal on conventional sequences. Increased signal may be seen in degenerating fibroids. There are no features to distinguish degeneration from much rarer malignant change. Adenomyosis may be diffuse (with thickening of the junctional zone), or focal with ill defined low signal areas. Linear striations or high signal foci increase the diagnostic confidence for adenomyosis. BENIGN DISEASE OF THE OVARY: Functional cysts are thin walled (<3 mm), unilocular and less than 3 cm in diameter. Haemorrhagic cysts return high signal on T_1 and intermediate to high signal on T_2 images. Endometriomas are usually small, but the walls may be thickened and irregular; hyperintensity on T_1 sequences and heterogeneous or low signal on T_2 images are characteristic features. Mature cystic teratomas are slow growing, usually asymptomatic and bilateral in 10%. Malignant transformation is very rare. The presence of fat is diagnostic and solid components may also be detected. Fibromas and thecomas are low signal on T_1 and T_2 images.

1455 Invited review: Ultrasound in infertility

L MacDonald
Department of Radiology, Guy's & St Thomas NHS Trust, London, UK

No abstract provided.

1520 Invited review: Fibroid embolisation

J F Reidy
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Since uterine artery embolisation (UAE) was first reported as an alternative treatment for fibroid disease in 1995 there has been considerable interest, particularly by interventional radiologists. The technique depends on fibroids being particularly susceptible to ischaemia and involves selective catheterization of both uterine arteries and embolisation to the point of near-total occlusion with particulate emboli (most commonly PVA). Technical aspects of UAE will be detailed. The indications for UAE are the same as for surgery, but many women will self-select as they wish to avoid hysterectomy. Other women, considered difficult cases for myomectomy, may be referred by gynaecologists. Short-term results are encouraging, with about 85% of women gaining benefit and fibroid uteruses shrinking by about 50%. Long-term studies or randomized controlled data are not as yet available. Complications apart from the post-embolisation syndrome are rare but can be major, with infection being the most serious. Rarely this can lead to hysterectomy and this appears more likely with the large fibroid uterus (<20/52). Other concerns are of fibroid expulsion and amenorrhoea, which is rare. For younger women, where future fertility is an important issue, there are extra concerns, but successful pregnancies are increasingly being reported post UAE. If radiologists are to establish a UAE service, they need to work in close co-operation with gynaecologists who have a knowledge of the procedure and its possible problems. All these issues and the current views on UAE will be discussed.

1545 Discussion

1430–1600 Olympian Suite 2
Refresher Course
Chest

1430 Invited review: Chest trauma

J H Reynolds
Department of Radiology, Birmingham Heartlands and Solihull NHS Trust (Teaching), Bordesley Green East, Birmingham B9 5SS, UK

The major organs within the chest, namely the heart, lungs and major blood vessels, have a crucial role in providing oxygen to the tissues of the body and in removing carbon dioxide. Major trauma to the chest can disrupt one or more of these processes and there are therefore a number of potentially serious intrathoracic injuries. In this lecture, particular attention will be given to injuries that can cause diagnostic difficulty, which include diaphragmatic, thoracic spine and aortic injury. Despite advances in imaging technology, diaphragmatic rupture remains a diagnostic challenge. The imaging assessment of suspected aortic rupture remains contentious, but a strong body of evidence is building that suggests that good quality CT is a safe technique for evaluating the aorta. Thoracic spine fractures are often missed initially as the clinical and radiographic signs can be overshadowed by other injuries.

1455 Invited review: High resolution CT of the lungs: a simplified approach

D M Hansell
Radiology Department, Royal Brompton Hospital, Sydney Street, London SW3 6NP, UK

A distillation of the many review articles and texts giving guidance on the interpretation of high resolution CT (HRCT) of diffuse lung disease may be useful, particularly for radiologists who only occasionally report HRCT examinations. The first step of assigning normality, or otherwise, does not usually present any difficulty, but images with non-standard window settings or images obtained on an unfamiliar scanner may be problematic. Categorizing a chronic diffuse lung disease as predominantly fibrotic (*vs* non-fibrotic) is the next key step and is usually straightforward. A simple algorithm for refining the differential diagnosis of fibrosing lung disease revolves around the near pathognomonic HRCT appearances of UIP. The features of the relatively limited number of alternative fibrosing lung diseases encountered will be discussed. Those diffuse lung diseases with relatively characteristic HRCT features, as opposed to those with variable and non-specific appearances (in which the limited usefulness of HRCT must be remembered), will be explored. A simplified approach to the interpretation of the two most basic HRCT signs, ground-glass opacification (grey lung) and decreased attenuation lung (black lung), will be emphasized.

1520 Invited review: Chest CT in the immunocompromised host

P J Shaw
Imaging Department, University College Hospital, Grafton Way, London WC1E 6AU, UK

Pulmonary disease still accounts for most AIDS-defining illnesses, with lung infections still having a high mortality. Diagnosis of pulmonary disease is only possible by knowing the relevant clinical information, including the immune status and relevant risk factors, typical and atypical patterns of disease and the natural history of HIV disease. CT is useful in confirming active pulmonary disease in patients with a normal chest X-ray and in characterizing non-specific appearances. An accurate and confident diagnosis of PCP and Kaposi's sarcoma is possible on high resolution CT scans, and both common and atypical patterns will be presented. The potential diagnosis of nodules and solitary masses will be discussed. Nodule size cavitation and distribution are useful in differentiating infectious from neoplastic causes. Additional common patterns of disease, including lymphadenopathy and pleural effusions, will also be presented. In addition to the superiority of CT in establishing the diagnosis, it also identifies the best route for biopsy.

1545 Discussion

1530–1700 Hall 9
Refresher Course
CT Imaging

1530 Invited review: Multislice CT and dose levels

L DArcy
Clinical Specialist in CT, Wexford General Hospital, UK

Multislice CT scanning was introduced in 1993 by Elscint with the release of their CT Twin, a dual slice scanner. This machine acquired two axial slices per tube/detector rotation. In 1998, quad multislice was released by most of the major manufacturers and now 16-slice scanners are widely available. The ever increasing power and resolution of these systems and their ability to scan rapidly through large volumes using thin slices has raised concerns over the ease with which patient dose may be significantly increased. This presentation will address system geometry, advantages of multislice acquisition, clinical applications and protocols, with particular reference to scan parameters and their impact on patient dose.

1555 Invited review: 3D helical CT of the nasal airway

J Cathcart, N Bailie, G Gallagher and D Hill
Department of Radiology, Antrim Hospital, United Hospitals Trust, Antrim BT41 2RL, UK

The quality of 3D CT imaging depends on the protocol and factors that are used. The general principles used are the same for any anatomical area and are then tailored to suit. Optimizing the lowest possible radiation dose whilst maintaining image quality should also be uppermost when developing any protocol to be utilized. The present area of study is the nasal airway. CT is widely regarded as the optimal imaging technique for the nose and paranasal sinuses. The technique, however, involves exposing the lens of the eye to ionizing radiation, risking cataract formation. Accordingly, it is important to minimize the radiation dose whilst at the same time delivering high quality images. A protocol for scanning the nose and paranasal sinuses is presented that produces high quality image data using a relatively low radiation dose. The technique may be readily adapted to produce images suitable for endoscopic sinus surgery or for production of 3D models of the nasal passages suitable for airflow analysis and virtual endoscopy prior to surgery. As the study develops, it is hoped to carry out pre-surgery virtual endoscopy and to compare the results found at

surgery to see how effective it is. Also, with the use of 3D computed models of the nose, it is possible to predict airflow in an individual patient's nose and to correct abnormalities on the computer model to predict the outcome of surgery. However, the requirements for CT technique and 3D imaging need to be optimized before advancing.

1620 Invited review: To be confirmed.

1645 Does monitoring change the outcome in abdominal–pelvic CT scans?

V Goh, J M Anderson, A Leonard and S Halligan
Department of Clinical Radiology, Northwick Park and St Marks Hospitals, Harrow, Middlesex HA1 3UJ, UK

PURPOSE: In our institution, abdominal–pelvic CT scans have traditionally been supervised directly by radiologists, but we could find no studies that determine the value of this, especially with scans protocolled in advance. This prospective study aims to determine the value of direct radiologist supervision, if any, and to identify the situations in which this occurred. MATERIALS AND METHODS: 180 consecutive patients undergoing abdominal–pelvic scans for various indications were recruited prospectively. Cases were protocolled in advance of the examination by a radiologist based on clinical information on the request form, as is usual practice. The scan was reviewed immediately after acquisition by a radiologist, and any changes to protocol on review were noted. RESULTS: 180 patients (median age 66 years) were scanned. Most scans (141/180 cases (78%)) were protocolled and monitored by a specialist registrar. Scan outcome altered in only 19/180 (11%) cases. In 6 of the 19 cases (32%), additional scans were performed owing to insufficient anatomical coverage by the radiographer. In only 2 of the 19 cases (11%) were additional scans performed owing to an unsuspected mass, changing scan outcome. In 7 of 10 cases, the protocol of "plain and see" resulted in intravenous contrast medium administration. CONCLUSION: Direct monitoring by a radiologist alters the pre-existing protocol in approximately 1 in 10 cases.

1655 Discussion

1600–1700 Hall 11B
Symposium
Radiotherapy Planning Update: on-treatment verification

1600 Invited review: Principles and applications of portal imaging

K Langmack
Department of Medical Physics, Lincoln County Hospital, Lincoln LN2 5QY, UK

In recent years an electronic portal imager has become a standard accessory for linear accelerators. Commercial devices are based on one of three technologies: fluorescent screens and cameras; liquid ion chamber arrays; or amorphous silicon flat panel arrays. The first half of the lecture will describe the principles of operation of these three technologies and will describe some of the limitations of devices based on these technologies. The second part of the lecture will be devoted to a discussion of the application of portal images to treatment verification. These images can be used to verify treatment set-up (geometric verification) and the dose delivered (dosimetric verification). It is their quality that determines the usefulness of portal images for geometric verification, but what do we mean by "image quality"? The concept of detector quantum efficiency (DQE) will be introduced and used to explore the idea of portal image quality. Some approaches to image registration will then be described. Finally, there will be a brief overview of dosimetric portal imaging.

1630 Invited review: Impact of portal imaging on treatment plans: when, how and who to intervene

S Stanley
Cookridge Hospital, Leeds, UK

Improvements in megavoltage imaging (MVI) methods have resulted in many radiotherapy departments reviewing the imaging process with a view to improving the reproducibility of daily set-up. As treatments become increasingly complex, with reduced margins and escalated doses, the magnitude of the "acceptable" error has been reduced. However, identifying and correcting errors in set-up requires careful strategic planning that should incorporate factors such as the site, clinical information, critical structures, technique reproducibility, organ motion, complexity of the plan and the MVI equipment available. Therefore, a multidisciplinary approach involving clinicians, radiographers and physicists is required. This presentation will review how errors impact on the treatment plan, the methods available for MVI analysis and the roles of the multidisciplinary team in the process. The radiographer's role in image review will be explored, along with the use of online imaging, and finally the impact of IMRT will be discussed.

1600–1730 Hall 11A
Advances
Perspectives on Ultrasound Scanning

1600 Invited review: The role of the independent sonographer within the NHS

S Hill
Ultrasound Department, East Surrey Hospital NHST, Redhill, UK

No abstract provided.

1630 Invited review: Facilitating the implementation of occupational standards for the practice of diagnostic ultrasound

[1]R Fernando, [3]S Mather, [3]N Prime, [2]M Lovegrove, [2]M Stocksley and [2]A Taket
[1]Department of Radiography, University of Hertfordshire, Hatfield, Herts AL10 9AB, [2]Centre for Research in Professions Allied to Medicine (CeRPAM), Faculty of Health, South Bank University, London SE1 0AA and [3]Commission for Health Improvement (CHI), 103-105 Bunhill Row, London EC1Y 8TG, UK

Occupational standards are precise specifications of competent workforce performance and are a powerful strategic and operational tool for organizations in the healthcare sector. Their main aim is to improve the quality of the service provided. This presentation concerns phase III of a project that commenced in 1997 to develop occupational standards for the interprofessional practice of medical diagnostic ultrasound. The first phase of the project work led to the publication of the occupational standards in June 1998. In the following year, phase II involved a survey and a workshop with practitioners to establish the current levels of implementation. This current phase was designed to facilitate implementation of the standards in clinical practice and to provide some case study examples of this. Phase III commenced in September 2000 and evaluated three different approaches to the application of the occupational standards in clinical practice. Managers and practitioners were briefed to use the occupational standards to support objective appraisals. Practitioners were briefed to use the occupational standards to facilitate CPD. Postgraduate clinical ultrasound students were briefed to use the occupational standards as a framework for self-directed learning. The evidence collected enabled three exemplar case studies to be documented. A brief description of the processes used in phase III will be presented prior to a discussion on the outcomes and the main barriers to implementation in clinical practice. In addition, evidence of the extent to which these standards have been accepted and utilized in the UK will be explored.

1700 Invited review: Developing the ultrasound service: challenges and opportunities

V Aitken
Department of Medical Engineering & Physics, King's College, London SE5 9RS, UK

Diagnostic ultrasound is undergoing constant change. On the one hand, technology is growing more complex. On the other, there are demands that ultrasound be used in a growing number of clinical applications. As a result, practitioners in ultrasound are asked to do more, know more and provide more. A review of current literature suggests that a series of challenges and opportunities faces the providers of ultrasound services. The challenges identified are resources, quality and appropriateness of services rendered. Staffing is a major concern. Many services are under staffed and report low staff morale. However, both the Government and users are demanding that services provide value for money and are of the highest quality. Clinical governance is seen as the framework that will ensure these demands are achieved. Evidence is required to show that services are clinically and cost effective, but ensuring that this evidence is precise, unequivocal and not conflicting

has proved difficult. It is proposed that these challenges can be met by the provision of more flexible training and working practices that maximize the benefits of the multidisciplinary team. The possibility exists for the introduction of innovative learning models and role extension. The scope to enhance personal fulfilment, job satisfaction and prestige has been recognized. As in the past, these challenges need to be faced and viewed as opportunities to reinforce the value of diagnostic ultrasound. To do this the professions providing ultrasound services must respect autonomy and creativity, and must respond flexibly to emerging patterns and changes in work practices.

1600–1630 Kingston Lecture Theatre
Keynote Lecture
Imaging in Radiotherapy

1600 Invited review: Review: imaging in radiotherapy

G J Lowe
Physics Department, Mount Vernon Hospital, Rickmansworth Road, Northwood, Middlesex HA6 2RN, UK

No abstract provided.

1630–1730 Olympian Suite 1
Scientific Session
Interventional

1630 Do it yourself anaesthesia: an alternative to poorly controlled sedation

M P Callaway and T Gould
Departments of Radiology and Anaesthesia, Bristol Royal Infirmary, Bristol BS2 8HW, UK

PURPOSE: As interventional radiology becomes more complex, an emphasis on safe and effective sedation is required. Most radiologists rely on intravenous medazolam, titrating the dose very roughly with the patient's apparent conscious level. In addition, it is unusual to have an anaesthetist present. This often leads to sedation that may be suboptimal. This abstract describes a method of patient-controlled sedation producing a consistent level of sedation that is easily reversible. In effect, "Do it yourself sedation". METHOD: Under the supervision of a Consultant Anaesthetist, patients undergoing biliary procedures have been offered this method. Once in the interventional suite, the patients are oxygenated. An intravenous propofol infusion is set up using the same method as for patient-controlled analgesia. The patient can then administer propofol via a switch in their hand. A pre-procedure loading dose is administered. Once started, the patients are encouraged to press the button if a particularly stimulating event is about to be performed, *i.e.* placement of a metal stent. Once the procedure has been completed, infusion is discontinued and the patient's sedation is completely reversed in a matter of minutes. RESULTS: Five patients had procedures performed using this method. All procedures went well, with little patient movement. Several of the patients had to be encouraged to press the button, but all patients were fully sedated. All patients returned to a normal level of consciousness within 10 min of completion of the procedure.

1640 Histological comparison of vibrating guidewire with conventional guidewire technique in an experimental coronary *in vivo* model

C S Katsouras, L K Michalis, M R Rees, V Malamou-Mitsi, D Niokou, V Giogiakas, D Nikas, G Massouras, D Tsetis and D A Sideris
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AIMS: Vibrational angioplasty is a low energy technique that facilitates wire passage through occluded arteries. This study compares the arterial damage caused by vibrational angioplasty with conventional guidewire manipulation in normal coronary arteries. METHODS: The coronary arteries of six lambs were randomized to vibrational angioplasty, conventional guidewire manipulation or no treatment. At the end of the procedure, 3–5 samples from different vessel segments per artery were examined histologically and scored from 1 (no damage) to 4 (severe damage) by assessing the endothelial and smooth muscle cell integrity as well as thrombus formation in the luminal surface. Arterial damage was evaluated by the means of the percentage of damaged samples, the mean score of damage (sum of the damage score of each sample/total number of samples), the mean maximum damage score per artery (sum of the maximum damage score per artery/6) and the percentage of samples with damage a score of 3 or 4. RESULTS: 62 samples were scored (vibrational angioplasty 25; conventional angioplasty 18). There was no difference in the percentage of damaged samples between the two groups (vibrational angioplasty 40.0%; conventional manipulation 66.6%). Using vibrational angioplasty, the mean score of damage (1.52 ± 0.71) and the mean maximum damage score per artery (1.33 ± 0.51) were lower than after conventional guidewire manipulation (2.33 ± 1.08, $p=0.005$; and 2.66 ± 1.03, $p=0.018$, respectively). Also, the percentage of samples with a damage score of 3 or 4 was lower in the vibrational angioplasty group (12.0% *vs* 55.0%, $p=0.006$). CONCLUSIONS: Vibrational angioplasty is a low energy mechanical method and may be a safer way of passing a guidewire through a vessel than conventional manipulation.

1650 Pirenzepine *vs* buscopan as a bowel paralytic in visceral angiography

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PURPOSE: Bowel paralysis is paramount for successful diagnostic mesenteric angiography. Buscopan is limited by tachycardia, which may be dangerous in some patients. Pirenzepine is a relatively bowel-selective muscarinic antagonist and therefore theoretically has fewer cardiovascular side effects. In this small-scale randomized controlled trial, we compared the effects of buscopan and pirenzepine for the first dose bowel paralytic agent in visceral angiography. MATERIALS AND METHODS: 22 patients presenting with chronic gastrointestinal bleeding necessitating visceral angiography were recruited. Either buscopan 40 mg or pirenzepine 0.1 mg kg^{-1} were given intravenously as the first paralytic agent. The angiographer carrying out the procedure and the patient were blinded to which drug was given. RESULTS: 10 patients received pirenzepine and 12 received buscopan as the first dose. There were no significant differences between the two groups in terms of age, sex, weight or length of time the procedure took. Buscopan caused a significant increase in heart rate (79–106 bpm at 1 min; $p=0.00009$), whilst no significant change in heart rate was seen with pirenzepine. Diagnostic quality angiograms were obtained on each patient, but the effects of buscopan lasted significantly longer (14.8 min *vs* 6.4 min; $p=0.04$). This difference became non-significant if three outliers in the buscopan group were ignored. Similar minor side effect profiles were seen in each group. CONCLUSION: Pirenzepine is an effective bowel paralytic agent that appears to have no cardiovascular effects. This study does not demonstrate what effect repeated doses may have, or what the most effective dose is.

1700 Use of 1064 nm NA-YAG laser for interstitial laser photocoagulation of osteoid osteoma

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MATERIALS AND METHODS: Seven patients (six males and one female; age range 4–38 years) with typical clinical and radiographic features of osteoid osteoma consented to undergo interstitial laser photocoagulation (ILP). Patients had not had any previous surgical intervention and had been symptomatic for between 6 months and 4 years. All patients were taking oral analgesia and/or anti-inflammatory drugs. Procedures were performed under general anaesthesia or conscious sedation and local anaesthesia. With CT guidance, overlying cortical bone was drilled or hand cored to a minimum 14 G hole. The nidus was biopsied for confirmation of the diagnosis. A 600 m optical fibre tip was introduced into the nidus via a metal canula and the position was confirmed. Depending on nidus size, energy ranging from 600 J to 1000 J was delivered into the lesion. Patients were discharged within 4 h. Follow-up included telephone interview at 10 days and clinical review at 6 weeks. RESULTS: So far, all patients reported complete relief of symptoms attributed to osteoid osteoma within 2 days of laser ablation. Two patients reported immediate relief of pain following the procedure. All patients were ambulatory on discharge (one on crutches) and resumed normal activities within 3 days. No post-operative infection or other complications occurred.

CONCLUSION: Early results from the use of a 1064 nm wavelength NA-YAG laser suggest effective ablation of osteoid osteoma. Results of long-term follow-up will be presented.

1710 Comparison of chest and arm placement of implantable central venous access devices in the imaging department

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AIM: This study was undertaken to document the success rates of device placement, longevity and complications between chest or arm placement of central venous access devices. In addition, patient and device user satisfaction were also measured. MATERIALS AND METHODS: 40 patients were alternately assigned to receive either chest or arm placement of central venous access devices between December 1997 and January 1999. Two interventional radiologists performed all the procedures using a standard technique. Aftercare, hygiene, flushing techniques and infusion methods were standardized. Patient and device user preferences were determined by structured questionnaire. RESULTS: Primary success for placement of devices was achieved in all 20 (100%) patients assigned for chest placement and in 19 (95%) patients for arm placement. Longevity of device for chest placement ranged from 20 to 372 access days per device (mean 184 access days per device) and for arm placement from 10 to 280 access days per device (mean 122 access days per device). Immediate complications for chest placement were documented in 3 (15%) patients. 1 patient had local haematoma (5%) and 2 placements (10%) resulted in kinking of catheters. There were no immediate complications in the arm placement group. Delayed complications for chest placement were seen in 3 (15%) patients, which included 2 (10%) patients with thrombosis and 1 (5%) patient with infection. There were 2 (10%) patients with catheter dysfunction and 1 (5%) patient with infection in the arm placement group. 17 patient and 24 device user preference questionnaires were analysed. CONCLUSION: There was no significant difference between chest and arm placement. However, arm placement was preferred in patients at risk of pneumothorax, in those undergoing chest physiotherapy and for cosmetic reasons in young patients.

1630–1700 Olympian Suite 2 Scientific Session

Chest

1630 Scanning for venous thrombosis during CT pulmonary angiography: should we do it?

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INTRODUCTION: We assess the value of limited scanning from the diaphragm to the knees to identify venous thrombosis in addition to our routine CT pulmonary angiography for pulmonary embolus. METHODS: Patients underwent spiral CT of the chest (3 mm collimation, pitch 1.5; IGE; or 5 mm collimation, pitch 1; Philips) using 120 kV and 210 mAS for both systems. Thereafter, sequential 10 mm sections were performed every 50 mm from the diaphragm to the knees using the same exposure factors. 325 consecutive patients were retrospectively analysed. RESULTS: The effective dose for the examination was increased from 2 mSv (chest only) to 3.2 mSv (chest plus DVT study) using the IGE, and from 5 mSv to 7 mSv with the Philips SR scanner. This increased dose equates to a theoretical increase of fatal cancer induction in 1.2 and 2 patients, respectively, for every 20 000 patients scanned. Significant unsuspected infradiaphragmatic pathology was demonstrated in 3% of patients, including bladder, uterine and renal tumours. Pulmonary embolus was confirmed in 20%, was equivocal in 5% and was absent in 75%. DVT was found in 13%, 8% of whom had evidence of both DVT and PE. 4% had DVT alone, which had not been suspected clinically and, despite appropriate symptoms, there was no evidence of PE. The diagnosis of PE was made with increased confidence in 1% of patients shown to have DVT in an otherwise equivocal scan. CONCLUSION: Additional sections from the diaphragm to the knees altered clinical management in 8% of patients. We feel this is a valuable addition to the standard PE protocol.

1640 Does multiplanar image reconstruction assist diagnosis of airways diseases?

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PURPOSE: To determine the effects of multiplanar image reconstruction (MPR) in the diagnosis of airways disease in comparison with standard axial images. METHODS AND MATERIALS: We examined 23 consecutive patients referred for assessment of possible airways disease using multislice CT. The thorax was scanned contiguously at 1 mm slice thickness and this was reconstructed at 1 mm slice thickness (lung windows utilizing high spatial frequency algorithm) in the axial (10 mm apart), sagittal (4 per lung) and coronal (6) planes. Paddle wheel reconstructions were also performed. Axial images were assessed by three chest radiologist with and without the help of MPR at two separate occasions. The presence of bronchiectasis, emphysema and bronchiolitis in each lobe was documented on a confidence scale of 0–3. Results of axial images and MPR were compared. A total score of 3 or more was considered diagnostic, whereas a score of less than 3 excluded the diagnosis. A consensus diagnosis was reached for every case. RESULT: The prevalence of bronchiectasis, bronchiolitis and emphysema in our study population was 9/23, 6/23 and 9/23, respectively. With the help of MPR, the diagnosis was influenced (both in diagnosing and excluding disease) in eight instances of bronchiectasis (Obs. A = 2, Obs. B = 4, Obs. C = 2), six instances of bronchiolitis (Obs. A = 2, Obs. B = 0, Obs. C = 4) and four instances of emphysema (Obs. A = 1, Obs. B = 1, Obs. C = 2). CONCLUSION: Our results demonstrated that MPR can influence the diagnosis of airways disease. This was most evident in cases of bronchiectasis.

1650 Measurement of changes in bronchi diameter during the respiratory cycle using spiral CT

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INTRODUCTION: Previous CT studies have demonstrated changes in tracheal diameters during the respiratory cycle. The purpose of the present study was to evaluate the influence of inspiration on the measured diameters of main, lobar and segmental bronchi. MATERIALS AND METHODS: 10 patients (mean age 76±6.3 years; range 64–88 years) underwent spiral CT of the lung (slice thickness 2 mm; table increment 5.5 mm; reconstruction interval 2 mm). Scans were performed during inspiration and expiration, and the maximum bronchial diameters were measured at defined locations in the main, lobar and segmental bronchi in both lungs. RESULTS: In expiratory scans, the diameters of the main bronchi (0.9±0.33 cm *vs* 0.78±0.34 cm; p=ns), the lobar bronchi (0.67±0.21 cm *vs* 0.57±0.21 cm; $p<0.01$) and the segmental bronchi (0.49±0.25 cm *vs* 0.39±0.14 cm; $p<0.001$) were lower than in the inspiratory scans. CONCLUSION: Using spiral CT, the measured diameters of the main, lobar and segmental bronchi of the lung depend on the level of inspiration. Thus, spiral CT of the lung may be used in the evaluation of not only tracheal, but also bronchial wall instability.

1630–1730 Kingston Lecture Theatre Keynote Lecture and Scientific Session

Brachytherapy

1630 Invited review: Practical dosimetry for intravascular brachytherapy using strontium-90

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In-stent restenosis is one of the major problems confronting interventional cardiology today. One method of preventing this is to use balloon angioplasty followed by vascular brachytherapy. For vascular irradiation with catheter-based systems, AAPM Task Group 60 [1] recommends that the dose rate should be measured at a radial distance 2 mm from the centre of the source, the dose rate should be uniform to within ±10% over the central two-thirds of the treated length and the relative dose should be measured from 0.5 mm to the distance where 90% of the energy from a point source is absorbed. Beta emitters, including $^{90}Sr/^{90}Y$, are ideal for vascular brachytherapy, but it is difficult to measure dose distributions in the high dose gradient region at

short distances from the source. Suitable systems for beta dosimetry include GAF-chromic™ film, polymer gel dosimetry and scintillator-based devices such as the Optidos system (PTW-Freiburg). GAF-chromic™ film combines simplicity of use with relatively low cost. Polymer gel dosimetry will give the most comprehensive measurements in three dimensions but requires either high resolution MRI measurements using, for example, a 4.7 T, 200 MHz MRI scanner or an optical scanner. Scintillator-based devices are relatively easy to use but give point measurements. All three methods require calibration. The results of measurements made at the Glenfield Hospital, Leicester using all three systems and a Beta-cath™ (Novoste) brachytherapy device are presented and compared. ([1] Report of the AAPM Radiation Therapy Committee Task Group No. 60. Med Phys 1999;26:119–52.)

1700 Prostate specific antigen kinetics following I-125 brachytherapy for prostate carcinoma

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In the USA, the advent of widespread testing for prostate cancer using prostate specific antigen (PSA) screening has led to an increase in the number of patients diagnosed with early stage disease (T1 and T2). This group is offered several forms of therapy at the Cleveland Clinic, including I-125 seed implantation. The efficacy of the therapy is assessed using PSA determinations at intervals of several months following the brachytherapy procedure. We have studied the time-course of the PSA levels using kinetic models originally developed for external beam patients. The PSA–time data were fitted to a three-parameter exponential decay model using regression techniques. The model can be written as follows: $PSA(t) = a\ e(-bt) + c$, which describes a pattern of exponential decline from an initial value of $a + c$ with a time constant of $1/b$ and final steady-state value of c. We have included data from patients in whom there was a transient, small rise in PSA following the initial decline, but not those patients in whom there was no long-term steady-state value (biochemical failure). In a series of 78 patients, the PSA half-life ($.693/b$) had a mean value of 0.715 mo (maximum 3.32 mo and minimum 0.006 mo). CT-based post-implant dosimetry with measures of the standard parameters (V100, V150, V200, D90) was available for each patient. The relationship of each of these parameters to the kinetic data will be examined.

1710 Investigation of polyacrylamide gel dosimetry with high resolution MRI for beta source intravascular brachytherapy

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INTRODUCTION: Post-angioplasty restenosis is one of the major problems confronting interventional cardiology today. This can be effectively prevented by intravascular irradiation. For intravascular brachytherapy with catheter-based systems, AAPM Task Group 60 recommends that the dose rate should be measured at a distance 2 mm radially from the centre of the source, that the dose rate should be uniform to within ±10% over the central two-thirds of the treated length and that the relative dose should be measured from 0.5 mm to the distance where 90% of the energy from a point source is absorbed. Beta emitters, including $^{90}Sr/^{90}Y$ are ideal for this purpose, but it is difficult to measure dose distributions in the high dose gradient region at short distances from the source. Intravascular brachytherapy dosimetry is possible using GAF-chromic film and polymer gel dosimetry. 3D dose distributions are only measurable using polymer gel dosimetry. In this paper the results of measurements of depth–dose distributions and dose profiles for a $^{90}Sr/^{90}Y$ source train using polymer gel dosimetry and a 4.7 T, 200 MHz MRI scanner are presented and discussed. RESULTS: The measurements of absorbed dose orthogonal to the source axis show good agreement between the polymer gel and MD-55 GAF-chromic film. The HD-810 gives some slightly higher relative results, which may indicate a reading error. For the profiles parallel to the source axis there is good agreement between the polymer gel and the two measurements with GAF-chromic film, with the exception of the fall off in dose at the end of the train.

1720 Brachytherapy planning using a mobile image intensifier and a commercial planning system

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AIM: The traditional planning process for gynaecological brachytherapy involves transferring the patient with applicators *in situ* from the operating theatre to the simulator and then to the treatment room. These movements inevitably lead to small movements in the applicators relative to the tissues, which may alter the implant dosimetry. For LDR therapy this was accepted, as with treatment times of many hours the applicators unavoidably move. With HDR therapy times of a few minutes, applicator motion is less likely during therapy so a planning process that eliminates patient transfers would be advantageous. We have developed such a planning process using a mobile image intensifier and a commercial planning system. METHODS AND RESULTS: Patients are anaesthetized in our HDR suite. After insertion of standard applicators, a Nucletron reconstruction box is place over the patient and two semi-orthogonal fluoroscopy images are obtained using a GE OEC series 9800 C-arm. These images are transferred to film and scanned into a PLATO planning system. Reconstruction of the insertion takes place as standard for the planning system. Distortion in the C-arm images could limit the reconstruction accuracy. The accuracy of the entire process has been measured using an in-house designed phantom and a maximum error of 2 mm in 70 mm was found. DISCUSSION AND CONCLUSIONS: We have shown that C-arm images can be used to accurately plan gynaecological brachytherapy. Further developments include a DICOM link between the C-arm and the planning system and correcting the pincushion distortion in the images.

Posters

National Indoor Arena Exhibition Floor

Audit

POSTER 0201 An audit of impaired renal function and angiography: what happens and how do clinicians follow them up?

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Contrast media-induced nephrotoxicity (CMN) remains a common and under recognized problem. This audit highlighted deficiencies in our approach to CMN. Guidelines are now available for reducing the incidence of CMN and, with the possibility of nephroprotective agents in the future, we must ensure that patients receive the appropriate care. Avoiding CMN: (1) Contrast: use low osmolar rather than high osmolar contrast media. Minimize dose and consider greater use of carbon dioxide angiography or ultrasound. (2) Hydration: avoid dehydration. Give at least 100 ml fluid per hour (PO or IV), starting at least 4 h before the procedure, and continue ideally for 24 h after. Ensure a diuresis >1 ml min^{-1}. Avoid nephrotoxic drugs, *e.g.* NSAIDs and aminoglycosides, frusemide (controversial), and reduce aspirin dose to 150 mg or less. (4) Nephroprotective agent: acetyl cysteine, endothelin antagonist; further research is needed. (5) Appropriate follow-up: serum creatinine measurements at 24 h and 72 h as a minimum. (6) Avoid repeated injection of iodinated contrast medium within 72 h and, if possible, wait for serum creatinine levels to return to baseline before further contrast medium is administered. What have we instituted in Sheffield? [1] New guidelines have been drawn up that take into account the above points 1, 2 and 4. These take into account recent ESUR advice. [2] A re-audit has been instituted. [3] We hope to begin a trial of oral acetylcysteine and an oral endothelin antagonist in the near future.

POSTER 0202 An audit of barium enema requests by general practitioners and hospital clinicians

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INTRODUCTION: The Radiology Department noted an increase in the number of patients presenting inappropriately for barium enema. Most alarmingly, some of these patients were young (<50 years). AIM: To establish whether there was a problem with the number of inappropriate requests for barium enema and whether there was a difference between the number of inappropriate requests from general practitioners and hospital clinicians. METHODS: A retrospective audit of 200 barium enema requests from the year 2000 was performed. 100 consecutive barium enema request cards from GPs and the Gastrointestinal (GI) Unit were analysed to see whether they complied with the hospital's barium enema guidelines. RESULTS: 26% of GPs' barium enema requests were inappropriate compared with 21% of those from the GI Unit. There was no significance difference between the two results (p=0.66). This audit attempts to look at the reasons for the high number of inappropriate barium enema requests.

POSTER 0203 An audit of intravenous urograms performed at Warrinton General Hospital for acute loin pain

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PURPOSE: This study aims to determine whether intravenous urograms (IVUs) need to be performed on patients with acute loin pain in the absence of haematuria on urinalysis. MATERIAL AND METHODS: A retrospective study of 50 patients admitted with a history of renal colic and who underwent intravenous urography between 1/8/99 and 1/2/00 was performed. All patients had their urine tested for haematuria either by Combi-9 dipstick in A&E or by MSSU microscopy on the ward. RESULTS: 30 patients' urine tested positive for haematuria, 28 of whom had a positive Combi-9 dipstick urine test for blood. Two patients' urine tested positive for blood on MSSU microscopy. 17 patients had an abnormality on the IVU, all of which had haematuria. 13 patients tested positive for haematuria but had normal IVUs. Three cases were diagnosed as a urinary tract infection. In 10 cases no diagnosis was made. 20 patients had normal IVUs, all of which had a negative urine test for haematuria. Haematuria on urinalysis has a positive predictive value of 57% for an abnormal IVU. The absence of haematuria on urinalysis has a negative predictive value of 100% for a normal IVU. CONCLUSION: We conclude that 20/50 of the patients had IVUs performed unnecessarily. We recommend that the dipstick urine or MSSU microscopy result is noted prior the patient being considered for an intravenous urography. This gives the potential for cost savings and avoids the risks of ionizing radiation. Alternative diagnoses should be sought for patients with a negative dipstick or MSSU microscopy test for haematuria despite a strong history of renal colic.

POSTER 0204 An audit of Specialist Radiology Registrar reporting skills

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AIM: To evaluate the reporting skills of specialist registrars in radiology and to assess whether they conform to established guidelines produced by the Royal College of Radiologists (RCR). The RCR defined standard is that all IVU, barium examinations, non-obstetric ultrasound and CT examinations by specialist registrars should indicate the precise imaging examinations, state the drugs used, briefly describe the relevant findings and provide a differential diagnosis and advise on further appropriate imaging. METHOD: A retrospective study of 200 selected examinations (IVU, barium examination, non-obstetric ultrasound and CT) carried out by 20 specialist radiology registrars in years 2–4 of the Birmingham training programme was performed. All procedures had been performed at Birmingham Heartlands Hospital, a large inner city teaching hospital. Each report was analysed and scored on a 10-point scale provided by the RCR. Outcome was assessed by the percentage of reports that achieved 10 points on the audit assessment sheet. RESULTS: 65% of reports achieved 10 points on the audit assessment scale. The main shortcomings were that there was a failure to state the drugs and contrast media used in 20% of the reports, there was failure to provide a differential diagnosis and provide suggestions for further imaging in 10% of the reports, and the summary or conclusion was not included in 25% of reports. CONCLUSION: The majority of the reports show conformity with established standards. However, suggestions for further improvements include a refresher course in reporting skills and formal teaching of reporting skills in the FRCR course.

POSTER 0205 Comparison of the cost and nursing impact of two haemostatic closure devices

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PURPOSE: To evaluate the nursing and cost implications of using two selected haemostatic closure devices after vascular intervention in the radiology department. MATERIALS AND METHOD: The Angio-Seal device is a collagen plug mediated closure device, and Perclose is a stitch mediated closure device. In the last 12 months we have deployed 102 Angio-Seal devices. We now also use the Perclose device. We have analysed the costs of the devices and the additional staff costs of the Angio-Seal device. RESULTS: The list price of the Angio-Seal device is £141, and the additional cost of an E grade nurse for 30 min aftercare is £4.90, giving a total cost per patient of £145.90. The list price of the Perclose device is £170. There is no additional nursing requirement. The Angio-Seal system is £24.10 cheaper per patient, giving a saving at list prices of £2458.20. With discounts provided for our unit there will be a saving of £2254 per annum at the

current rate of use. The advantages of using the Perclose system include re-puncture of the vessel 24 h post deployment. It is necessary to avoid the Angio-Seal site for 90 days post deployment. Patients are able to ambulate 2 h post deployment and may sit semi-erect immediately after Perclose use. The Angio-Seal ambulation time is 4 h. Deployment time for both devices is similar. CONCLUSION: The Angio-Seal is the more cost effective closure device, but has additional nursing resource implications. Final device selection is determined upon clinical grounds.

POSTER 0206 WIP: Survey to assess on-call working patterns for interventional radiologists

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AIM: The aim of this study was to assess the pattern of on-call services in interventional radiology (IR) in England and Wales. MATERIALS AND METHOD: A postal survey form consisting of 10 questions was sent out to Radiology Consultants from 169 Hospital Trusts in England and Wales. Hospitals were categorized into teaching hospitals (THs) and district general hospitals (DGHs). The main issues explored were the frequency of on-call commitments, whether there was a dedicated IR on-call service and the degree of sharing on-call with other hospitals. RESULTS: The response rate for THs was 100% (24/24) whereas for DGHs it was 31% (45/145). 41% (10/24) of THs had separate on-call rotas for diagnostic and interventional radiology, whereas only 2% (1/45) of DGHs did. The average frequency of on-call in IR within THs was 1 in 5.5 compared with 1 in 7 for DGHs. In DGHs it was more common for the interventional radiologists to cover diagnostic radiology on an *ad hoc* basis. None of the DGHs shared an on-call service with a neighbouring Trust. Only one of the DGHs who replied did not provide an on-call service for IR. CONCLUSION: Although interventional radiologists in DGHs are working on average 1 in 7 on-call rotas, they cover their diagnostic colleagues more frequently on an *ad hoc* basis compared with those THs that have separate rotas for IR. The out-of-hours interventional workload in THs is likely to be higher, although this survey did not assess this. Very few Trusts share on-call and this may be a possible method of decreasing the frequency of on-call commitments in IR.

POSTER 0207 WIP: An audit of staging CT protocol in the assessment of colorectal cancer

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Colorectal cancer is the second most common internal malignancy, with a 5-year survival rate of 50%. Prognosis is closely related to the stage of disease and pre-operative staging is therefore critical. It is imperative to optimize the CT protocol for accurate staging. The aim of this audit is to evaluate whether it is necessary to include the thorax in the initial and follow-up staging CT scans. The RCR 1994 Working Party recommendation did not include the thorax in the initial staging CT for colorectal cancer. In our centre, we routinely include the thorax in the initial and follow-up CT scans. A total of 79 scans performed over a 2-year period were reviewed. Five patients had pulmonary metastasis alone. Liver metastases were seen in four patients and one patient had both. We would have missed pulmonary metastasis in 5 of our patients (approx. 4%) if CT was performed without including the thorax in the staging protocol. The metastatic nodules were too small to detect on the chest radiograph, even in retrospect. The results of the audit will be presented to the regional colorectal cancer team. Steps will be taken to adhere to the local practice and to collect more data in view of publication.

POSTER 0208 WIP: Is radiographic quality (rejects) a function of radiographers' circadian rhythms?

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AIM: To investigate whether there is a correlation between the time of day and rejected radiographs, and consequently to provide data/information that could lead to a more informed on-call staff roster by maximizing radiographers' potential and reducing the incidence of rejected radiographs, and minimizing the exposure of patients and staff to the effects of ionizing radiation. METHODS: Data (reject films) were collected over 4 consecutive weeks from radiographers working in the "general radiography" area of the X-ray Department at Maidstone Hospital, with particular attention paid to the time of day at which the reject occurred and the circadian chronotype of the individual responsible. The study was directed to the interindividual differences of those radiographers who had previously been grouped according to their particular circadian types (owls or larks) by means of a questionnaire regarding preferences and habits of activity and time of day. Four subgroups were identified: "definitely morning", "moderately morning", 'neither" (intermediate) and "moderately evening". Reject films for each of these subgroups were recorded and compared on an hourly basis, with patient flow (which was also monitored on an hourly basis), to provide a realistic backdrop to the data collected. The results will show comprehensive patient flow and incidence of rejects as they occurred on an hourly basis, potentially identifying which subgroups, if any, are more prone to, owing to management overlooking valuable information regarding the circadian rhythm of staff when constructing the on-call staff roster.

POSTER 0209 Dr J F Hall-Edwards: a Birmingham radiology pioneer

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Dr John Francis Hall-Edwards was born on 19 December 1858 to a distinguished Birmingham medical family and was educated at King Edwards School and the Medical School in Birmingham. He started off as a general practitioner in Moseley but his real interest seemed to be in photography, a subject in which he won several medals. He was active in photographic societies in Birmingham and so when Roentgen discovered X-rays in 1895, it was not surprising that Hall-Edwards found this new medical photography of great interest. He was one of the first doctors to demonstrate the application of X-rays in Birmingham and one of the first to demonstrate the application of localizing foreign bodies using this technique. He was eventually appointed to the staff of Birmingham General Hospital as well as several others in the region. He served in the Boer War and wrote important articles on the role of radiology in military medicine. He was editor of the Archives of the Roentgen Ray, President of the British Electrotherapeutic Society and an honorary member of the British Institute of radiology. He was an early radiation martyr, unfortunately developing dermatitis in his left hand, which was eventually amputated. In spite of this, he continued to work and even managed to paint as a hobby (his paintings will be presented). He also gave his time to Birmingham Municipal activities. He died in 1926 and was one of the original British radiation martyrs acknowledged at the memorial in Hamburg.

POSTER 0210 Setting up consultant appraisal: the pitfalls and pleasures

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The Department of Health (DoH) stipulated that all consultants must undergo an annual appraisal commencing in the year from April 2001. The appraisal is to use forms issued by the DoH and should contain all the documentation required by the GMC for its revalidation scheme once this been decided. All appraisers must be suitably trained. This presentation describes how the appraisal system was set up in a DGH with 100 consultants with no previous record of consultant appraisal. It details the difficulties encountered and the successes and failures that ensued in this process. Difficulties revolved around the time needed to appraise and be appraised, and the over-prescriptive and over-detailed appraisal document. Concerns were expressed about who should conduct the appraisal and problems were identified with the competent but difficult doctor who refuses to get involved. Fears were expressed that a single interview could not be both an assessment of fitness to practice and a forum for the more positive appraisal that aims to build towards excellence from an assumed high level of competence. There were also doubts that despite what was discussed during the interview, lack of resources meant that nothing would ever change. Once doctors had been apprised, however, most thought that the process was worthwhile and the levels of paranoia were much reduced. As the system matures and the paper trail is hopefully reduced, appraisal may become as useful in medicine as it is in industry.

POSTER 0211 Development of an image filter for radiology teaching

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BACKGROUND: Searching for relevant radiology images on the Internet can be a time consuming and frustrating experience. An active user-friendly matrix preview of images to select images together with a display of associated relevant Web links has been developed to aid radiology teaching and research by facilitating fast relevant image searching. MATERIALS AND METHODS: The project was implemented by construction of a client server application operating in a Web browser. The server side was capable of processing synchronized multiple threads to provide efficient crawling of hundreds of Web pages. Facilities were incorporated to filter only black and white images and also to determine search of image type. Systems were also introduced to prevent hang-up of the search by inactive sites by using URL timeouts. The program could accommodate multiple client requests using instance pooling. The program allowed for typing in key words or phrases or a specific URL search. RESULTS: Initial research demonstrated that the program could be transferred onto any desktop or laptop computer and could be used effectively by non-experts. Experts and non-experts demonstrated relevant radiology images with virtually all searches. The potential for the program was rated as high by a group of radiology trainees. CONCLUSION: Non-computer experts and radiology trainees demonstrated the active image filter program to be effective and user friendly in both desktop and portable environments.

POSTER 0212 The life and work of the Birmingham radiologist, Dr James F Brailsford 1888–1961

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James Brailsford was born in Walsall and educated in Birmingham and first began working in local laboratories as a technician. He served in the RAMC as a radiographer during the First World War. On qualifying from Birmingham Medical School at the age of 35 years, he was immediately appointed assistant radiologist to the Queen's Hospital, Birmingham. Other appointments followed. In 1928 he obtained the MD, and was elected FRCP in 1941. His book, "The Radiology of Bones and Joints", first published in 1934, gave him an international reputation. Despite busy appointments and a large private practice, he contributed numerous papers to the medical literature, including his classic descriptions of chandroosteodystrophy. (Morquio–Brailsford syndrome). Honours came from many sources, some non-radiological. His services to orthopaedic surgery were recognized in 1927 by the Robert Jones Medal and Prize of the British Orthopaedic Association. He was also a Hunterian Professor of the Royal College of Surgeons. In 1936 he received the Rontegen Award of the British Institute of Radiology. Later, he was elected the first president of the British Association of Radiologists, now the Royal College of Radiologists. In 1945 he delivered the McKenzie Davidson lecture on "Reflection on the Teaching of Radiology". Brailsford's later years were marred by his forceful expression of views opposing orthodox opinion, robbing him of much of the reputation and status he had previously won.

Breast

POSTER 0301 Adenomyoepithelioma of the breast: a spectrum of disease

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PURPOSE: To demonstrate the spectrum of biological behaviour of adenomyoepithelioma (AME) and to illustrate the associated imaging and pathological appearances. AME is a recently recognized and rare tumour that has been described in the breast and salivary glands. Breast AME is usually benign, generally occurs in middle aged or elderly females and typically comprises biphasic proliferation of epithelial and myoepithelial cellular elements. There is a spectrum of activity, with initial myoepitheliosis progressing to benign AME, and malignant myoepithelioma may occur with proliferation of one or both cellular elements. Malignant myoepithelioma with proliferation of epithelial and myoepithelial cells is extremely rare and is associated with haematogenous rather than nodal metastasis. Benign AME is prone to local recurrence. We present three cases that illustrate the characteristics of AME and its malignant potential: (1) benign AME; (2) AME with associated ductal carcinoma; and (3) malignant myoepithelioma with proliferation of both epithelial and myoepithelial elements. CONCLUSION: In this pictorial review the spectrum of disease associated with breast AME is discussed and the imaging and pathological features are presented. There is particular reference to the potential for local recurrence with benign AME and haematogenous metastasis with the malignant variant.

POSTER 0302 Menstrual variation of breast volume and T2 relaxation in controls and patients with cyclical mastalgia

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PURPOSE: To determine changes in breast volume and T2 relaxation times of water and fat within breast occurring during the menstrual cycle in controls and in patients with cyclical mastalgia. METHOD: Breast volume was determined by the Cavalieri method of point counting on MR images. T2 relaxation times of the water and fat in a voxel of breast tissue were obtained using ^{1}H magnetic resonance spectroscopy (MRS). 15 controls and 8 patients were studied on three occasions corresponding to menses, ovulation and premenses. RESULTS: ANOVA demonstrated highly significant differences in breast volume between the three stages of the cycle (p <0.0005). Patients did not exhibit an increase in volume pre-menstrually that was significantly above controls. Breasts of patients were not significantly more asymmetrical than controls. According to ANOVA, T2 of fat or water did not depend on stage of cycle. T-tests demonstrated no significant differences in T2 of water or fat between patient and control groups. The mean Tof water was lowest during ovulation. Patients had the highest T2 of water pre-menstrually (8.0% increase compared with ovulation). Multiple regression analyses demonstrated that fat/water ratio significantly correlates with breast type. There was no significant correlation of breast volume with T2 of fat or water. CONCLUSION: For the first time, breast volumes have been obtained with the unbiased Cavalieri method of modern design based stereology. ^{1}H-MRS has been used to obtain T2 of fat and water compartments and we have quantitatively evaluated differences occurring in the breasts of women suffering from cyclical mastalgia.

POSTER 0303 Comparison of prognostic indicators in screen-detected and symptomatic breast cancers

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INTRODUCTION: Breast screening remains a contentious subject. We feel intuitively that detection of a carcinoma before symptomatic presentation will improve prognosis. However, how precisely do our screening and symptomatic populations differ? METHODS: To address this issue we performed a retrospective audit of women with a malignant diagnosis over a 2-year period (April 1998 March 2000). We then examined the differences in the two populations and assessed the impact on prognosis. Tumour size, grade and axillary node status were recorded. Each case was then classified into good, moderate and poor prognostic groups using the Nottingham Prognostic Index (NPI). For DCIS, grade only was recorded. RESULTS: 75 screen-detected and 233 symptomatic cases were identified. In the screen-detected population there was a significantly higher proportion of DCIS (17% *vs* 7%). Grade I cancers were the most commonly identified through screening (44%), whereas grade III tumours predominated in the symptomatic group (47%). Furthermore, of those undergoing axillary node dissection, nodal involvement was less frequent and less extensive in the screen-detected group. Consequently, the majority (53%) of screening patients fell into the good prognosis group, whereas 69% of symptomatic cancers fell into the moderate or poor prognostic groups. Closer

analysis also confirmed that for each tumour grade the prognostic indicators were better, on average, when detected through screening. CONCLUSION: In summary, there was a substantial difference in prognostic indicators between the two groups. Screening detects a higher proportion of DCIS, smaller tumours with less likelihood of axillary lymph node involvement, thus providing further evidence of its effectiveness.

POSTER 0304 WIP: Automated image quality assurance in digital mammographic imaging

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Direct digital and computed radiography mammography imaging techniques are entering into routine clinical use and will progressively replace film–screen systems. Over the last decade of the Breast Screening Programme, a wealth of experience and data in the comparative assessment and serial monitoring of mammography system imaging performance have been built up. Measures of acceptability have been established using the TOR(MAM) phantom and these are being used in the important process of optimizing dose and image quality. The individual performance and subjective judgement of the human observer remains a significant variable in image quality assessment. Purely empirical or quantitative methods may be applied, but these suffer the disadvantage of being distant from the visual experience of the radiologists, radiographers and medical physicists. Progress with computer analysis of images of TOR(MAM) features (fibre, disc lesion type and microparticle details) and their quantification is described. The objective is to establish quantitative measures that are correlated with the "expert observers experience" and so substantially reduce subjectivity in describing image quality. Automating the analysis enables previous images to be re-evaluated should performance be called into question, or for many individual images to be assessed using consistent criteria. This is contrasted with the current TOR(MAM) methodology, which provides limited statistical confidence. A test object suitable for computer analysis of small field digital systems is proposed.

POSTER 0305 WIP: Practical procedures in digital prone table biopsy

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The most recent innovation in minimally invasive breast biopsy combines the use of a mammotome vacuum biopsy system with digital imaging. This latest technique for obtaining core cut samples uses a 3 mm needle containing a cutter that rotates around its own axis to remove several tissue samples from a single insertion position. The equipment can also be used for wire localization procedures and for taking core cuts using the conventional "Bard" or "Bip" guns. At University Hospitals Trust, the Fischer Digital Prone Table was installed in May 2000. Following 3 days training with the applications specialist, we began an in-house training programme. This poster aims to give an overview of the procedure.

POSTER 0306 Textural analysis of high resolution breast images

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INTRODUCTION: A fundamental goal of any diagnostic imaging investigation is tissue characterization. In making a diagnosis, a radiologist assesses the local properties of the tissue of interest. Texture analysis is an attempt to quantify and emulate this "expert eye". Texture analysis involves the quantification of spatial variations of grey tones in an image and, as such, has been successfully used in conventional mammography. This work aims to assess the efficacy of texture analysis in contrast enhanced MRI of the breast. MATERIALS AND METHODS: Data from 79 patients (45 malignant and 34 benign cases) with suspected primary breast cancer were retrospectively analysed. High resolution post-contrast medium images were initially decimated to 32 grey levels to avoid subsequent data sparseness. Co-occurrence matrices, which contain the joint probability of two adjacent pixels along a given direction having co-occurring values i and j, were then calculated for each enhancing lesion. The 14 textural measures defined by Haralick [Proceedings of the IEEE 1979;67:786–804] were then computed. The resulting data were randomized into two groups (test and validation data sets) for statistical analysis using logistic regression. Other parameters, including patient age and lesion size, were also incorporated. RESULTS: Using four parameters (angular second moment, entropy, age and lesion size), an accuracy of 85% was obtained both for test and validation sets. Improved accuracy could be obtained for the test data by increasing the number of variables incorporated into the logistic regression model. However, the validation data set accuracy was subsequently reduced, indicating a lack of model robustness. CONCLUSION: Texture analysis can aid in the diagnosis of contrast enhanced breast lesions.

POSTER 0307 Evaluation of the ALVIM mammography phantom

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PURPOSE: The ALVIM mammography test phantom offers the prospect of eliminating user bias owing to the ability to change detail positions, coupled with a simple method of evaluating image quality. This work aimed to evaluate the practicality and effectiveness of using this phantom to detect changes in image quality for a LORAD M-IV digital spot mammography system. METHODS: A set arrangement of details was imaged using four sets of exposure factors (28 kV, 16 mAs; 28 kV, 35 mAs; 32 kV, 16 mAs; and 32 kV, 35 mAs) with a molybdenum target and filter. The images were scored by five observers on a high resolution monochrome monitor. Each scorer gave a score based on the likelihood of the detail being present (0%, 25%, 50%, 75% or 100%). From these results, the probabilities of true/positive, true/negative responses and correct detection probability were calculated. The correct detection probabilities were compared in order to determine the sensitivity of the technique to changes in kVp or mAs. RESULTS: Practically, the mammography phantom was too large for the small field of view of the system. The speck and fibre sizes were too large for high resolution mammography systems, and rearranging the 100 separate discs was time consuming. The time required to score the phantom was acceptable (7 min); however, the phantom could not detect the changes in kVp or mAs. CONCLUSION: It was concluded that this phantom is not well suited for detecting changes in image quality in small-field digital mammography.

Chest

POSTER 0401 Detection of DVT by indirect CT venography

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Introduction of a new algorithm for diagnosis of suspected acute pulmonary embolism including perfusion scintigraphy and CTPA resulted in a reduction in cases requiring a clinical diagnosis from 70% to 45%. Indirect CT venography has been demonstrated to identify thrombus in 8–24% of studies. This was introduced in January 2000 into our diagnostic algorithm to further reduce the rate of clinical diagnosis. Concerns have been expressed by radiographers and radiologists that positive results were not meeting publishing standards. We present an audit of indirect CT venography over a 12-month period (as part of our CTPA protocol), reviewing results of positive diagnosis, technical parameters and dose considerations.

POSTER 0402 Ultrasound guided transthoracic biopsy of thoracic lesions abutting the chest wall

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INTRODUCTION: Ultrasound guided percutaneous transthoracic biopsy has the potential to reduce the requirement for CT guided biopsy of peripheral thoracic lesions, so reducing patient irradiation and scanner usage. PURPOSE: To assess the safety, diagnostic yield and usefulness of ultrasound guided transthoracic biopsy of peripheral lung lesions. MATERIALS AND METHODS: 10 consecutive patients with thoracic mass lesions abutting the chest wall underwent percutaneous ultrasound guided fine needle aspiration and biopsy or cutting needle biopsy. Patients routinely underwent chest X-ray examination between 2 h and 4 h after the procedure. The specimens were sent for cytological or histological examination. A definitive histopathological

diagnosis was taken to be evidence of a conclusive biopsy. The incidence of any complications was noted. Changes to patient management as a result of the biopsy findings were noted. RESULTS: A diagnostic biopsy was achieved in 90%. No complications were noted and all patients were discharged at 4 h, with no re-admission. Direct changes to patient management were seen as a result of the biopsy findings. CONCLUSION: Ultrasound guided percutaneous transthoracic biopsy of peripheral lung lesions is a safe and accurate technique that is cheap, free of ionizing radiation and can significantly aid patient management.

POSTER 0403 The role of virtual bronchoscopy in a district general hospital

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AIM: To compare CT virtual bronchoscopy (VB) with conventional fibre-optic bronchoscopy (FOB) findings in patients with suspected lung cancer and to evaluate its role in a DGH set-up. METHODS: 40 patients underwent helical CT scan and FOB. VB images were constructed using a dedicated workstation and were read by a radiologist and a clinician blinded to the FOB results. Data sets were assessed for navigation, visualization of various bronchial segments and their abnormalities, and the duration of each study. The results were compared with the FOB findings. RESULTS: 24 of the 40 patients had abnormal airway occlusions, mass lesions or airway stenoses on FOB. 16 patients had normal FOB. VB was normal in 6 cases and abnormal in 34. VB correlated well with FOB for all major lobar (17) or segmental bronchi (23), or both, in terms of occlusions and narrowing. In our analysis of VB images, 537 bronchial segments appeared normal, 57 were blocked due to disease (also abnormal on FOB) and a further 126 segments were also thought to be abnormal. Of those 16 cases with normal FOB, VB was abnormal in 10 patients. The possible causes for these false positives include mucus impaction, the selected values of window and level of construction, and artefacts secondary to respiratory and cardiac motion. These occlusions could not reliably be differentiated from pathological occlusions. CONCLUSION: VB correlates well with FOB for major airway occlusions and stenosis. It allows more distal views of smaller airways and has the ability to visualize segments distal to central occlusions beyond the reach of FOB. The limitations are duration of the technique (which is becoming less with advances in hardware and software), pseudo-occlusions due to mucous and motion and construction artefacts, and difficulty in evaluating mucosal changes. These result in low specificity of this technique. We conclude that VB has a very limited role to play in the routine assessment of patients suspected of lung cancer in a DGH.

POSTER 0404 Low attenuation pulmonary pathology on high resolution CT made easy: a pictorial review

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A variety of pulmonary diseases result in a low attenuation pattern on high resolution CT of the lung. These include cystic lung diseases, bronchiectasis and emphysema. Disorders giving rise to cystic changes in the lung include pneumatocoele, lymphangioleiomyomatosis, Langerhans' cell histiocytosis, honeycomb lung, *Pneumocystis carinii* and invasive aspergillosis. Bronchiectasis causes a low attenuation pattern within the airways and the lung where there is associated small airways disease. Heterogeneity of the pulmonary parenchyma may be seen in small airways disease or chronic vascular disease. Emphysema causes a focal or global low attenuation pattern within the lung. An extensive illustration of these pathologies will be demonstrated including important features that enable an accurate diagnosis.

POSTER 0405 The effects of mode of delivery of Tc-MAA on lung perfusion scans

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PURPOSE: Perfusion lung scans at our hospitals are performed with technetium-labelled macro-aggregated albumin (Tc-MAA) supplied from the regional radiopharmacy. The syringes were transported with the capped end down to prevent particles adhering to the plunger. Suboptimal perfusion lung scans can occur for a number of reasons. The number of suboptimal scans was felt to be excessive. METHOD: 62 consecutive lung perfusion scans were prospectively audited. Activity in the syringe with the needle attached both pre and post injection, the needle size, and the count rate on the AP projection scan were recorded. RESULTS: 12.9% of delivered syringes contained a suboptimal dose prior to injection (average 2.3 kcounts s^{-1} compared with an average 7.9 kcounts s^{-1} for all scans). In 40% of these cases activity in the syringe cap was also recorded. In all these caps there was a greater dose than in the syringe. The mode of delivery was then changed to "cap up". A re-audit showed a satisfactory count rate (>7 kcounts s^{-1}) prior to injection in all cases, with no increase in the activity remaining in the syringe after injection. CONCLUSION: Alteration in the mode of transport of Tc-MAA syringes has eliminated a low injected dose as a cause of suboptimal perfusion lung scans.

POSTER 0406 A pictorial review of the features of lung volume reduction surgery

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Lung volume reduction surgery (LVRS) is used as an adjunct treatment in selected patients with severe pulmonary emphysema. The patients generally selected are from the heterogeneous group of emphysema with predominantly upper lobe disease. Bullectomy can also be carried out in patients with emphysema. Patients with large bullae that may be isolated or can occur on a background of emphysema can sometimes be mistaken as having pneumothoracies. Radiology is important in the diagnosis and subsequent management of these patients. LVRS improves not only the symptoms but also the quality of life in all of these groups of patients. The aim of the operation is to remove those portions of the lung that are non-functioning, whilst conserving less diseased sections of lung. This increases the compressibility of the remaining lung and allows improvement in diaphragmatic function. Correct patient selection is paramount for LVRS, and radiology has a vital role to play. We use a combination of plain film, ventilation/perfusion scans and high resolution CT to achieve this. We present a pictorial review illustrating the pre-operative and post-operative radiological findings in these groups of patients.

POSTER 0407 Imaging features of allergic bronchopulmonary aspergillosis: a pictorial review

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Allergic bronchopulmonary aspergillosis (ABPA) is a disease of asthmatic patients and represents a hypersensitivity reaction to *Aspergillus* fungus. It is associated with blood eosinophilia and circulating antibodies to *Aspergillus* antigen. An immediate (type 1) hypersensitivity reaction accounts for acute episodes of cough, wheezing and dyspnoea. However, an immune complex mediated (type 3) hypersensitivity reaction accounts for bronchial wall inflammation and subsequent proximal bronchiectasis with its associated cough and sputum production. Radiological imaging is vital in the diagnosis and subsequent follow-up in these patients. We present a pictorial review of the radiological features of ABPA, including the bronchial, parenchymal and pleural abnormalities seen on plain film and CT. The features illustrated include patchy consolidation, dilated air-filled bronchi, mucoid impaction, pleural thickening, central bronchiectasis and pulmonary fibrosis.

POSTER 0408 CT features of advanced primary pulmonary lymphoepithelioma-like carcinoma

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PURPOSE: Primary pulmonary lymphoepithelioma-like carcinoma (LELC) is an exceedingly rare non-small cell lung cancer (NSCLC), primarily affecting Orientals, with distinct clinicopathological features and an association with the Ebstein-Barr virus. The aims of this study are to document pertinent CT features of advanced primary pulmonary LELC. MATERIALS AND METHODS: 10 consecutive patients (4 men, mean (± SD) age 45.67 ± 7.21 years) with biopsy-proven LELC, and 25 controls (4 men; mean age 44.7 ± 5.4 years) with other

NSCLC (13 adeno, 1 large cell, 2 squamous cell and 9 undifferentiated carcinomas) were recruited over 3 years. All had inoperable disease. The following CT features were evaluated: site (central *vs* peripheral); size and border characteristics of the tumour; pattern of intrathoracic nodal metastasis (mediastinal, hilar and peribronchovascular); and presence of pleural, pulmonary and lymphangitic spread, including vascular encasement. Differences between the two groups were evaluated with Mann–Whitney rank sum test. RESULTS: There were 6, 1 and 3 LELC patients and 15, 2 and 8 controls with stage 4, 3A and 3B disease, respectively. LELC tumours were larger (45.67 cm^2; p=0.02), were centrally sited (p=0.01) near the mediastinum, had well defined borders (p=0.02) and were associated with peribronchovascular nodal spread (p=0.01) and vascular encasement (p=0.02). Other NSCLCs that served as controls were smaller (17.71 cm^2), peripherally sited (p=0.04) and had irregular/spiculated edges (p<0.001). Seven LELC patients had positive Ebstein-Barr virus serology. CONCLUSION: Advanced primary pulmonary LELC hass distinct radiological features compared with other NSCLC. They are often centrally sited in close contact with the mediastinum, with vascular encasement and peribronchovascular nodal involvement.

POSTER 0409 Imaging features of asbestos-related disease: a pictorial review

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Asbestos is a group of naturally occurring fibrous silicates. There are two main subgroups: the serpentines and the amphiboles. The serpentine subgroup comprises chrysotile (white asbestos). The amphibole subgroup comprises amosite (brown) and crocidolite (blue). Asbestos was extensively used for insulation, resulting in occupational exposure by many professions (*e.g.* construction workers). There has also been exposure to the general population following demolition of buildings. Asbestos inhalation may lead to disease and white asbestos in particular has a high fibrogenic and carcinogenic potential. Asbestos disease has many manifestations; inhalation can lead to disease of the pleura, parenchyma, airways, lymph nodes and peritoneum. We present a comprehensive review of the various radiological appearances using plain film, ultrasound, CT, MRI and PET. We illustrate examples of pleural plaques (both parietal and visceral), pleural effusion and pleural thickening. We also depict the interstitial fibrosis of asbestosis as well as potential malignancies, *e.g.* malignant pleural mesothelioma, peritoneal mesothelioma and lung cancer. The predicted mortality from mesothelioma is expected to rise over the next 20 years. There are important issues relating to compensation in asbestos disease. Radiology is integral in the diagnosis and patient management in asbestos-related disease.

POSTER 0410 A pictorial review of the radiology and histology of small round cell tumours of the thorax

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PURPOSE: Small round cell tumours make up a diverse group of clinical tumours both in adults and in children. They range from the common to the extremely rare. All have similar histological appearances of small round cells. They are a diagnostic challenge to histopathologists and are usually referred to a specialist in their interpretation. The site of origin of these tumours is extremely relevant in order to establish the correct diagnosis. Assessment of the type of tumour involved is further complicated in the chest by the diverse appearances of metastases to the chest. MATERIALS AND METHODS: We have conducted a literature search and utilized our own experiences demonstrate the radiological and histological appearances of these tumours. Conventional single slice CT images and multislice CT images were compared with the appropriate histological specimens. RESULTS: A pictorial review of the different small round cell tumours on CT and their appropriate histology is presented. CONCLUSION: With the histology of small round cell tumours being similar, CT assessment is essential in making the correct diagnosis. It is radiological imaging that provides the most accurate assessment of the true site of origin of these tumours.

POSTER 0411 CT pulmonary angiography: common pitfalls and how to avoid them

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AIM: CT pulmonary angiography is a useful and widely used imaging modality for the diagnosis of pulmonary emboli. In the hands of experienced radiologists, the technique has high sensitivity and specificity. There are, however, well recognized pitfalls in image interpretation. We aim to give examples of important imaging artefacts in the diagnosis of pulmonary emboli on CT pulmonary angiography. MATERIALS AND METHODS: Representative images from 15 CT pulmonary angiograms will be presented in a pictorial quiz format. Answers will be concealed on the poster under paper flaps. The scans will have both positive and negative examples. The observers can examine the films and check for the answers. Explanatory notes will describe the findings. DISCUSSION: The important pitfalls in interpretation of CT pulmonary angiograms are owing to technical problems related to timing of contrast medium injection, respiratory motion artefacts, projection of extraluminal structure such as lymph nodes and lung lesions within the vessels, artefacts in the horizontally running vessels, and problems related to secondary lung pathology such as pulmonary oedema, infection and infarction. If the artefacts caused by these pitfalls are known, then erroneous interpretation can be avoided. Our objective is to provide a mixed collection of representative images from patients who have positive and negative scans for pulmonary emboli. CONCLUSION: In summary, the poster will provide a good learning experience for both junior radiologists and radiographers. They should be able to gain a lot of useful knowledge about CT pulmonary angiography in an interesting manner.

POSTER 0412 Embryology and radiology of aortic arch anomalies in adults: a pictorial review

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The embryological development and radiology of aortic arch anomalies is a complex and interesting subject. We will illustrate the embryological development of the aortic arch and its main branches and explain how anomalies arise. The common clinical presentations in adults of the major anomalies will be discussed. In recent years there has been a shift from previously used barium and invasive angiographic studies to non-invasive assessment. State of the art radiological non-invasive assessment of these anomalies will be illustrated with a collection of case studies. In particular, we will show that these anomalies can be exquisitely demonstrated with contrast enhanced spiral multislice CT angiography and magnetic resonance angiography.

POSTER 0413 Spot fluoroscopy for CT biopsy of thoracic lesions

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PURPOSE: To assess the impact of CT spot fluoroscopy on procedure time, sample adequacy, complication rate and radiation dose for thoracic lesion biopsy. METHOD: 44 patients who had undergone CT guided biopsy of thoracic lesions since July 2000 were included in the study. All biopsies were performed on a Siemens Volume Zoom Somatom Plus 4 scanner. Group A (21 patients) were biopsied using a conventional technique of CT guidance and Group B (23 patients) were biopsied following the addition of "biopsy combine", a CT spot fluoroscopy facility. Procedure times were calculated from the time of the topogram to the post-biopsy scan. Patient effective dose estimates were calculated for both techniques. RESULTS: Mean procedure times decreased from 34.7 min (range 15–61 min) in Group A to 21.9 min (range 6–30 min) in Group B, with adequate samples for histology achieved in 86% and 78%, respectively. Pneumothorax rates in the two groups were comparable. CONCLUSIOS: CT spot fluoroscopy facilitates biopsy of thoracic lesions, with a clinically significant reduction in procedure time and radiation dose without compromising sample adequacy or complication rate.

POSTER 0414 CT appearances of tracheal abnormalities: a pictorial review

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Diseases of the trachea and main stem bronchi often present with non-specific symptoms such as shortness of breath, cough or wheeze. CT provides clear demonstration of the calibre of the airways and the distribution of tracheobronchial pathology, be it focal or diffuse. It also provides information regarding associated mediastinal or lung abnormalities. We describe the CT features of a spectrum of abnormalities of the trachea and main stem bronchi, encompassing both normal variants and diseases, encountered over a 5-year period. We define the normal appearances and include cases of tracheal bronchus, post-endotracheal tube stenosis, broncholith, hamartoma, squamous cell carcinoma, carcinoid tumour, Mounier–Kuhn disease, tracheomalacia, tracheopathia osteoplastica, tracheobronchitis associated with ulcerative colitis, and follicular carcinoma of the thyroid invading the trachea. Because many of these pathologies are encountered infrequently, we will demonstrate useful discriminating features, as well as describing common pitfalls that may cause diagnostic confusion.

POSTER 0415 CT scanning in pericardial constriction: a pictorial review

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Pericardial constriction is a fairly rare condition, and clinical signs may be difficult to interpret. The diagnosis may be overlooked, particularly in patients who present with ascites, and differentiation from restrictive cardiomyopathy may be a problem. CT is well recognized as being helpful in this condition. We present a pictorial review of seven patients with pericardial constriction recently seen in our hospital, six of whom subsequently underwent surgery.

POSTER 0416 Mediastinal cysts: a pictorial review

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Mediastinal mass lesions often present challenges to the clinician and radiologist alike. We illustrate a comprehensive array of mediastinal cystic pathology using plain films, CT, MRI and ultrasound, and discuss ways of facilitating an accurate diagnosis in the majority of cases.

POSTER 0417 Pitfalls in chest radiograph interpretation

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We present a pictorial review of the important principles in the interpretation of the chest radiograph. Important rules for interpretation of the chest radiograph are presented. The importance of assessing factors that influence the appearance of the chest radiograph, and that may simulate or mask pathology, is highlighted. These include exposure factors, patient position (AP, erect, supine, degree of rotation or lordosis) and phase of respiration. The need to review the criteria of a satisfactory examination (correct labelling, lungs completely visualized, hair and clothing artefacts avoided) is emphasized. CONCLUSIONS: Interpretation of the chest radiograph should begin with evaluation of the technical factors that may influence the appearance and quality of the image. Following this, the main structures (heart, lungs, mediastinum, chest wall) are assessed. Analysis of the review areas (apices, behind the heart, below the hemidiaphragms) completes the process. Conventional chest radiographs are the mainstay of thoracic imaging. It is essential to recognize the diagnostic limitations of the chest radiograph owing to technical factors.

POSTER 0418 Thoracic complications of intravenous drug abuse: a pictorial review

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Intravenous drug abuse (IVDA) is a common problem in European countries and is becoming an increasing problem in the developing countries. Complications may arise as a direct result of intravenous drug injection or secondary to the effects of immunosuppression. Any organ system can harbour these complications. The radiology department is often called upon to establish the diagnosis. We present a pictorial review of the radiology of thoracic complications of IVDA on plain radiographs and CT.

POSTER 0419 WIP: Outpatient ventilation perfusion lung scans: how useful are they?

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PURPOSE: To review the referral pattern for outpatient lung scintigraphy, scan findings and impact on management and to evaluate its role within the range of other investigations. METHOD: Retrospective analysis of the case notes in 48 consecutive outpatients referred for lung scintigraphy between 1 January 2001 and 1 July 2001 was performed. Emergency referrals were excluded. RESULTS: The majority of referrals (52%) originated from the Respiratory Medicine Clinic. Reasons for referral were chronic dyspnoea, chronic chest pains and acute dyspnoea/chest pain in 23 (48%), 10 (21%) and 8 (17%) cases, respectively. Four scans were requested to assess the long-term effects of pulmonary embolus (PE). Only 9 (19%) referrals mentioned thromboembolic risk factors. The results were normal, low probability and non-diagnostic in 25 (52%), 14 (29%) and 9 (19%) cases, respectively. No scan suggested high probability of PE. Pulmonary function tests and echocardiograms were performed before V/Q in 42% and 40%, respectively. No therapeutic or diagnostic action was taken following 39 (81%) lung scans. Anticoagulants were withdrawn in 3 (6%) patients, while no patients were commenced on anticoagulants. No record of subsequent therapy, investigation or diagnosis was found in 13%. CONCLUSION: Outpatient lung scans can exclude PE in 50% of patients, but otherwise have a limited role in the diagnosis and management of patients with suspected PE. There is a need for focused referrals following a structured protocol.

Genitourinary

POSTER 0501 Manifestations of renal osteodystrophy on the plain radiograph

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PURPOSE: To highlight the important radiological manifestations of renal osteodystrophy on the plain radiograph. MATERIALS AND METHODS: A pictorial review. RESULTS: The wide range of manifestations of renal osteodystrophy on the plain radiograph, including the chest radiograph, is presented. Emphasis is placed on the importance of detecting bone resorption (subperiosteal, subligamentous and subchondral) in the diagnosis of hyperparathyroidism, the predominant complication in patients with chronic renal failure. The importance of the hand radiograph is highlighted. CONCLUSIONS: Chronic renal failure may lead to abnormalities of the musculoskeletal system, referred to as renal osteodystrophy. Secondary hyperparathyroidism, osteomalacia, osteosclerosis and soft tissue calcification are the main components of this condition. Other associated abnormalities include amyloid deposition, osteonecrosis, arthropathy and a destructive spondyloarthropathy. Despite increasing use of biochemical markers, plain radiographs are still widely used in the investigation of renal osteodystophy. Recognition of the plain radiographic findings in this condition is essential.

POSTER 0502 Transrectal ultrasound and guided biopsy of the prostate: a practical illustrative guide

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PURPOSE: Transrectal ultrasound (TRUS) is an imaging modality that lends itself especially well to guided needle biopsy of the prostate. Increasing use of prostate specific antigen (PSA) screening as well as an ageing population seem certain to increase requests for TRUS guided biopsies of the prostate. This pictorial presentation aims to demystify this essentially straightforward procedure, using both photographic and ultrasound illustrations. It provides an introduction for

those new to the procedure and a focus of discussion for those experienced in its application. We prompt a discussion of the complimentary and contrasting techniques used at two London hospitals. A sound knowledge of prostate zonal anatomy is central to targeted biopsy. Normal prostate anatomy together with the distribution of disease in the gland is summarized. Patient preparation is important for what many find a frightening prospect. Patient education, precautions taken to minimize complications, the equipment used and the biopsy techniques employed are all considered. Specific points examined include choice of antibiotic prophylaxis, methods of gland anaesthesia and the differing types of ultrasound probes and biopsy needle guides used. Photographs and ultrasound images illustrate the description, enhance understanding of the procedure and highlight the differences between procedures at The Middlesex and Central Middlesex Hospitals. CONCLUSION: As with any ultrasound procedure there is a learning curve, and a sound understanding of zonal anatomy is fundamental if more radiologists are to acquire the skill of TRUS and biopsy. In turn this will maximize patient acceptability of the procedure and minimize complications.

POSTER 0503 Inferior vena cava extension of renal cell carcinoma: a comparison of imaging modalities

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PURPOSE: Surgically treated patients with renal cell carcinoma (RCC) and inferior vena cava (IVC) extension without distant organ metastases have a 5-year survival, comparable with patients with localized tumour. The surgical approach is dependent on the level of tumour extension. Suprahepatic IVC or right atrial invasion requires a radical incision and intraoperative cardiac bypass; localization of tumour extent prior to surgery is therefore essential. We compared different modalities for localization of tumour thrombus. MATERIALS AND METHOD: Preoperative imaging of 13 patients with RCC and IVC extension was analysed retrospectively. CT/MR images were blind reviewed by two radiologists. The presence and level of tumour extension were recorded. Abdominal and transoesophageal (TOE) ultrasound results were based on original reports. Results were correlated with surgical findings. RESULTS: CT/MRI correlated with surgical findings in 11 of 13 cases (McNemar's test p=1.00). There was 90–100% confidence for CT/MRI diagnoses. TOE ultrasound was performed in five patients, with 100% correlation, and correctly diagnosed the level of tumour extension when CT/MRI was inaccurate. Abdominal ultrasound was the least reliable test, with three indeterminate studies and three inaccurate diagnoses. CONCLUSION: CT/MRI provides an accurate level of IVC extension from RCCs. Tumour within the suprahepatic IVC and right atrium can be difficult to demonstrate on CT/MRI, but this region is very well visualized with TOE ultrasound. We recommend that CT/MR scans that include the cardiac chambers are sufficient work-up for patients with RCC unless tumour is seen within the intrahepatic IVC or when confinement to the infrahepatic IVC is doubtful. A TOE ultrasound is then required.

POSTER 0504 MRA and MRI in patients with renal tumours considered for partial nephrectomy

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Nephron-sparing surgery for renal cell carcinoma is being considered in a selected group of patients at our institution. These are patients with either single kidneys, multiple renal tumours in patients with Von Hippel–Lindau syndrome or patients whose tumours would be suitable for curative resection by this procedure. Tumours that are small and peripheral in kidneys with multiple renal arteries are considered most suitable for nephron-sparing surgery. We now perform MRA and MRI of these patients to determine the anatomy of the tumour as well as the number and size of the renal arteries. This examination has been found to be helpful for surgical planning and patient counselling, particularly in those patients with single kidneys. This pictorial review will show some of the cases where MRA and MRI have been helpful.

POSTER 0505 MRU = RIP IVU

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PURPOSE: Magnetic resonance urography (MRU) is a new technique. In around 30 min, MRU provides angiographic, parenchymal and collecting system information with no radiation burden. It has been shown to be of value in demonstrating dilated renal tracts in children and during pregnancy. Its benefit in diabetic patients is unknown. This latter group is known to have a high incidence of renal disease and may develop nephrotoxicity from iodinated contrast medium. Hence, the diagnostic accuracy and efficacy of MRU *vs* IVU in diabetic patients was investigated. MATERIALS AND METHODS: All diabetic patients referred for IVU were recruited into the study. The IVU protocol involved a routine sequence after 70 ml omnipaque350. The MRI protocol was undertaken on a 1.5 T Phillips scanner, with 20 ml intravenous gadolinium (Gd). Angiography consisted of a contrast enhanced MRA–3D FISP sequence. Parenchymal T_1 weighted axial and coronal images were obtained both pre and post Gd. MRU 3D FISP images were acquired 5 min and 15 min post Gd. Small and large FOV images maximize PC system detail. No compression was applied but all patients were given 20 mg iv frusemide at the onset. Maximum intensity projections (MIPs) of the MRA and MRU sequences were viewed on a workstation and were compared with IVU. RESULTS: PC system abnormalities were demonstrated on MRU in concordance with IVU findings in all cases, although calculi were poorly imaged. MRU is additionally able to identify renal artery stenosis and parenchymal masses. CONCLUSION: MRU provides "three tier" diagnostic information, although renal tract calculi are suboptimally imaged. We advocate the use of MRU in routine practice.

POSTER 0506 Ovarian vein varices as a cause of female infertility

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PURPOSE: To study the possible use of transvaginal colour Doppler imaging (TVCDI) in revealing ovarian vein varices (OVV) and reno-ovarian reflux in cases of female infertility and to determine the frequency of combination of OVV with other gynaecological diseases. MATERIALS AND METHODS: TVCDI was performed in 136 women (age range 19–45 years) with infertility. Infertility was primary in 88 cases and secondary in 48 cases. RESULTS: OVV were revealed in 65 (47.8%) patients. More frequent clinical complaints were low abdominal pain and disturbance of the menstrual cycle. In 66% cases TVCDI demonstrated a combination of OVV with structural changes in the ovaries (multicystic or policystic ovaries, the syndrome of ovary inanition). In addition, in 46% of cases, along with ovarian structural changes were noted: chronic inflammatory disease in 46%, myoma in 28% and endometriosis in 26%. In 82% OVV were noted bilaterally, 12% on the left side and 6% on the right side. Based on the diameter and location of varicosis, we defined three degrees of OVV: I, one side dilation of ovary vein to 5 mm; II, bilateral OVV and dilation of plexus venus uterovaginalis from 6 mm to 10 mm; III, dilation above 10 mm in cases of total pelvic veins varicosis. Valsalva's manoeuvre was used for revealing reno-ovarian reflux; it was positive in 53% cases. CONCLUSION: TVCDI appears to be an effective and non-invasive modality in the diagnosis of OVV as a cause of female infertility. In 66% this pathology was an independent disease with secondary changes in the ovaries, combined with various hormonal gynaecological pathology.

Gastrointestinal

POSTER 0601 Transabdominal ultrasound examination in the diagnosis of various types of gastrointestinal disease

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AIM: The aim of this study is to assess the efficacy of transabdominal ultrasound (TAUS) in routine examinations of the gastrointestinal tract (GIT). METHODS: 6 years of results of the initial diagnosis of a range of diseases of the GIT in routine TAUS of patients with abdominal pain with or without diarrhoea are reviewed. The examination was

carried out including the GIT from the distal end of the oesophagus to the rectum as the scanning area. Criteria for identifying GIT abnormalities were as follows: wall thickening; loss of peristalsis; stasis of the contents in the affected region; fluid collection; and tenderness on compression by the ultrasound probe. RESULTS: The following abnormalities were detected as the major source of abdominal pain: appendicitis; Crohn's disease; fistula formation in Crohn's disease; ulcerative, pseudomembraneous and ischaemic colitides; diverticular disease of the colon; acute inflammation due to *Salmonella* and *Campillobacter* infections; gastritis; duodenitis; perforated gastric and duodenal ulcers; cancers of the distal end oesophagus, stomach, duodenum and colon; intestinal changes due to advanced carcinoid; gastric lymphoma; and intestinal amyloidosis. CONCLUSION: TAUS is judged to be a valuable tool in detecting the site responsible for abdominal pain originating from the GIT, and inclusion of the GIT in routine TAUS should be encouraged. TAUS was also useful in the assessment of efficacy of treatment for Crohn's disease, as the changes of the walls became less marked as the inflammation subsided. These results suggest that TAUS will supersede contrast studies such as small barium enema as the first line examination and for follow-up examinations.

POSTER 0602 Primary duodenal tumours: a pictorial review

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We reviewed 41 primary duodenal tumours (23 benign and 16 malignant) detected at our institution. Features of malignant *vs* benign lesions on barium examination are highlighted and correlated with endoscopic appearances and clinicopathological data. The role of other imaging modalities such as ultrasound and CT are discussed.

POSTER 0603 Imaging features of desmoid tumours in familial adenomatous polyposis

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Familial adenomatous polyposis (FAP) is the commonest polyposis syndrome, characterized by multiple colorectal adenomas. Malignant transformation is inevitable and prophylactic colectomy usually performed. Following colectomy, the commonest cause of death is desmoid tumours, infiltrating fibroblastic tumours that are benign but locally aggressive. Desmoids are present in up to 18% of FAP cases and arise within the abdominal wall, or more commonly within the small bowel mesentery. Life threatening complications include bowel and ureteric obstruction, and encasement of vascular structures. CT features range from diffuse mesenteric infiltration and perivascular cuffing to well delineated large soft tissue masses. Involvement of adjacent structures will depend on the site and size. Enhancement is variable. On MRI, the degree of high signal on T_2 weighted imaging is believed to reflect cellularity and growth potential. This presentation will detail the cross-sectional features of desmoids, including the various appearances possible and secondary signs of involvement on oral contrast medium studies.

POSTER 0604 Managing pain during barium enema: carbon dioxide yes; mebeverine no!

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INTRODUCTION: Previous investigators have shown significant benefit using CO_2 for bowel insufflation. Others have suggested that the long-acting muscle relaxant mebeverine may be of benefit. We subjected this to a double-blind, randomized, placebo-controlled trial. METHODS: 180 patients were randomized to receive either mebeverine or placebo as pre-medication, and either air or CO_2 for bowel insufflation, thus creating four treatment groups. Visual analogue lines were used to record pain scores before, during and up to 8 h after the enema. RESULTS: All groups showed increased pain scores during the enema, with peak pain scores at the end of the examination, falling to baseline scores by 8 h. Patients receiving CO_2 and placebo had significantly lower pain scores at 1 h and 4 h (p=0.00 and p=0.014, respectively; Kruskal–Wallis) compared with all other groups. Mebeverine did not significantly lower pain scores compared with placebo, and it decreased the amount of benefit received from CO_2. CONCLUSION: We confirm that CO_2 is of benefit in decreasing pain during barium enema and we would recommend its use to improve the comfort of patients. Mebeverine is not of benefit, and its use as a pre-medication for enemas is not recommended.

POSTER 0605 Abdominal wall hernias: a pictorial review of anatomical considerations and imaging features

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PURPOSE: Radiology departments are increasingly being asked to diagnose potential abdominal wall hernias. A number of imaging modalities are available, all with their own strengths and weaknesses. The aims of this poster are to review the indications for investigating potential hernias, to outline the important anatomical considerations required for accurate diagnosis, to discuss the strengths of the modalities available, to illustrate the findings within the different modalities and to develop a suggested protocol for investigation. MATERIALS AND METHODS: High resolution near field ultrasound has taken a pre-eminent place in the detection of abdominal wall hernias. It can be performed dynamically whilst the patient performs a valsalva manoeuvre. Herniography requires injection of contrast medium into the peritoneal cavity but is often considered the gold standard. CT is good at identifying non-reducible hernias. MRI has the potential to replace CT and to be used dynamically to identify those hernias occurring only during raised intraabdominal pressure. RESULTS: Ultrasound is the first line investigation but requires meticulous technique. Herniography may be negative in incarcerated hernias or in hernias in concealed positions such as midline anterior hernias. Hitherto, CT has not been able to demonstrate transient hernias present only during episodes of raised intraabdominal pressure. Fast MRI techniques show promise in this latter regard, but the speed of herniation may still be too fast. CONCLUSION: Radiologists and radiographers need to be familiar with both the anatomy of the abdominal wall and the appearances of hernias to allow accurate diagnosis.

POSTER 0606 Double contrast barium enema examinations: effect of multiple reporting

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PURPOSE: To assess the impact on detection rate of multiple reporting and to evaluate the reasons for missed diagnosis. MATERIALS AND METHODS: Images from 100 randomly selected barium enema examinations performed in the last year were reviewed. Assessment of technical quality was made by a combination of factors. Double reporting of the examinations was performed independently and any discrepancies were noted as perceptual or interpretative. In all cases where there was disagreement between the two reports, a review of the case notes was conducted. The period since the enema, any alternate investigations and further management was noted. RESULTS: A difference of opinion was noted in 23/100 reports. 12 errors were technical in nature, 7 perceptive and 4 interpretive. On colonoscopy, polyps or carcinoma were seen in three cases (one more awaited) of perceptive errors and in two cases of technical errors. CONCLUSIONS: All double contrast barium enemas should be double reported, as there is failure to perceive significant numbers of polyps or carcinomas. All enemas with poor coating or preparation should be repeated, and no attempts should be made to interpret such an examination.

POSTER 0607 WIP: Splenic trauma: a pictorial review

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The spleen is the most commonly injured organ in blunt abdominal trauma such as road traffic accidents or falls from great heights. Injuries can be minor, such as subscapular haemorrhage, or more serious, such as laceration or a fragmented spleen. Delayed splenic rupture is haemorrhage that occurs greater than 48 h after trauma. CT and ultrasound are the screening modalities of choice. MRI and nuclear medicine studies can be useful in follow-up. Splenic angiography provides valuable diagnostic information and is useful in non-surgical intervention in acute splenic injuries in the form of embolisation. Embolisation is important in the management of blunt splenic injuries because of the

tendency towards splenic salvage, to prevent the uncommon but real lifetime risk of post-splenectomy overwhelming sepsis. Of all the solid visceral abdominal organs, the spleen is most ignored by radiologists. We present a review of salient imaging findings in the context of splenic trauma.

POSTER 0608 WIP: Emergency ultrasound in the initial evaluation of blunt abdominal trauma

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PURPOSE: The purpose of this study was to evaluate the efficacy of ultrasound (US) as a primary screening tool in patients with blunt abdominal trauma. MATERIALS AND METHODS: Records of trauma patients who underwent emergent abdominal US in our department during the period 1996–2001 were reviewed. US examination was considered positive if free intraperitoneal fluid or visceral injury were identified. The results of US examinations were compared with findings of CT, surgery and the clinical course. RESULTS: Findings from 525 emergent US examinations were evaluated and were considered positive in 85 cases. The presence of free fluid was identified in 56 examintions, parenchymal injuries in 18, and free fluid and injury in 11 cases. In 69 positive cases, assumed gold standards confirmed the initial US examination as true positive, while 423 were true negative. The sensitivity of US was 80.2%, sensitivity 96.3% and overall accuracy 93.7%. The positive predictive value was 81.2% and the negative predictive value was 96.1%. CONCLUSION: Emergency US must be considered as the initial diagnostic modality in the evaluation of patients with blunt abdominal trauma because it is fast, non-invasive and has high specificity, accuracy and negative predictive value.

Musculoskeletal

POSTER 0701 Radiographic and bone scintigraphy findings in the painful non-resurfaced patella in total knee arthroplasty

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AIM: Patellofemoral pain following total knee arthroplasty (TKA), with or without patella resurfacing, is a common cause of patient dissatisfaction and revision surgery. Our study aims were to investigate patients with patellofemoral pain who had undergone TKA without patella resurfacing and to establish correlations with radiographic and bone scintigraphy findings. METHODS: A consecutive cohort of 52 patients (71 knees) was reviewed clinically at a mean follow-up period of 29 months. Standardized 45° skyline and standing lateral radiographs were used to measure patella tilt and displacement using Gomes' method, and patella height using the Insall-Salvati ratio. We identified eight knees with significant patellofemoral pain. There was no significant difference in patella tilt, displacement or height between pain-free knees or those with patellofemoral pain or with control knees. Triple-phase $^{99}Tc^{m}$-MDP bone scintigraphy with vascular, blood pool and static (3 h) images of seven of the painful knees revealed a spectrum of activity from complete normality to globally increased knee activity. Only two of these knees had specifically increased patellofemoral activity. We conclude that the sensitivity and specificity of plain radiology and bone scintigraphy in investigating these patients remains unclear.

POSTER 0702 MRI features of foot and ankle injuries in ballet dancers

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PURPOSE: The aim of this study was to demonstrate the range of foot and ankle injuries sustained by ballet dancers as shown by MRI. METHODS AND MATERIALS: A review of all MRI scans of the foot and ankle of ballet dancers from the previous 19 months was performed. RESULTS: 18 scans were performed in 16 patients. Nine scans showed signs of posterior impingement, three of which were associated with os trigonum. The features of posterior impingement will be demonstrated, including posterior capsular thickening, synovitis, bone marrow oedema within the posterior trigonal process, posterior malleolus or os trigonum. In addition, five patients were further analysed with dynamic scanning in the neutral position and in "pointing", demonstrating impingement of the posterior soft tissues and anterior translation of the talus in one patient. Eight scans showed flexor hallucis longus tendinitis. Bone marrow oedema within the tarsal bones was seen in eight patients, most commonly the talus and calcanium, presumably secondary to a stress response. Injury of the anterior talofibular ligament was frequently seen. Three patients showed sesamoiditis. CONCLUSION: A range of foot and ankle injuries are sustained by ballet dancers. Although posterior impingement and os trigonum complex are well recognized in this group, there needs to be a high index of suspicion for other injuries.

POSTER 0703 Orthopaedic hardware in trauma

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Orthopaedic surgeons are, on the whole, far more comfortable than some radiologists when it comes to looking at post-operative trauma films. All too often reports read "Please see films for position", but with the introduction of new IR(ME)R guidelines and the advent of clinical governance, radiologists have a responsibility to make some valuable comment about these films. The main aims of fracture fixation are fracture reduction and stable fixation with a view to early pain-free mobilization. Fixation devices may be internal (screws, plates, rods and wires) or external (plaster casts, splints and external fixators). Radiologists have the benefit of training in the use and interpretation of imaging but may not be familiar with all the devices available to orthopaedic surgeons. A basic knowledge of the types of device and their function is required to interpret the post-operative plain film. We illustrate the more common pieces of orthopaedic hardware and highlight the important features to look for on post-operative and follow-up plain films.

POSTER 0704 Imaging of common surgical hardware: a pictorial review

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Surgical hardware seen on radiographs is extremely common in everyday practice. Radiologists are commonly asked to interpret radiographs with surgical hardware on them. However, many radiologists are not familiar with the names and appearances of common surgical hardware, leading to vague descriptions of the presence and function of the hardware. A pictorial review is presented with radiographs and photographs of various surgical hardware (non-orthopaedic), *e.g.* lines, pressure monitors, swabs etc., and their significance is discussed. Familiarity with their appearances will lead to a more precise and knowledgeable description of the radiographic appearances.

POSTER 0705 Assessment of the level of bifurcation of the sciatic nerve above the popliteal crease using MR

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PURPOSE: There is a significant incidence of failure of peripheral nerve blocks of the sciatic nerve (SN). In this study, the level of bifurcation (BF) of the sciatic nerve into its tibial and common peroneal branches above the popliteal fossa is assessed. Using markers at the popliteal crease (PC) and knowing the level of usual anaesthetic access, the incidence of SN bifurcation at this level can be ascertained. MATERIALS AND METHODS: 20 healthy volunteers (40 knees; age range 23–32 years) underwent axial T_1 weighted MR of the thighs to identify topographical variations of the bifurcation of the SN. The subjects lay supine in the standard anatomical position and markers were placed at the PC. Contiguous 10 mm thick sections were performed cranially from the popliteal crease until the SN bifurcation was reached. RESULTS: The mean distance of BF to PC was 12.23 cm (range 3–21 cm, mode 12 cm, standard deviation 4.78). At a level 5 cm above the PC, 90% of SNs were found to already be bifurcated. With a 95% confidence level, we concluded the interval of BF to be 12.23 ± 1.23 cm from the PC. CONCLUSION: This variance in BF is of clinical importance for the successful conductance of peripheral

nerve blocks in the popliteal fossa. The classical posterior approach to the SN is performed 5 cm cranial to the PC, *i.e.* at a level at which we noted 36/40 SNs had bifurcated. This might explain the varying degree of success of this particular peripheral nerve block. Pre-procedural MR might help with more accurate localization of SN bifurcation.

POSTER 0706 Diagnostic value of bone scans in painful total knee replacements

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INTRODUCTION: Problematic total knee replacements (TKRs) are commonly investigated using three-phase scintigraphy, but there is a paucity of published data. Increased uptake has been shown to be present on scans in asymptomatic patients for long periods of time post surgery, attributed to post-operative bone remodelling. However, there appears to be no consensus of opinion as to when this ceases, and some reports have concluded that scans are of little value in the management of painful TKRs. METHOD: A retrospective review was carried out of 52 painful TKRs investigated by three-phase bone scans. RESULTS: In 20 cases there was evidence of abnormal pathology, whereas in 32 cases symptoms settled with conservative treatment. Positive scans were obtained in all those with abnormal pathology and in 10 "normal" cases. The 22 scans that showed no significant abnormality were all obtained in patients who were at least 16 months post surgery. 6 of the 10 false positive scans were carried out within 16 months of surgery. In total, 38 scans were performed at least 16 months post surgery. The negative predictive value of these scans was found to be 1.0, whilst the positive predictive value (PPV) for abnormal pathology was 0.75. However, the PPV specifically for infection was only 0.25. CONCLUSION: It is concluded that bone scanning is of no value in investigating painful TKRs within 16 months of surgery either to confirm the presence of, or to rule out, abnormal pathology. After this period it has a limited role, but not in identifying the presence of infection.

POSTER 0707 Variability of cruciate ligament avulsion fractures: CT evaluation

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PURPOSE: To review the CT features of cruciate avulsion fractures. MATERIAL AND METHODS: Radiographs and CT examinations in 33 consecutive patients (28 males, 5 females; mean age 31.3 years, range 15–77 years) with cruciate avulsion fractures of the knee presenting over a 46-month period between February 1998 and November 2001 were reviewed. RESULTS: ACL and PCL avulsion fractures occurred with almost equal frequency. ACL avulsion fractures occurred more commonly in adults than previously believed. About one-half of ACL avulsion fractures are partial, involving the anteromedial bundle only, one-quarter are comminuted and one-half are extended. PCL avulsion fractures occur in an older age group than ACL avulsion fractures. The majority are complete, half are comminuted (between the individual PCL bundles) and half are extended. When compared with anteroposterior and lateral radiographs, CT is helpful at delineating the fracture margins (for Type I and Type II fractures) and at delineating comminution and extent in PCL injuries. 3D CT allows good perception of the fracture type and tibial bony defect as a prelude to operative reduction. CONCLUSION. The demographic distribution of cruciate avulsion fractures differs from that of intrasubstance tears. There is considerable variability in the size, shape and comminution both of ACL and PCL avulsion fractures. This has an important bearing on operative fixation.

POSTER 0708 Shoulder MRI in ankylosing spondylitis: enthesopathy is common and occurs independently of tendon tear

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BACKGROUND: Patients with shoulder pain and ankylosing spondylitis (AS) are usually diagnosed clinically as having glenohumeral synovitis, bursitis or tendon tear. HYPOTHESIS: MRI findings of shoulder involvement in AS differ significantly from a control population. METHOD: Two groups of patients were retrospectively studied. The study group comprised 12 shoulders in 11 AS patients (age range 37–54 years, mean 44.4 years; 9 males, 2 females). The control group comprised 72 shoulders in 69 patients investigated for shoulder pain (age range 39–69 years, mean 48.8 years; 51 males, 18 females). All scans were performed in the last year on 1.5 T magnets. Two observers independently read the scans and disagreement was resolved by a third independent opinion and arbitration. RESULTS: Tendon tear was present in 40 control shoulders but only 3 study shoulders (p=0.049). Bone marrow oedema (BMO) in the humeral tuberosities was prominent in five AS patients (none had tendon tear). This finding was not seen in the control group (p<0.001) in the absence of rotator cuff tear. BMO in the acromion process at the deltoid origin (separate from the AC joint) occurred only in AS shoulders (two patients). The incidence of joint effusion, bursitis and synovial thickening was not significantly different between the groups. CONCLUSION: Enthesial inflammation was prominent in 50% of AS shoulders, occurred independently from cuff tear and was not a feature of the control group. Although the study group is small, our results suggest that AS patients with shoulder pain are more likely to have enthesopathy than cuff tear, synovitis or bursitis.

POSTER 0709 MRI features of osteomyelitis in the paediatric population: pictorial review

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PURPOSE: Diagnosis of osteomyelitis in children can be difficult, with symptoms often being non-specific. Undetected infection can have a devastating effect on the growth plate and articular cartilage. The aim of this presentation is to demonstrate typical MRI findings of osteomyelitis with growth plate and articular involvement in children. MATERIALS AND METHODS: A retrospective study of MRI examinations from January 1999 to November 2001 was performed. Examinations were performed on a 1.5 T magnet and all included STIR, post-gadolinium T1 and cartilage-specific imaging sequences. RESULTS: 47 cases of proven osteomyelitis secondary to a variety of pathogens, including *Staphylococcus*, *Mycobacterium* and *Salmonella*, were reviewed. In 12 cases there was growth cartilage involvement that included altered signal change in the cartilage, destruction of the physis, slipped epiphysis, bone sequestrum and epiphyseal abscess formation. Other complications detected included soft tissue abscess, sinus tract formation and septic arthritis. CONCLUSION: MRI is superior to other imaging tools in the diagnosis of osteomyelitis, with the advantage of detecting early marrow changes and demonstrating the extent of local spread. It should be used at early stages of non-specific presentation to prevent some of the disabling complications of growth plate and joint involvement. Cartilage imaging is improved by specialized sequence selection.

POSTER 0710 The diagnostic utility of SPECT in imaging of the spine: a pictorial review

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Single photon emission tomography (SPECT) of the spine improves lesion detection and localization and increases image contrast compared with planar scintigraphy. Many practitioners use bone SPECT based on anecdotal experience only. From our extensive experience, the key indications for the use of SPECT in spinal imaging, with reference to the differentiation of benign from malignant disease, are presented. In particular, the value of SPECT imaging in the cervical spine has not been appreciated previously, and cases are shown to illustrate the utility of cervical spine SPECT. The patterns specific to facet joint disease, degenerative disease, fracture, metastatic disease and recent/longstanding benign as opposed to malignant vertebral body collapse are shown. In addition, the appearances of the relatively new intervention of vertebroplasty (together with CT correlation) are presented. LEARNING POINT: The key indications for spinal SPECT, the potential usefulness of SPECT in the cervical spine and the specific pattern recognition for a number of pathologies.

POSTER 0711 Ultrasound of muscle injury

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The extensive use of MRI has limited the role of ultrasound (US) in

the assessment of musculoskeletal injury. However, the real-time capability and exquisite spatial resolution of US confer advantages over MRI in both the acute and chronic muscle trauma setting. Furthermore, US provides a readily accessible and comparatively inexpensive means of true symptom–imaging correlation, allowing accurate diagnosis. We present our experience of US in the assessment of both acute and chronic muscle injury, using high resolution transducers with extended field-of-view techniques and colour Doppler imaging. Normal US anatomy demonstrating the perimysium, and intramuscular and intermuscular septae will be illustrated. Acute muscle injuries including strains, tears and contusions will be shown, illustrating the superiority of US over MRI in distinguishing grade II strains or intramuscular tears from grade I muscle injuries. The use of US to assess tissue healing and the presence of associated haematoma will be illustrated. Chronic muscle injuries including intramuscular scarring, which predisposes to recurrent muscle tears, heterotopic calcification and muscle hernias will be demonstrated. The appearance of delayed onset muscle soreness, which is a common cause of symptoms in the professional athlete, will be shown. In conclusion, US provides a rapid, readily available, high resolution technique for assessing muscle injury, which is relatively inexpensive. Both acute and chronic injuries may be detected. The superior spatial resolution of US over MRI helps in differentiating grade I from grade II muscle strains, which is important in prognostication and rehabilitation, especially in the elite athlete.

POSTER 0712 Osteomyelitis, infective spondylitis and infective arthritis: characteristics of diagnosis with MRI and CT

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PURPOSE: To review the MR and CT features of musculoskeletal infection. MATERIALS AND METHODS: A retrospective review of 70 scans (22 CT, 48 MR) performed on 48 patients (33 male), aged 8–83 years (median 42 years), with CT or MR evidence of osteomyelitis (OM), infective spondylitis (IS) or infective arthritis (IA) was performed. RESULTS: 51 cases of infection were identified: OM, 22 (43%); IS, 19 (37%); and IA, 10 (20%). MR was the modality of choice for IS (24/28) and IA (10/12) and was used approximately equally with CT in OM (14/30). OM occurred most frequently in the lower limb (16/22), 8/16 cases affecting the tibia. 11/22 cases were acute, 4/22 chronic, 4/22 acute or active-on-chronic and 3/22 Brodie's abscess. Features documented included periosteal reaction (14/22), cloaca (7/22), sequestrum (9/22), penumbra (1/22) muscle wasting (7/22) and previous surgery/trauma (7/22). All had associated soft tissue changes, including three with abscess. Bacteria were cultured in 10/22. 14/19 cases of IS occurred between T6 and S1 levels. Features recorded were disc involvement (18/19), >50% marrow oedema above/below disc (17/19), end-plate erosion (16/19), paraspinal mass (19/19), epidural extension (11/19) and previous surgery (3/19). Bacteria were identified in 9/19. IA most frequently affected the hip (6/10). Features noted were effusion (9/10), joint space narrowing (8/10), chondrolysis (8/10), cortical erosion (10/10), crossing joint (10/10), muscle wasting (7/10), associated soft tissue infection (3/10) or OM (2/10) and previous surgery/trauma (0/10). Bacteria were cultured in 3/10. CONCLUSION: MR/CT features of musculoskeletal infection vary widely. A complete understanding of the appearances is therefore crucial to establishing a diagnosis.

POSTER 0713 Hip aspiration and arthrography in suspected prosthetic hip infection

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AIM: Distinguishing between an infected and a loose hip prosthesis can be difficult. It is, however, important to establish prior to hip revision surgery, as infected patients may require a two-stage operation. Conventional imaging is non-specific. Our aim is to assess the role of hip aspiration arthrography in these patients in our medium-sized district general hospital. MATERIAL AND METHODS: We reviewed 44 aspirations in 42 patients with suspected prosthetic hip infection over a 3-year period from 1998 to 2000. ESR, CRP, aspiration culture and arthrography findings were recorded. RESULTS: The mean patient age was 72 years. Aspiration yielded a positive culture in 10 patients, and all cultures grew coagulase-negative *Staphylococcus aureus* organism. The arthrogram showed a loose prosthesis in 24 patients, 9 of which had positive culture. In patients with positive culture, the ESR and CRP were both raised in five patients. ESR alone and CRP alone were raised in one patient each, and both were normal in three patients. RESULTS: Of the 10 patients with positive culture, 4 patients had revision surgery, with positive operative culture in 3 patients. Four patients are awaiting surgery and three are under review. 13 patients had surgery in the negative group, with one positive operative culture. CONCLUSION: Although there was one false positive and one false negative culture compared with the per-operative cultures, we consider that aspiration arthrography is a useful investigation in the diagnosis of suspected prosthetic hip infections in this difficult group of patients. ESR, CRP and arthrography findings are less specific.

POSTER 0714 Dislocations around the wrist: a pictorial essay

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Although injuries of the wrist and hand are common, dislocations of the carpal bones are less common. Interpretation of carpal bone dislocations can be difficult on the plain film with overlapping of the bones and there is often a confusing appearance. The abnormalities may either be subtle or the degree of bony displacement may make interpretation difficult. A pictorial presentation of the various appearances of carpal dislocation is made and the classifications are described.

POSTER 0715 WIP: MRI for Morton's neuroma

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PURPOSE: Morton's neuroma is a common orthopaedic condition causing chronic forefoot pain and disability. The MR appearances and the usefulness of various sequences in the diagnosis of Morton's neuroma are analysed. MATERIAL AND METHODS: A prospective analysis of 48 MR scans of the foot (from 45 patients) between June 1996 and April 2000 for clinically suspected Morton's neuroma was undertaken. The MR appearances were correlated with histology as a gold standard. The initial patients had T_1 and T_2 weighted images through the forefoot. Subsequently, as a standard protocol, T_1 weighted, T_1 fat suppressed (T1FS) images with and without intravenous contrast enhancement (gadolinium-DTPA) and STIR sequences were performed through the region of interest in the coronal plane. RESULTS: Histological correlation was available in 23 patients who underwent excision. 18 of the 23 patients operated upon were histologically shown to have Morton's neuromas. MR had positively identified 12 (66.6%); the other 6 patients had MR scans reported as normal (16.6%) or uncertain/atypical for Morton's neuroma (16.6%). Of the five patients who had normal histology, two were normal and three were uncertain on MR scans. Among the individual sequences, STIR was the most sensitive (91%) and T1FS with gadolinium enhancement was the most specific (67%) in diagnosis. CONCLUSION: STIR sequence is the most sensitive for demonstration of Morton's neuroma. Intravenous contrast enhancement may be helpful in equivocal cases. However, the place of MRI in Morton's neuroma is limited by a high false negative rate.

POSTER 0716 WIP: Occult slipped upper femoral epiphyses and early total hip replacement: the missing link?

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AIM: To determine whether there is an association between occult slipped upper femoral epiphysis (SUFE), degenerative change and the need for total hip replacement (THR) in patients less than 60 years old who have had radiographs for a symptomatic hip. MATERIALS AND METHODS: Our X-ray database was searched under X-ray code "HIP" and "PELVIS" from April 1997 to October 2001. The radiographs of all patients less than 60 years of age at the time of X-ray were reviewed by two radiology registrars trained in musculoskeletal radiology and one consultant musculoskeletal radiologist. All patients with occult SUFE as well as those who had undergone or who were awaiting THR were identified and their case notes were reviewed. RESULTS: Selected images of patients with occult slips, degenerative changes and THRs are included in this poster. A total of 742 patients have been reviewed

to date, 356 female and 386 male. 47 SUFE were identified in 1484 hips (3.2%), 34 in males and 13 in females (male:female ratio 2.6:1). 27/34 slips involved the left hip and 20/34 the right hip (L:R ratio of 1.35:1). 6 (14.6%) patients had bilateral slips. A total of 103 THRs were identified. 5 of the 55 THRs with pre-operative films available had a SUFE; none had previous surgical intervention. 4 of these were in male patients. CONCLUSION: Our findings to date suggest that occult SUFE is a relatively common finding in young patients who have undergone THR. It is of clinical relevance to detect these lesions as early as possible so that preventative measures against exacerbation of OA can be taken.

POSTER 0717 WIP: Bone scans: Paget's disease or metastases?

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AIM: To determine our accuracy in detecting Paget's disease in patients referred for bone scans. MATERIALS AND METHOD: All bone scan reports amongst patients referred with possible bony metastases over an 8-year period were reviewed and those reports describing Paget's disease were selected. All the available case notes and plain films were then reviewed retrospectively, looking for evidence (biochemical, histological or plain film) of Paget's disease. RESULTS: 5126 patients were referred to our department during this time. 39 patients were felt to have concurrent Paget's disease on their bone scans. Evidence of Pagets disease was shown biochemically in 15% of patients. We were correct in 46% of patients regarding our diagnosis of Paget's disease, and misidentified metastases as Paget's disease in the remainder. Overall, an incidence of 0.35% was found for concurrent Paget's disease and bony metastases. CONCLUSION: It is essential to have relevant plain films available at the time of reporting bone scan abnormalities.

POSTER 0718 WIP: Are clinical signs relevant to the decision to X-ray adults presenting with fall onto outstretched hand (FOOSH)?

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PURPOSE: Current practice and textbook advice indicates that all adults presenting with wrist pain after a fall onto outstretched hand (FOOSH) injury require an X-ray. It was hypothesized that clinical signs may aid in refining this decision, reducing the number of X-rays taken. To assist in planning a prospective study, an analysis of 1 month's X-rays was made. MATERIALS AND METHOD: 99 adults (>18 years of age; median age 57 years, range 18–94 years) were identified as sustaining a unilateral FOOSH from standing during December 2000. Patient notes were searched for documented clinical signs. A consultant trauma radiologist reported all the X-rays. The information was used to generate sensitivities and positive predictive values for the detection of bony injuries. RESULTS: A total of 112 X-ray series (89 wrist, 23 scaphoid) were taken on 97 patients. A total of 66 fractures were identified (51 distal radius, 9 distal radius and ulnar, 2 scaphoid and 3 carpal avulsions). DISCUSSION: FOOSH can result in a variety of wrist injuries; 68% in this study were bony. Of the 32 patients with no bony injuries detected, 14 were X-rayed as clinical scaphoid fractures. Thus, only 18 (19%) could be considered radiologically normal. Given the implications of missing wrist injuries, this proportion may be a small price to pay to maintain 100% sensitivity. Better correlation of subjective, objective and quantitative pain in a prospective study may confirm that localized pain and not simply presentation should indicate X-ray. Also, more attention to these factors may reduce dual investigation. Clinical signs overall generate better positive predictive values at the expense of sensitivity. However, inconsistent and under recording of signs will have introduced error into the figures. Prospective subgroup analysis at different ages may reveal different values.

POSTER 0719 WIP: Skiing and snowboarding injuries and the implications for diagnostic imaging

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PURPOSE: The purpose of this study was to identify the risks of injury in alpine skiing and snowboarding. The study highlights the differences between skiing and snowboarding injuries as well as the differences in injury patterns and rates. In the field of radiography, the study investigates the implications of these injuries to the radiographer's work. METHOD: This retrospective quantitative study analysed data from the Ski-Patrol database from the Cairngorm ski area for the 1999–2000 skiing season. Data were also extracted from the X-ray Department database for any patients that were referred to Raigmore Hospital. Graphic analysis and statistics were used to determine injury patterns, rates and trends in diagnostic imaging. RESULTS: Significant differences between alpine skiing and snowboarding in both injury patterns and incidence rates were found ($p<0.001$). Differences were also found for the requirements of diagnostic imaging and hospital care. Because both alpine skiing and snowboarding have characteristic injury patterns, there are implications for the radiographer with regard to technique, workload and management. CONCLUSION: By analysing data from Ski-Patrol and X-ray Department records, it was found that alpine skiing and snowboarding have characteristic injury patterns, which has an impact on the workload, management and protocols within a diagnostic imaging setting.

Head & Neck

POSTER 0801 Imaging and staging of paranasal sinus tumours: a pictorial review

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Tumours of the paranasal sinuses present with non-specific symptoms that overlap with benign disease. 90% of tumours are squamous cell carcinomas, with the majority of the remainder arising from the minor salivary glands. The majority of tumours are either stage 3 or stage 4 at presentation. We present the staging system for the different sinus tumours and illustrate these with our own cases. Nodal staging is also discussed. Distal metastases are uncommon at presentation, but we also consider the value of systemic screening either by isotope bone scanning or imaging of the chest. The literature regarding the relevant merits of different modalities is reviewed. The imaging features of extension that potentially precludes surgery are presented and illustrated. We also demonstrate the post-operative appearances of free flaps inserted into the large defects such as the deep circumflex iliac graft. Imaging is also valuable for post-treatment assessment and in the assessment of recurrence, as clinical evaluation following large volume grafting can be particularly difficult.

POSTER 0802 Cystic lesions of the mandible: a pictorial review

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We present the plain film and MRI findings of 14 cystic mandibular lesions. The diagnoses included ameloblastoma, cherubism, lateral periodontal cyst, arteriovenous malformation, recurrent keratocyst, periapical cemental dysplasia, two cases of osteogenesis imperfecta, basal cell naevus syndrome, hyperparathyroidism, osteosarcoma, acroosteolysis, osteoblastoma and locally invasive salivary gland tumour. The solitary mandibular cyst is a common incidental finding but often presents difficulty in diagnosis. The purpose of this review is to demonstrate the imaging characteristics of these lesions and to illustrate how these are used to refine the differential diagnosis.

POSTER 0803 A pictorial review of glomus tumours

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Glomus tumours are benign tumours, also known as chromaffin, paragangliomas or chemodectomas, arising from the middle ear of jugular fossa. Two common types are the glomus jugulare and glomus tympanicum. These tumours may show permeative bone erosion of the ossicles, petrous bone and jugular foramen on plain radiographs and CT. Intense contrast enhancement is also seen on CT. On MRI, glomus tumours show an intermediate signal on T_1 weighted images and a high signal on T_2 weighted scans. Marked contrast enhancement is seen following iv contrast medium. Serpentine areas of signal void due to multiple small tumour vessels are also shown (salt and

pepper appearance). Various examples of glomus tumours, with the radiological findings on plain radiographs, CT and MRI, will be shown.

POSTER 0804 MRI demonstration of the oropharyngeal musculature and lip morphology when playing wind instruments

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The exact anatomy and physiology of the oropharyngeal musculature, the lip morphology and laryngeal structures when playing wind instruments is important with regard to instrumentalists' overuse syndromes and is of considerable interest when studying musical acoustics but has hitherto been difficult to study. MRI is the best method of studying the musculature and was therefore considered suitable for analysis of this occupation. A pilot study was undertaken using a Siemens open 0.2 T MRI scanner and metal-free wind instruments. The scan sequence parameters were Tru Fisp, 90° flip angle, 4 acquisitions, 5 mm slice thickness, 112 x 256 matrix, 350 mm field of view providing 3 slices in 14 s. A player of wind instruments was scanned whilst sequentially playing several different wind instruments. These included a plastic toy trumpet (purchased from Hamleys' London) adapted such that all metallic material was removed, a clarinet consisting of a standard mouthpiece connected to a piece of plastic piping and a plastic recorder. An adapted oboe and a wooden flute had not yet been scanned at the time of writing the abstract. The volunteer produced notes from the trumpet by "bugle blowing" and scans were undertaken whilst the notes were playing continuously. The musician played a series of different notes and the appearances of the musculature were correlated with the pitch of the notes. The experiment was repeated whilst the musician played the other instruments in the usual manner. The technique provided unique information about the position of the lips, tongue and uvula whilst playing wind instruments.

POSTER 0805 MR compatibility of dental pins and posts: an update

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Knowledge of the artefacts produced by dental materials is important in assessing whether or not MRI will be successful when studying the head and neck and should inform the dental profession in their choice of materials. A number of new dental materials have appeared on the market since the presentation of MR artefacts at the 1999 Radiology Congress [L Tutton, S Dunne, P Goddard. Dental materials causing artefacts on MRI sequences. Radiology UK 1999 poster]. In addition, several dental materials that were coming into use at that time were not included in the first study. To assess the MR compatibility of such materials, a study was undertaken using the Siemens 0.2 T open MRI scanner. The posts and pins examined included Filpins, Filposts, Whaledent pins, Paraposts and Radix Anker posts. The pins and posts were made from titanium, stainless steel, carbon fibre and custom-made alloy posts. The objects studied were placed in apples and were then scanned in a plastic bowl whilst surrounded by cooking oil. This had previously been found to act as a good phantom for displaying artefacts on a range of sequences. The series of sequences used in the previous experiment were repeated, including T_1 and T_2 spin echo, STIR and FLASH.

POSTER 0806 Varying pathologies encountered on the orthopantomogram: a pictorial review

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In the hospital setting, the majority of orthopantomograms (OPGs) are performed for evaluation of the mandible in trauma or for evaluating a specific clinical problem such as pain, mass or local tumour spread from oropharyngeal malignancy. There are a great variety of pathologies that affect the mandible, many of which are found incidentally on trauma films. The vast majority of OPGs are reported by general radiologists and it is therefore important for them to be familiar with these diseases. We present a pictorial review of mandibular pathology identified on the OPG, including caries, periodontal disease, infection, trauma, developmental anomalies, cystic, metabolic, and benign and malignant neoplasms. Our review helps to characterize the varying pathologies and helps the general radiologist to re-familiarize themselves with some of the common and rarer diseases of the mandible.

POSTER 0807 Screening for acoustic neuroma with MRI: experience in a district general hospital

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PURPOSE: Audiovestibular symptoms are common within the general population; approximately 15% of patients attending a district general hospital ENT outpatient clinic will have symptoms that could be attributed to an acoustic neuroma. MRI is now established as the investigation of choice for suspected acoustic neuroma. METHODS: As the first line investigation of these patients at our institution, we perform a T_2 weighted CISS (continuous interference in the steady state) volume acquisition through the internal acoustic meati (IAM) and T_2 weighted axial images through the brain, performed within a 10 min appointment. Patients are recalled for further imaging if required. We retrospectively reviewed 572 consecutive studies performed over a 17-month period from January 2000. We recorded the patient's age, sex, presenting symptoms and radiological findings. RESULTS: *De novo* acoustic neuromas were identified in 11 (1.9%) patients (8 male, 3 female; age range 40–69 years), with 4 (0.6%) further patients undergoing follow-up of known or previously resected tumours. Vascular loops within the IAM and impingement on the nerves were reported in 34 patients (5.9%) and 5 patients (0.9%), respectively. Cerebral ischaemia was reported in 99 patients (17.3%), sinus disease in 90 (15.7%) and mastoid disease in a further 17 (3.3%). In addition, a number of other pathologies were seen, including demyelination, pituitary tumours, cholesteatoma, meningioma and an MCA aneurysm. CONCLUSION: MRI is a highly sensitive and specific method for screening patients with audiovestibular symptoms, although widespread implementation would have significant implications in terms of cost and resources.

POSTER 0808 Biopsy under ultrasound control in the assessment of palpable parotid gland lesions

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PURPOSE: To evaluate the efficacy and safety of ultrasound guided biopsy in the management of palpable parotid lesions. MATERIALS AND METHODS: 56 patients with clinically palpable unilateral (50 patients) or bilateral (6 patients) swelling in the parotid gland were included. A single operator performed the initial ultrasound examination using a 5–10 MHz linear array transducer followed by biopsy under local anaesthesia. Biopsies were performed with a spring-loaded biopsy gun 18 or 20 gauge needles. An average of two passes per patient was made. RESULTS: In the 50 patients with unilateral swelling, biopsy revealed 27 benign tumours and 11 malignant tumours (5 primary, 2 metastatic and 4 lymphoma). Pathologies in the remaining 12 patients with unilateral swelling included sarcoidosis, tuberculosis and reactive adenopathy. In the six patients with palpable bilateral swelling, biopsy demonstrated fatty change in four patients and sialadenitis in two. Diagnostic accuracy was 100% in the 28 patients who underwent subsequent surgery; 28 patients avoided surgery after diagnosis with guided biopsy. There were no immediate complications. CONCLUSIONS: Ultrasound guided biopsy is a quick and safe procedure. It provides a core of tissue for histological analysis where assessment of tissue architecture is critical for diagnosis, *e.g.* lymphoma. Results correlated well with final histology in those patients who underwent subsequent surgery. It allows accurate pre-operative diagnosis, which influences the decision to undertake conservative or radical surgery and allows surgery to be avoided in some patients.

POSTER 0809 Clearing the neck

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PURPOSE: Imaging the cervical spine in trauma is often technically challenging and time consuming in the unstable patient. This poster aims to illustrate the role of multislice CT in the assessment of this group of patients. METHODS: In cases where there are areas of the cervical spine not "cleared" by conventional films, multislice CT is used as the preferred imaging modality. This involves acquisition of

thin slice volume of the anatomy under investigation using a fine beam collimation. An overview of the area in question is first viewed in the axial plane and then supplemented with appropriate multiplanar reconstructions. RESULTS: Illustrative cases will be presented to demonstrate the efficiency of multislice CT in this particularly difficult clinical setting using our state-of-the-art Siemens Volume Zoom CT scanner. A normal result from this technique will enable the referring clinician to "clear the neck". CONCLUSION: Multislice CT is revolutionizing imaging of the difficult trauma cervical spine case. It is replacing the need for the more technically challenging plain film techniques such as conventional tomography or the swimmers view, and is providing images of far superior diagnostic quality.

POSTER 0810 Computer and manufacturing assisted surgery: a case of maxillofacial clinical diagnosis

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INTRODUCTION: This paper describes the development of a clinically requested anatomical model. A patient presented with a condition of an abnormal mandible. Routine CT imaging of the skull was unable to provide an answer to the case. A computer and manufacturing assisted diagnostic method was pursued, which involved image processing of CT data, 3D reconstruction and development of an anatomical model through rapid prototyping techniques. MATERIALS AND METHODS: A Siemens Somatom Plus 4 Spiral CT scanner provided 88 overlapping slices. Image data were saved to a magneto-optical disk in a DICOM format and transferred to a PC workstation. The CT images were then processed and the tissues of interest were reconstructed in three dimensions. The geometrical characteristics of healthy and pathological tissues were exported in a stercolithography format that is accepted by rapid prototyping manufacturing systems. RESULTS: A rapid prototyping model of the patient's skull with selective colouring of the problematic area was developed. Image processing and subsequent 3D and physical modelling showed that the cause of the patient's condition was a screw implanted at a previous surgical operation. The model accurately depicted the problematic area, the position of the screw and the affected tissues. CONCLUSION: The overall method helped the surgeon to reach a diagnosis and to decide the potential surgical intervention avoiding unnecessary patient discomfort and risk. Communication of the pathology among the medical team, as well as between the surgeon and the patient, was greatly facilitated. The application of computer and manufacturing methods in the diagnosis and treatment of complex maxillofacial cases is often decisive for the success of the clinical result.

POSTER 0811 MRI of orbital tumours

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METHODS: MRI was undertaken in a series of patients with suspected orbital masses. The MRI findings were correlated with surgery and pathology. The standard protocol included T_1 weighted spin echo (SE), turbo SE T_2 weighted, and turbo STIR scans of the orbits and brain pre intravenous (iv) Gd chelate, and T_1 weighted SE coronal and transverse scans post iv Gd chelate. RESULTS: Lymphoma was characteristically shown as homogeneous signal and followed the shape of the orbit. It showed uniform enhancement with iv contrast media. Meningioma could be distinguished from glioma post iv contrast media, since the former spared the optic nerve, which could be seen running through the tumour, whilst the latter diffusely involved the nerve. Orbital pseudotumour and myositis showed painful involvement of individual muscles, whilst thyroid eye disease involved multiple extraocular muscles. Metastatic disease to the orbit was encountered, including breast carcinoma, small cell carcinoma and prostatic carcinoma, as well as direct involvement by sinonasal tumours. Lachrymal gland tumours and dermoid cysts were also scanned. CONCLUSION: MRI was shown to provide details of position, shape, extent and signal intensity. T_1 weighted scans with iv contrast enhancement were particularly useful in showing extension intracranially, whilst the STIR sequence provided high conspicuity against the annulled orbital fat. These features helped in characterizing the masses and in planning surgery. Pathological correlation was particularly informative and helped to explain the MRI findings.

Hepatobiliary

POSTER 0901 Transjugular liver biopsy performed in a DGH: the Derby experience

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PURPOSE: This study was undertaken to document the indications, success rate, complications, adequacy of samples and the clinical impact of transjugular liver biopsy. MATERIALS AND METHODS: 48 transjugular liver biopsies were performed over a 2-year period. There were 36 patients with abnormal clotting and gross ascites. Seven patients had gross ascites alone and a further six patients had abnormal clotting without gross ascites. All the biopsies were performed in a standard fluoroscopy room. All patients received sedation with continuous monitoring. Right jugular vein puncture was performed using ultrasound guidance. An 18 G Tru-Cut biopsy system was used to acquire samples. RESULTS: Primary success was achieved in 46 (96%) patients. There were no major complications. There were 13 minor complications, which included 3 patients with neck haematoma and 6 patients with transient cardiac arrhythmias. Samples were adequate for diagnosis in 38 (83%) patients. In 6 (13%) patients the samples were marginal and in 4 (4%) the samples obtained were inadequate for histological diagnosis. Cirrhosis was confirmed in 27 patients and it was possible to stage the disease in 20 (74%) patients. CONCLUSIONS: Transjugular liver biopsy is a safe alternative to percutaneous liver biopsy but it is expensive, time consuming and the samples obtained can be less than adequate. In a DGH setting, where the referral pattern is from a non-transplant patient group, percutaneous liver biopsy may be attempted after correction of abnormal clotting and/or draining of ascitic fluid, while transjugular liver biopsy can be reserved for high risk patients.

POSTER 0902 Sensitivity and reliability of spiral CT in detecting small hepatocellular carcinoma with thin collimation and imaging reconstruction

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PURPOSE: To investigate the value of spiral CT with thin section and image reconstruction in the sensitivity and reliability in detecting small hepatocellular carcinoma (SHCC). MATERIAL AND METHODS: Spiral CT was performed in 22 cases of SHCC proved by histology. with 5 mm collimation through the whole liver (212–250 mA, 0.6 s, matrix 512 x 512, pitch = 1). Two-phase spiral CT started at 20–30 s (arterial phase) and 60–70 s (portal vein phase) after intravenous administration of contrast medium (0.5 g I kg^{-1} body weight). Continuous axial sections with 6.5 mm and 10 mm slice thickness (ST) were reconstructed. The former was performed using a 2.5 mm and 5.0 mm reconstruction interval (RI), the latter using 4.0 mm and 8.0 mm, respectively. Lesions were classified into three groups according to their diameter (=10 mm, 11–20 mm and 21–30 mm). Each set of images was evaluated to determine lesion detection and was further analysed statistically. RESULTS: The sensitivity in detecting SHCC in the group of lesions =10 mm and 11–20 mm in diameter was significantly different in each set of images ($p<0.05$), while the number of definite lesions was partly statistically significant ($p<0.05$). Significant differences between images with 6.5 mm ST, 2.5 mm RI and images with 10 mm ST, 8.0 mm RI ($p<0.025$) were only found in the 21–30 mm lesions. CONCLUSION: Spiral CT of the liver with thin collimation and image reconstruction in combination with section overlap are helpful to improve the sensitivity and reliability in detecting of SHCC.

POSTER 0903 Current management of complex biliary hilar strictures: retrospective analysis of 11 cases

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INTRODUCTION: Non-surgical palliation of unresectable, complex, malignant, hilar strictures via percutaneous insertion of metallic biliary stents is a reccognized procedure. ERCP is often unsuccessful and inappropriate in such cases. MRCP is invaluable in allowing assessment of complex strictures and in demonstrating the extent of

segmental duct involvement prior to percutaneous intervention. It identifies the level of the stricture, characterizes the cause and helps to provide the additional information necessary for therapeutic planning. Multiple stents reduce the incidence of cholangitis from potentially undrained segments. METHODS: From March 1999 to February 2001, 11 patients with complex malignant hilar obstruction were palliated via multiple percutaneous endoprostheses. Previous MRCP was obtained in nine cases. The underlying diagnoses included colorectal metastases (4), cholangiocarcinoma (4), gall bladder carcinoma (1), hepatocellular carcinoma (1) and an unknown primary (1). RESULTS: All patients had successful procedures, with a total of 37 stents being used in 11 patients (5 male:6 female; 2–3 stents per patient). Complications occurred in four patients, including infection (3) and bleeding (2). Stent occlusion requiring re-intervention occurred in only two cases (mean time 9.5 months). The 30-day mortality was 18%, with a mean survival of 5.8 months (range 2–23 months). CONCLUSION: Management of complex hilar strictures is difficult. MRCP is invaluable to assess and plan procedures. Extensive intrahepatic ductal involvement makes PTC preferable to ERCP. Multiple stents may be required to alleviate jaundice, symptoms and to eradicate sepsis.

POSTER 0904 Does intravenous glucagon improve common bile duct visualization during MRCP? Results in 42 patients

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PURPOSE: To establish whether intravenous glucagon administration (IVGA) improves visualization of the common bile duct (CBD) and ampulla during magnetic resonance cholangiopancreatography (MRCP). MATERIALS AND METHODS: 42 consecutive patients (16 male, 26 female; median age 68 years) with clinical evidence of choledocholithiasis were included in the study. Patients with diabetes mellitus were excluded. Patients were scanned in a 1 T MR scanner with a body coil, and a TSE sequence (HASTE) was used to obtain T_2 weighted images through the biliary tree. Maximum intensity projections (MIPs) were obtained to provide optimum demonstration of the CBD and ampulla. Images were obtained prior to and then 1 min, 3 min and 5 min post IVGA. The MIPs were reviewed blindly by three radiologists and were evaluated using a grading system and a consensus grading was reached. RESULTS: MRCP demonstrated CBD or ampullary calculi in 15 patients, although calculi were only seen post IVGA in 3 of these. A stricture was seen in one patient, with normal ducts in the remainder. CBD visualization was considered diagnostic in 32/42 patients pre IVGA and in 40/42 patients post IVGA, with ampullary visualization diagnostic in 15/42 pre IVGA and 33/42 post IVGA. 12 patients proceeded to either surgery or ERCP, with 100% correlation with post-IVGA MRCP findings. CONCLUSION: In this study, intravenous glucagon improved visualization of the CBD and ampulla during MRCP and allowed identification of duct calculi in three additional patients. Glucagon has a good safety profile and its use should be considered in patients undergoing MRCP.

POSTER 0905 Detection of small focus hepatic metastasis using spiral CT and imaging reconstruction

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PURPOSE: To evaluate the value of spiral CT with 2.5 mm collimation and image reconstruction for the detection of small focus of hepatic metastasis. MATERIAL AND METHODS: The whole liver was scanned in 16 cases of hepatic metastasis with 2.5 mm collimation, beginning at 55–65 s (portal vein phase) after administration of contrast material in a cubical vein. The same data set was used to performed reconstruction with 2.5 mm, 5.0 mm and 7.5 mm section thickness (ST) with 50% section overlap. Lesions were divided into three groups according to their diameter (=10 mm, 11–20mm and 21 30 mm). Each set of images was evaluated to determine lesion detection and was further analysed statistically. RESULTS: The sensitivity, number detected and margin demonstration of lesions with a diameter =10 mm was significantly different in each set of images ($p<0.01$). However, for 21–30 mm diameter lesions there was no significant difference ($p>0.05$). For 11–20 mm lesions, a statistical difference was found between images with 2.5 mm and 7.5 mm ST ($p<0.01$). CONCLUSION: Spiral CT scanning of the liver with 2.5 mm collimation and image reconstruction with section overlap is helpful to improve detection of small metastasis lesions.

POSTER 0906 Spiral CT cholangiography in the investigation of the biliary tree: an alternative to ERCP

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PURPOSE: We describe a working strategy for investigation of the potentially abnormal biliary tree. Spiral CT was utilized in patients without significant biliary dilatation (especially post pancreatitis) who may have small common duct calculi and/or deranged LFTs and in whom ERCP represents a significant risk (of infection or perforation). METHODS: Our technique required a fasting patient who commenced a Biloscopin (meglumine iotroxate) 105 mg 100 ml^{-1} intravenous infusion running over 1 h. Using a Marconi CT Twin Flash scanner, the patient was scanned supine in suspended respiration using 2.5 mm collimation, 2 mm reconstructions at a pitch of 1.5 with a scan time of approximately 20 s. Images were viewed in axial and 3D MIP reconstructed formats. RESULTS: 25 patients have been scanned to date. No patient had adverse reactions to contrast media. Biliary contrast was suboptimal in two patients with hepatic dysfunction and low biliary excretion of contrast media. DISCUSSION: This technique has proven a useful adjunct to ultrasound and ERCP. It is cheaper and faster than ERCP and it is non-invasive, although it does not offer the facility for biopsy or intervention. It may be a more appropriate investigation than MRCP where the lack of a high field strength magnet and optimum coils confer inferior spatial resolution compared with spiral CT. Our results show that spiral CT cholangiography offers a useful alternative to ERCP and MRCP in this group of patients in whom it has proven to be the investigation of choice.

Paediatrics

POSTER 1101 The os subfibulare in children: its evolution

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PURPOSE: To demonstrate evolution of the os subfibulare from an avulsion fracture of the fibula. A number of different bones, all with well defined cortices and marginally juxtaposed to the bones of the foot and ankle have been described. These accessory bones, often noted incidentally on radiographs, are thought to represent failure of an accessory ossification centre to unite with the main bone and are considered to be normal variants that may simulate disease. MATERIALS AND METHODS: Two consultant radiologists retrospectively reviewed all radiographs of fibular fractures that were reported from January to December 2000. RESULTS: We present a series of radiographs taken following trauma, the so called "Big Bang" to the ankle, that demonstrate an avulsion fracture of the fibula and evolution of a corticated "accessory ossicle". CONCLUSIONS: Avulsion fractures occur in childhood and adolescence at the origin or insertion of muscles or ligaments. In conjunction with a supination–inversion injury to the ankle in children, a bony fragment may be avulsed from the tip of the fibula, usually at the attachment of the anterior talofibular ligament. Children with recurrent symptoms after ankle injuries and a bony fragment close to the tip of the fibula have been reported to have been successfully treated by excision of the fragment. The os subfibulare may represent such an avulsion fracture of the tip of the fibula owing to supination–inversion ankle injuries sustained as a child.

POSTER 1102 Acute limb ischaemia in children: a retrospective study and pictorial review

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INTRODUCTION: Acute limb ischaemia (ALI) in children is uncommon and most reported cases follow femoral artery catheterization. The purpose of this paper is to present our recent 24-month experience and to outline our angiographic and thrombolytic practice in such cases. MATERIALS AND METHODS: A retrospective study covering a 24-month period ending August 2001 was carried out on 13

consecutive patients (age 2 days to 15 years) referred to radiology with ALI (8 lower and 5 upper limb events). Angiography was carried out in 11/13 patients (catheter angiography 9, catheter and MR angiography 4, MR angiography 2) and Doppler ultrasound in 6/13. IV heparin was given in 11/13 patients (1 commenced on warfarin). Thrombolytics were used in 5/13 (locally 2, systemically 3), intra-arterial vasodilators in 7/13, intravenous prostacyclin in 7/13, and 5 were started on oral steroids. RESULTS: ALI occurred after transarterial procedures in 5 patients, arterial surgery in 2, trauma in 1, non-infective vasculopathies in 3, venous sclerotherapy in 1 and idiopathic in 1. Limb threatening was present in 4/13 cases. Ischaemia was secondary to thrombosis ± embolism in 7, aneurysmal disease and thrombosis in 2, vessel wall inflammation and thrombosis in 2, and arterial dissection ± embolism in 2. Surgery was under taken in 8 (revascularization 6, amputation 2). 5 were treated conservatively. Systemic thrombolysis was effective in 2/3 and local thrombolysis had some beneficial effect in 1/2. CONCLUSIONS: Vascular interventional procedures are the commonest cause of ALI in infants and children, particularly those in the neonatal period. Inflammatory vasculopathies, however, can lead to limb threatening and their diagnosis should be considered when there is no history of vascular intervention.

POSTER 1103 Mediastinal foregut duplication cysts: a pictorial review

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Congenital cysts of the embryological foregut include bronchogenic, oesophageal duplication, gastric and enteric duplication and neuroenteric cysts. Histologically, the lesions are often mixed and the term "foregut duplication cysts" is now preferred. Mediastinal foregut duplication cysts are usually solitary asymptomatic masses, but may present with airway obstruction early in life. The cysts are typically in the carinal region but can occur in the paratracheal, paraoesophageal and hilar regions as well as in the neck. Scoliosis due to vertebral abnormalities may be the presenting feature and they may cause dysphagia, pain or other symptoms owing to adjacent structure compression. Ectopic gastric mucosa within the cyst can cause haemorrhage or perforation. Radiological signs of these cysts may be very subtle. Plain films may be normal, but large lesions may be visible as unilocular, spherical or oval masses. Calcification is rare. Contrast studies typically show posterior displacement of the oesophagus and anterior displacement of the trachea and carina, displacements rarely seen with other lesions except ectopic thyroid and an aberrant left pulmonary artery. CT and MRI typically reveal a thin-walled, fluid-filled cyst with uniform attenuation and signal characteristics. Four cases of mediastinal foregut duplication cysts are presented (mean age 3.25 years, range 4 weeks to 9.5 years) illustrating characteristic appearances on chest X-ray, contrast studies, CT and MRI.

POSTER 1104 The imaging characteristics of simple and complicated intussusception: correlation with surgical findings

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PURPOSE: To present the imaging characteristics of surgically proven intussusception and to specifically identify signs suggesting complications of intussusception. MATERIALS AND METHODS: The radiology and clinical databases were reviewed to identify patients where a surgically proven diagnosis of intussusception was established. Findings on barium enema, ultrasound and CT were correlated with the appearances of intussusception at surgery, and special attention was directed to determine signs suggestive of complications. RESULTS: Surgically proven small bowel (n=2), ileocolic (n=1) and colocolic (n=1) intussusception were identified. The characteristic ultrasound and CT findings of simple intussusception are presented. In complicated intussusception, findings suggesting a low probably of hydrostatic reduction on barium enema are manifest as the dissection sign with barium between the outer intersussipiens and the middle returning wall, and lack of coil spring appearance of the entering tube, which at surgery was as a result of an oedematous obstructing entering tube. The presence of vascular compromise was suggested on CT by (1) a hypodense layer between the outer intersussipiens and the middle returning wall (thought to indicate mural wall oedema of the returning wall) and (2) a fluid collection in the space between the returning wall and the entering wall (thought to indicate trapped peritoneal fluid). These findings were confirmed at surgery. CONCLUSION: Ultrasound, CT and barium enema are very useful imaging modalities in diagnosing intussusception. Complications of intussusception suggesting a low probability of hydrostatic reduction and vascular compromise are readily identifiable by their imaging characteristics.

POSTER 1105 WIP: Early experience of MR digital subtraction angiography for the assessment of paediatric head and neck vascular abnormalities

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AIM: To evaluate a new dynamic MR angiographic method in the assessment of paediatric vascular abnormalities. BACKGROUND: Paediatric head and neck vascular abnormalities are common yet difficult to assess. Conventional catheter angiography has been the mainstay for the evaluation of these lesions. Recent advances in MRI have produced novel imaging techniques (MR digital subtraction angiography (MR-DSA)) that could be valuable in non-invasive assessment of vascular abnormalities. We present our early experience of MR-DSA in the diagnosis and assessment of paediatric head and neck vascular abnormalities. PATIENTS AND METHOD: A total of 7 patients (aged 2 months to 16 years) with a range of known or suspected vascular abnormalities was studied. MR-DSA TECHNIQUE: Routine MRI and MR angiography was supplemented with MR-DSA, which is a thick slice (6–10 mm) selective RF spoiled fast gradient echo sequence (RF- FAST). 60 frames (1 s^{-1}) were acquired, in 2–3 planes, before and during passage of Gd-DTPA bolus. The images were subtracted and viewed as a video-inverted cine loop. RESULTS: MR-DSA was performed successfully in all patients. Two patients with known Sturge–Weber Syndrome were shown to have choroidal angioma ipsilateral to the brain abnormalities. In one case, a child with a suspected low flow vascular lesion of the scalp, MR-DSA showed the presence of a high flow lesion and excluded intracranial extension. In three children, high flow vascular lesions (two eyelid, one parotid) were shown on MR-DSA. In all of these, the high flow state was not suspected clinically. CONCLUSION: Our early experience suggests that MR-DSA allows accurate assessment of paediatric head and neck vascular abnormalities.

POSTER 1106 WIP: Ultrasound study of the gall bladder during neonatal sepsis

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Neonatal infection is a major cause of morbidity and mortality in the neonatal intensive care unit. Cholestasis is one manifestation of infection that may correlate with the severity of illness and participate in the complexity of management. A few data have been published regarding the effect of neonatal sepsis on the gall bladder. The aim of this study is to evaluate the effect of infection on the ultrasound findings of the gall bladder and to relate the finding to severity of infection and microorganisms as well as to mortality and morbidity. A total of 35 septic newborn infants as well as 6 reference cases were included in this work. Inclusion criteria included clinical, haematological and bacterial evidence of sepsis. Exclusion criteria were other cases of neonatal cholestasis and congenital anomalies. All cases were subjected to full history taking, physical examination, including gestational age, and Apgar score and were managed according to our routine. Laboratory investigations included CBC, blood gases and electrolytes, blood glucose, liver function tests, and total and direct bilirubin. Our results showed a significant increase in the mean values of direct serum bilirubin (p<0.001). There was a significant increase in the size of the gall bladder among the septic newborns compared with control cases (p<0.001). Enlargement was correlated with the severity of infection, serum bilirubin, gestational age and post-natal age. There was also an increase in the thickness of the wall of the gall bladder. Sludge formation was also detected in 15% of cases. One case showed perforation and biliary perotinitis. Gall stone was found in one of the studied cases. Cholecystitis should not be overlooked by the neonatologist when evaluating newborn infants with septicaemia.

Neurology

POSTER 1201 "To screen or not to screen": high-risk families for colloid cysts of the third ventricle

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Colloid cysts of the third ventricle are benign and curable neoplasms. However, they can cause significant morbidity such as acute hydrocephalus and brain herniation, and can sometimes be fatal. The aetiopathogenesis of these neoplasms is now widely accepted to be congenital. We present the seventh case of familial incidence (in a father and son) of colloid cysts. Together with the previous six, this highlights the increasing numbers of such familial incidences and makes genetic predisposition a good possibility. Neuroimaging by CT or MRI is a sensitive diagnostic tool. There is a high-risk population (families with two or more confirmed cases) for a benign yet serious condition. Screening by neuroimaging should have been a presumption. However, such screening of asymptomatic family members is not without significant shortcomings. "To screen or not to screen"—this is discussed.

POSTER 1202 Interobserver error for three radiologists reporting CT scans in stroke

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PURPOSE: Assessment of CT scans in acute stroke can be difficult when considering the issue regarding haemorrhagic infarction or haemorrhagic transition of an infarct compared with primary intraparenchymal haemorrhage. To evaluate these difficulties, three radiologists agreed to report 100 consecutive CT scans reported clinically as showing intraparenchymal haemorrhage. METHODS: The three radiologists reviewed scans independently and for each scan completed a tick sheet proforma. 72 scans were interpreted in this manner. The results were analysed using Kappa for multiple raters. Agreement between two radiologists was described using percentages and was analysed using Kappa. RESULTS: It was found that all three radiologists agreed for 70.8% of diagnoses. For primary intracerebral haemorrhage, all three agreed on only 63.2% of occasions. All three agreed for haemorrhagic transition on a transformation on an infarct in only 1.5% of cases. Analysis showing agreement between combinations of two radiologists increased the percentages for primary intracerebral haemorrhage by 17.6% and for haemorrhagic transformation by 8.8%. Kappa values for radiologist pairs varied between 0.4% and 0.6%. CONCLUSION: There is, therefore, overall poor agreement regarding the diagnosis of haemorrhagic transformation of infarct. The study showed that the longer the delay between acute presentation and performance of CT scanning, the more difficult the diagnosis was to establish and the more likely it was to have disagreement between radiologists. We discuss the imaging features that may allow differentiation of these diagnoses and consider the implications for scan interpretation.

POSTER 1203 Radiology of the orbit: a pictorial review

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We present a comprehensive array of orbital pathologies on CT, MRI and ultrasound. We discuss the differential diagnoses of orbital lesions and will outline a method to facilitate making the correct diagnoses in the majority of cases.

POSTER 1204 Is there a role for contrast agents with high relaxivity in MRI of the CNS?

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INTRODUCTION: The T1 relaxation rate of Gd-BOPTA in blood (9.7 mM-1 s-1) is greater than that of other available gadolinium agents owing to a capacity of the Gd-BOPTA molecule for weak and transient interaction with serum albumin. This property might improve the visualization of small or poorly enhancing lesions for which BBB breakdown is minimal. METHODS AND MATERIALS: The enhancement mechanism of Gd-BOPTA is presented along with the principal results from a phase II trial in patients with CNS metastases and two phase III trials in which Gd-BOPTA was compared with Gd-DTPA-BMA in patients with CNS pathology. The effect of Gd-BOPTA on signal intensity, lesion enhancement and diagnosis, as well as patient management is discussed. RESULTS: In patients with CNS metastases, a dose of 0.1 mmol kg^{-1} Gd-BOPTA is sufficient for most clinical situations, but an increased dose of 0.2 mmol kg^{-1} may provide additional information in certain cases. A cumulative dose of 0.3 mmol kg^{-1} Gd-BOPTA does not provide any further information beyond that available with 0.2 mmol kg^{-1} Gd-BOPTA. The Phase III trials demonstrated that whereas Gd-BOPTA and Gd-DTPA-BMA provide equivalent diagnostic information at a single dose of 0.1 mmol kg^{-1}, a cumulative dose of 0.2 mmol kg^{-1} Gd-BOPTA is diagnostically equivalent to a cumulative dose of 0.3 mmol kg^{-1} Gd-DTPA-BMA. DISCUSSION: Gd-BOPTA behaves in a similar manner to Gd-DTPA-BMA and other gadolinium chelates at a dose of 0.1 mmol kg^{-1}. However, the increased relaxivity of this agent compared with other agents is of significant benefit when the need is for higher doses of contrast medium.

POSTER 1205 A visualization system for the clinical evaluation of cerebral aneurysms from MRA data

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The endovascular surgical planning tool has been developed as part of a clinical visualization project. The software has been designed to meet the specific needs of interventional neuroradiologists evaluating the suitability of intracranial aneurysms for endovascular coiling and also for planning the procedure. Providing rapid (real-time) interaction with high resolution isosurfaces derived from time-of-flight (ToF) magnetic resonance angiography (MRA) data will enable the clinician to quickly assess the ability of the aneurysm to accept a coil, with greater reliability than existing 2D film techniques. Noise reduction methods can be applied to the data, from which multiple crops can be selected and visualized through an easy to use and intuitive interface. Simulating the interface and imaging of the C-arm angiography system used during the procedure allows the clinician to evaluate various surgical strategies. The clinician can use the software to find the C-arm rotations for the projections that they require during the actual procedure, potentially reducing procedure times and therefore patient radiation dosage. Results can be exported as images and 3D models for dissemination and collaborative purposes. The first release of the software is currently undergoing clinical evaluation.

POSTER 1206 Cranial and spinal manifestations of von Hippel-Lindau disease: a pictorial review of MRI and histological appearances

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Von Hippel-Lindau (VHL) disease is a rare familial condition. Whilst the MRI appearances of cerebellar haemangioblastomas that characterize this condition are widely recognized, some of the supratentorial and particularly the spinal manifestations are less widely appreciated. From our extensive experience of imaging VHL disease, cases are presented to illustrate the wide anatomical distribution of disease that can occur in the supratentorial and spinal intramedullary, intradural, extramedullary and extradural compartments. The appearances of enhancing/non-enhancing disease, cord compression, nodular disease involving the cauda equina and of recurrent post-operative disease are also shown. The histological features of VHL disease are also presented. LEARNING POINT: Recognition of the wide anatomical distribution and different MRI appearances of VHL disease in the spine, together with the histological features.

POSTER 1207 Acute headache and subarachnoid haemorrhage: a retrospective review of CT and lumbar puncture findings

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PURPOSE: Acute severe headache of recent onset is a common presenting complaint to the A&E department. Without an obvious immediate cause, and in the presence of focal neurological signs, subarachnoid haemorrhage (SAH) must be considered in the differential diagnosis. Without accompanying clinical findings, the diagnosis is often more difficult. Cranial CT and, where appropriate, lumbar puncture (LP) are important diagnostic tools for SAH. METHODS: We performed a retrospective review over a 1-year period of all patients referred from a major A&E department with clinically suspected SAH. 128 consecutive patients were included in the study. Patients were divided into three groups according to CT results: diagnostic of SAH (19), abnormal without evidence of SAH (18) and normal (91). The clinical management of the latter group was analysed, with particular emphasis on the performance and results of LP. In those patients with a diagnosis of SAH on LP, their initial CT examination was re-assessed in a double-blind review. It was noted that a significant number of patients with a normal CT examination did not have a LP. We conclude that acute severe headache clinically suggestive of SAH should be initially investigated by CT, and by LP if the former is negative. In addition, we review the differential diagnosis of SAH and the CT findings.

POSTER 1208 A comprehensive review of proton magnetic resonance spectroscopy studies in dementia and Parkinson's disease

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METHODS: We reviewed the literature on proton magnetic resonance spectroscopy (MRS) in dementia and Parkinson's disease (PD), and quantitatively compared the reported values of the markers N-acetyl aspartate (NAA), choline and myoinositol between control and disease groups. We analysed a total of 27 reports in dementia (21 of which included Alzheimer's disease (AD) patients and 7 included vascular dementia). RESULTS: Combining the quantitative data from these reports showed a relative decrease of 15% in NAA level in the temporal lobe tissue in AD compared with controls. The rest of the brain showed a seemingly uniform 10% decrease in NAA levels in AD compared with controls. Myoinositol was raised by about 15%, again uniformly throughout the brain. CONCLUSIONS: There is evidence that the degree of change in myoinositol and NAA may indicate the progression of the disease. We found 15 reports of MRS in PD, which show a small decrease (5%) in the NAA level in the lentiform nucleus compared with controls. In progressive supranuclear palsy (PSP), there is a greater decrease in NAA levels in the frontal region and the lentiform nucleus. This may aid in the diagnosis of PSP. Further research is needed to determine spectroscopic changes in other dementias, how markers change with disease progression and to establish clinical utility.

POSTER 1209 *In vivo* proton MR spectroscopy techniques and applications in neuroradiology

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INTRODUCTION: *In vivo* proton MR spectroscopy (^{1}H-MRS) is a powerful technique of obtaining biochemical information non-invasively. The technique has found extensive application in the diagnosis and management of various disorders affecting the human central nervous system (CNS). While the spectra are fairly easy to interpret, obtaining a good spectrum requires many technical considerations. The following presentation discusses various technical aspects, with clinical examples of *in vivo* ^{1}H-MRS as applied to neuroradiology. MATERIALS AND METHODS: *In vivo* MRS was conducted on a 1.5 T superconducting system and included patients with both focal and diffuse neurological diseases. More than 1000 spectra have been obtained in over 4000 MR investigations in a 3-year period. Single voxel spectroscopy (SVS) and chemical shift imaging (CSI) techniques have both been employed, at various TE times of 20 ms, 135 ms and 270 ms. The spectra were evaluated for signal-to-noise ratio (SNR), baseline evolution, water suppression and resolution of peaks. RESULTS: The spectra with adequate water suppression and shimming demonstrated sharper and better resolved peaks, with no line widening and straighter baselines. Spectra obtained from lesions showing susceptibility effects on imaging (*e.g.* haemorrhage) were poor in resolution despite adequate water suppression. 2D CSI spectra at 135 ms were most useful in focal lesions such as granulomas and tumours. Outer volume contamination was less, SNRs were better due to adjacent voxel comparisons, which helped elimination of fat contamination from scalp and skull base and assisted site-specific image-guided biopsies. Furthermore, metabolite maps from MRS studies helped in therapeutic monitoring of lesions. SVS also demonstrated well resolved peaks in lesions >2 cm in size. CONCLUSIONS: *In vivo* ^{1}H-MRS is a useful non-invasive technique to investigate lesions of the human CNS. Adequate shimming, water suppression, right choice of TE and 2D CSI volume localization techniques are contributory to a well resolved proton spectrum.

POSTER 1210 How well do we investigate patients with suspected subarachnoid haemorrhage: the continuing need for CSF investigations

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PURPOSE: There are established guidelines for the diagnosis of subarachnoid haemorrhage (SAH). It is recognized that the sensitivity of CT falls precipitously after the fifth day of ictus and there are well recognized reasons why acute SAH may be missed on CT. The guidelines recommend CSF examination in cases where CT is negative. Our study aims to show the extent of non-compliance at a neuroscience referral centre and a large DGH. METHODS: This was a prospective study at two centres. Over the period of study, all requests for suspected SAH were reviewed until 50 negative CT scans were obtained at each centre. The case notes of the 100 patients were reviewed to determine whether a LP was performed and to record the results. The time of CT in relation to ictus was also recorded. RESULTS: Our results to date show that approximately 25% of cases at the neuroscience centre did not have an LP and approximately 34% at the DGH. In six cases LP was refused. In cases where CT was negative and LP was performed, SAH was diagnosed in approximately 10%. The majority of these were diagnosed in the acute phase (0–3 days from ictus). CONCLUSION: There is significant non-compliance in following the established guidelines for the investigation of SAH. Our results suggest that some patients investigated for SAH are discharged from hospital without the diagnosis being excluded. As the primary cause of SAH is ruptured aneurysm, and because of the high morbidity/mortality associated with a second haemorrhage, this highlights a major source of concern for clinical governance.

POSTER 1211 WIP: MR diffusion tensor imaging of neocortical developmental abnormalities

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PURPOSE: Abnormalities on magnetic resonance diffusion tensor imaging (DTI) represent localized differences in water diffusivity/organization of cellular macrostructure. The aim of this work is to determine whether DTI can detect intracranial areas of abnormal neocortical development. METHODS: Eight children/young adults who were referred for MR investigation with a clinical suspicion of developmental brain abnormality underwent routine MRI plus DTI performed at 1.5 T (Eclipse, Philips Medical Systems) using a single-shot spin-echo EPI technique (TE = 125 ms; TR = 3500 ms). Six contiguous slices were acquired in the transaxial plane over the cerebrum. The DTI-specific parameters were: d = 24 ms; D = 63 ms; 6 directions with b = 100 s mm^{-2}; 72 directions with b = 1600 s mm^{-2}. DTI data were fitted to the diffusion tensor signal equations to yield the six independent diffusion tensor elements. Using the latter, maps of the trace (mean diffusivity) and relative anisotropy (RA) were calculated. RESULTS: Five of the eight patients studied showed lesions that were apparent on conventional imaging. One of these showed additional information. CONCLUSION: Focal areas of abnormal neocortical development appear to be associated with local perturbations

in water diffusivity/local cellular architecture. This detection mechanism may be of particular use in areas of microscopic abnormal neuronal invasion/development that are not detectable using a conventional imaging technique.

POSTER 1212 Dural venous sinus thrombosis: pictorial review

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Dural venous sinus thrombosis is an unusual condition that can present with unusual and variable clinical features. Late diagnosis is associated with a poor prognosis and high mortality. We present six different cases of venous sinus thrombosis. The clinical presentation varies from headaches and confusion to complete coma. We present the specific CT, MRI and angiographic findings in these cases and demonstrate the causes. MRI proved reliable in establishing the diagnosis even at an early stage. MR venography was very helpful in confirming the diagnosis in equivocal cases on standard pulse sequences. The causes in this group include mastoiditis, meningitis, cerebral abscess and Behçet's disease. We emphasize the importance of a high radiological index of suspicion in order that subtle changes are detected on imaging. The late complication of multiple haemorrhagic infarcts is also presented, which is associated with a particularly poor prognosis.

Cardiac and Angiography

POSTER 1301 MRI of surgical corrections for congenital heart disease

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This poster is a pictorial review of the common surgical corrections for congenital heart disease, illustrating some of the important complications that occur. The following conditions are reviewed: coarctation repair; tetralogy of Fallot; mustard repair for transposition of the great vessels; intracardiac/extracardiac conduits; Fontan repair. Coarctation repair: end-to-end anastomosis; subclavian flap repair; patch repair; tube graft; angioplasty. Complications include: (1) recoarctation, primarily seen with end-to-end repair; (2) patch graft dilatation and aneurysm formation; (3) tube graft restenosis or leak forming pseudoaneurysms; (4) angioplasty can cause localized dissection. Tetralogy of Fallot: intracardiac complications include: (1) pulmonary insufficiency, common with a transanular patch; (2) right ventricular and atrial dilatation; (3) ventricular septal defect: residual leak; (4) right ventricular outflow tract aneurysm due to stretching of the trananular patch. Extracardiac complications include: (1) pulmonary artery stenosis, focal or diffuse; (2) dilatation of the ascending aorta owing to an aortopathy. Mustard procedure complications include: (1) progressive RV (systemic ventricle) dilatation and dysfunction due to long-term pumping against systemic pressures; (2) baffle stenosis; (3) baffle leakage functioning like an atrial septal defect; (4) pulmonary vein stenosis. External conduit or shunt stenoses: Blalock–Taussig shunt; Waterston shunt; Pott's shunt. Upon definitive repair, these shunts are usually taken down, but if elected to be kept in place, they need to be assessed for patency or stenosis. 3D MR angiography allows a non-invasive method of evaluation. Fontan repair complications include: (1) clot formation in the Fontan circulation; (2) stenosis in the conduit; (3) decreased function of the single ventricle.

POSTER 1302 Biphasic contrast enhanced MR angiography of aortic dissection

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PURPOSE: Acute aortic type A dissection represents a life-threatening condition in which MRI plays a minor role in diagnosis since immediate surgical intervention is necessary. However, in patients with type B dissection a more conservative therapeutic approach can be adopted. Thus, a non-invasive technique for evaluation of branching vessels in the abdomen for follow-up is of clinical interest. METHODS AND MATERIALS: 17 patients with aortic dissection type B, previously diagnosed or with unclear findings from other imaging modalities, were studied by CE MRA. Gd-BOPTA at a dose of 0.1 mmol kg^{-1} BW was employed. To achieve optimal contrast enhancement of the true and false lumen, a test bolus was given since automatic techniques may fail to display contrast enhancement in the sometimes compressed true lumen. Following an unenhanced MRA sequence, two contrast enhanced sequences were acquired, each timed for optimal enhancement of either the true or the false lumen. RESULTS: Using the biphasic approach, the true and false lumens were successfully identified in 14 of 17 patients, with clear depiction of branching vessels on MIP projections. Owing to simultaneous enhancement of both the true and false lumen in two patients, evaluation of branching vessels was only possible on source images. In one patient, images were rated as non-diagnostic owing to insufficient breath-hold. CONCLUSION: CE MRA using a biphasic approach is a useful tool for follow-up of type B dissection and gives important clinical information non-invasively.

POSTER 1303 Demystifying cardiac MRI: the how, why and when of cardiac perfusion scanning

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Although invaluable in a small range of cardiac examinations, MRI has yet to be accepted into mainstream cardiology. 80% of cardiac referrals are for ischaemic heart disease and until now MRI had little offer. With the introduction of first-pass contrast enhanced myocardial perfusion scanning, this is about to change. MR perfusion can be combined with pharmacological stress, and early reports indicate sensitivities and specificities of >90% for the detection of coronary artery disease compared with PET. With the absence of ionizing radiation and its ability to provide high quality images in obese or emphysematous patients, MR perfusion suffers few of the problems of scintigraphy. The potential is enormous, yet the technique is rarely performed, even in major centres. Myocardial perfusion scanning is perceived as being complex, difficult and potentially dangerous, with lengthy post-processing needed to obtain good image quality. The aim of this exhibit is to demystify the technique with a step-by-step account of the process. We will discuss patient preparation; patient monitoring; the use of adenosine stress; the whys and wherefores of the pulse sequences chosen, image post-processing and image interpretation. Particular emphasis will be placed on potential pitfalls and how to avoid them. We will show how to perform a successful MR perfusion study, and when, with multiple illustrations in health and disease. Radiologists with an interest in cardiac imaging should consider providing this service for cardiology colleagues before cardiology colleagues provide it for themselves.

POSTER 1304 Demystifying cardiac MRI: the how, why and when of pulmonary MRA

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Contrast enhanced pulmonary MR angiography (MRA) has become a robust and reproducible tool for examination of the pulmonary vascular tree. Its multiplanar capability and high resolution allow accurate demonstration of anatomy without the need for ionizing radiation or a risky invasive procedure. In the setting of pulmonary hypertension, pulmonary MRA combined with phase contrast velocity mapping can distinguish between chronic thromboembolic disease, intracardiac shunts and by exclusion primary pulmonary hypertension. In patients with a shunt, velocity mapping not only confirms its presence but also provides absolute shunt quantification. Despite the fact pulmonary MRA can be extremely useful in patients with pulmonary hypertension, it is rarely performed outside major centres. It is perceived to be an erratic and difficult examination requiring complex post-processing to obtain good quality images. The aim of this exhibit is to demystify the technique with a step-by-step account of the process. We will discuss patient preparation, contrast medium administration, bolus timing, the whys and wherefores of the pulse sequences and parameters chosen, post-processing techniques and interpretation of the images generated. Particular emphasis will be placed on potential pitfalls and how to overcome them. We will show how to perform a successful pulmonary angiogram, with multiple illustrations of its application to patients with pulmonary hypertension.

POSTER 1305 Diagnosis of right ventricular dysplasia by MRI

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PURPOSE: To audit the firmness of a diagnosis of right ventricular dysplasia by MRI in 39 consecutive patients referred with clinical and ECG features of the disease. MATERIALS AND METHODS: A retrospective analysis of 39 cases referred for MRI examination over a 3-year period to exclude or diagnose right ventricular dysplasia was carried out. All patients had clinical symptoms and ECG evidence suggestive of the disease. MRI was carried out on a Siemens 1 T scanner with a cardiac package. Examinations were carried out using cine and static imaging and were reported by experienced cardiac radiologists. RESULTS: 17 cases were judged to be normal, 3 cases were given a definite diagnosis of right ventricular dysplasia and 19 cases were said to be indeterminate. These 19 indeterminate cases all showed one or more of the following abnormalities: (1) areas of high signal intensity in the right ventricular myocardium; (2) irregularity of the right ventricle and/or right ventricular outflow; (3) dilatation of the right ventricle; (4) abnormalities of contraction of the right ventricle; and (5) abnormalities of thickness of the right ventricular myocardium. CONCLUSION: This audit demonstrates the difficulty of diagnosis of right ventricular dysplasia and indicates that there might be a variety of findings in this condition. Double reporting or even reference centre reporting may be of value in diagnosis of this condition by MRI.

POSTER 1306 Comparison of myocardial perfusion scanning and coronary angiography in patients referred from a chest pain clinic

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AIM: To determine the accuracy and relevance of myocardial perfusion scanning in selecting patients for coronary angiography referred from a chest pain clinic. PATIENTS AND METHODS: 556 patients were referred to a new chest pain clinic over a 1-year period. 320 of these patients were referred for either exercise testing or myocardial perfusion scanning. RESULTS: Of the 273 patients who underwent exercise testing, 125 were positive, 95 were indeterminate and 53 were negative. Based on these results, 134 were referred for coronary angiography. To date, 21 angiograms were normal in these patients. 11 patients have undergone myocardial perfusion scanning and angiography; 9 patients with abnormal scans had abnormal coronary angiograms, with concordance of disease findings in 8/9. Two patients with normal scans had normal coronary angiography. CONCLUSION: This series demonstrates that myocardial perfusion scanning has a useful role in determining whether patients referred from a chest pain clinic should undergo coronary angiography.

POSTER 1307 The spectrum of acute traumatic and non-traumatic injury to the thoracic aorta: a pictorial review

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PURPOSE: To describe the spectrum of imaging findings in acute injury to the thoracic aorta, both of traumatic and non-traumatic aetiology. MATERIALS AND METHODS: Imaging findings and surgical records of patients presenting with acute aortic injury diagnosed over a 3-year period were reviewed. RESULTS: We present a pictorial review showing the spectrum of appearances of acute injury to the thoracic aorta. Non-traumatic cases presenting acutely include penetrating thoracic ulcer, intramural aortic haematoma, thoracic aortic dissection and complications of thoracic aneurysm formation. Traumatic cases include transection of the thoracic aorta. CT and angiographic findings in these cases will be presented. CONCLUSIONS: Imaging plays a vital role in the assessment of acute traumatic and non-traumatic injury to the thoracic aorta. Making the correct diagnosis is essential as it influences subsequent surgical management.

POSTER 1308 Multislice spiral CT in congenital heart disease

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In a series of 36 patients, multislice spiral CT (MSCT) has provided important and sometimes critical information. No ECG gating was used. 3D image reconstruction was used in all. The speed of the examination allowed children to be imaged under supervised sedation; most of these children would have required general anaesthesia for MRI. Infants were usually studied under general anaesthesia. 1 mm collimation and reconstruction allowed for excellent spatial resolution in the smaller patient. Visualization of great vessel anatomy was the most frequent reason for MSCT. Four groups will be presented. (a) Coarctation of the aorta: good anatomical display of recoarctation with or without aneurysm formation was achieved in all cases, including one of acute rupture of a complex aneurysm. There was excellent demonstration of associated arch hypoplasia in infants. (b) Aortic arch anomalies: using colour-coded 3D reconstruction of the arch, airways and oesophagus, pre-surgical information was optimal. In particular, the contribution of any aneurysm of an aberrant subclavian artery was very clear. (c) Pulmonary artery anatomy: the size and position of complex pulmonary arterial connections, or of isolated arteries, was well seen. One case of truncus arteriosus yielded diagnostic images when prior angiography and MRI had been suboptimal. In two cases of dysmorphic right lung, subsequent angiography did not provide any further information. (d) Intracardiac anatomy: in larger patients with poor echo windows, the anatomy of the right atrium and pulmonary arteries in Fontan repair was usefully demonstrated.

POSTER 1309 Multislice CT angiography in peripheral vascular disease: early experiences in Liverpool

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INTRODUCTION: Since the introduction of multislice CT, CT angiography (CTA) of the lower limbs has become feasible. We present our initial experience of CTA in the management of peripheral vascular disease. METHODS: 10 patients (age 54–82 years) underwent CTA. Studies were performed on a quad spiral 0.5 s rotation machine using 130 ml of iodinated contrast 320 mg ml^{-1} IV at 3 ml s^{-1}. Images were reconstructed to 3 mm slice thickness from 2.5 mm collimation, 1.5 mm increment and a pitch of 4 with 45 s delay. The distal aorta to mid tibial arteries were imaged. Additional delayed images limited to the femoropopliteal and tibial vessels were obtained in three patients as flow was slow. Reformed MIPs and MPRs were comparable with conventional angiography. RESULTS: Two patients had conventional angiography. Occlusion of both iliacs and SFAs were identified in one patient and an EIA stenosis and CFA occlusion were identified in the other on CTA. Both were managed surgically. Brachial artery punctures were avoided in three patients as iliac occlusions or complications of grafts were demonstrated on CTA. Two patients had surgery and one had iliac angioplasty. One patient with a mediastinal mass had a CT thorax in addition, without further contrast medium. Five patients with cardiac diseases had peripheral vascular problems. No intervention was indicated in four patients, avoiding conventional angiography. The fifth patient had bilateral iliac stenoses. CONCLUSION: CTA provides a less invasive alternative to arterial angiography, particularly when a brachial approach would be necessary. It is cheaper, faster and becoming more available than MRA.

POSTER 1310 Cardiac SPECT: what needs to go right?

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AIM: To determine the factors affecting final image quality after processing cardiac SPECT data, as shown by examples of their effects on reconstruction. METHOD: Quality of data, attenuation, matrix size, distance of camera head, movement, decay correction, camera uniformity, correction for offset in centre of rotation, collimator type, energy window and type of filter were all investigated. Data from a

torso phantom (incorporating a cardiac insert) with $^{99}Tc^{m}$ concentrations in different compartments simulating those from patients were acquired using a dual-headed SPECT camera (Elscint) in L-mode. The raw data were processed using filtered back projection on three workstations: HERMES, EXPERT and GENIE. The final images were compared against the (known) activity distribution in the phantom. RESULTS: Data quality, filter type, matrix size and tissue attenuation altered the reconstructed activity distribution. Camera non-uniformity, movement and centre of rotation offset produced gross artefacts. Changing from high resolution to a general purpose collimator resulted in increased blurring at a distance. CONCLUSION: Valid data acquisition and optimum processing are basic to cardiac SPECT image interpretation.

Interventional and Angiography

POSTER 1401 Resection of soft tissue sarcomas with Intraoperative MR guidance

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AIM: To evaluate the role of intraoperative image guidance in soft tissue sarcoma surgery. INTRODUCTION: The introduction of open access MRI scanners has led to an important advance in image guided surgery. The greatest application is likely to be in the resection of malignant tumours. Soft tissue sarcoma is an excellent example of a tumour that is well visualized by MRI but in which adequate surgical resection margins may be difficult to judge owing to the presence of microscopic tumour extensions. MATERIAL AND METHOD: This study is the first report of MR guided sarcoma surgery. Seven patients with the skin sarcoma dermatofibrosarcoma protuberans underwent MR guided resection. We describe a method of determining adequate resection margins with pre-operative MRI. Adequate resection margins were planned using STIR sequences and intraoperative imaging was used to confirm complete tumour excision. RESULTS: In each case the extent of the tumour at MRI was greater than suggested by clinical examination. Histological examination confirmed clear surgical margins of at least 1 cm in each case. All seven procedures were undertaken without anaesthetic or surgical complication. CONCLUSION: MR guided surgery of soft tissue malignancy represents a single procedure that ensures complete excision and therefore reduces the rate of a second operation. Surgical excision is tailored in all directions to reduce the amount of non-involved tissue removed and the need for subsequent reconstructive surgery with its morbidity. We believe this technique may reduce the incidence of local recurrence and specimen margins positive for tumour following resection, and consequently the need for further excision surgery.

POSTER 1402 Percutaneous laser vaporization in the treatment of intervertebral disc hernias

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PURPOSE: The purpose of this work is to study the ability of laser vaporization in the treatment of intervertebral disc hernias under helical CT control. MATERIALS AND METHODS: 135 operations under CT control were performed in patients with discogenic lumbosacralic radiculitis. The results of transcutaneous destruction of interveretebral discs with a Neodim YAG laser medialis fiberton 5060/5100 (Dornier) were analysed. The dates of anamnesis, clinical signs and the results of MR tomography were assessed. In 42.3% of cases the sequestrated disc hernias were observed (8 patients had two-level hernias). In all patients, transcutaneous vaporization was performed under helical CT control. RESULTS AND DISCUSSION: Reducing or vanishing radicular pain syndrome (from score 8 to score 1 on an analogic scale) was observed in 82.2% of cases. It was confirmed objectively by research of stretch symptoms by increasing movement amplitude for 15–30° in 80.9% of patients. 3–4 h after operative intervention, all patients were allowed to get up in a semi-strict bandage. During control MRT 2 months after vaporization, lessening of hernias was absent. In 27 observations hernia sizes were unchanged in spite of decreasing pain (although hypoesthesia and less reflections were noticed). CONCLUSION: As our research shows, transcutaneous laser vaporization of degenerated discs is an effective minimally invasive method of treatment of discogenic radicular disorders. The operation is more expedient in cases of absent of radiculoishaemic symptoms.

POSTER 1403 The role of pre-procedural CT angiography in patient selection for endovascular stent insertion

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INTRODUCTION: The feasibility of endovascular stent exclusion of abdominal aortic aneurysms varies according to three parameters: the anatomy of the aneurysm, stent-graft variables and the patient's eligibility for the procedure. The aim of our study was to demonstrate the role of CT angiography in depicting the anatomic variables that preclude stent deployment. MATERIALS AND METHODS: A retrospective analysis of 110 patients who were considered for endovascular treatment between October 1998 and June 2001 was completed. Aortic dimensions were measured in concordance with those of the EVAR trial. RESULTS: 12 of the 110 patients were considered suitable for stent deployment. The mean proximal neck length was 2.4 cm, aneurysm width was 5.1 cm and distal neck length was 1.9 cm. Reasons for exclusion included thrombus, unfavourable width/angulation of the proximal neck and aneurysm sac, or tortuosity and/or aneurysm formation of the iliac vessels. CONCLUSION: CT angiography has an important role to play not only in the selection but also the exclusion of patients for stent deployment.

POSTER 1404 Embolisation of the thoracic duct: a new minimally invasive approach for managing chylothorax

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AIM: To describe for the first time in UK a technique for transabdominal translymphatic occlusion of the thoracic duct for management of chylothorax. PATIENT AND METHOD: The patient was a 52 years male smoker with moderate obstructive lung disease. He underwent a palliative transhiatal oesophageal resection for pT2, N2 carcinoma of the oesophagus. Post-operatively the patient developed a high output thoracic duct fistula from injury to the thoracic duct, which failed to respond to conservative treatment. The thoracic duct was occluded using the following technique: Step 1, pedal lymphangiography; Step 2, cannulation of the thoracic duct under fluoroscopy; Step 3: transabdominal catheter lymphography; Step 4, embolisation using platinum coils to block the duct and stop the leak. CONCLUSION: Chylothorax is potentially a life threatening disorder with profound respiratory, nutritional and immunological consequences. Early surgical intervention for post-oesophagectomy chylothorax is advised and we recommend embolisation of the thoracic duct as first line of treatment for a high output chylous fistula.

POSTER 1405 What's the bleeding point?

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PURPOSE: Angiographic demonstration of a bleeding point is an important component of management in the patient with suspected active haemorrhage. The results of angiography will frequently influence subsequent treatment, either embolisation or surgery. METHOD: We present a pictorial review of a number of haemodynamically unstable patients who failed to respond to medical management. Despite differing sources of haemorrhage (gastrointestinal both upper and lower, renal, liver, pelvic) and varying aetiologies of haemorrhage (spontaneous such as angiodysplasia, trauma and iatrogenic), the techniques for demonstrating a bleeding point and subsequent embolisation are similar. In all cases, angiography was performed using a Seldinger technique at the groin. Flush angiography, aortic angiography or selective angiography of the relevant organ was performed to demonstrate the bleeding point. In all but one case, selective catheterization of the bleeding vessel was performed with subsequent embolisation. A combination of coils and particles was used to achieve haemostasis. Further details of the interventional techniques common to all cases will be given, with important technical considerations relevant to individual cases. DISCUSSION: Demonstration of a bleeding point is a prerequisite for embolisation and to direct surgery in critical patients who are actively bleeding.

POSTER 1406 3D rotational angiography of the renal transplant artery: technique, preliminary results and dose measurements

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PURPOSE: To describe the technique of 3D rotational angiography (3D-RA) in the imaging of the renal transplant artery and to present preliminary results. The use of 3D-RA in diagnostic and endovascular therapeutic procedures is well established in neuroradiology. However, the role of this imaging technique has yet to be established in the renal transplant artery. MATERIALS AND METHODS: 3D-RA was performed on a cohort of symptomatic patients being investigated for renal transplant artery stenoses and re-stenoses. A 3D-RA protocol was used. This involves acquiring images over a 180° arc at a speed of 30° s^{-1}. The acquisition is a single breath-hold technique with no collimation or filters and use of maximum focus-to-object distance. 48 ml of half strength Iohexol350 (Omnipaque350) is infused with a pump at a rate of 8 ml s^{-1} with the catheter positioned in the ipsilateral common iliac artery. The total time required is 8 s; when obtaining images for 3D reconstruction no mask images are required. Images were obtained on an Integris Allura Monoplane Vx000/BVx000 imaging system (Philips Medical Systems, The Netherlands) and viewed on an Integris 3D-RA workstation. The radiation dose was measured and compared with a standard digital subtraction angiogram (DSA) using a phantom. RESULTS: Two patients with long and tortuous transplant arteries have so far been investigated. In both patients the renal transplant artery was clearly visualized throughout its length and there were no focal stenoses. On one there was a severe kink in the external iliac artery but no focal stenosis. The intrarenal arteries were also clearly demonstrated. The radiation dose in the pelvis for a DSA was 12 Gy cm^2 and 13 Gy cm^2 for each oblique view (LAO 30 and RAO 30, respectively) and for 3D-RA the dose was 4 Gy cm^2. CONCLUSION: In this small cohort of patients, 3D-RA of the renal transplant artery has been shown to be feasible and associated with a significant reduction in radiation dose. Our previous standard technique of common iliac artery injections plus use of obliques in the pelvis has been substituted by this new technique in cases with difficult anatomy. As further patients are recruited, we expect to be able to comment regarding the diagnostic sensitivity of the technique.

POSTER 1407 3D rotational angiography of the carotid arteries: technique, preliminary results and dose measurements

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PURPOSE: To describe the technique of 3D rotational angiography (3D-RA) in the imaging of the carotid arteries and to present preliminary results. The use of 3D-RA in diagnostic and endovascular therapeutic procedures is well established in neuroradiology. However, the role of this imaging technique has yet to be established in the carotid arteries. MATERIALS AND METHODS: 3D-RA was performed on a cohort of symptomatic patients being investigated for carotid artery disease. A 3D-RA protocol was used. This includes acquiring images over a 180° arc a speed of 30° s^{-1}. The acquisition is a single breath-hold technique with no collimation or filters and use of maximum focus-to-object distance. 96 ml of half strength Iohexol350 (Omnipaque350) is infused with a pump at a rate of 12 ml s^{-1} with the catheter positioned in the aortic arch. When obtaining images for 3D reconstruction, mask images are not required. Images were acquired on an Integris Allura Monoplane Vx000/BVx000 imaging system (Philips Medical Systems, The Netherlands). The images were viewed on an Integris 3D-RA workstation. The radiation dose was measured and compared with a standard digital subtraction angiogram (DSA) using a phantom. RESULTS: Of the five patients so far investigated, carotid artery stenoses were demonstrated in seven internal carotid arteries; two were occluded and one was normal. Both vertebral arteries were visualized in four patients. The radiation dose in the neck for a DSA was 5 Gy cm^2 for each lateral anterior oblique view (LAO 30 and RAO 30) and for 3D-RA the dose was 2 Gy cm^2. CONCLUSION: In this small cohort of patients, 3D-RA of the carotid arteries has been shown to be feasible and associated with a significant reduction in radiation dose.

POSTER 1408 Life threatening prostatic bed haemorrhage following TURP treated by subselective internal iliac artery embolisation

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PURPOSE: Transurethral prostaectomy (TURP) is a common urological procedure. Rarely, this operation can be complicated by a variable blood loss from the large prostatic bed. We report three cases where this blood loss was so pronounced that it became life threatening despite active resuscitation. These cases were all treated successfully by subselective embolisation of the arterial supply to the prostatic bed. METHOD: Three patients with active bleeding from the prostatic bed following TURP were referred for embolisation. The first patient was treated immediately after TURP had been performed, when operative methods failed to stop the source of prolonged bleeding from the prostatic bed. Two further patients were treated within 24 h of TURP being performed, when, despite conservative methods, the source of bleeding was not stopped and both patients had received over 15 units of transfused blood and associated blood products. All three patients were treated by subselective embolisation of the branch of the internal iliac artery leading to the prostatic bed once a bleeding point was identified. In all three cases, coils were used to embolise the subselective artery catherized. RESULTS: All three patients had successful embolisation of a subdivision of the internal iliac artery. None of the three patients required further transfused blood following embolisation, and all patients stopped bleeding. There were no post-remobilization complications. CONCLUSION: Subselective embolisation of the internal iliac artery provides a safe method of treating a rare life threatening complication of TURP.

POSTER 1409 WIP: Impact of peripheral MR angiography on the rate of transfemoral angiography

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PURPOSE: To evaluate the impact of peripheral contrast enhanced MR angiography (MRA) on the rate of transfemoral angiography (TFA) and angioplasty, and the resultant health economic implications. METHOD: The annual rates of MRA, TFA and angioplasty were compared over the 2 years since the introduction of peripheral MRA in our unit. The mean examination times for MRA and TFA were calculated from the 20 most recent examinations, and comparative costs were estimated. The diagnostic accuracy of MRA was assessed by comparison with TFA in patients who underwent both examinations (n=9) and by comparison with angiography at angioplasty (n=7). RESULTS: In the year February 2000 to January 2001, 91 patients underwent TFA, 33 underwent MRA and there were 37 angioplasties. In the following year, 46 patients underwent TFA, 67 underwent MRA and there were 33 angioplasties. This represents a reduction of 50% in the rate of TFA. The mean examination time was 48 min (range 15–90 min) for TFA and 36.5 min (range 20–60 min) for MRA. The estimated examination cost was £331 for TFA and £232 for MRA. All MRA images were diagnostic above the knee, and were consistent with TFA or angiography at angioplasty, indicating that diagnostic accuracy was not impaired. CONCLUSIONS: Introduction of MRA has rapidly reduced the rate of TFA by 50% in our hospital, with no apparent deterioration in diagnostic accuracy. The rate of angioplasty has remained relatively constant, suggesting a stable referral pattern. MRA is less invasive, less time consuming and cheaper than TFA.

Radiography

POSTER 1501 MRI of the brain adapted for radiotherapy planning

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PURPOSE: To demonstrate the problems and solutions related to adapting MRI of the brain for radiotherapy (RT) planning. MATERIALS AND METHOD: A 0.2 T open magnet with RT positioning lasers is used. Adaptations to the RT head jig and base have been made to facilitate its use in the scanner. Patients undergo a RT planning CT followed by a pre- and post-gadolinium planning MRI scan. The scans are performed in identical positions using the RT head jig, positioning lasers and markers. The centre slice "0" corresponds on both sets

of scans. The MR images are corrected for geometric distortion using an in-house software package, co-registered with the CT scan and sent to the RT planning computer and used to plan the RT field. RESULTS: The T2 images demonstrate normal anatomy. Post-gadolinium MR images demonstrate tumour borders more accurately, differentiate between enhancing tumour and surrounding oedema, and demonstrate lesions that are invisible on pre-contrast MRI or CT. The CT images demonstrate the patient outline more accurately, and the Hounsfield numbers can be used to assess absorption and dosage for the planned RT field. CONCLUSION: Non-MR compatible equipment has been successfully modified, image distortion has been corrected, and CT and MRI data sets have been integrated to enable the resultant image to be viewed by the oncologist. With increased tumour delineation, treatment fields and target volumes can be made smaller and more accurate.

POSTER 1502 KCARE: what we can do for you?

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In 1979, the Medical Devices Agency (MDA) opened the Kings Centre for the Assessment of Radiological Equipment (KCARE) at Kings College Hospital, London. The aim of the centre was to undertake in-house assessment of diagnostic X-ray equipment to provide information to the NHS regarding its fitness for purpose and performance. As part of the assessment, the equipment would be used over a period of time to undertake a range of clinical examinations generated from the radiology department. This allowed the performance of the system both technically and clinically to be assessed by radiographers, radiologists and physicists, resulting in the production of a single product report. With technological advances and the increased number of systems available, KCARE has chosen to undertake out-assessments in clinical departments throughout the UK. This has increased the number of assessments and consequently the amount of information available. Additionally, the centre now produces comparative product reports to enable direct comparison of equipment. To compliment the reports, additional services continue to be developed. The centre organizes user groups to discuss report content and our products, including safe specs and an installation equipment monitoring programme pilot study. The MDA device evaluation service is unique, and KCARE is the only evaluation centre to undertake the technical and user evaluation of equipment in the clinical environment. The presentation will provide an overview of the evaluation process and the services available from KCARE.

POSTER 1503 WIP: Safe management of the immobilized cervical spine patient

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It is estimated that 2–3% of all trauma patients suffer cervical spine injuries. Victims of trauma therefore frequently attend the Accident & Emergency Imaging Department, and radiographs of their cervical spine are obtained in order to determine the presence of any injury. Trauma patients are immobilized in a supine position, wearing a hard collar, using sandbags and tape. However, the immobilized trauma patient has a high risk of aspiration if they begin to vomit. The technique recommended by the Advanced Trauma Life Support Guidelines for clearing the airway in a vomiting patient with cervical spine immobilization is a properly executed log roll, or head down tilting of the stretcher and use of large bore suction to clear the mouth, oropharynx and airway. The former technique requires a minimum of four people, whereas the latter only requires one. This technique is particularly useful for the lone radiographer. It is therefore essential that all staff members have knowledge of and can perform this technique for the safe management of the immobilized cervical spine patient.

Miscellaneous

POSTER 1601 Computerized diagnostic algorithms for radiology

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PURPOSE: Diagnostic algorithms significantly facilitate the diagnostic process in radiology. A syndrome approach together with merging diagnostic technologies constitute a methodological basis for the modern diagnostic process. In each clinical case a specific set of standardized techniques should be used individually in considering its informative value, risk and economy. METHODS: We have developed a computerized program for radiologists that consists of two parts. The first was diagnostic algorithms; the second was standardized diagnostic protocols. The program offers selection of a certain radiographic image and provides opportunities to fill in the record as well as information on the key symptoms, and indicates the most likely diagnosis in each case and presents additional symptoms. Thus, while using the program a physician is simultaneously searching for an accurate diagnosis and is filling in a record. RESULTS: The program has been used in the every day activities of six radiological departments of several municipal and rural hospitals. It has proved its effectiveness in all hospitals, but especially in the rural ones where radiologists have used it as an experienced consultant. The computerized program has provided fast detection of radiological symptoms and accurate diagnosis. CONCLUSIONS: New diagnostic technologies are becoming more and more expensive and demand development of optimal diagnostic programs or algorithms that are becoming a first stage of the automatization of diagnosis. In the future, addition of X-ray images to the program and more powerful instruments to compare them could result in complete robotization of the diagnostic process.

POSTER 1602 Tuberous sclerosis: a pictorial review of the radiological appearances

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Tuberous sclerosis is an autosomal dominant disorder that may present with abnormalities in almost all body systems. The classical triad of epilepsy, mental retardation and adenoma sebaceum defines the syndrome clinically. This review presents the commoner radiological findings in this disease, including involvement of the brain, heart, lung, kidney and bone. We also present the common complications and malignancies associated with this syndrome.

POSTER 1603 WIP: The role of radiology in forensic medicine

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INTRODUCTION: Radiology and forensic science are closely interlinked areas of medicine. Although all doctors are likely to be required to demonstrate knowledge of both these topics in combination at some stage, both fields are grossly underrepresented in the medical undergraduate curriculum. AIM: To review the role of imaging in forensic medicine in a manner that is most useful, interesting and educational for medical students and junior doctors. METHOD: A Medline literature search of all published articles on radiology and forensic medicine from 1986–2001 was performed. RESULTS: Radiographs are taken on post-mortem examinations to locate foreign bodies or to document fractures and other types of injuries. Radiological examinations play a significant role in diagnosing non-accidental injuries of children, in medical negligence and in establishing biological aging in disputed cases. In forensic anthropology and odontology, comparison of ante-mortem and post-mortem radiographs is an essential feature of positive identification of human remains. DISCUSSION: The importance of imaging in forensic medicine is widely recognized. Newer modalities and techniques afford opportunities for the expansion of forensic radiology if problems of accessibility and cost can be resolved along with an improvement in interdisciplinary cooperation and understanding.

POSTER 1604 WIP: MRI of the transplant kidney

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PURPOSE: To evaluate the role of MRI in assessing the transplant kidney. SUBJECTS AND METHODS: 15 patients with suspected failing transplant kidneys were evaluated with MRI and findings were correlated with ultrasound and clinical parameters. The MRI sequences included: (1) HASTE MR urography to evaluate obstruction and perirenal collections; (2) gadolinium enhanced 3D FISP MRA to evaluate

the transplant arterial and venous anatomy; and (3) T_1 weighted post-gadolinium imaging to evaluate renal parenchymal function. RESULTS: In 10 of the 15 patients, MRI showed a normal transplant kidney. In one patient, MRI showed renal vein stenosis not detected by ultrasound. This patient also had bilateral avascular necrosis of the femoral heads noted incidentally on MRI. In one patient, MRI showed a lymphocoele and abnormal perfusion of the transplanted kidney whereas ultrasound showed a decreased pattern of corticomedullary differentiation only. Other MRI abnormalities, not seen on ultrasound, included renal artery and vein thromboses, renal artery stenosis and hydronephrosis. Polycystic kidney disease and unsuspected cortical cysts were also detected by MRI in our study. CONCLUSION: MRI provides a fast, non-invasive evaluation of the transplant kidney without the risks of ionizing radiation or iodinated contrast media. It offers a comprehensive assessment, including vascular anatomy and the collecting system. Preliminary results show MRI to be superior to ultrasound in evaluating complications following renal transplantation.

POSTER 1605 The "starry sky" appearance on ultrasound: a pictorial review

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The "starry sky" appearance is the description applied to the ultrasound finding of multiple small hyperechoic or echoreflective foci in various organs such as the testis, prostate, liver, pancreas and salivary glands. We present a pictorial review depicting the various organs in which the "starry sky" appearance may be found, along with a discussion of the significance of the finding in individual organs. In some sites it is merely a curiosity or an incidental finding, while in other locations it is pathognomonic of a disease process. In the testis, many authorities believe that the presence of microlithiasis in an otherwise normal testis warrants clinical and ultrasound follow-up. We discuss the current opinions and data available.

POSTER 1606 MRI of twin pregnancies

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AIMS: To use methods of MRI of singleton pregnancies to image twin pregnancies with one or more abnormal fetuses and to compare the imaging results with ultrasound. METHODS: Eight women carrying twins were imaged using single shot fast spin echo MR techniques. Mean gestational age was 27 weeks (range 24–32 weeks). There were two monochorionic monoamniotic twins, five dichorionic twins and one set of conjoined twins. Ultrasound imaging in two cases demonstrated an interuterine fetal death of one twin. In one case one twin had a lumbar sacral spina bifida. In two cases there was ventriculomegaly, in one case an encephalocoele and in the final case holoprosencephaly. The MR results were compared with antenatal ultrasound. RESULTS: MR provided detailed anatomy on all the abnormal twins and was normal in the other twin in all but two pairs. In three cases there was no additional detail obtained from MRI compared with ultrasound. In one case both babies were normal on MRI. In three cases further detail was provided, a frontal encephalocele in one, hemimegalencephaly in one and, in the case of conjoined twins, anatomical detail important for post-delivery surgery was obtained. CONCLUSION: MRI of twins is technically challenging as there is no real-time component as with ultrasound and it is essential that both twins are imaged fully and that one twin is not imaged twice. This is particularly important when reporting normality. MRI provides additional detail to ultrasound in cases of twins, as it does with singleton pregnancies.

POSTER 1607 Inequalities in UK cancer care

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Drawn from evidence presented to the recent European Cancer Conference, this poster provides an illustration of the geographic and social inequalities faced by UK patients at every stage of their cancer journey.

POSTER 1608 The role of multislice CT in the assessment of polytrauma

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PURPOSE: Imaging of the potentially unstable polytrauma patient is both technically challenging and time consuming, and carries with it the risk of exacerbating existing injuries. Any examinations must be prompt, efficient and diagnostically accurate. This poster will demonstrate the role of multislice CT in the assessment of polytrauma, including the scanning protocols used. METHOD, MATERIALS AND RESULTS: A scanning protocol for polytrauma patients will be demonstrated and will be illustrated with relevant cases. This protocol allows for efficient, safe and accurate assessment of soft tissues, including major vessels, and the skeleton. The protocol can be tailored to individual patient requirements and clinical need. It involves the acquisition of three spiral volumes using a 2.5 mm beam collimation: (1) the head (including cervical spine); (2) the thorax; and (3) the abdomen and pelvis. The data sets from these ranges allow for multiple reconstructions, which will be listed and demonstrated. In all cases an initial axial image set is reviewed prior to selection from a large menu of potential multiplanar reconstructions. This reconstruction menu includes 3D imaging for pelvic fractures and oblique sagittal reformats for assessment of thoracic aortic injury. The radiation dose risk/benefits will also be demonstrated. A state-of-the-art Siemens Volume Zoom multislice CT was used to develop the protocols. CONCLUSION: The use of multislice CT in polytrauma provides a safe, rapid and accurate assessment of injuries in line with the Advance Trauma and Life Support (ATLS) guidelines. It provides for a "one stop" imaging strategy, replacing multiple radiographic techniques, in keeping with the philosophy of the "golden hour" of trauma management.

Physics

POSTER 1701 WIP: Image quality, the CEC and "S"

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OBJECTIVE: To evaluate the relationship between CEC quality criteria and sensitivity levels for paediatric lateral spine radiographs obtained using a Fuji CR5000 digital system. MATERIALS AND METHOD: Two radiologists independently analysed 203 lateral spine radiographs according to CEC quality criteria. Images were assigned an image criteria score (ICS = number of criteria fulfilled/total number of criteria). Sensitivity values were recorded and entrance surface doses were calculated on a small group of children. RESULTS: Interobserver variability varied from fair to very good for the individual CEC criteria, and was fair for overall ICS. Mean sensitivity values were significantly related to age and to the visually sharp reproduction of the cortex and trabecular markings (CEC criterion 6); however, the standard deviations were extremely wide for each age group. Entrance surface doses were well within local dose reference limits. CONCLUSION: The CEC criteria are a useful tool for auditing image quality within and between departments, although modification is required. The sensitivity value on its own can only be used as a rough guide to image quality.

POSTER 1702 WIP: Quality and dose optimization in thorax radiology

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Image quality and radiation surface dose in chest radiography were studied for three exposure protocols. Protocol 1 represents the most commonly used technique in radiology services in Brazil. This technique consists of 81 kV tube voltage with a grid and at 2 m. Protocol 2 uses the same parameters as Protocol 1 but without the grid. Protocol 3 uses 133 kV without a grid and at 3.5 m. In Protocols 2 and 3, an air gap of 30 cm was used between the patient and film. Two groups of 50 patients each were radiographed in two different facilities. Protocol 1 was used in facility I to radiograph the first group, and Protocols 2 and 3 were used in facility II to radiograph the second patient sample. Three experts in chest radiology evaluated the chest images. For each patient exposure, the radiation dose at the skin entrance was measured. In this work, a chest phantom containing test objects to

provide quantitative image evaluation was developed. The phantom was radiographed with the three protocols. Results of this study showed clearly that Protocol 3 presents an average surface dose entrance about half that of Protocol 2 and about one-third of Protocol 1. In regard to chest radiographic images and radiation dose, it was statistically demonstrated that Protocol 3 is better than the others, with an improvement in image quality and a patient dose reduction of the order of 3 times. This work also discusses the perspective of Protocol 3 as an alternative technique for chest radiography.

POSTER 1703 Student Work: Effect of orientation on stereological estimation of hemisphere volumes measured from MRI in healthy adults

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When applying unbiased stereological techniques to estimate hemisphere volumes from MR images obtained *in vivo*, it is essential to ensure that all brains are orientated along the same plane. The plane of interest may be determined by which brain subregions, such as the hippocampus or prefrontal cortex, are also to be measured. Here we compare cerebral hemisphere volumes estimated with Cavalieri method of modern design-based stereology in combination with point counting in a data set of high resolution 3D volume MR brain images of healthy adults whose ages ranged from 20–95 years (n=81). Subjects were recruited to an aging study that had LREC approval. MRI was obtained in a 1.5 T GE whole body scanner with a proprietary quadrature head coil. 124 coronal T_1 weighted images comprising 1.6 mm thick tissue slices were acquired throughout the brain using a spoiled gradient echo sequence (SPGR), employing TE 9 ms, TR 34 ms, flip angle 30°. FOV was 20 cm, containing 256 x 256 pixel matrix. Multislice T_2 weighted FSE sequence was employed (TE 90 ms, TR 3000 ms, flip angle 90°, interslice gap 10 mm) to estimate intracranial volume. Brain data sets were re-orientated independently along both ACPC and hippocampal axes using NRIA software (University of Pennsylvania) and stereology was performed using ANALYZE software (Mayo Foundation). Repeated measures ANOVA, covarying for both age and intracranial volume, revealed that there was no significant difference between cerebral hemisphere volumes measured from scans orientated along ACPC and hippocampal axes ($F_{1,77}$=0.11, p=0.75).

POSTER 1704 Student Work: Hemisphere volumes from MRI using Cavalieri method of modern design-based stereology and point counting

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A variety of approaches have been used for measuring brain structures *in vivo*, including computer-based planimetry and semi-automatic boundary tracing techniques. However, stereological methods are increasingly being used for efficient estimation of surface area and volume from MR images. The importance of acquiring data using unbiased stereological techniques is recognized, as many editors of scientific journals now stipulate that where geometric parameters are to be reported, only manuscripts employing stereological methods will be published. Here we describe the application of Cavalieri method of modern design-based stereology in combination with point counting to a data set of high resolution 3D volume MR brain images acquired *in vivo* to estimate cerebral hemisphere volumes for healthy adults whose ages ranged from 20–95 years (n=97). Subjects were recruited to an LREC approved aging study. All subjects were screened with Folstein's MMSE test to exclude subjects' early signs of dementia. MRI was obtained using a 1.5 T GE whole body scanner with a proprietary quadrature head coil. A total of 124 coronal T_1 weighted images comprising 1.6 mm thick tissue slices were acquired throughout the brain using a 3D spoiled gradient echo sequence (SPGR), employing TE 9 ms, TR 34 ms, flip angle 30°. FOV was 20 cm, containing 256 x 256 pixel matrix. Multislice T_2 weighted FSE sequence was employed (TE 90 ms, TR 3000 ms, flip angle 90°, interslice gap 10 mm) for estimation of intracranial volume. Brain data sets were re-orientated along the ACPC axis using NRIA software (University of Pennsylvania) and stereology was performed using ANALYZE software (Mayo Foundation).

POSTER 1705 Student Work: A comparison of radiation dose (ESD) for supine and prone examinations of the lumbar spine

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This study investigates the effect on effective patient dose of changing patient position from supine to prone for radiographic examination of the lumbar spine. Dose–area product (DAP) measurements were recorded for 101 male and female adult patients, 50% being examined supine and the remaining 50% prone, using a PTW Diamentor M2. Entrance surface dose (ESD) values were calculated from DAP measurements and Monte Carlo Technique was used to calculate estimated effective doses (EEDs). However, conversion coefficients used to calculate effective dose (ED) were only available for the supine but not for prone positions for lumbar spine. Results of the whole sample showed supine patients received significantly greater DAP and ESD, but when obese patients were removed from the supine group the difference between groups remained but was no longer significant. Mean EED for supine patients, excluding extremes and outliers, was 0.34 mSv. This value can be compared with the British recommended ED for an examination. It is not possible to compare EED for supine and prone lumbar spine examinations using the same technique because of lack of availability of conversion coefficients for the latter position. However, EED calculated in this study can be compared with values of total energy imparted from other studies using thermoluminescent detectors positioned inside a sliced phantom in locations that correspond to internal organs, for examination of posteroanterior lumbar spine. These values are found to be equivalent and are the only means of comparing potential detriment to a prone and a supine patient undergoing examination of the lumbar spine.

POSTER 1706 WIP: Determination of T2 from MRI magnitude images with low SNR

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PURPOSE: The transverse relaxation time (T2 or T2*) is a variable with the potential to quantify clinical conditions. This is conventionally determined from magnitude images at different relaxation times using a log/linear fit that takes no account of any systematic bias due to noise. In cases of low SNR (<2), this technique is confounded and alternative methodologies are required. METHODS: Simulated sets of observed data were created using a defined relaxation time and the addition of Gaussian noise to the signal prior to quadrature addition of the real and imaginary components. Using a Levenberg–Marquardt fitting method, different functions representing the observed signal were used to determine relaxation time. These functions (from the literature) include terms to represent the noise present in the images. These calculated relaxation times were compared with the known value and that determined by log/linear fit. RESULTS: The log/linear fit demonstrates poor accuracy in the determination of relaxation times compared with the other functions. For data where significant errors (>25%) in the log/linear fit were observed, accurate results (±5%) were obtained using the more appropriate functions. CONCLUSIONS: For the determination of T2 (or T2*) relaxation times from low SNR images, the log/linear fit is unsuitable. In cases where the observed signal has a significant noise bias, curve-fitting using functions appropriate to low SNR regimens resulted in a more accurate determination of the relaxation time.

POSTER 1707 Acceptance testing of a new 1.5 T MR scanner

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There continues to be an increase in the number of new MR systems in the UK through initiatives such as NOF. Acceptance testing of an MR system is an important part of the installation to ensure optimum performance. This work describes the detailed quality assurance procedures that were carried out at our centre following replacement of a 0.5 T system with a state-of-the-art 1.5 T scanner. Tests were performed in both the head and body coils and were repeated on a pre-existing 1.5 T system to allow comparison. Tests of signal-to-noise ratio, uniformity and ghosting were done using specific manufacturer's head and body phantoms, which were positioned in a frame support to simulate patient loading. Conventional spin echo sequences

were acquired for the majority of tests. However, for the head coil alone, echo planar sequences were additionally assessed in terms of ghosting and stability. Further measurements of slice profile, spatial resolution, and geometric linearity and distortion were carried out in the head coil using the Eurospin test objects. Results revealed that both systems were performing within currently accepted levels of tolerance for each of the tests with the standard sequence. The echo planar assessment revealed good short-term stability on both scanners, but unacceptable ghosting levels on the new scanner, which required further investigation by the engineers. This work provides a baseline with which results from further tests may be compared following future software or hardware upgrades, and may benefit anyone attempting to perform similar tests on new MR systems.

Digital Imaging

POSTER 1901 Towards an integrated healthcare facility at the BRI

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There are now more digital imaging and diagnostic systems in use than ever before, a natural progression of technology in today's "techno needs-based medicine". Exposure to secure and confidential digital facilities, and integrated work environments for the end user, the clinicians, are very important. The availability of an integrated healthcare facility providing images and patient data throughout their health cycle is very important for patient management and care. We have been involved in wideband "vendor neutral" PC-based telemedical solutions since late 1996. The requirements of the telemedical systems are dictated by the "Clinical Champions"; to the diagnostic specialties, the quality of the images are paramount; for multidisciplinary patient management and clinical meetings the needs are procedures and the pre- and post-treatment outcomes. We have a number of firsts to our credit in providing innovative solutions for integrated healthcare. Working with clinicians, industry and academia, we have been able to provide more facilities for clinicians and patients at remote clinics and sites: ISDN6 image transfer links for real-time ultrasound scan transfers in 1997; a GP link for transfer of X-rays and reports for consultant clinics and video conferencing for clinical discussions and training in 1998; wireless links for A&E requirements from accident sites in 1998/99. We are following phased implementation for surgeons and physicians, with radiology, cardiology and similar diagnostic departments. The problems that we have encountered are primarily related to inadequate knowledge, exposure to and confidence in users, implementation people and technophobes.

POSTER 1902 Smart cards as a tool for integrated healthcare provision

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Smart cards have existed in the commercial world since the mid 1970s as simple storage devices based on electromagnetic data storage strips. The smart card of today is more than just a storage device. The microprocessor-based smart card is the latest addition in the world of information technology. It has the potential to offer a form of integrated healthcare and global networking. It is the size of a conventional credit card and it has an electronic microchip embedded in it. The chip stores electronic data and programs that are protected by advanced security features. They can use integrated and/or discrete peripheral devices towards providing active interaction with the user, as defined by the user requirement. Smart card technology will make deeper in-roads in to the medical arena. At the moment, smart cards have flirted with medically related topics such as electronic patient records (EPRs) and similar patient data based activities in the medical insurance arena. Smart cards have the potential to be more interactive as smart keys triggering off a sequence of user-defined events. Their applications in medicine can be quite widespread, covering clinical and administrative tasks in medical specialities such as general practice, radiology, cardiology, dermatology, obstetrics and gynaecology, ophthalmology, and psychiatry to name a few. While reviewing smart card developments and the current status in medicine, we are looking at the possibilities for smart card based NHS Trust wide imaging as well as data systems integration developments and applications.

POSTER 1903 An investigation of wavelet compression on image quality using an ALVIM statistical phantom

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PURPOSE: This study was undertaken to investigate the effects of lossy wavelet compression algorithms on image quality. Compression thresholds were varied to investigate levels at which diagnostic information is compromised. MATERIALS AND METHODS: Wavelet compression was applied to a CR image of an ALVIM TRG statistical phantom. The phantom consisted of 120 equal size disks, half made of bone substitute material and half made of muscle substitute material. Holes (bone, 0.5–1 mm; muscle, 0.9–2 mm) simulated pathology in 50% of the disks. Software was developed using IDL (version 5.4) to apply second order Daubechies wavelet compression to the image. Seven images were produced at compression levels between 1:1 and 100:1 of the original image. Images were viewed by five independent observers, each being allowed to freely optimize window, level and zoom parameters. The reliability of detection of each hole size at each compression level was assessed using a ROC scoring methodology. RESULTS: At 20:1 compression, all hole sizes were identifiable, with no significant difference from the original. 50:1 compression gave correct detection probabilities $p_{det} \geq 90\%$ for muscle substitute holes ≥ 1.4 mm. At 100:1 compression, only 2 mm holes in muscle gave $p_{det} \geq 90\%$. CONCLUSION: Detection probably was seen to vary with compression level and hole size. The study has shown the feasibility of using this approach to assess wavelet compression effects, and that, depending on the imaging task, compression ratios up to 20:1 could be considered.

POSTER 1904 Experiences of installing an interventional cardiology mini-PACS

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PURPOSE: The aim of this work is to share experiences gained whilst installing a product for the remote viewing and reporting of interventional cardiology examinations. METHOD AND MATERIALS: The installation was carried out as part of a wider procurement of a new catheterization laboratory. It consisted of a PC server, six workstations, a CD writer and a tape archive. Existing 100 Mbps Ethernet networking was utilized. Installation was managed via a project team consisting of Trust Medical Physics and IT staff along with the manufacturer's technical and managerial representatives. Measurements of image retrieval times were carried out at 6, 12.5 and 25 fps. RESULTS: Problems were experienced due to not involving IT staff at an early stage of the procurement and also due to the newness of the product and the resulting unfamiliarity to the vendor's staff in the UK. These led to misunderstandings of some technical aspects of the specification, resulting in delays in the procurement of some items and difficulties in defining service contract agreements. Baseline performance measurements showed that five workstations were able to concurrently retrieve and view studies from the server in real-time at up to 12.5 fps. CONCLUSIONS: Involvement of IT staff early in the procurement of a cardiology mini-PACS is essential. Many problems can be resolved by good communication and goodwill between vendor and customer.

POSTER 1905 The clinical utility of 3D multiplanar reformatting with multislice CT

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The advent of multislice CT combining rapid gantry rotation time with multirow detector array has revolutionized cross-sectional imaging. Current technology utilizing multislice CT with advanced software programs and user-friendly workstations has a wide range of clinical applications, with relevance to almost all specialties. Because of reduced scanning time, we can now obtain images at multiple different phases of contrast enhancement, acquiring thin sections over a wide field of view with high resolution. The excellent quality of images obtainable enables high diagnostic accuracy and provides invaluable anatomical information where surgical intervention is contemplated. We present a pictorial review of images obtained using the General Electric Light Speed Plus Four Slice CT ScannerÓ, with multiplanar reconstructions using Advantage Windows 4.0 Ó software.

Our case study profile encompasses a comprehensive display of upper abdominal anatomy with particular reference to vascular mapping and normal variants of interest to surgeons. We also include a range of pathological processes for illustrative purposes. We describe our current scanning protocols with reference to contrast infusion rates, scan delay times, pitch, slice collimation, reconstruction parameters and multiplanar reformatting appropriate to individual applications. Our review illustrates the high quality images and diagnostic accuracy that can be obtained in a district general hospital setting with modern multislice CT applications.

Radiotherapy

POSTER 2101 Commissioning and clinical implementation of a large bore CT simulator

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CT images provide information not only on target volumes, but also on critical structures. Using CT images for radiotherapy treatment planning has enabled us to improve dose delivery to target volumes whilst reducing the dose to critical structures. CT images also provide density information for heterogeneity-based dose calculations. As part of a new department, the AcQSim CT simulator (Marconi Medical Systems) was installed. The AcQSim CT simulator was designed specifically for radiotherapy purposes. The system incorporates a large bore CT scanner, an Exact couch top (matched to the treatment machines), tracking lasers and virtual simulation software. The 85 cm bore increases the type of patient positions that can be fitted through the scanner. Additionally, the increase in scan field of view of 60 cm, compared with 48 cm with a conventional scanner, allows full visualization of larger patients and immobilization devices. The scanner, when installed at Lincoln, was only the fifth in the world and the second in Europe. The aim of this poster is to discuss the assessments that were made during the commissioning period. Diagnostic, radiotherapy and ImPACT all assessed the scanner. A discussion of the tests made as well as the results are given.

POSTER 2102 Calibration factors for absorbed dose to water at SCDs other than those recommended by IAEA

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The IAEA has recently published recommended reference conditions for determination of absorbed dose to water calibration factors ($N_{D,w}$) in a Co-60 beam. Besides a fixed chamber depth of 5 cm, two choices of beam parameters are offered: FS=10 × 10 cm^2 at SSD = 80 cm (equivalent to FS=10.63 × 10.63 cm^2 at SCD = 85 cm) [choice 1], or FS=10 × 10 cm^2 at SCD = 100 cm [choice 2]. We investigate whether $N_{D,w}$ for a given field chamber changes significantly between choice 1 and choice 2 over a range of SCDs. The $N_{D,w}$ of two field chambers, namely NE2581 and NE2571A, were determined by cross-calibrating them, one at a time, against a secondary standard chamber NE2571 in a Co-60 beam (Eldorado 8(#104)). The wall material of NE2581 is A-150, *i.e.* tissue-equivalent, while for both NE2571A and NE2571 it is graphite. All three chambers have a volume of 0.6 cm^3. For each field chamber and choice of FS, five values of $N_{D,w}$ were obtained at SCD = 85 cm, 90 cm, 95 cm, 100 cm and 105 cm. For NE2581 and choice 1, the results obtained lay between 57.13 mGy nC^{-1} and 57.31 mGy nC^{-1} (mean 57.19 ± 0.12 mGy nC^{-1}). For NE2581 and choice 2 we obtained 57.30–57.41 mGy nC^{-1} (57.36 ± 0.11 mGy nC^{-1}), for NE2571A and choice 1, 44.74–45.03 mGy nC^{-1} (44.92 ± 0.13 mGy nC^{-1}), and for NE2571A and choice 2, 44.99–45.37 mGy nC^{-1} (45.11 ± 0.21 mGy nC^{-1}). Careful analysis of these results shows no significant variation in $N_{D,w}$ over a much wider range of irradiation conditions than those recommended by IAEA. We therefore propose that the IAEA should consider alternative recommendations for performing intercomparison studies, or should allow SSDLs greater freedom to select radiation conditions, *e.g.* within stated ranges of SSD. For example, BARC India, which coordinated the Asia Pacific Metrology Programme for $N_{D,w}$ intercomparison, uses SSD = 60 cm and FS=10 × 10 cm^2 at SSD.

POSTER 2103 Comparison of two IAEA protocols for determining absorbed dose to water in a Co-60 beam

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PURPOSE: The two protocols are those published by the IAEA in 1987 (TRS 277) and 2000 (TRS 398). Use of a chamber's calibration factors N_K and $N_{D,w}$, plus its known electrometer reading in water M_w (corrected for influence quantities), under these two protocols will yield two absorbed dose to water values, $D_{w,277}$ and $D_{w,398}$. Since calculation of $D_{w,398}$ involves fewer parameters, it is possible that its uncertainty is smaller. METHOD AND METERIALS: This study compares the accuracy and precision of $D_{w,277}$ with $D_{w,398}$. The agreement between the two protocols is expressed as the percentage deviation of $D_{w,277}$ from $D_{w,398}$ (call this A), and their precision is compared by evaluating the fractional uncertainty of $D_{w,277}$ and dividing this by the corresponding quantity for $D_{w,398}$ (call this P). Experiments started with a field chamber $c1$ (NE2581) placed in a Co-60 beam (Eldorado 8) for the determination of a set of $(N_K, N_{D,w}, M_w)_{c1}$, in which each value in the parenthesis was the average of five readings. The first two quantities were obtained by cross-calibrating $c1$ against a secondary standard chamber $c4$ (NE2561). We repeated this procedure to obtain five sets, so obtaining the corresponding five sets of $(D_{w,277}, D_{w,398})_{c1}$. We then calculated $(A, P)_{c1}$ for the five sets and reduced these to one set containing only the average value. For consistency purposes two other field chambers $c2$ (NE2571A) and $c3$ (NE2571) were also tested. RESULTS: The average value sets of (A, P) for $c1$, $c2$ and $c3$ were (−0.473 ± 0.487%, 4.742 ± 0.046), (−1.067 ± 0.456%, 4.498 ± 0.001) and (−1.071 ± 0.456%, 4.497 ± 0.002), respectively. There is some evidence of a systematic difference between $c2$, $c3$ (which have graphite walls) and $c1$ (which has tissue-equivalent walls). CONCLUSION: We conclude that TRS 398 shows comparable accuracy as well as a five-fold improvement in precision.

POSTER 2104 Commissioning a radiotherapy centre in 20 weeks: lessons learnt

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PURPOSE: The radiotherapy service in Lincoln transferred from St George's Hospital to new, purpose built accommodation at the County Hospital in 2001. The new equipment installed included two dual modality, matched Varian 2100C/D linacs with MLC and EPID, a Nucletron HDR microSelectron with Plato planning system, a Marconi AcQSim wide bore CT scanner, and Varis networking. Transferred equipment included a Varian Ximatron C-series simulator, DXT300 orthovoltage unit and CMS Focus planning system. Installation to opening time was 20 weeks, during which the routine service at the old site was maintained. RESULTS: The department was completed on time, despite some inevitable delays. Regular commissioning meetings were held before and during commissioning, and a detailed schedule was maintained. CONCLUSION: Commissioning the department provided a great learning opportunity for all concerned. However, improvements and pitfalls were identified, which others who are about to embark on commissioning new equipment or a whole department may find useful. For example, the network was installed only a few weeks before going clinical, and therefore only limited time was available for integrity and connectivity checks. With hindsight, earlier on-site applications training by the manufacturer would have been invaluable in preparing for these checks. The tight time-scale meant that it was difficult to cross-train staff during commissioning, and this process is therefore ongoing. Valuable experience has been gained and lessons learnt that will be put to good use in the commissioning of a third linac in 2002.

POSTER 2105 Monte Carlo characterization of multileaf collimator performance for linear accelerator produced photon fields

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As implementation of conformal and intensity modulated radiotherapy becomes more widespread, quantitative characterization of multileaf collimator (MLC) performance is required by the majority of planning system algorithms as well as for independent dose check calculations. This study has used the Monte Carlo N-Particle radiation transport code MCNP (version c) on a PC to simulate open and wedged 6 MV photon fields produced by a MLC. The depth–dose distributions and dose profiles at constant depth for various regular symmetric field sizes have been simulated and found to be within acceptable limits. Positional spectral information on the effect of the wedge and the MLC on the radiation field has been obtained. In-phantom variations of "leaf response" obtained by MCNP simulations have been shown to agree with measured data for single and multiple leaves. Results of the application of superposition for dose computations under the MLC using the "leaf response function" will be presented.

POSTER 2106 Results of radiotherapy for Peyronie's disease

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PURPOSE: To review the results of radiotherapy for Peyronie's disease. PATIENTS AND METHODS: Between 1983 and 2000, 154 patients were irradiated for Peyronie's disease. The mean duration of symptoms was 17 months. The disease was progressive in 74 patients. In the majority of patients, penis deviation was between 30° and 50° and there were one or two foci with a diameter of 5–15 mm. Pain was reported by 66 patients. All patients received radiotherapy using either parallel opposing fields with X-rays or a direct field with electrons to a total dose of 30 Gy (98 patients) or 36 Gy (49 patients) within 3 3.5 weeks. Mean follow-up was 4.7 years. RESULTS: The main result was an improvement in deviation (48% of patients), number of foci (28%), size of foci (44%) and softening of foci (55%). Pain relief was recorded in 50% of patients. The probability of improvement within 2 years was: deviation, 33%; size of foci, 33%; number of foci, 26%; and softening of foci, 45%. Acute side effects were moderate and there were no late effects. Outcome depended on the size of foci and age, but not on total dose. CONCLUSION: Radiotherapy yields an improvement in 25–50% of patients. Side effects were very rare.

POSTER 2107 Does local recurrence after surgery adversely affect prognosis of patients with soft tissue sarcoma?

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PURPOSE: To compare the prognosis of patients irradiated for locally recurrent soft tissue sarcoma following surgery with patients treated for primary sarcoma following surgery. PATIENTS AND METHODS: Between October 1983 and June 1999, 69 patients were irradiated for primary soft tissue sarcomas and a further 21 patients for local recurrence (data in parentheses). All patients had undergone surgery before radiotherapy (R0 resections 33% (42%); after a second surgical procedure 52%). The mean age at the start of radiotherapy was 53 years (54 years) and the mean Karnofsky performance index was 83% (90%). The majority of patients had a histiocytoma or a liposarcoma stage II–III UICC. Radiotherapy was performed using 6–23 MV X-rays or electrons from a linear accelerator, applying a total dose of 60–66 Gy in daily equal fractions of 2 Gy. RESULTS: In follow-up, there were local recurrences after radiotherapy in 32% (43%; difference ns) and distant metastases in 20% (33%; difference ns). Computing the Kaplan–Meier estimate for survival and event-free survival, there were no significant differences between the groups, with a trend towards a slightly more unfavourable prognosis in the case of recurrence. Significant prognostic factors were local tumour control, development of metastases during follow-up, age, performance index and R status of surgery. CONCLUSION: In our patients there is probably a slightly more unfavourable prognosis in those with locally recurrent soft tissue sarcoma compared with those with primary sarcoma. In the case of local recurrence, an adequate surgical procedure followed by radiotherapy is recommended.

POSTER 2108 Risk estimation of radiation effects on people with different genotypes

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METHODS: Genotype analysis of the radioactive effects at different levels of biological organization was carried out on nuclear industry workers. RESULTS: Those with a higher relative risk of chronic radiation syndrome had haptoglobin (Hp) homozygotes 2-2 compared with a lower risk for genotypes Hp 1-1 and 2-1 at summary doses of 100–400 cGy. Carriers of genotypes Hp 2-1 and Hp 2-2 had a higher risk of early cerebral atherosclerosis and chronic gastritis at doses greater than 400 cGy. People above 60 years of age have essential changes in age elimination of Hp genotypes and alleles: at small doses, a higher risk of genotype Hp 2-2 elimination because of cardiovascular pathology and diabetes mellitus; at higher doses, a higher risk of genotype Hp 2-1 elimination because of oncological pathology. Exposed people with different Hp genotypes have differences in changing of some biochemical indexes. The relative risk of radiation effects at genotype Hp 1-1 is always less than 1.0; at genotype Hp 2-1 it may be less than, equal to or sometimes greater than 1.0; and at genotype Hp 2-2 it is always greater than 1.0. Children of nuclear industry workers who received to the moment of conception summary doses greater than 200 cGy, at population-genetic examination had genotypical changes, in particular increasing risk of delivery of children with genotype 2-2, decreasing average adaptation of Hp genotypes in the population and decreasing of heterozygosis, as well as increasing risk of change in genotypical combination. Increasing risk of mutation frequency in minisatellite DNA was not revealed for the exposed people offspring.

POSTER 2109 A novel approach of dose mapping using a humanoid breast phantom in radiotherapy

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BACKGROUND: We describe a dose mapping technique to investigate dose distribution throughout the planning target volume (PTV) in a humanoid breast phantom exposed to a 6 MV photon beam similar to that of treatment conditions. MATERIALS AND METHODS: For tangential breast irradiation, dose is mapped in various locations within the PTV using thermoluminescent dosemeters (TLDs) and radiographic films. An average woman sized Perspex breast phantom with the ability to hold the dosemeters is fabricated. The TLDs are exposed after packing them in various locations in a particular slice as planned by the treatment planning system (TPS). To map the dose relative to the isocentre, films are exposed after tightly packing them between the phantom slices, parallel to the central axis of the beam. The dose received at every location is compared with the given dose as generated by the TPS. RESULTS: The mapped dose in each location in the isocentric slice from shallow to deep regions is found to be in close agreement with the TPS-generated dose to within ±2%. The mapped dose towards the superior region and the closest inferior region from the isocentre is also found to agree with those of the TPS. Conversely, results for the farthest inferior region are found to be in significant discord, with discrepancies of as much as 17.4% at some points, which is believed to be owing to variation in size and shape of the contour in this region. The results obtained from films are also in agreement, showing a similar trend in dose mapping. CONCLUSION: Considering the significance of correct doses in radiotherapy, evaluating the dose distribution using the proposed techniques and tool was found to be useful, which provides options in choosing the proper technique and planning optimum dose delivery in radiotherapy.

POSTER 2110 WIP: Analysis of 3D conformal treatment planning in elective nodal irradiation for laryngopharyngeal carcinoma

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PURPOSE: To investigate the potential of 3D conformal radiotherapy planning to achieve adequate dose delivery and sparing of uninvolved healthy tissue structures in elective nodal irradiation for laryngopharyngeal carcinoma. PATIENTS AND METHODS: CT scans of 16

patients with T2–4, N0, M0 laryngopharyngeal carcinoma were acquired and transferred to a treatment planning system. A conventional 2D treatment plan with two lateral parallel opposed fields with abutted low anterior radiation field and two types of 3D conformal radiotherapy plans were compared for each patient. (3D-1: two lateral parallel plus two anterior oblique fields; 3D-2: two lateral parallel plus two posterior oblique fields). The target volumes and uninvolved dose-limiting structures were contoured on axial CT slices throughout the volume of interest. Delineation of various neck node levels was performed according to proposed guidelines. Doses of 65 Gy to the primary tumour (PTV-1) and 50 Gy to the elective subclinical regions (PTV-2) wer prescribed. The planning parameters for these volumes and the degree of parotid gland and spinal cord protection were evaluated for both treatment techniques. A comparison of plans and treatment techniques was assessed using isodose distributions, dose statistics and dose-volume histograms (DVHs). RESULTS: Comparing DVH and dose statistics for PTV-1, no significant differences were found between 2D and 3D planning techniques for minimum dose, average dose, D95, V95 and V90. The apparent size of PTV-2 was underestimated with the conventional 2D planning method relative to the 3D methods. The dose conformity observed with 3D techniques was increased compared with that observed with 2D techniques, which delivers unnecessary radiation doses to the uninvolved structures. Dose–volume analysis and statistics of 3D techniques showed that this approach provides a reduction in the irradiated volume of parotid (3D-1) and spinal cord tissue (3D-1 and 3D-2) compared with 2D techniques. CONCLUSION: Using 3D conformal radiotherapy techniques, satisfactory dose delivery to involved tissue (PTV) and efficient protection of normal tissue can be achieved, with improve dose–volume characteristics over conventional 2D treatment designs.

POSTER 2111 Student Work: Making room for treatment

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A new suite of four adjacent radiotherapy treatment bunkers is to be constructed on an existing site where space is constrained. Each bunker is required to have a 10 MV linear accelerator. As part of the design process, the Monte Carlo code MCNP-4C is being used to investigate the effect of radiotherapy maze design on dose to occupied areas above the treatment bunkers, at the maze entrance, at the operator position and to patient waiting areas as well as other areas of particular interest. The situation is further complicated by the need for a service plant above the bunkers that prevents disruption to clinical service as well as office space on an adjacent second storey. The MCNP simulated results are compared with the empirical "rules of thumb" calculations used at present. The simulated result for the maze entrance was found to be 10 times higher than the "rules of thumb" calculations, but still within the recommended dose constraint. The results for outside the bunker were in close agreement with the calculated results. Also investigated were innovative particle traps within the maze that cause a reduction in dose at the maze entrance. The MCNP code was utilized on a PC running the MS Windows 98 operating system. Typical simulation times of around 14 days were required to achieve statistically robust results. It is hoped that using MCNP in this context will facilitate minimizing construction costs whilst ensuring safe levels of protection. Additionally, it enhances the planning process where different layouts, construction materials or isocentre position can be evaluated.

POSTER 2112 WIP: Initial experience in commissioning a dedicated oncology CT scanner

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PURPOSE: A GE HiSpeed FX/i CT scanner was purchased for dedicated use in radiotherapy treatment planning. It was necessary to ensure that the system performed within the stringent tolerances specified for radiotherapy applications. Since significant additional hardware and software was involved, it was important to consider the CT Sim system as a whole during commissioning and when devising a QA programme. MATERIALS AND METHODS: To reproduce the flat table top of a treatment unit, an insert was fixed onto the CT couch. This required accurate levelling, and tests were performed to ensure deflection under loading was minimal. Correct transferring of CT number and geometrical information to two treatment planning systems was verified and checks were made of the geometrical accuracy of the Advantage Sim virtual simulation software. An external LAP laser gantry was installed to enable patient marking and it was verified that that the plane defined by the LAP lasers coincided with the scan plane so that patient marking based on Advantage Sim was accurate. Modifications to phantoms supplied with the scanner enabled measurements at different points along the couch, and a phantom was developed to examine slice position and orientation. RESULTS: Initial scans exhibited a reconstruction artefact whereby the scan was rotated in the plane of the slice, resulting in significant misalignments. Considerable effort was expended ensuring that the LAP lasers and both sets of scanner lasers all coincided with the scan plane. CONCLUSION: A significant amount of time is required to commission a dedicated oncology CT scanner and to establish an appropriate QA programme. Particular attention must be paid to factors such as laser alignment, couch levelling and reconstruction artefacts.

Radiation Protection

POSTER 2201 Patient dosimetry in abdominal angiography using multislice helical CT

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PURPOSE: This study aims to evaluate effective dose to the patient in abdominal angiography using multislice helical CT. METHODS AND MATERIALS: Aortography and renal arteriography performed with a LightSpeed QX/i Advantage (GE Medical Systems) scanner was studied. Technique factors for both examinations were defined by radiologists and related to a standard-sized patient. Dose measurements were performed according to EUR 16262 EN Guidelines, with a 10 cm long CT pencil ionization chamber and a PMMA phantom with a diameter of 32 cm (CEI EN 61223-2-6). In this way, an estimate of effective dose was derived from the values of dose length product (DLP) using region-specific normalized coefficients. RESULTS: The weighted computed tomography dose index ($CTDI_w$) values were always lower than the DRLs, but the total DLP values varied between 0.7 Gy cm and 1 Gy cm for renal arteriography and between 1.2 Gy cm and 1.5 Gy cm for aortography. Thus, the total effective dose is suitable to reach, respectively, 12 mSv and 18 mSv. These results are comparable with dosimetric data reported in the literature for digital subtraction angiography (DSA). Our results were also used for the calibration of the automatic dose evaluation system of the multislice scanner; calculated DLP values systematically underestimate the measured DLP values. CONCLUSION: Helical CT angiography using a multislice scanner is a minimally invasive imaging technique for the evaluation of vascular pathology and will completely replace DSA. The effective dose imparted to the patient is quite high compared with those reported for DSA, although an improvement of CT technique factors could bring some dose sparing.

POSTER 2202 Use of X-rays in neonatal intensive care: information and guidance for parents and radiographers

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PURPOSE: Diagnostic radiographs are important in assessment and monitoring of infants born prematurely. However, parents often express concern about the possible detrimental effects of radiation resulting from direct exposure of their child, as well as from examinations of neonates in adjacent incubators. The aim of this work was to design an informative leaflet for parents that aimed to reassure them about the risk associated with such exposures. METHOD: Risk assessments have been made for the current practice in the Neonatal Intensive Care Unit. In addition, environmental dose measurements have been made and patient doses have been assessed. RESULTS: A short information leaflet has been produced for radiographers to issue to concerned parents. To complement this, advice has been provided to radiographers, including background information and guidance on radiographic techniques, such as the use of gonad shields. CONCLUSION: The

availability of a short leaflet for parents of neonates goes some way towards reducing their concerns, and is also useful to nurses and midwives. Guidance for radiographers is also a useful tool in the optimization of neonatal X-ray exposures, as required by the Ionising Radiation (Medical Exposure) Regulations 2000.

POSTER 2203 Re-audit of patient doses in ERCP procedures

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METHOD: A regional dose audit was recently carried out in East Anglia with the aim of establishing diagnostic reference levels, intended to promote control in medical radiation exposure in line with the ALARP principle. Dose–area product (DAP) was chosen as the indicator of patient dose. Data were collected from a range of fluoroscopic examinations used for both diagnostic and therapeutic procedures. RESULTS: Sufficient data were available to study ERCP examinations, which had previously been audited in the East Anglia region 3 years ago. Two units had submitted data for this procedure in both audits, each showing an increase in mean DAP apparently due to a marked increase in screening time. Sufficient data for both units were available to make it unlikely that this result was due to any statistical error. CONCLUSION: Further data collection is planned for more units in the region to further investigate this apparent increase in mean DAP. This audit highlights the importance of re-audit of procedures to ensure optimization and high standards of radiation protection care.

POSTER 2204 A retrospective analysis of radiation outputs from dental X-ray units to inform remedial and suspension levels

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PURPOSE: The aim of the investigation was to analyse variations in radiation outputs from intra-oral dental X-ray units. These variations were then considered in order to predict the effect of implementing various remedial and suspension level regimes, as no current guidelines exist. MATERIALS AND METHODS: Data for 17 intra-oral units for the previous 8 years were analysed (91 separate QC surveys), both in terms of variations from baseline values and maximum variation between two consecutive measurements. Data were further analysed by unit manufacturer and exposure time selections to test for relative performance differences. The effect of implementing IPEM 77 tube guidelines was then considered by use of a cumulative histogram. RESULTS: 67% of outputs fell within 10% of their respective baseline value and 94% fell within 20%, which is the IPEM X-ray tube remedial level. The maximum change between any two consecutive measurements was 46%, and no measurement fell outside 50% (IPEM X-ray tube suspension level). There were no significant trends on performance by exposure time setting; however, there was a significant difference between manufacturers at the 95% confidence level. No unit exhibited an upward or downward temporal trend in output. CONCLUSIONS: If IPEM 77 radiographic X-ray tube standards were adopted for dental equipment, approximately 1 in 16 tests would lead to remedial action. However, in the absence of any clear temporal trend in annual output in any unit surveyed, it is unclear what such remedial action should be.

POSTER 2205 Patient radiation doses in electron beam CT

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PURPOSE: To calculate the effective dose to patients undergoing electron beam CT (EBCT). Few studies have considered this problem, yet dosimetry information is required to justify clinical exposures and screening techniques such as coronary calcification detection. MATERIALS AND METHODS: As Monte Carlo program has been developed to simulate photon transport through the patient resulting from irradiation using EBCT. The key features of the model are: a voxelized adult hermaphrodite phantom to simulate the patient; a 130 kVp tungsten X-ray spectrum that matches the beam characteristics of the scanner; and an X-ray source that rotates 210° about the scanner isocentre at a radial distance of 90 cm and steps along the phantom according to the scanning protocol being simulated. The program calculates organ doses and effective dose normalized to the computed tomography dose index (CTDI) measured in air at the isocentre. The simulation of the scanner and beam geometry has been verified against experimental measurements of CTDI in cylindrical Lucite phantoms. RESULTS: In preliminary results, agreement between the Monte Carlo simulation and the experimental measurements of CTDI is better than 10%. The effective dose to the patient is dependent on patient orientation owing to the asymmetric irradiation of critical organs. For example, the dose to the breast in the prone position is 3 times higher than in the supine position when the chest is irradiated. CONCLUSION: Monte Carlo techniques improve the accuracy of patient dose calculations and provide a useful insight into the factors that determine effective dose in EBCT.

POSTER 2206 Blood parameters in the 45–50 years after diagnosis of chronic radiation sickness

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The results of blood system examination are shown on 636 patients with chronic radiation sickness (CRS) following exposure to exterior γ-radiation at doses of 150–900 cGy, accumulated for the period of contact with ionizing radiation, the annual dose being 50–430 cGy exposure per year. Patients were divided into four groups depending on the summary exposure dose: I, exposure dose up to 200 cGy; II, 201–400 cGy; III, 401–600 cGy; IV, >600 cGy. Changes in the blood parameters were tested from primary medical examination before the beginning of work, during CRS formation and during the 45–50 period year of observation. Decreasing thrombocytes (less than 180 10^9 l^{-1}) before the beginning of work was found in 17% examined, and moderate leukopenia was found in 12.6% of cases. Constant leukopenia in combination with thrombocytopenia was expressed in the period of CRS formation. The blood parameters of examined patients recovered after ending of contact with γ-radiation. Full recovery of thrombocyte level was seen for the observation period of 45–50 years. The leucocytes level achieved its initial value in groups II–IV; for the patients of I group moderate unstable leukopenia was detected in 35.6 % of cases. The per cent of patients with leukopenia in this group was higher than in other groups under primary medical examination.

Bone Mineral Density

POSTER 2301 Diagnosis of osteoporosis using DEXA and QUS techniques

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PURPOSE: In this study we compared the diagnosis of osteoporosis for a group of patients as determined by DEXA and QUS methods; and, according to WHO guidelines; we also examined the optimum T-score threshold that could be used to identify the risk of osteoporotic fractures using a commercial QUS system. MATERIALS AND METHODS: 99 female Caucasian patients aged 42–84 years underwent both bone densitometry check-up at the lumbar spine on a Norland XR-26 DEXA scanner and QUS measurement of the calcaneus using Sahara Clinical Bone Sonometer. Results obtained from the X-ray examinations were regarded as a reference condition for each patient in establishing the presence/absence of pathology. Then, a statistical analysis of QUS parameters was elaborated to assess significant differences between normal, osteopenic and osteoporotic patients; ROC curves were developed as a parametrical function of the threshold QUS T-score value (TQUS). RESULTS: The correlation coefficient (R) for BMD values measured with DEXA and QUS techniques was 0.589 ($p<0.01$). Nevertheless, ANOVA test showed some significant differences between the three classes but, according to Bonferroni test, these were principally between osteoporotic and healthy patients. The best values of sensitivity (Sn) matched with best specificity (Sp) were observed in the range $-1.5<TQUS<-1.0$, namely $64\%<Sn<81\%$, $60\%<Sp<78\%$ discriminating between osteoporotic and non-osteoporotic subjects, and $81\%<Sn<87\%$, $46\%<Sp<71\%$ discriminating between non-normal (osteoporotic or osteopenic) and normal subjects. CONCLUSION: In this study, QUS did not provide a strict distinction between osteoporotic and osteopenic patients, but a better result was obtained when comparing healthy and osteopenic patients.

POSTER 2302 Dependence of FEXI-derived stiffness upon resolution

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INTRODUCTION: Mechanical stiffness derived from finite element analysis of conventional X-ray images (FEXI) has the potential to provide a superior prediction of fracture risk than conventional bone mineral density assessment. FEXI may be applied to a range of X-ray based imaging modalities including MCT data, digitally scanned plane radiographs and conventional dual energy X-ray absorptiometry (DXA) scans; and may be performed at various anatomical sites including the distal radius, proximal femur and phalanx. However, the spatial resolution of these techniques varies significantly, with typical values being 20 mm, 50 mm and 800 mm, respectively, for MCT, digitized plane radiographs and DXA. METHODS: The dependence of FEXI-derived stiffness upon spatial resolution was investigated in a 4 mm cubic sample of calcaneal sample bone that had previously been digitized via MCT, providing a 3D voxel map (141 x 141 x 141) at a resolution of 28 mm. 2D projections simulating a radiograph or DXA scan were created for each of the three orthogonal directions. Maximum FEXI stiffness anisotropy was obtained with loading in the *Y*-direction, described by *XY* and *ZY* projections. The resolution of these 2D projections was gradually reduced by re-sizing the images. RESULTS: The degree of anisotropy decreased with reducing spatial resolution. Whilst the *XY* stiffness remained approximately constant, the *ZY* stiffness decreased significantly. This may be explained by the *XY* and *ZY* projections describing plate face surfaces and plate edges, respectively, as image resolution is reduced, there is a more significant change in the finer detailed plate edge "structure". The clinical implications of these findings warrant further investigation.

POSTER 2303 Development and validation of a multiecho computer simulation of ultrasound propagation through cancellous bone

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Cancellous bone consists of a porous open-celled framework of trabeculae interspersed with marrow. Although measurement of broadband ultrasound attenuation has been shown to be sensitive to osteoporotic changes, the exact dependence on material and structural parameters has not been elucidated. A 3D computer simulation of ultrasound propagation through cancellous bone has been developed, based upon simple reflective behaviour at the multitude of trabecular/marrow interfaces. A cancellous bone framework is initially described by an array of bone and marrow elements. An ultrasound pulse is launched along each row of the model with partial reflection occurring at each bone/marrow interface. If a reverse direction wave hits an interface, a further forward (echo) wave is created. This process is monitored for each wave within each row. Phase reversal is implemented if an ultrasound wave crosses from a high (bone) to low (marrow) impedance interface. When the amplitude of active waves within a particular propagation row falls below a pre-defined value, the simulation considers the next propagation row. The simulation ends when all propagation rows have been analysed. By summing the time domain data for each propagation row, the effective received signal is created, thus simulating detection by a phase-sensitive ultrasound transducer, as incorporated in clinical systems. The simulation has been validated on a hexagonal honeycomb design of variable mesh size, first against a commercial computer simulation solution (Wave 2000 Pro) and second via experimental measurement of physical replicas produced by stereolithography.

POSTER 2304 Comparison of bone mineral density derived form plain X-rays with DEXA scanning in rheumatoid arthritis

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PURPOSE: Evaluation of bone mineral density (BMD) requires specific equipment, such as a dual-energy X-ray absorptiometry (DEXA) scanner or quantitative CT scanner, which is not always readily available. The Pronosco X-Posure System calculates forearm BMD from a scanned plain X-ray of the patient's forearm. Whilst this system has been validated for normal population groups, it has not been validated for patients with rheumatoid arthritis (RA). Our study compares BMD derived from the Pronosco X-Posure system with BMD from a DEXA scanner in the distal forearm of RA patients. MATERIALS AND METHODS: Ethics committee approval and patient consent were obtained. A total of 56 patients with established RA were recruited. A DEXA scan and a plain radiograph of the distal forearm and hand were obtained. The Pronosco X-Posure System was used to calculate the BMD from the plain radiograph using a weighted average of cortical and bone width measurements at the radius, ulna and three metacarpals. RESULTS: There was a high correlation between the DEXA scanner data and the Pronosco X-Posure System data (Spearman's rank correlation 0.83; 95% CI: 0.72, 0.90). CONCLUSION: The Pronosco X-Posure System is a cheap and versatile method of assessing BMD from plain radiographs. It also correlates strongly with DEXA scanning of the distal forearm in patients with RA.

Computerized Posters

POSTER 2401 An educational CD-ROM about water soluble X-ray iodinated contrast media

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Although iodine was recognized very early as a positive X-ray contrast medium, it took more than 30 years for development of the clinically acceptable contrast medium to be used. In this computerized poster we present a comprehensive and educational CD-ROM that includes fundamentals of water soluble X-ray iodinated contrast media principles, as well as essential guidelines for their optimum use in every day practice. Questions commonly asked regarding the efficacy and safety of contrast media are also discussed. Structure, physicochemical properties, pharmacokinetics, tolerance and the influence of contrast media on different organ functions and vessels are analysed. Risk factors, precautions, side effects, and reactions and their management will be presented in a question–answer design model.

POSTER 2402 Role of imaging in malignant external otitis: a retrospective study of 14 cases

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INTRODUCTION: Malignant external otitis is a serious disorder of the external auditory canal (EAC), caused by a saprophyte germ *Pseudomonas aeruginosa* in more than 90% of cases. The purpose of this work is to define the role of imaging (CT and MRI) in the management of this pathology. MATERIALS AND METHODS: Over a period of 4 years we retrospectively studied 14 patients (11 male; average age 58 years). 13 patients were diabetic and the remaining 1 was immune depressed. All the patients benefited from a complete clinical examination and high resolution CT with injection of contrast medium. Bone scintigraphy was performed on eight patients. Only one patient had an MRI scan. RESULTS: Clinical examination showed a stenosis and inflammation of the EAC in all patients. Neurological involvement was found at five patients. CT revealed a tissue process of the EAC in 12 cases. In two cases CT showed a mastoid and tympanal lyses with extension towards prestylien spaces and temporomandibular articulation, and in four cases osteitis of the skull base. CT was normal in two cases. CONCLUSION: Malignant external otitis is serious owing to its inclination to be spread along the vasculonervous fascias towards the skull base and deep spaces. CT is often undertaken first to allow an exhaustive diagnosis with a forecast value. MRI nevertheless allows early diagnosis before clinical examination, and even scintigraphy.

POSTER 2403 Primary correlative study between CT features and expression of related genes in hepatocelluar carcinoma

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OBJECTIVE: To study the relationship between the expression of nm23-H1 gene, CD44v6 gene, N-ras gene, C-erbB-2 gene and C-myc gene with the CT features in hepatocellular carcinoma (HCC). MATERIAL AND METHODS: Spiral CT scanning was performed in 36 patients with pathologically proven HCC. Expression of nm23-H1, CD44v6, N-ras, C-erbB-2 and C-myc genes was estimated using the immunohistochemical SABC method. RESULTS: Positive expression of nm23-H1 protein in the whole group was 58.3%, but it was significantly lower in the high potential invasion and metastasis group than the others ($p<0.05$). The positive rate of CD44v6 protein was 38.9%; positive expression of CD44v6 protein was higher in the group of HCC with pseudocapsula-invaded than those without ($p<0.05$). CD44v6 protein positive rate was higher in the high potential invasion and metastasis group. The C-myc protein positive rate of HCC specimens was 38.9%; the C-myc protein positive rate was higher in the medium size HCC group (>3 cm, =5 cm in diameter) than small HCC group (=3 cm) ($p<0.05$); and positive expression was lower in the liver cirrhosis group than in those without ($p<0.05$). Positive expression of C-erbB-2 protein was 71.1%. Positive expression was higher in the medium size HCC group (>3 cm, =5 cm) than the small HCC group (=3 cm) and the large HCC group (>5 cm) ($p<0.05$). Expression of nm23H1 had a significant correlation with expression of CD44v6 and C-erbB-2 ($p<0.05$). Expression of CD44v6 had a significant correlation with expression of C-erbB-2 ($p<0.05$). CONCLUSION: The CT appearances of HCC are related to the expression of these genes.

POSTER 2404 Paediatric lymphangiomas and lymphangiomatosis: a pictorial review

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Lymphangiomas and lymphangiomatosis are congenital malformations of the lymphatic system. Lymphangiomas are focal malformations that are more common, whereas generalized lymphangiomatosis is a rare spectrum of the disease. The overall spectrum of imaging findings seen in this congenital malformation will be demonstrated in the pictorial review.

POSTER 2405 Radiological aspects of unusual locations of hydatid disease

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INTRODUCTION: Hydatid disease is due to development in the human body of the embryonic form of *Taenia echinoccocus*. Once it crosses the intestinal barrier and enters the portal system, it may develop in the liver and lungs or follow the systemic vessels to affect various organs. The purpose of this work is to illustrate unusual locations of the disease and to determine the role of imaging in the diagnosis of these forms. MATERIAL AND METHODS: 12 observations of hydatid cysts in unusual locations were studied retrospectively. The locations involved the kidney, muscles, diaphragm, retroperitoneum, heart, bladder, adrenal glands, brain and maxillary sinus. All the cysts were investigated by ultrasound, CT and/or MRI according to their location. RESULTS: The various imaging techniques allowed a diagnosis to be made in all cases. Ultrasound showed unilocular or multilocular cystic lesions without blood flow inside. CT and MRI allowed the location to be clarified and other cystic locations to be detected. CONCLUSION: Diagnosis of hydatid cyst must be made prior to any cystic lesion arising without a general state alteration, especially since it occurs in an endemic region and except the positivity of the hydatid immunology. Ultrasound generally allows the diagnosis to be suspected. CT and sometimes MRI are necessary to facilitate differential diagnosis with tumoral masses, to help in the topographic diagnosis due to multiplanar acquisitions, and to clarify the extension of the disease.

POSTER 2406 "Missile effect": the importance of adhering to safety measures in MR environments

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INTRODUCTION: The static magnetic field associated with MRI systems can attract ferromagnetic metal objects with considerable strength, generating the phenomenon referred to as the "missile effect". The missile effect can pose a significant risk to the patient inside the magnet as well as to anyone standing in the path of the flying object, possibly with fatal consequences. METHODS: Images depicting accidents that have occurred in MRI environments owing to the "projectile effect" are presented. It has been possible to collect them through contributions received from other technologists via the "American Section of Magnetic Resonance Techologists" (SMRT) mailing list. DISCUSSION: Several accidents due to the "missile effect", some of which were serious, have been reported. A recent fatal accident where a young patient was struck by an oxygen tank pulled into the bore was widely reported in the media (The New York Times, July 31). The case illustrates the importance of careful attention to objects that may represent hazards in the MR environment and highlights the need for formal safety training of all personnel and compliance of all staff (maintenance workers, housekeeping staff, nurses, technologists) with the established policy of the MR site.

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