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# Scientific Programme Abstracts Sunday 15 June

0930–1045

## Involvement of Patients

**0930 Invited review: Working with patient representatives**

J Luthert

*Royal Marsden Hospital, Surrey, UK*

No abstract supplied.

**1000 Invited review: Delivering on patient involvement**

R Dennett

*Guy's & St Thomas NHS Trust, London, UK*

No abstract supplied.

1030 Discussion

0930–1045

## Paediatrics and Obstetrics

**0930 Invited review: "Take your foot off the pedal!" A practical approach to reducing dose in paediatric fluoroscopy and CT**

M Hiorns

*Great Ormond Street Hospital, London, UK*

Increasing awareness of radiation dose in the paediatric population, coupled with developments in equipment, necessitate a review of our working practice when delivering ionizing radiation in children. Fluoroscopy remains the imaging modality of choice in many neonatal and paediatric gastrointestinal investigations and modern equipment allows opportunities for significant dose reduction. The use of CT, particularly multislice, increasingly delivers a large dose at a single examination. This review will discuss the radiation burden in children as well as current techniques that can be used in fluoroscopy and CT to keep dose to a minimum whilst maintaining good quality diagnostic studies.

**0955 Invited review: Imaging the paediatric chest**

J Fairhurst

*Southampton University Medical NHS Trust, Southampton, UK*

No abstract supplied.

**1020 Invited review: The radiology of diffuse interstitial pulmonary disease in children**

C Owens

*Great Ormond Street Hospital, London, UK*

Diffuse interstitial lung disease (ILD) represents a heterogeneous group of disorders characterized by restrictive lung function and impaired gas exchange. As these diseases occur on a background of developing lungs and immune system, the clinical presentation and disease progression is modified compared with their adult equivalents. Morbidity and mortality associated with paediatric interstitial lung disease are high (range 14–39%), with a higher mortality in younger infants. The diagnosis may be delayed but once suspected the aim of HRCT is to confirm the presence and severity of ILD, to uncover any predisposing factors and to identify the dominant pathology of the ILD. HRCT TECHNIQUE: As the chest radiograph (CXR) is often non-specific, HRCT has been shown in adults and children to increase the accuracy in diagnosis of diffuse lung disease. The trade-off in sensitivity and specificity of HRCT over the CXR is related to radiation dose, which is significantly higher with conventional spiral or volumetric CT. However, the use of low dose (50 mA, 0.75 s), limited (1 mm slices every 15–20 mm) HRCT in inspiration with three expiratory supplementary scans allows accurate assessment of the presence and extent of diffuse lung disease at a dose equivalent to approximately 10 chest radiographs. Images are reconstructed on a high spatial resolution algorithm and displayed with a wide window setting, at a width of 1500 Hounsfield units (HU) and at a level of –500 HU. If a child is unable to breath-hold, the scans can be performed

during quiet breathing and decubitus scans replace expiratory scans (the dependent lung behaving as the "expiratory lung"). The role of HRCT in paediatric interstitial lung disease is evolving. In adults, the diagnostic accuracy of HRCT has led to a decrease in the number of lung biopsies. The diseases that were correctly diagnosed in recent studies on HRCT with a high degree of confidence were alveolar proteinosis, pulmonary lymphangiectasia and idiopathic pulmonary haemosiderosis. Differentiation between non-specific interstitial pneumonitis, desquamative interstitial pneumonitis and lymphocytic interstitial pneumonitis was, however, less reliable. There are several pitfalls in the interpretation of HRCT in children, including distinguishing diffuse ground-glass infiltration from increased lung attenuation resulting from a suboptimal inspiration. Technique pitfalls and a range of pathology will be discussed and explained.

0930–1045

## Radiation Protection & IR(ME)R

**0930 Invited review: Experiences of an IR(ME)R inspection: the Trust and the inspector**

<sup>1</sup>S Ebdon-Jackson and <sup>2</sup>P Marsden

*<sup>1</sup>Department of Health, London, UK and <sup>2</sup>UCL Hospitals NHS Trust, London, UK*

PURPOSE: To draw attention to issues of implementation of IR(ME)R that have been identified by hospitals and inspectors before or during inspections and to demonstrate how to approach resolution of these issues. MATERIALS AND METHODS: Cases for inclusion in this study have been selected using stochastic techniques from a cohort comprising frequently occurring incidents and those expressing acute symptoms. These have been drawn together into a single fictional body presenting with a mixture of prime examples of health and varying degrees of onset of fatal or severe humour-threatening conditions. Using the latest 3D technology, the distressed body will be projected onto the form of one of the presenters, and will be dissected, restructured and stitched up well and good by the complementary team member. RESULTS: The outcome of this study is an organism that, though not guaranteed IR(ME)R resistant, will show some defence against the common complaints experienced in the population since this legislation was introduced. The side effects may be excruciating and could lead to loss of composure and vital humours, involuntary convulsions and temporary epilation. Sufferers have reported reduction in acute gluteal discomfort. CONCLUSION: Adoption of the approaches presented may not provide complete protection against IR(ME)R maladies but should provide some relief against extreme symptoms if administered after infusion to separate out the mirth.

**1015 2002 UK computed tomography dose survey: an update and preliminary results**

<sup>1</sup>MA Dunn, <sup>2</sup>PC Shrimpton and <sup>3</sup>M Lewis

*<sup>1</sup>University Hospital Nottingham NHS Trust, Nottingham, UK,*

*<sup>2</sup>National Radiological Protection Board, Chilton, Didcot,*

*Oxon, UK and <sup>3</sup>ImPACT, St Georges Hospital, London, UK*

Computed tomography (CT) already accounts for approximately 40% of the population dose resulting from medical X-ray examinations in the UK and it is likely that this contribution is increasing. The last national survey of CT dose was undertaken by the National Radiological Protection Board in 1989. Since then the number of scanners in use in the UK has more than doubled. The introduction of faster helical scanners has removed some of the limitations of the early units by reducing acquisition times, prompting new variations in practice, for example multiphase contrast-enhanced studies. Newer multislice scanners have the potential to further extend practice and to increase doses owing to their capacity to scan extended ranges using smaller slice thicknesses. At least one author reports that the absorbed dose per examination may be up to 40% higher. These developments have made it impossible to set reliable national diagnostic reference levels (DRLs) based on the old survey data. Consequently, a new national CT survey was started at the end of 2002, which aims to cover the whole of the UK, all healthcare sectors, single and multislice

scanners and both adult and paediatric CT. The results will be used to assist professional bodies when setting DRLs and as a resource for optimization. Data on scanning protocols and from individual patients have so far been collected from at least 70 scanner units. An update on the progress of the survey and preliminary findings will be presented.

### 1025 Comparison of patient radiation doses of CT- and fluoroscopic-guided lung biopsy

<sup>1</sup>LA Kurban, <sup>1</sup>L Gomersall, <sup>1</sup>J Weir and <sup>2</sup>P Wade  
<sup>1</sup>Aberdeen Royal Infirmary, Aberdeen, UK and <sup>2</sup>Aberdeen University, Aberdeen, UK

**PURPOSE:** To compare the radiation dose of fluoroscopic-guided lung biopsies with those performed under CT guidance. **METHODS:** We retrospectively reviewed a consecutive series of 105 patients who underwent percutaneous lung biopsies. 100 patients had the procedure performed under fluoroscopic guidance and the remaining 5 under CT guidance. The effective radiation dose (ED) from fluoroscopy was calculated using the X-dose program of the National Radiological Protection Board. This was compared with CT ED calculated using the CT dose program of the National Board of Health, Denmark. The overall success rate was assessed by the number of patients who had a sufficient diagnostic aspirate. Pneumothorax rates were also recorded. **RESULTS:** Compared with fluoroscopy, CT-guided lung biopsies were associated with a considerably higher radiation dose (162 times). The mean ED for CT-guided procedures was  $4.6 \pm 6.5$  milliSievert compared with fluoroscopic guidance ( $0.028 \pm 0.14$  milliSievert). The success rate for fluoroscopic-guided lung biopsy was 82%, which is comparable with previously published results from many series. Pneumothorax occurred in 25 patients (25%) under fluoroscopic guidance and in 2 patients (40%) under CT guidance. **CONCLUSION:** Fluoroscopic-guided lung biopsy is a safe and accurate procedure that is performed at much lower radiation dose to the patient. We recommend that fluoroscopy should be the modality of choice in performing lung biopsies in the majority of cases. CT with or without CT fluoroscopy should be reserved for lesions not amenable to biopsy under fluoroscopic guidance.

### 1035 Discussion

0930–1100

## Ethics of Screening

### 0930 Invited review: The ethics of screening

E Davies  
UK Breast Cancer Coalition, London, UK  
No abstract supplied.

### 1000 Invited review: The ethics of screening

Speaker to be confirmed

### 1030 Invited review: Disclosure of audit

P Maguire  
Cancer Research UK, Manchester, UK  
No abstract supplied.

0930–1100

## Imaging and Treatment of Colorectal Liver Metastases

### 0930 Invited review: Ultrasound and liver metastases

C Harvey  
Hammersmith Hospital, London, UK

This presentation reviews the role of ultrasound in the detection and characterization of hepatic malignancies, showing how recent advances in technology and the use of microbubbles have improved this. Ultrasound is the most frequently used modality in the hepatic staging of a malignancy as well as in the follow-up and assessment of response to therapy. Although ultrasound is accessible, quick, safe and inexpensive, it has certain limitations. It is operator dependent, insensitive to the detection of subcentimetre metastases and may have a false negative rate of up to 30%. The advent of microbubbles has expanded the

liver applications of ultrasound and has improved the sensitivity and specificity for the detection of metastases to rival that of CT and MRI. Ultrasound microbubbles may be deployed to show morphological or functional abnormalities. Numerous microbubbles are currently available or under development that can be used in a variety of ways to demonstrate morphological abnormalities. Some microbubbles have liver-specific properties, and multicentre trials demonstrate a significant increase in the sensitivity for the detection of metastases. The vascular phase of microbubbles can also be imaged using low Mechanical Index (MI) non-destructive techniques to depict the arterial and portal enhancement phases. Metastases can be differentiated from benign lesions such as FNH and haemangioma. Microbubbles have also found a role in the assessment of the presence of viable residual tumour post ablation. Functional ultrasound can demonstrate pathophysiological changes in liver haemodynamics prior to the development of overt metastases in colorectal cancer, which may allow early therapeutic intervention.

### 1000 Invited review: CT (including CT angiography) of liver metastases

J Karani  
King's Healthcare NHS Trust, London, UK  
No abstract supplied.

### 1030 Invited review: MRI of liver metastases

PJA Robinson  
St James's University Hospital Trust, Leeds, UK  
Liver metastases larger than 1–2 cm should be detected with high quality CT or sonography, therefore MRI is not a first line test for diagnosis or surveillance. The added value of MRI is in three specific clinical applications. (1) Early detection of small metastases: MRI with SPIO enhancement is currently the most sensitive non-invasive technique for detecting liver tumours smaller than 1–2 cm. This is critical for patients who are candidates for resection of liver metastases, and valuable in other patients when liver staging is critical for choice of treatment. (2) Characterizing dubious liver lesions: metastases, especially when small, may be indistinguishable from cysts and benign malformations (haemangiomas and von meyenberg complexes) on CT or sonography. A combination of heavily  $T_2$  weighted unenhanced images and dynamic Gd-enhanced  $T_1$  weighted images will differentiate almost all of these problematic lesions. Liver-specific contrast agents (SPIO, or the T1 enhancers gadobenate, gadoxetic acid and mangafodipir) are used to distinguish focal nodular hyperplasia (which is more common than has previously been recognized) from malignant lesions. (3) Pre-operative mapping: for surgical assessment, 3D  $T_1$  weighted dynamic Gd-enhanced images will demonstrate liver parenchyma, tumours and the major arteries and veins of the liver in a single sequence. All liver MRI examinations require surface coils, breath-hold acquisitions and careful attention to individual sequence parameters to obtain optimum results.

0945–1045

## Creating the Image: digital radiography I

### 0945 Invited review: Computed radiography: the basics and clinical application

G Bailey  
Kodak Ltd, Hemel Hempstead, UK

Computed radiography (CR) uses traditional type cassettes, often referred to as imaging plates (IP), and "captures" an image on a reusable phosphor screen housed in one of these cassettes. The "latent" image is processed using a laser scanner and is displayed on a computer screen. Whilst the process of acquiring an X-ray image prior to processing is the same as film-screen systems, the once simple process of putting patient details on the image and actually viewing it can, at first, appear to be quite complex. In addition, the CR equipment manufacturer will also show you how to "annotate" (write on) your image; "post process" (change speed/contrast) your image and how to "distribute" (put in an envelope and post) your image. So, as we can see, the digital age and the techies associated with it have created a new language and image quality criteria quite alien to the majority of radiographers who are perfectly happy with film, cassettes and processors. Not any more...

**1005 Invited review: Direct digital radiography: the basics**

E Hunt

*Addenbrooke's Hospital, Cambridge, UK*

Addenbrooke's has had experience of DR over the last 5 years. The first unit was a direct digital unit.

**1025 A randomized controlled trial comparing lateral skull computerized radiographs exposed with or without a grid**

A Bartholomew, M Shaw, T Marshall, D Erika and A Toms  
*Norfolk and Norwich University Hospital Trust, Norwich, UK*

**PURPOSE:** This prospectively randomized trial was designed to compare the quality of lateral skull radiographs obtained with or without a grid on a computerized radiography (CR) system (General Electric (GE)). **MATERIALS AND METHODS:** 100 patients sequentially attending A&E requiring skull radiographs were entered into the study. They were randomized to have the lateral radiograph exposed either with or without a grid. Exposure factors were standardized for the two limbs. 99 radiographs were independently scored by four consultant radiologists who were blinded to the randomization and the exposure factors. One patient was excluded from the trial because of a clerical error. Quality of the radiographs was assessed using a pre-defined scoring system (1 to 5), subjectively assessed to be diagnostic or non-diagnostic quality and viewed on GE PACS workstations. **RESULTS:** All the radiographs were of diagnostic quality and there was no significant difference between the scores for the two limbs. **CONCLUSION:** Using a grid for lateral skull radiography on a CR system does not result in an appreciable improvement in quality. Similar results can be obtained without a grid and with a reduced radiation dose to the patient.

**1035 Long line visibility on the neonatal unit: does the use of computed radiography improve detection rates?**

<sup>1</sup>A Evans, <sup>2</sup>J Natarajan and <sup>2</sup>CJ Davies

*<sup>1</sup>Bristol Royal Hospital for Children, Bristol, UK and <sup>2</sup>Royal Glamorgan Hospital, Llantrisant, Wales, UK*

**AIM:** To compare the use of plain film and computed radiography (CR) techniques for the visibility of central venous long lines in neonates. **METHODS:** A retrospective review of all long lines inserted on the neonatal unit over a 1-year period was performed. 45 lines were inserted over this time. Review of both the plain film and CR images was performed by three independent observers. Use of the CR system allowed contrast and brightness windowing to facilitate detection. **RESULTS:** All lines could be visualized using both techniques. Accurate identification of the line tip could be made in 30/45 cases (66.7%) using plain imaging and in 43/45 cases (95.6%) using the CR system. Of the 15/45 cases in which the line tip could not be identified on plain films and where positioning could adversely affect patient management, 4 (9%) required re-imaging with IV contrast medium injection to improve visibility. No patients required re-imaging in the CR system group. **CONCLUSION:** The use of CR systems improves the accurate detection of neonatal long-line tips and may obviate the need for repeated films following IV contrast medium injection. This may have implications for the provision of CR system access on the neonatal unit, particularly for out-of-hours work when radiological review may not be possible.

1110–1230

**Creating the Image: digital radiography II**

**1110 Invited review: Direct digital vs computed radiography: workflow issues**

G Goff

*Princess of Wales Hospital, S. Wales, UK*

Direct radiography (DR) vs computed radiography (CR) systems in a DGH setting: an evaluation of workflow patterns and time utilization. **PURPOSE:** With the advent of DR, the anticipated productivity of such a system installed within a radiology department is claimed to be much greater than that of CR. The purpose of this study was to evaluate this hypothesis in a working environment. **METHOD:** Workflow patterns were identified and mapped in a DR and CR system. The time for the following steps within the process were established for

both DR and CR systems: (i) time from the start of the examination to the end of the examination; (ii) time from the start of the examination to patient departure from the department; (iii) and time from the start of the examination to the availability of an image. Examinations were matched for type and patient condition. **RESULTS:** (i) The time taken from the patient entering the examination room, being examined, to the patient exiting the room: in this section DR is 17% quicker than CR. (ii) The time taken from the patient entering the examination room, being examined, to the patient exiting the room and leaving the department: in this section DR is 55% quicker than CR. (iii) The time taken from the patient entering the examination room, being examined, to the patient exiting the room, leaving the department and the radiographer completing the examination: in this section DR is 45% quicker than CR. **CONCLUSION:** Overall, production of a DR image is 45% quicker than producing the same image using CR.

**1130 Invited review: Digital mammography: acquisition and display issues in clinical practice**

E Denton

*Norfolk & Norwich University Hospital NHS Trust, Norwich, UK*

Making the move to either computerized radiography or digital imaging for mammography poses many challenges for Breast Imaging Departments. The impact of different image acquisition techniques on clinical practice will be explored. I will discuss the various image display facilities available and the impact of these on clinical practice. We have found soft-copy reporting satisfactory and it has enabled us to reduce the number of standard assessment films for cases of calcification; this reduces the patient dose and limits the need to print films.

**1150 Evaluation of clinical workflow of digital image capture modalities to enable forecasting of annual costs**

SW Ward

*Xograph Imaging Systems, Tetbury, UK*

**PURPOSE:** Workflow study to enable forecast of costings for digital capture X-ray systems. Many departments are in the process of or are anticipating upgrading their current film-based image capture system to a digital one, the choice being either a computed radiography (CR) or a direct digital (DR) image capture system. It is accepted that there are benefits associated with either digital capture system. The extent to which said benefits have been extrapolated to business proposals is not so well known. To assist in forecasting the relative ongoing costs of each modality a study comparing the workflow of the digital systems was undertaken. **METHOD:** Workflow analysis of the image capture systems was undertaken to enable timings of various routine radiographic projections. Averages of all projections per modality were calculated and compared. **RESULTS:** DR projections were on average 2.3 times faster than the equivalent CR projections. Results were statistically significant to a high degree ( $p < 0.0001$ ) using Student's *t*-test. **CONCLUSIONS:** From the results obtained, and knowing the initial equipment, the image capture system costs together with ongoing costs associated with each modality, a forecast has been produced showing that after 3 years the costs of DR are less than those of CR systems.

**1200 A comparison of image quality and dose on conventional and digital imaging systems for mammography**

<sup>1</sup>CP Lawinski, <sup>1</sup>H Cole, <sup>2</sup>DA Goodman and <sup>3</sup>E Kulama

*<sup>1</sup>King's College Hospital, London, UK, <sup>2</sup>Addenbrooke's Hospital, Cambridge, UK and <sup>3</sup>Hammersmith Hospital, London, UK*

Currently, mammography imaging is primarily based on film-screen technology, although small-field digital imaging is widely used for stereotactic localizations. Recent developments in digital technology have resulted in the introduction of computed radiography (CR) and direct digital radiography (DDR) for full-field imaging. CR in mammography was initially based on systems for general radiography. Dedicated mammography CR systems are now available with improved imaging capability. Full-field DDR systems use a number of technologies, including amorphous silicon and amorphous selenium flat panels and tiled array and scanning charge coupled device (CCD) systems. Image quality data for a range of CR and DDR systems were

obtained using standard test objects. All acquired images were printed onto film using a high resolution laser printer and were scored under typical film viewing conditions. A number of images were also scored as softcopy on a workstation. Breast dose was also assessed. The results were compared with data for film–screen imaging. The low contrast sensitivity and small detail detectability performance of the CR systems was very close to that of film–screen imaging, whilst the performance of the DDR systems was slightly better. The high contrast resolution performance of both the CR and DDR systems was significantly poorer than for film–screen imaging, although the measured values were very close to the nominal values derived from the pixel size. On the systems evaluated, the dose levels were generally comparable with that for a modern film–screen combination.

### 1210 Comparison of film–screen and computed radiography for chest imaging

ID Honey and A Mackenzie

*King's College Hospital, London, UK*

**PURPOSE:** To compare the image quality of film–screen (FS) and computed radiography (CR) for adult chest examinations across a range of beam energies. **METHODS:** A series of images of the CDRAD (University of Nijmegen) threshold contrast detail detection phantom was acquired across a range of kVp values and exposure levels with both CR and FS. The phantom was placed within 9 cm of the Perspex to provide scatter in the image. Hardcopy images were scored at a fixed distance from a masked light box by two scorers. Threshold contrast indices were used to calculate Gallacher image quality indices (QI). **RESULTS:** Film image quality dropped off at optical densities above 2.5 whilst CR improved with exposure across a much wider dynamic range. At AEC levels CR produced 20% lower QI than FS at 125 kVp. At 75 kVp and 90 kVp CR was found to produce QI 10% and 1% higher than FS, respectively. Exit exposures from chest images vary by a factor of approximately 5 (lung to mediastinum). At these extremes CR performs better relative to FS than it does at the AEC level. The QI obtained using CR at 75 kVp and 90 kVp were found to be statistically significantly better than at 125 kVp. **CONCLUSION:** The relative performance of FS and CR varies as a function of energy owing to the different k-edges of the systems. When changing from FS to CR, using a lower kVp may allow image quality to be maintained whilst reducing effective dose.

### 1220 Image quality and dose in digital mammography

<sup>1</sup>BP Johnson, <sup>1</sup>KC Young and <sup>2</sup>H Bosmans

*<sup>1</sup>Royal Surrey County Hospital, Guildford, Surrey, UK and*

*<sup>2</sup>University Hospital Gasthuisberg, Leuven, Belgium*

**PURPOSE:** To determine the performance of digital mammography systems with a view to establishing minimum standards for image quality and dose. **METHODS AND MATERIALS:** Image quality at varying doses was measured using the Nijmegen CDMAM type 3.4 on GE Senographe 2000D and Fuji 5000MA digital systems and using 16 film–screen systems. **RESULTS:** Contrast detail (CD) curves for the digital systems were generally as good or better than screen–film systems provided a sufficient dose was used. **CONCLUSIONS:** The data enable a minimum CD curve to be established for the digital systems that is at least as good as current film–screen systems. This forms the basis for a proposed standard of CD performance across a range of detail sizes from 0.1–5 mm.

## 1115–1230

### Paediatrics and Obstetrics: non-accidental injury

#### 1115 Invited review: Imaging in non-accidental injury and a new standard for skeletal surveys

A Sprigg

*Sheffield Children's Hospital, Sheffield, UK*

**PURPOSE:** To improve awareness of paediatric non-accidental injury (NAI) and to unify standards for skeletal surveys in the UK. **METHOD:** There is currently no uniform practice for skeletal surveys in suspected NAI in the UK. The British Society of Radiologists has produced an evidenced-based protocol for skeletal surveys in NAI. This will be presented together with a review of the imaging findings in NAI. **CONCLUSIONS:** We aim to detect NAI at an early stage, such that

the child is protected from further injury. Improved awareness amongst radiographers and radiologists may improve early diagnosis. Good radiographic technique, documentation and communication are essential to gain maximum information whilst minimizing radiation dose and distress to the child and its carers.

#### 1140 Invited review: Imaging the brain and non-accidental injury

N Stoodley

*University Hospital of Wales, Cardiff, UK*

Non-accidental injury (NAI) in infants is not uncommon. Most of the morbidity and mortality in NAI is due to the associated head injury. Long-term outcomes in children who sustain head injuries following accidental trauma tend to be much better than if the head injury was due to a non-accidental injury. Despite this, most imaging investigations in suspected child abuse concentrate on identification of skeletal injuries which, although important from the point of view of mechanism of injury, are of little long-term consequence to the child. This presentation will review the “typical” neuroimaging features of non-accidental head trauma as seen on plain radiographs, CT and MR, emphasizing the important role of the radiologist in recognizing this condition. Recommendations will be made about the routine use of neuroimaging techniques in the investigation of suspected child abuse. The role of neuroimaging in giving some insight into the possible pathophysiology of non-accidental head injury will also be discussed.

#### 1205 Invited review: Paediatric musculoskeletal imaging

KJ Johnson

*Birmingham Children's Hospital, Birmingham, UK*

Musculoskeletal disorders in children encompass a wide spectrum of abnormalities ranging from minor trauma to complex skeletal dysplasias. Imaging plays a crucial role in the diagnosis, assessment and treatment of these children. The initial choice of imaging will depend on the child's clinical presentation. Selection of any additional imaging will depend on the initial imaging findings, the patient's clinical status, equipment availability and local expertise. As in all aspects of paediatric radiology, ionizing radiation should be kept to a minimum. Particular reference should also be made to the child's age and level of development, as this will also affect the choice of imaging. Recognition of the normal variation in the imaging features that alter with age and that can cause confusion with some pathological conditions is also important. The aim of this lecture is to provide an overview of the techniques that are available in imaging children of different ages as well as some of the normal variants that can be confused with disease. The normal physiological changes that the musculoskeletal system undergoes with age will be illustrated along with corresponding pathological conditions.

## 1115–1245

### Involvement of Patients

#### 1115 Invited review: Working in partnership with users

T Patel

*Epsom General Hospital, Surrey, UK*

No abstract supplied.

#### 1135 Invited review: Patient liaison groups: their function and achievements

D Videlo

*Royal College of Radiologists CRPLG, London, UK*

I will describe my experience of patient involvement in the field of radiology, in particular the function, work and achievements of the Clinical Radiology Patient Liaison Group of the Royal College of Radiologists. As a result of this group, a Patient Liaison Group was recently set up in the radiology departments in each of four local hospitals. The findings of these pilot sites are summarized. The experience of serving as a patient representative on a Quality and Patient Group within a Cancer Centre is also described. The differing characteristics of these three forms of patient involvement are compared, and what is required of a patient representative is suggested for each case.

**1155 Invited review: The new CHAI and how to prepare for a CHAI inspection**

J Dent

Commission for Health Improvement, London, UK

No abstract supplied.

**1215 The effects of giving patients a copy of their ultrasound report**

<sup>1</sup>A Alam and <sup>2</sup>N Graham

<sup>1</sup>John Radcliffe Hospital, Oxford, UK and <sup>2</sup>Milton Keynes General Hospital, Milton Keynes, UK

AIM: To determine the response of patients being offered an immediate copy of their ultrasound report. MATERIAL AND METHODS: 100 consecutive patients attending for general ultrasound scans were offered a copy of the typed report to supplement the verbal explanation of the findings. Those accepting were given a simple questionnaire to determine whether the written report had been of any use to them. RESULTS: All patients found the verbal explanation useful. 95 patients received a typewritten report and 54 returned the questionnaire. 53 patients had found the report useful and many had used it as a starting point for further discussion with other people such as family members or their medical practitioner. 17 patients had used the report to find out more about their condition. None of the patients found it worrying, negative or unhelpful. CONCLUSION: Patients find the provision of a paper copy of their ultrasound report useful and reassuring.

**1225 A study of the impact of multimedia Web-based patient information prior to MRI**

S Brown and R Harrison

Nuffield Orthopaedic Centre, Oxford, UK

INTRODUCTION: Current literature suggests that many patients undergoing MRI scans are poorly informed about the procedure and its implications, which affects patient attendance and scan tolerance. 70% of the UK population now have Internet access, and many utilize the Web as a primary source of medical information. We aimed to determine whether access to such information is well tolerated and informative. MATERIALS AND METHODS: A website was designed in-house, comprising pictures and audio and video sequences, which was peer-reviewed prior to use. 20 patients attending for MRI completed a questionnaire before and after viewing the website to assess their level of knowledge and insight of the MR procedure. RESULTS: All patients found the website user friendly and easily navigable, and 95% found it to be "useful" or "very useful". 90% had significantly increased knowledge levels after viewing the site. 80% felt that the website helped their scan preparation, changed their expectations and 85% recommended its use to other patients. CONCLUSION: We have shown that Web-based multimedia MRI patient information is well tolerated, easy to use and improves patient knowledge levels. We suggest its enhanced role in patient education and its potential to reduce patient anxiety and prevention of scan intolerance.

**1235 Discussion**

1115–1315

**Radiation Protection & IR(ME)R**

**1115 Invited review: The Medical and Dental Guidance Notes (MDGN)**

PJ Allisy-Roberts

BIPM, Sèvres, France

The background to the production of the new Medical and Dental Guidance Notes (MDGN), the drafting and the consultation process with the extended use of electronic mail (over 3000 exchanges) will be presented. The document was freely available on the IPREM website, with updates, until it was finally published in 2002. The contents include 19 chapters, 20 appendices and over 150 references to cover all aspects of radiation protection in the clinical environment. The aim was for a "good practice guide" (not a "best practice guide"), and with the many helpful suggestions for amendments to improve the clarity and practicability of the guidance received during (and after) the consultation period we feel we have achieved this. The contribution to the MDGN from the IPREM SIGs and all our professional colleagues working with patients or in governmental organizations, including inspectors, was exceptional. Joint meetings with the Royal

College of Radiologists, the Society and College of Radiographers and the Department of Health helped to ensure that the situation regarding the use of the term "practitioner" under IR(ME)R 2000 was clear and unambiguous. The final version of the MDGN was subject to external review, editorial scrutiny and the normal production process of IPREM publications. The printed version was available in the spring of 2002. Putting the guidance notes into practical use has highlighted some areas where we could have been clearer in the application of the regulations, some of which will be mentioned during the presentation.

**1145 Invited review: IR(ME)R inspection**

C Davies

Royal Glamorgan Hospital, Llantrisant, UK

No abstract supplied.

**1215 Invited review: Progress on meeting the IR(ME)R training requirements**

A Walker

Christie Hospital, Manchester, UK

PURPOSE: The purpose of this presentation is to review the current provision of training under IR(ME)R, to highlight possible problem areas and to discuss possible ways forward. BACKGROUND: Pre IR(ME)R, many so-called "core of knowledge" courses existed to deliver the basic syllabus outlined in the POPUMET legislation to a wide range of clinicians. It was generally agreed that this scatter gun approach delivering minimalistic, very generalized training was not ideal and it was understood that under IR(ME)R training would be targeted at those who really needed it and would be specific to the particular groups requiring training. It was certainly understood that one of the intentions of IR(ME)R was to limit the responsibilities for most exposures to those who were radiation protection trained professionals, e.g. radiologists or radiographers. At the IR(ME)R training workshop held at the Department of Health in early 2000, it was clear that the expectation was that the bulk of clinicians who had required training under POPUMET would be spared under IR(ME)R. Instead, the responsibilities for justification and carrying out physical aspects would be primarily taken by radiologists and radiographers, with just a small number of other groups of staff requiring some level of training for certain physical aspects, e.g. performing QC, processing films etc. It was, however, agreed that cardiologists should have appropriate training, as in many instances it was felt appropriate for them to act as both IR(ME)R practitioner and operator. There appears to be very few new courses aimed at delivering IR(ME)R training. IPREM has maintained its course accreditation panel but was hesitant about accrediting courses that covered clinical aspects (e.g. covering such areas as justification of clinical procedures). So far we have only been approached to accredit operator courses in limited areas of work (haematology, bone densitometry and emergency radiography on-board ship). BIR has working with the RCP to ensure that adequate training in radiation protection is included in the new syllabus for cardiology SpRs and has taken on the task of accrediting courses.

**1245 Examination optimization in diagnostic paediatric radiography in Ireland**

K Matthews, M McCaffrey, M McEntee, D O'Leary,

L Rainford, E O'Carroll-Sullivan and PC Brennan

University College Dublin, Dublin 4, Ireland

The Health Research Board has funded a 3-year study of paediatric practice in Ireland. The study is investigating radiographic practice across a range of paediatric diagnostic examinations. In line with European recommendations, diagnostic reference levels (DRLs) are being established for a number of examinations with high effective dose. In addition, image quality is being analysed and correlated with dose and applied technique, such that recommendations may be made for greater optimization of practice. The presentation will provide a review of the wide spectrum of paediatric practice occurring in X-ray departments nationwide and the importance of this in formulating a non-biased sample for the establishment of reference doses. The European Commission gives no guidance on what proportion of hospitals should be included in a national dosimetric survey, but recommends that "DRLs for diagnostic radiology should be based on doses measured in various types of hospital, clinic and practice, and not just in well-equipped hospitals". The difficulties in undertaking a comprehensive analysis of image quality will also be discussed.

Optimization demands that acceptable definitions and assessment methods are developed for analysis of image quality in clinical radiographs. Several image evaluation methods have been reported in recent literature: all have advantages and disadvantages; none seem to give an absolute image quality measure such that the lowest achievable dose for an examination may be specified. In particular, in paediatrics it is acknowledged that essential image details depend heavily on the clinical situation and image quality must be adapted to the particular clinical problem.

### 1255 Variations in radiation dose between the same model of multislice CT scanner at different hospitals

CJ Koller

*North Staffordshire Hospital NHS Trust, Stoke-on-Trent, UK*  
A survey was undertaken to investigate the variation in exposure factors between seven centres using identical multislice CT scanners. Data were collected for six standard examinations and, using FDA (Food and Drug Administration) phantom measurements, patient dose values were calculated for the seven centres. Dose values were compared between centres and with the relevant diagnostic reference level for each examination. The range in CTDI<sub>w</sub> (weighted computed tomography dose index) values between the seven centres was small for abdominal scans and head scans. For other examinations however, such as FESS (functional endoscopic sinonasal surgery), the variation in CTDI<sub>w</sub> was as high as a factor of seven between the lowest and the highest values. At one centre a programme of dose optimization had been undertaken and at this centre CTDI<sub>w</sub> values ranged from 3–47% lower than the average value for all seven centres. This study demonstrates that there exists a wide variation in dose for patients undergoing the same CT examination on the same model of CT scanner between different centres, and also that significant dose reduction can be achieved through close collaboration between medical physics, radiologists and radiographers.

### 1305 The effect of X-ray kilovoltage peak on radiographic image quality and patient effective dose with digital image acquisition systems

MF McEntee, PCO Brennan and GA Connor

*UCD, Dublin, Ireland*

**PURPOSE:** This study aims to establish the effect of X-ray beam energy (kVp) on image quality and effective dose (ED) to the patient during PA chest and AP abdomen digital radiography. **MATERIALS AND METHOD:** PA chest radiographs ( $n = 407$ ) were carried out using 70 kVp, 90 kVp, 110 kVp, 125 kVp and 150 kVp. Four image acquisition systems were used (GEMS Revolution XQ i (FPD); Phillips Thorovision (DSD); Agfa-Geveart ADC (CR1); and Kodak KESPR 300 (CR2)). AP abdomen radiographs ( $n = 66$ ) were carried out using 70 kVp, 90 kVp, 110 kVp and 125 kVp on the CR1 and CR2 systems. An anthropomorphic phantom and a contrast detail resolution assessment device (CDRAD) were used. Patient and anthropomorphic phantom images are evaluated using modified European Guidelines on Quality Criteria for Diagnostic Radiographic Images. Correlation between the patient study and the phantom study results is assessed. ED was calculated from DAP measurements recorded during the patient study. **RESULTS:** Good correlation was shown between the anthropomorphic phantom data and the patient data for digital systems. Image quality and ED data indicated that the kVp currently employed in the departments in this investigation and those levels recommended by the CEC may be inconsistent with optimum practice. **CONCLUSIONS:** It is recommended for the PA chest examination with the DSD and CR2 systems that 70 kVp should be employed and that 125 kVp be used with the FPD and CR1 systems. For AP abdominal radiography, 70 kVp is recommended for both computed radiography systems tested.

1130–1200

## Imaging and Treatment of Colorectal Liver Metastases Scientific Session

### 1130 Portal vein embolisation for colorectal cancer metastases: minimum future liver remnant requirement

S Anthony, I Beal, N Davies, G Fusai, R Hutchins, B Davidson and J Tibballs

*Royal Free Hospital, London, UK*

**PURPOSE:** Prospective assessment of liver volumes following portal vein embolisation (PVE) and assessment of minimum future liver remnant (FLR) required to achieve sufficient hypertrophy to enable hepatic resection. **METHODS:** 14 patients with colorectal cancer liver metastases underwent right PVE for FLR <30% based on MRI volumetry. Transhepatic direct portal vein puncture was performed and right portal vein branches were embolised using Histoacryl glue + Lipiodol ( $n=11$ ) or absolute alcohol  $\pm$  PVA ( $n=3$ ). MRI liver volumes of the whole liver, tumour volume, tumour-free liver (TFL) and segments I–III or I–IV (FLR) were measured prior to PVE and at a mean of 6.9 weeks post PVE. **RESULTS:** The mean FLR increased from 297 ml (110–517 ml or 7.5–30% of TFL) to 445 ml (245–689 ml or 17–44% of TFL). Overall, this represents an increase in FLR of 10% (4.5–17%). Tumour volume increases in our series were not significant ( $p<0.14$ ). 12 of the 14 patients achieved sufficient hypertrophy to be considered for surgery. One patient experienced a significant complication resulting in total portal vein occlusion with no significant hypertrophy post PVE. **CONCLUSION:** PVE is an effective technique that facilitates extended hepatic resection. Our results suggest that patients with initial FLR <15% are unlikely to benefit from PVE.

### 1140 Portal vein embolisation and chemotherapy prior to hepatic resection for colorectal liver metastases

IK Beal, S Anthony, N Davies, R Hutchins, G Fusai, R Begent, B Davidson and J Tibballs

*Royal Free Hospital, London, UK*

**PURPOSE:** To assess the effects of chemotherapy on liver regeneration and tumour growth following portal vein embolisation (PVE) in patients with colorectal liver metastases. **METHODS:** 14 patients with colorectal carcinoma liver metastases underwent right PVE. The indication for PVE was a future liver remnant (FLR) of less than 30% in an otherwise normal liver ( $n=13$ ) or less than 40% ( $n=1$ ) in a diseased liver as assessed by CT or MRI volumetry. PVE was performed using Histoacryl glue + Lipiodol ( $n=11$ ) or absolute alcohol  $\pm$  PVA particles ( $n=3$ ). Seven patients received adjuvant chemotherapy following PVE and seven did not. Liver volumes were measured at a mean of 6.9 weeks post PVE. **RESULTS:** In the chemotherapy-treated group the FLR increased from a mean of 19% (range 12–30%) to 28% (range 19.5–44%). In the non-chemotherapy-treated group, the FLR increased from a mean of 17% (range 7.5–23%) to 28% (range 17–39%). Overall, the tumour volume increased from a mean of 278 ml (range 29–1147 ml) to 336 ml (range 10–1597 ml). In those patients treated with adjuvant chemotherapy, the mean tumour volume increased from 349 ml to 422 ml. However, there was tumour volume regression in six of these seven patients. The tumour volume in those patients not treated with adjuvant chemotherapy increased from 206 ml (range 29–727 ml) to 249 ml (range 10–966 ml). **CONCLUSION:** Chemotherapy does not appear to adversely affect the degree of liver hypertrophy and may prevent tumour progression. Patients with very large tumour volumes may have less hypertrophy following PVE.

### 1150 Contrast-enhanced ultrasound in the assessment of focal liver lesions treated using radiofrequency ablation

MD Bradley, K Burney, M Callaway and J Virjee

*Bristol Royal Infirmary, Bristol, UK*

**AIM:** Radiofrequency ablation under ultrasound guidance is a safe method of treating primary and secondary malignant lesions in the liver, but assessing treatment margins immediately post ablation and identifying local recurrence during follow-up is difficult. The consensus is that a 0.5–1 cm margin is required for complete treatment, but there is no surgical specimen to assess resection margins, and radiofrequency ablation produces imaging artefacts around the treated area on conventional ultrasound. This small study assesses the role of contrast-enhanced ultrasound post ablation to identify the area of treatment, both in the immediate and follow-up periods. **METHOD:** Five patients (two primary hepatocellular carcinoma, three metastatic liver disease) undergoing radiofrequency ablation were assessed immediately and at 1, 3 and 6 months post ablation with both conventional and contrast-enhanced ultrasound (Sonovue™; Bracco, UK) in all three phases of liver enhancement. Lesion vascularity, enhancement and ease of identification were compared with the surrounding parenchyma. **RESULTS:** All lesions were less than 5 cm and were treated with a



Radionics cooled tip radiofrequency probe heated to over 70°C for 12 min. Imaging artefact on conventional ultrasound immediately post ablation prevented identification and measurement of the ablation area, but this was clearly seen as an area of hypoechogenicity post contrast medium administration. During follow-up, contrast-enhanced ultrasound proved to be the most sensitive method of identifying local recurrence. CONCLUSION: Contrast-enhanced ultrasound is superior to conventional ultrasound in examining the site of malignant liver lesions treated with radiofrequency ablation and is also the most sensitive method for identifying early disease recurrence.

1130–1230

## Breast Scientific Session

### 1130 The impact of image-guided biopsy on the outcome of mammographically detected indeterminate microcalcifications

MA Al-Attar, MJ Michell, S Bose, G Ralleigh, N Akbar, D Evans and R Wassan

*King's Breast Radiology and National Breast Screening Training Centre, King's College Hospital, London, UK*

**PURPOSE:** To measure the effect of the implementation of image-guided needle biopsy on the outcome of mammography screening-detected indeterminate microcalcification. **MATERIALS AND METHODS:** 2107 patients underwent surgery for lesions detected by the South East London Breast Screening programme between 1/04/1991 and 31/03/2001. The mammography sign in 392 (18.6%) of these cases was classified as indeterminate microcalcification. During this time there have been changes in practice: initially cases were for diagnostic surgical excision, subsequently stereotactic fine needle aspiration cytology was introduced in 1992 followed by 14 G core biopsy in 1994 and 11 G vacuum-assisted biopsy in 1998. The final surgical histology result (benign, malignant non-invasive, malignant invasive) was compared between group A (cases seen between 1/04/1991 and 31/03/1996) and group B (cases seen between 1/04/1996 and 31/03/2001). **RESULTS:** In group A, 102/201 (50.7%) were benign compared with 47/191 (24.6%) in group B. The decrease in the number of benign cases in group B is due to the decrease in the number of cases of fibrocystic change undergoing surgery. Of the malignant cases, there is a significantly higher percentage of non-invasive cancer in group B compared with group A (77% vs 62.2%). **CONCLUSION:** Implementation of more effective methods of image-guided breast biopsy has led to a 50% reduction in benign surgical biopsy. The more recent study group has a higher proportion of cases of DCIS, possibly due to more active investigation of indeterminate low suspicion microcalcifications.

### 1140 Stereotactic breast biopsy within the NHSBSP: effects of changing to prone 11 G vacuum-assisted technique

P Whelehan, P Britton, R Sinnatamby, R Warren, A Freeman and R Davies

*Addenbrooke's Hospital, Cambridge, UK*

**PURPOSE:** To evaluate the effects of developments in stereotactic biopsy technology for the investigation of screen-detected mammographic abnormalities in a UK breast unit. **MATERIALS AND METHODS:** A database survey was carried out of women undergoing stereotactic breast biopsy for screen-detected mammographic abnormalities between April 1998 and March 2002. 294 biopsies were performed using 14 G conventional core with upright analogue stereotaxis, and 150 biopsies using 11 G vacuum-assisted sampling and prone digital stereotaxis. Performance criteria and outcomes have been compared between the two study groups. **RESULTS:** Calcium retrieval rates were 74.1% in the 14 G group and 97.2% in the 11 G group. The miss rate decreased from 11.5% to 2%. Absolute sensitivities were 74.4% in the 14 G group and 86.0% in the 11 G group. Complete sensitivity increased from 88.5% to 98%. Full specificity increased from 78.9% to 88%. Incidence of carcinoma being underestimated as ADH decreased from 55.5% of 9 cases to 50% of 8 cases. Underestimates of invasive disease fell from 15.9% to 13.5%. In women with screen-detected cancer, rates of achieving complete surgical therapy with only one operation rose from 55.8% to 74.0%. Fewer benign surgical biopsies were carried out in the 11 G group. The overall early recall rate during the study period fell from 0.7% to 0.1%. **CONCLUSIONS:** 11 G vacuum-assisted breast biopsy with prone

digital stereotactic guidance offers greater diagnostic accuracy compared with 14 G conventional core biopsy and upright analogue stereotaxis. This benefits women by improving the management of screen-detected lesions.

### 1150 11 G vacuum-assisted core biopsy vs 14 G automated stereotactic needle biopsy

MA Al-Attar, MJ Michell, S Bose, G Ralleigh, N Akbar, R Wassan and D Evans

*King's Breast Radiology and National Breast Screening Training Centre, King's College Hospital, London, UK*

**PURPOSE:** To compare underestimation of invasive and non-invasive breast cancer between 14 G automated needle biopsy (ANB) and 11 G vacuum-assisted core biopsy (VACB). **MATERIALS AND METHODS:** 1192 stereotactic core biopsy procedures were performed at King's College Hospital from June 1998 to May 2002 for non-palpable, mammographically suspicious lesions. Procedures were performed using dedicated prone stereotactic biopsy equipment (Fischers). The study group consisted of 263 cases diagnosed as malignant non-invasive carcinoma (188 cases using 14 G ANB; 75 cases using 11 G VACB) and 108 cases of B3/B4 core biopsy histology (61 cases using 14 G ANB; 47 cases using 11 G VACB). Final surgical histology is available in all the cases with *in situ* diagnosis and in 96 cases with B3/B4 diagnosis (54 cases with 14 G ANB; 42 cases with 11 G VACB). In each of the study groups the surgical histology outcome for 14 G ANB is compared with the surgical outcome for 11 G VACB. **RESULTS:** The underdiagnosis rate of invasive tumour in an area of DCIS is 18.6% using both techniques. When the core biopsy histology showed B3/B4, the under diagnosis rate for malignancy using 11 G VACB is 35.7% compared with 46.29% for 14 G ANB. **CONCLUSION:** In this series there is a significant difference in the underdiagnosis rate for B3/B4 cases, but no difference in the underdiagnosis rate of invasive tumour when comparing 11 G VACB with 14 G ANB.

### 1200 Increased cancer detection rates following the introduction of two-view screening mammography in the incident round

K Gower Thomas, S Jenkins, D Brook, J Blethyn, C Flowers, S Hotston, H Fielder and C Rogers

*Breast Test Wales, Cardiff, UK*

The NHS Breast Screening Programme recommends two-view mammography for the prevalent round screen as it is recognized that, compared with the single view, this significantly increases sensitivity for cancer detection. The UK programme is currently undergoing expansion to screen women up to 70 years and also to introduce two views for all incident screens. This had been predicted to detect 8.9% more cancers. Breast Test Wales, which screens women in Wales, introduced two views at each round in 2001. We present our results comparing detection rates before and after, which show significantly increased cancer detection for the incident round using two views (8.2/1000 women screened vs 5.9/1000 with single view) as well as small invasive cancer detection (*i.e.* cancers less than 15 mm) (3.9/1000 vs 2.4/1000 before). It is hoped that this will lead to more cancers being detected and treated at an early stage and to a reduction in the number of interval cancers presenting symptomatically between two screens.

### 1210 GP access to breast imaging: efficient but is it safe?

K Gower Thomas, J Gahir, K Preece, E Vaughan-Williams and R Williams

*Royal Glamorgan Hospital, Llantrisant, UK*

Direct GP referral for breast imaging provides a rapid service that efficiently uses a valuable resource throughout the week, shortening time to cancer diagnosis and treatment. National guidelines are critical of GP open access to mammography in isolation, recognizing that cancers may be missed. To determine whether our service was missing cancers, we audited the symptomatic cancers diagnosed in our catchment population over 2 years from April 2000. For each patient identified from pathology and Cancer Registry data, outpatient and radiology records were checked from April 1998 to detect attendances in surgical outpatient and radiology prior to cancer diagnosis. Mean annual new referral rates were 285 to radiology and 532 to outpatients. Over 2 years, 54 cancers were diagnosed by the former route and 159

by the latter route. 12 patients had their cancer diagnosed after their initial presentation to our service. Eight of these were initially seen for other benign lesions elsewhere in the breast (mean delay 24 months, range 3–34 months). A cancer was at first misdiagnosed in four patients (mean delay 11.5 months, range 4–16 months). Two had palpable lumps that were considered normal on imaging, one a cyst and one breast oedema. Two were seen in surgical clinic and two were sent to radiology by their GP ( $p=0.221$ , Fisher's exact test). Our complimentary referral routes provide expeditious and accurate diagnosis of breast problems. Patients in whom a benign diagnosis is established are reassured; the cancers are referred for treatment. A small number with image negative abnormalities may have clinical cytology or core biopsy.

## 1220 Discussion

1300–1400

### Royal College of Radiologists

#### Tesla Lecture

##### **Eponymous Lecture: Blood flow to the liver: normal and pathological features on CT**

D Balfe

*Washington University School of Medicine, St Louis, MO, USA*

Two systems supply the liver with blood: the hepatic artery and the portal vein. It has been known for some time that there is dynamic interplay between the two, and that alterations in hepatic blood flow lead to characteristic changes on contrast-enhanced cross-sectional images. The fundamental observation to be presented in this talk is transient hepatic attenuation difference (THAD), which is observed when the liver is imaged during the hepatic inflow phase. It occurs when there is segmental or lobar decrease in portal venous inflow, so that there is unopposed arterial enhancement in that segment. The effect is much more difficult to observe, or disappears entirely, on images obtained during the hepatic venous phase. There are many potential causes for segmental decrease in portal venous flow, including portal thrombosis, hepatic vein obstruction, biliary obstruction, intrahepatic tumour, extrinsic capsular pressure and systemic vein to portal vein shunting. Examples of THAD arising from each of these underlying causes will be given. Other conditions also produce unusual and often characteristic effects on contrast-enhanced imaging. These include main portal vein occlusion, generalized hepatic vein thrombosis (Budd–Chiari syndrome), right heart failure, arteriportal shunting and superior vena caval obstruction. Clinical and imaging characteristics of each will also be discussed. Finally, the probable relationship of THAD with focal fat infiltration and hepatic pseudotumours (as depicted on CT angioportography) will be elucidated.

1400–1445

### Handling the Image I

#### **1400 Invited review: Manipulating the image**

H Lemke

*CARS 2002, Berlin, Germany*

No abstract supplied.

1400–1530

### Dealing with Major Disasters

#### **1400 Invited review: Title to be confirmed**

Speaker to be confirmed

#### **1430 Invited review: The role of radiography in the forensic investigation of mass incidents**

<sup>1</sup>MD Viner, <sup>2</sup>W Hoban, <sup>3</sup>C Rock and <sup>4</sup>MT Cassidy

*<sup>1</sup>St Barts & The London NHS Trust, London, UK, <sup>2</sup>The Royal Free Hospital London, London, UK, <sup>3</sup>St James' University Hospital, Leeds, UK and <sup>4</sup>Royal College of Surgeons of Ireland, Dublin, Ireland*

**PURPOSE:** To review the role of radiology in the forensic investigation of mass incidents and to present guidance for planning of effective

forensic radiology services within temporary mortuary situations. **MATERIALS AND METHODS:** Radiological imaging is a powerful tool in forensic medicine. It is widely used to determine the cause of death or injury, to assist in the identification of deceased persons, or in the investigation of non-accidental injury (NAI) in children or the elderly. Whilst most cases involve radiological examination of an individual, radiology is playing a significant and increasing role in the investigation of mass disasters, terrorist incidents, war crimes and large-scale human rights abuses. Large-scale investigations of this nature require detailed organization and rapid deployment of teams of forensic professionals for the recovery of the deceased and their subsequent autopsy examination within a temporary facility designed for this purpose. **RESULTS:** Drawing on experience of incidents in the UK, the Republic of Ireland, the Former Yugoslavia and Sierra Leone, the Trauma Imaging Group has reviewed the requirements for the provision of an appropriate forensic radiology service within the temporary mortuary environment. **CONCLUSION:** This presentation will outline the history of radiography in the forensic investigation of mass incidents, its main uses and the potential for further development. It will examine the role of the radiographer within the forensic team, and the importance of training and familiarity with legislation and guidelines that underpin good forensic practice. It will review the current organization of forensic radiography services for the investigation of mass incidents and highlight some of the practical problems encountered by those asked to provide the service. It will discuss possible solutions that may be adopted when planning for such incidents, detailing the necessary training, organization, protocols and equipment to be considered.

#### **1500 Invited review: The Great Heck train crash**

<sup>1</sup>S Gilson and <sup>2</sup>C Rock

*<sup>1</sup>Pontefract General Infirmary, West Yorkshire, UK and <sup>2</sup>St James' Hospital, Leeds, UK*

This presentation will describe the radiological processes involved as a result of a major incident. We will describe the management of live casualties and the deceased. Issues addressed will be communication, staffing, equipment, protocols, the identification process and lessons learned.

1415–1515

### Imaging and Treatment of Colorectal Liver Metastases

#### **1415 Invited review: Surgery of liver metastases**

JAC Buckels

*Queen Elizabeth Hospital, Birmingham, UK*

Recent progress in the understanding of liver anatomy together with improved resection techniques have led to major benefits for selected patients with metastatic disease. Although patients with metastases from various primaries are treated in this way, surgery for colorectal liver metastases has the widest application and forms the major part of this review. Colorectal cancer is the second most common malignancy in the UK (28,000 cases annually) and 25% have identifiable metastases at presentation, with a further 35–40% developing metastases at a later date. If resectable, and in the absence of extrahepatic disease, 5-year survival rates are over 30%. Unfortunately only a minority of patients (between 10% and 20%) have resectable liver lesions, either because of the number and distribution in the liver or because of extrahepatic disease. Nevertheless, it is clearly important that these cases are appropriately identified and offered treatment. The importance of high quality cross-sectional imaging both to identify resectable cases and to plan surgery cannot be overemphasized. Although the role of follow-up imaging and investigations for colorectal cancer patients has been controversial, a recent meta-analysis suggests that identifying resectable lesions can produce a greater impact than adjuvant chemotherapy. Careful selection using established risk factors, including size and number of metastases, Duke's staging of the primary and the interval between initial diagnosis and development of liver disease, is likely to further improve outcomes. Finally, several ablative techniques have recently been developed. These include percutaneous radiofrequency ablation, which is currently under study.

**1445 Invited review: Treatment of liver metastases: an oncologist's perspective**

R Midgley

*University of Oxford, Oxford, UK*

Only a small proportion of liver metastases from colorectal cancer are amenable to curative resection. It therefore falls upon the oncologist to develop effective chemotherapy for patients with unresectable disease. 5-fluorouracil has long been the mainstay of such treatment. With infusional regimens and the addition of folinic acid, side effects have been decreased and effectiveness increased. However, more recent additions to our armamentarium, including irinotecan and oxaliplatin, have also doubled response rates and brought about significant improvements in overall survival. These improvements are, however, at the cost of increased toxicity, especially diarrhoea, neutropenia and neuropathy. New regimens are now being tested that may make completely oral chemotherapy regimens a real clinical possibility, which should significantly improve the health economics and patient acceptability of treatment for metastatic disease. The future is looking towards completely novel modalities of treatment, including gene therapy and immunotherapy, and the basic principles of these will be discussed.

**1415–1515**

**Paediatrics: service delivery**

**1415 Invited review: Paediatric service planning**

Speaker to be confirmed

**1445 Invited review: Consent issues in paediatrics**

Speaker to be confirmed

**1430–1535**

**Diagnostic Reference Levels in Diagnostic Radiology**

**1430 Invited review: Reference doses and DRLs: the background and the publication**

A Workman

*Forster Green Hospital, Belfast, Ireland*

No abstract supplied.

**1450 Invited review: Setting local DRLs: problems, pitfalls and solutions**

J Kotre

*Newcastle General Hospital, Newcastle-upon-Tyne, UK*

No abstract supplied.

**1515 Invited review: What examinations should I set a DRL for?**

B Bury

*Leeds General Infirmary, Leeds, UK*

There is an assumption that once national DRLs for a range of commonly performed examinations have been promulgated by the Department of Health, imaging departments will adopt them locally, amending the actual numerical dose level (usually downwards) where there are good reasons for doing so. The concept of "choosing" examinations will therefore relate chiefly to those for which a national level has not been set (*i.e.* truly "local" DRLs). When setting these local DRLs, a number of principles will guide the selection of examinations for inclusion. (1) Local DRLs should only be set where it is practicable (*i.e.* there must be sufficient numbers of examinations, and the dose data must be readily available for collection and monitoring). (2) There should be a DRL for at least one examination performed on each piece of equipment that contributes significantly to the workload of the department. (3) Where different groups of operators exist within an organization, there should be at least one DRL set within each group's field of practice. (4) The examinations chosen should not include those where the techniques used (and therefore dose) vary significantly between patients (for example many interventional procedures). These factors and others will be discussed, with reference to specific types of examination.

**1430–1600**

**Digital and MR Mammography**

**1430 Invited review: New developments in digital mammography**

K Young

*Royal Surrey County Hospital, Guilford, UK*

A remarkable variety of designs for full-field digital mammography have been developed. One of the oldest (photostimulable phosphors) has received a new lease of life with the introduction of dual reading technology at 50  $\mu\text{m}$  resolution. The most widely sold system is the GE Senographe 2000D. This uses a caesium iodide scintillator to convert X-rays to light, and an amorphous silicon panel to convert light into an electronic image, with a pixel size of 100  $\mu\text{m}$ . Although this limits the maximum spatial resolution to 5 lines per mm, this seems to be acceptable. Manufacturers are also developing systems using amorphous selenium to directly convert X-rays to an electronic image. This may achieve better image quality because of the elimination of light production. The first system is the Lorad Selenia, which has a 70  $\mu\text{m}$  resolution, and one is expected in the UK in January 2003. It is too early to say whether such systems will yield the benefits expected. A low dose system, which uses a scanning technique with a linear array of silicon detectors, has also been developed. Dual CRT displays with 2000  $\times$  2500 resolution are becoming standard, but it is likely that high-resolution liquid crystal displays may eventually supplant this technology. While such systems may be readily introduced into a symptomatic role, their use in screening remains problematic because of the high throughput required for both acquisition and display. The European SCREEN Research project is attempting to develop a workstation to specifically address these issues.

**1500 Invited review: New developments in clinical implementation**

E Denton

*Norfolk & Norwich University Hospital NHS Trust, Norwich, UK*

Our experiences of using computerized radiography (CR) for symptomatic breast imaging and screening assessment and the impact that this change has had on clinical practice will be described. We have found soft copy reporting to be satisfactory and it has enabled us to reduce the number of standard assessment films for cases of calcification, reducing patient dose and limiting the need to print films. The differences between CR and full-field digital mammography will be explored. The experiences of other units using digital mammography and differences between the available equipment for this will also be discussed.

**1530 Invited review: MR mammography: where are we now?**

M Hall-Craggs

*Middlesex Hospital, London, UK*

No abstract supplied.

**1515–1730**

**Handling the Image II**

**1515 Invited review: Displaying and maintaining the quality of the image: quality assurance in PACS**

D Bhachu

*Medical Devices Agency, London, UK*

No abstract supplied.

**1545 Invited review: Why does DICOM matter?**

DJ Harvey

*Medical Connections, Swansea, UK*

10 years ago, when DICOM was first developed, any vendor-independent connectivity at all was considered a great leap forward, and basic transmission of images was widely welcomed. Since then, "basic" DICOM features such as sending and receiving images or printing, have become so common that they are taken for granted, but several newer features have been introduced into DICOM to streamline the workflow through a department. The simplest of these, called Modality Worklist (MWL), sends data from the RIS to the imaging equipment and is greatly valued by radiographers as it saves re-entry of patient and examination data, but there are other protocols equally important

to smooth data flow such as Modality Performed Procedure Step (MPPS) and storage commitment. It is not possible to tell which of these are supported without looking at the conformance statement, so it is even more important than ever not to specify "DICOM conformant" without insisting on details, and checking whether these will work with your existing or proposed PACS.

**1610 Invited review: Image storage: current thinking**  
N Strickland

*Hammersmith Hospital NHS Trust, London, UK*

No abstract supplied.

**1635 Discussion**

**1640 Manipulation of digital images from hospital PACS and compilation of local image libraries**

P Morris

*Bromley Hospitals NHS Trust, Kent, UK*

With the recent expansion in the number of UK hospitals installing computed radiography (CR) and picture archiving and communication systems (PACS) there exists a potential for most X-ray departments to compile convenient image libraries on CD-ROM for local teaching purposes. Locally produced material reflects actual clinical practice rather than using highly selected purchased material. Medical images are stored and transmitted in a DICOM format that is not supported by most personal computer (PC) software; however, there are a number of software applications available as freeware that will manipulate and convert DICOM images to more conventional formats such as bitmap or JPEG. It is therefore extremely feasible to collate interesting cases from a variety of imaging modalities on to a CD-ROM at very little expense using a PC. These images can be inserted in applications such as MS PowerPoint for convenient projection in teaching sessions, clinical meetings and presentations. The techniques of image transfer, manipulation and storage are explained, as are the advantages and possible ethical implications such as patient confidentiality of using locally generated material.

**1650 Storage area networks: a new era for PACS storage**

AR McBride

*St Georges Hospital, London, UK*

PURPOSE: Modern PACS solutions with multi-site constructions increasingly require a different approach to the usual direct attached storage (DAS) model, *i.e.* storage attached to the server. To obtain the best utilization of the storage hardware and hence an improved return on investment, a new model is required. This is the storage area network (SAN), which allows all the servers on the system to access the storage through a fibre channel network. A PACS solution will benefit from this technology allowing the SAN to store all the image data centrally both on the RAID and the back-up storage. The servers at each site will be able to access specific space on the RAID. The benefits from this storage policy allows the RAID array to be treated as one virtual store where each site can store image data on a zone; as one site requires greater storage the zones can be enlarged to optimize utilization. The paper will examine the technology of the SAN, concentrating on its integration into legacy networks and systems. The simplicity of setting up a SAN will be discussed, focusing on the storage techniques used to increase utilisation.

**1700 Medical imaging: the data storage dimension**

R Beeby

*Sagitta, Havant, UK*

PURPOSE: It has been estimated that a hospital performing 100,000 digital examinations per year will require approximately 60,000,000 MB per year based on 10 MB per digital image. Medical equipment and computer technologies are merging so rapidly that neither medical practitioners nor IT departments have all the necessary expertise to specify them. There are many important and difficult considerations when selecting PACS. It is easy for decision-makers to lose sight of the task in hand—entering and storing data so that multiple users can access it over a computer network. METHODS: However, the most significant and critical expenditure is usually made in the most neglected areas of the system, the back-end servers and data

storage. It is easy to overlook the fact that similar data management issues are faced by other organizations and disciplines outside medicine. Despite the complexity of issues at the front end, none of the problems faced in managing and storing this data are new. Publishing and printing companies manage and process millions of very high-resolution images and their associated text every day. The data management skills and strategies used by commercial organizations come from experience. CONCLUSIONS AND PURPOSE: Managing, storing, archiving and protecting such data are essential for organizations wishing to maintain control over their data and increase the level of service provided to patients. This paper explores the benefits of integrating sophisticated storage infrastructures into medical/digital imaging processes.

**1710 Creation of a software application for the clinical radiologist**

S Herman

*University Health Network/Mt Sinai Hospital, Toronto, ON, Canada*

PURPOSE: To create a simple software application that automates a significant portion of the daily workflow of a clinical radiologist. MATERIALS AND METHODS: The daily workflow of clinical radiologists in a busy department was analysed, specifically looking for manual tasks that could be implemented in software. Using state-of-the-art technologies, an application that a radiologist would use in his daily work was created. RESULTS: A number of manual functions that could be automated were discovered. Important clinical information could be presented automatically, including patient and study data as well as the patient's study history and the report of appropriate prior study. Images of the current study and those of the appropriate prior study could be presented, "hung" in the desired fashion of the reading radiologist. Report creation, editing and sign-off could be completed immediately using speech recognition. The report could be faxed or emailed instantly to the referring physician. Medical reference information could be placed online for immediate access. Data entry forms for quality assurance reports could be displayed. A reminder system could alert the radiologist to important upcoming events. All tasks performed by the system could be noted and stored for future analysis, including productivity reports. Because the functions performed by the system exactly mimic what the radiologist is already doing, the application is very quickly mastered and is enjoyable to use, providing the radiologist with a rewarding sense of completion. CONCLUSIONS: A large portion of a clinical radiologist's workflow can be automated and implemented in software, significantly improving their productivity.

**1720 Discussion**

**1530–1630**

**Imaging and Treatment of Colorectal Liver Metastases**

**1530 Invited review: Laser ablation of liver metastases**

TJ Vogl

*Klinikum and Fachbereich Medizin, Frankfurt am Ma, Germany*

PURPOSE: To evaluate the potential of MR-guided laser-induced interstitial thermotherapy (LITT) for the treatment of colorectal liver metastases in a long-term follow-up of patients with palliative intention in non-surgical candidates. MATERIAL AND METHODS: MR-guided LITT was performed in 712 patients (mean age 60.8 years) with 1556 liver metastases from colorectal cancer. Survival rates were calculated using the Kaplan–Meier method. Patients with no more than five metastases with a maximum diameter of 5 cm were included. RESULTS: The mean survival time for all treated patients was 3.8 years (1-year survival 93%; 2-year survival 73%; 3-year survival 50%; 5-year survival 28%). The rate of clinically relevant side effects using LITT was low at 1.5%, with a 30-day mortality rate of 0.1%. The local hepatic tumour control rate in the 3-month follow-up was raised from 77.8% for the first patient group (treated 06/93 to 12/97;  $n=130$  patients) to 99.2% for the second patient group (treated 01/98 to 12/99;  $n=171$  patients). The mean survival rate for all treated patients was 41.8 months (1-year survival 93%; 2-year survival 71%; 5-year survival 30%). CONCLUSION: Minimally invasive, outpatient-based,

MR-guided LITT results in a high local tumour control rate and survival rate in patients with liver metastases.

**1600 Invited review: Radiofrequency ablation of liver metastases**

DJ Breen

*Southampton General Hospital, Southampton, UK*

Radiofrequency thermal ablation (RFA) has recently evolved into an effective treatment modality. This is largely due to ease of use and the ability to obtain reliable spheres of confluent tissue necrosis of 3–6 cm in 12–15 min. To date most experience has been gathered in the management of hepatocellular carcinoma. Encapsulated hepatomas appear particularly suited to interstitial thermal ablation where surgical resection is often limited by co-morbidity and diminished synthetic liver reserve. Local recurrence has been more of a problem in the RFA of colorectal metastases. With current technology, lesions need to be few in number (<5) and certainly less than 4 cm in diameter to ensure tumour eradication. Many workers are now looking at combining RFA with neoadjuvant chemotherapy or pre-treatment embolisation in an attempt to improve outcomes and to extend the scope of this ablative technique. Radiologists will have to be closely involved in patient selection and in the problematic area of imaging follow-up. Even given these current limitations there is a clear role for this form of therapy alongside traditional surgical resection. **LEARNING OBJECTIVES:** (1) An understanding of RFA: principles, techniques and equipment, and appropriate case selection. (2) An appreciation of the imaging features of RFA lesions and their follow-up with regards to local recurrence. (3) The place of combined procedures and their potential role in difficult case management.

**1530–1800**

**Paediatrics and Obstetrics**

**1530 Invited review: Cerebral ultrasound beyond the basics**

D Horton

*Hull Royal Infirmary, Hull, UK*

No abstract supplied.

**1600 Invited review: MRI of the fetal central nervous system**

EH Whitby

*University of Sheffield, Sheffield, UK*

Based on part of the ongoing research programme in the Department of Academic Radiology in Sheffield, we have studied the value of *in utero* MRI compared with antenatal ultrasound in cases with central nervous system abnormalities. The results were also compared with postnatal imaging techniques. **PATIENTS AND METHODS:** 93 women, 19–36 weeks gestation with a singleton pregnancy with known congenital abnormalities of the central nervous system, detected on antenatal ultrasound, were imaged on a 1.5 T superconducting magnet. A single shot fast spin echo technique was used to produce  $T_2$  weighted images, with an acquisition time of 20 s. Postnatal imaging or autopsies were used as the gold standard. **RESULTS:** Fetal brain MRI was performed in all 93 cases and spine MRI in 15. Postnatal findings or autopsy agreed with the MR findings in all but two cases (97.8% concordance). In 47 (55%) cases there was full agreement between ultrasound and MRI. In 35 (37.6%) cases MR altered the diagnosis. In the remaining 11 cases MR provided additional information. MRI changed the diagnosis or provided essential information in three main groups: ventriculomegaly of unknown cause (33 cases referred and a cause found in 24; this group will be presented in detail in the lecture), encephaloceles (5 cases referred, 1 confirmed) and posterior fossa abnormalities (13 referred and a definitive answer obtained from MR in all cases). **CONCLUSIONS:** MRI of the fetal CNS is a clinically important and highly accurate imaging modality. It is most useful in cases of ventriculomegaly and posterior fossa abnormalities.

**1630 Invited review: Recent advances in obstetric scanning**

P Twining

*Queen's Medical Centre, Nottingham, UK*

No abstract supplied.

**1700 Fast MRI of the non-sedated neonate in an MR-compatible incubator**

<sup>1</sup>EH Whitby, <sup>1</sup>MNJ Paley, <sup>2</sup>T Lonneker-Lammers,

<sup>3</sup>R Srinivasan, <sup>1</sup>D Connolly, <sup>1</sup>PD Griffiths

*<sup>1</sup>University of Sheffield, Sheffield, UK, <sup>2</sup>Lammers Medical Technology, Lubeck, Germany and <sup>3</sup>Phillips Medical Systems, Cleveland, OH, USA*

**PURPOSE:** To evaluate the combination of fast imaging methods and an MR-compatible incubator at 1.5 T to image non-sedated neonates. **METHODS:** LREC approval was obtained. Seven neonates were imaged at 1.5 T (Eclipse, Phillips Medical Systems) in an MR-compatible incubator (Lammers Medical Technology) using fast imaging techniques (SSFSE, 3D-FT gradient echo  $T_1$  images and diffusion weighted imaging) and, in four cases, time-of-flight angiography. A custom-built incubator with temperature and humidity control and a dedicated phased array receiver coil (Advanced Imaging Research) were used. The neonates were monitored throughout using MR-compatible pulse oximetry. The temperature and humidity of the incubator were maintained appropriate for the needs of the neonate and were monitored throughout. The images were scored for quality by two neuroradiologists and one neonatal radiologist and a radiological diagnosis was reached by consensus in each case. **RESULTS:** The neonates were stable throughout the scan time (range of 10–21 min). Good or excellent  $T_1$  and  $T_2$  weighted images were obtained in all cases.  $T_1$  data were best obtained from a spin echo sequence (acquisition time of 2 min 46 s) and  $T_2$ W from SSFSE (20 s). MR angiography was successful in the four cases attempted. Final diagnoses were normal (3), subdural haematoma (3) and germinal matrix haemorrhage (1). **CONCLUSION:** Fast imaging methods and a dedicated MR-compatible incubator/coil allow safe and efficient MRI of the non-sedated neonate.

**1710 Neonatal cranial ultrasound training**

<sup>1</sup>GR Cattell, <sup>1</sup>J McHugo, <sup>2</sup>P Davis and <sup>2</sup>R Cox

*<sup>1</sup>Birmingham Women's Hospital, Birmingham, UK and*

*<sup>2</sup>Birmingham Children's Hospital, Birmingham, UK*

**AIMS:** To identify the levels of expertise to perform scans amongst specialist registrars in both paediatrics and radiology within the Midlands region. To assess the availability of neonatal units with sufficient intensive care cots to provide structured training. **METHOD:** Questionnaires were sent to specialist registrars in paediatrics and radiology to ascertain their level of competence to perform cranial ultrasound examinations. Separate questionnaires were also sent to neonatal unit nurse managers/advanced nurse practitioners and to radiology departments to assess the number of intensive care cots, the professional backgrounds of those currently performing cranial ultrasound examinations and the level of service provision. **RESULTS:** 73% of registrars on the paediatric rotation within the region returned the questionnaire. 51% of respondents felt unsure or not at all confident in performing scans, whilst 57% were not confident to interpret the results. Of the eight Trusts within the Midlands region with 4–8 intensive care cots, only 50% had any radiology input to routine examinations, whilst only three of these Trusts had a routine service provided by radiographers. 21% of registrars on the radiology rotation returned the questionnaire. 41.6% said they had achieved level 1 (theoretical) and 58.3% level 2 (direct supervision) competency. **CONCLUSION:** The provision of structured and supervised training for registrars performing and interpreting cranial ultrasound examinations is dependent on a small number of dedicated potential trainers. The implementation of Clinical Governance requires that training should be provided by competent professionals and suggests that a regional training programme is now required.

**1720 Risk ultrasound screening for developmental dysplasia of the hip: important risk factors and treatment rates**

<sup>1</sup>ST Scott, <sup>1</sup>AM Taylor and <sup>2</sup>P Thomas

*<sup>1</sup>Dorset County Hospital, Dorchester, Dorset, UK and*

*<sup>2</sup>Bournemouth University, Bournemouth, UK*

Since 1992, 2500 babies with risk factors for developmental dysplasia of the hip (DDH) underwent ultrasound scans classified using the Graf criteria. A cohort of 769 scanned babies from a population of 5550 born in West Dorset between 10/1996 and 11/1999 were analysed using SPSS. There were approximately equal numbers of male and female subjects. 37 babies (6 male/31 female) required treatment

(Pavlik Harness), a treatment rate of 48 babies per 1000, against a predicted entirely unscreened UK population risk of 2.2 babies per 1000. Clinical dislocation and instability of the hip were identified as statistically significant predictors of receiving treatment within the at-risk population ( $p < 0.05$ ), a treatment rate of 200 babies per 1000. Clicky hip, breech and family history alone or in combination were not identified as being statistically significant predictors of receiving treatment within the at-risk population ( $p > 0.05$ ), but overall gave a treatment rate of 47 babies per 1000. Using the Graf criteria, 7 per 1000 of the babies born in the study period were treated compared with 2.2 babies per 1000 as would be predicted to present with hip dislocation in an entirely unscreened UK population. CONCLUSIONS: Clinical dislocation and instability are recognized statistically significant predictors of treatment for DDH. Click, breech and family history, although not statistically significant predictors for treatment in the at-risk population, would predict an increased treatment rate compared with the entirely unscreened UK population. The predicted 3-fold increase in treatment rate using the Graf criteria may reduce the incidence of late presenting hip dysplasia.

### 1730 Age-related changes in metacarpal morphometry and areal bone mineral density in children assessed by DXR

<sup>1</sup>RL Ashby, <sup>1</sup>KA Ward, <sup>2</sup>Z Mughal and <sup>1</sup>JE Adams  
<sup>1</sup>University of Manchester, Manchester, UK and <sup>2</sup>St Mary's Hospital, Manchester, UK

**PURPOSE:** The purpose of this study was to investigate age-related changes in metacarpal morphometry and areal bone mineral density (aBMD) from hand radiographs of normal children using DXR. This technique gives an assessment of the metacarpal index (MCI), cortical thickness (CT) (cm), outer bone width (BW) (cm) and aBMD ( $\text{g cm}^{-2}$ ). **MATERIALS AND METHODS:** Non-dominant hand radiographs of 119 healthy Caucasian children (mean age  $11.3 \pm 3.6$  years, range 5.4–19.0 years) were assessed using the Sectra/Pronosco X-posure system™ (version 2). Height, weight, grip strength (GS) and pubertal stage were measured. Statistical analysis was according to age, gender, pre-pubertal or pubertal status, and Tanner stage (TS) (females only). **RESULTS:** CT, BW, MCI and aBMD increased with age in males and females ( $p < 0.05$ – $0.001$ ). Females had a higher MCI but a lower BW compared with males ( $p < 0.001$ ). CT was higher in females overall ( $p < 0.05$ ), but this difference was not significant when the genders were divided into pre-pubertal or pubertal groups. There was no gender difference demonstrated in aBMD. MCI, CT and aBMD increased significantly in females at Tanner stage 3. Positive correlations were found for all subjects for age, height, weight, GS, MCI, CT, BW and aBMD. However, MCI did not correlate significantly with GS in pubertal males. **CONCLUSION:** The Sectra/Pronosco X-posure system™ is a useful tool for the study of age- and gender-related changes in metacarpal morphometry and BMD in children. Such important information regarding growth parameters in normal children can be applied to the study of paediatric conditions associated with increased fracture risk.

### 1740 PHACES syndrome: malformation or proliferation

<sup>1</sup>JJ Bhattacharya, <sup>2</sup>C Luo and <sup>3</sup>PL Lasjaunias  
<sup>1</sup>Institute of Neurological Sciences, Glasgow, UK, <sup>2</sup>Taipei Veterans General Hospital, Taipei, Taiwan, Republic of China and <sup>3</sup>Hopital Bicetre, Paris, France

PHACES is an acronym for a syndrome of variable phenotypic expression comprising Posterior fossa malformations, superficial Haemangiomas, Arterial anomalies, Coarctation and other cardiac disorders, Eye abnormalities and Stenotic arterial disease. The most typical feature of the syndrome is a large plaque-like cervicofacial haemangioma. We present eight patients with a range of disorders from this spectrum (five female, three male; age range 1 month to 14 years). Six patients had large facial haemangiomas but recent reports suggest that small haemangiomas may also occur and we suggest that such lesions could be unreported, missed or even absent, hence our inclusion of two possible cases. A wide variety of vascular anomalies were present. We also focus on the recently recognized feature of progressive intracranial arterial occlusive disease. This feature was present in four of our patients with a later presentation than previously recognized, ranging from 4 years up to 14 years of age. We discuss diagnostic and management issues and further propose that in spite of

its heterogeneity, an underlying abnormality of cell proliferation and apoptosis involving the neural crest could explain the various components.

### 1600–1700

#### Dealing with Major Disasters

1600 Invited review: The experience of September 11th

Y Milewski  
College of Physicians and Surgeons of Columbia University,  
New York, NY, USA  
No abstract supplied.

### 1610–1700

#### Diagnostic Reference Levels in Diagnostic Radiology

1610 Invited review: DRL values: where are the data to guide me?

J Williams  
Royal Infirmary of Edinburgh, Edinburgh, UK

The Working Party report recommends the use of locally collected dose data for setting the organization's DRL. However, the local DRL should not be greater than a national DRL unless clinically justified. The national DRL represents the boundary between acceptable and non-acceptable practice. Whilst national DRLs may not be available at the present time, there are many sources of dose data that may be used to determine whether the organization's proposed DRL is consistent with good practice elsewhere. Within the UK the most extensive data sources are the compilations of national dose data published by the NRPB. These include recommended reference doses that are likely to be used as the basis for national DRLs. These data will be reviewed along with other sources concerned with CT scanning, mammography and dental radiology.

1635 Invited review: DRLs and the audit cycle: what happens if I exceed a DRL?

D Sutton  
Ninewells Hospital, Dundee, UK

In this presentation we will consider the actions that need to be taken when a DRL is consistently exceeded. The concept of national and local DRLs fits very well with the audit and clinical governance models proposed by the RCR and can be looked at in terms of the audit spiral. When the target, *i.e.* "do not exceed a DRL", is exceeded, then an investigation should be performed to identify why it has been exceeded and subsequently to identify any remedial measures that need to be taken to ensure that the target is met in future. Triggers for the investigation have been considered in previous presentations. The investigation itself should be concerned with four main considerations: (a) the measurement methodology itself; (b) the equipment used to make the exposure; (c) the case mix involved; and (d) the techniques involved. The way that factors associated with each of these elements may result in patient doses that exceed DRLs will be discussed. Finally, the issue of closing the loop will be addressed, *i.e.* what remedial action should be taken (including the option of setting local DRLs that are higher than national ones) and what factors should be taken into account when assessing priorities for remedial action.

### 1650 Discussion

### 1630–1800

#### Breast Scientific Session

1630 Application of SENSE for high spatial and temporal resolution imaging of the breast

<sup>1</sup>A Knowles, <sup>2</sup>A Coulthard, <sup>2</sup>P English and  
<sup>3</sup>H van den Bosch  
<sup>1</sup>Philips Medical Systems, Best, The Netherlands, <sup>2</sup>Royal Victoria Infirmary, Newcastle, UK and <sup>3</sup>Catharina Ziekenhuis, Eindhoven, The Netherlands

**PURPOSE:** In recent years MRI of the breast has demonstrated its potential for high sensitivity and specificity compared with other

imaging modalities. However, the optimal method of dynamic imaging remains controversial. In this study we demonstrate the application of SENSE for breast imaging, allowing high spatial resolution in short scan times with fat suppression for improved lesion conspicuity during dynamic imaging. **MATERIALS:** Imaging was performed at 1.5 T and 3.0 T (Philips Intera) using four and six element breast coils, respectively. Both systems used Release 8 software. **METHODS:** Pre-contrast transverse SENSE T1w TSE, T2w TSE and diffusion imaging were performed. Two methods of SENSE fat-suppressed dynamic imaging were assessed. (1) High temporal resolution: transverse 3D imaging of the entirety of both breasts was acquired in 12 s (spatial resolution 1.8 mm × 2.5 mm × 3.0 mm). (2) High spatial resolution: transverse 3D imaging of the entirety of both breasts was acquired in 45 s (spatial resolution 1.8 mm<sup>3</sup>). Post dynamic imaging, a fat suppressed transverse 3D acquisition (0.6 mm<sup>2</sup> with 80 slices of 2.0 mm) was acquired in a scan time of 2 min. **RESULTS:** A SENSE factor of at least 2 was achievable in all imaging sequences with no artefact. Fat suppression during the dynamic acquisition assisted in delineating lesion boundaries. High quality 3D MIPs could be generated from different time points of the dynamic sequence. Diffusion imaging demonstrated malignant lesions as low signal on ADC maps. **CONCLUSION:** SENSE provides substantial benefits for breast imaging either in scan time reduction, reduced patient anxiety or improved spatial resolution.

#### 1640 Diagnosis of axillary nodal metastases by ultrasound-guided biopsy in patients with primary breast cancer

A Damera, AJ Evans, EJ Cornford, ARM Wilson, HC Burrell, JJ James, RD Macmillan, SE Pinder and IO Ellis

*Nottingham Breast Unit, Nottingham, UK*

**INTRODUCTION:** The purpose of this study was to examine the utility of ultrasound (US)-guided core biopsy of abnormal axillary nodes in patients presenting with operable breast cancer. **METHODS:** 163 patients presenting with suspected operable breast cancer had their ipsilateral axilla scanned. Nodes identified were classified as abnormal if the longitudinal-transverse axis ratio was <2 or an abnormal cortical morphology with a thickness of more than 2 mm was seen. Abnormal nodes underwent US-guided core biopsy/FNA. These results were correlated with subsequent axillary surgery. **RESULTS:** Nodes were identified in 101 of 163 axillae scanned. 54 (53%) fitted the criteria for biopsy. 48 cores (26 malignant, 20 benign, 2 normal) and 6 FNA (1 suspicious, 1 benign, 4 inadequate) were performed. On definitive histological examination, 63 of 163 (39%) had axillary metastases. Of the 44 patients with less than three involved nodes, pre-operative ultrasound identified nodes in 27 patients (61%), of which 16 (36%) fitted the criteria for biopsy, 9 (20%) of which were diagnosed at core. Of the 19 patients with more than three nodes involved at surgery, abnormal nodes were identified in all 19. 18 (95%) had positive histology on biopsy. In total, US-guided core biopsy/FNA identified 27 (43%) of the 63 node-positive patients pre-operatively. **CONCLUSIONS:** Ultrasound identifies abnormal nodes in patients presenting with primary operable breast cancer. Approximately one-half of these nodes are malignant and can be confirmed with US-guided core biopsy. US-guided core biopsy is more sensitive in identifying metastases in patients with extensive nodal involvement.

#### 1650 The current status of ultrasound-guided core biopsy in breast disease

<sup>1</sup>P Demaine, <sup>2</sup>CF Loughran and <sup>2</sup>MA Crotch-Harvey  
*<sup>1</sup>Manchester Radiology Training Scheme, Manchester, UK and <sup>2</sup>Macclesfield District General Hospital, Manchester, UK*

**PURPOSE:** The purpose of this study was to determine the accuracy of ultrasound (US)-guided wide core needle biopsy (WCNB) in a service setting and to review the impact of this procedure on patient management. **MATERIALS AND METHODS:** All 228 US-guided WCNBs performed between October 1997 and October 2001 were analysed. Correlation was made between WCNB findings and the surgical pathology or clinical/radiological follow-up. There were 88 biopsies in the screen-detected group and 141 in the symptomatic group. The majority were performed on impalpable or barely palpable lesions. **RESULTS:** In the screening group the sensitivity and specificity were 95.7% and 93.8%, respectively. In the symptomatic group there

was a sensitivity of 91.0% and a specificity of 94.8%. **CONCLUSION:** US-guided WCNB is therefore a highly accurate technique, has a high sensitivity for the detection of cancer and has a good negative predictive value for exclusion of cancer in benign disease. We now perform WCNB in all patients with breast cancer at presentation. This gives an early histological diagnosis, including oestrogen receptor status. This facilitates treatment discussions and gives tentative prognostic information. In the case of DCIS, axillary surgery can be avoided. In patients with malignant disease a treatment strategy can rapidly be formulated. Patients with benign disease can usually be discharged with confidence.

#### 1700 Mammographic casting calcification associated with small invasive breast cancers: is this a reliable prognostic indicator?

C Peacock

*St George's Hospital, London, UK*

**PURPOSE:** There are reports that casting calcification on mammography in association with small invasive cancers indicates a poorer prognosis, irrespective of traditional prognostic factors such as tumour grade and lymph node status. Our aim was to establish whether this mammographic feature could be a reliable prognostic factor. **METHODS AND MATERIALS:** We retrospectively identified 50 consecutive women diagnosed with an invasive cancer of less than 15 mm who showed associated casting calcification on their screening mammograms. Controls were identified that showed no microcalcification and were matched for tumour size, histological type and lymph node status. A minimum of 5 years follow-up was obtained, noting recurrence and outcome. Conditional logistic regression was used to analyse the data but, where small numbers prohibited this, Fisher's exact test was used. **RESULTS:** 5 deaths from breast cancer occurred out of the 50 cases, of which 3 were lymph node positive, 2 were lymph node negative and none were grade 3. None of the 78 control cases died from breast cancer. On analysis, all the results were highly suggestive of a poorer prognosis associated with the presence of casting calcifications, although they did not reach formal statistical significance ( $p=0.02$ ). **CONCLUSION:** Although the overall outcome for small, screen-detected breast cancers is good, our study suggests that casting calcification is a poorer prognostic factor. The advantage of a mammographic feature as an independent prognostic indicator lies in identifying high-risk patients early, allowing optimization of management.

#### 1710 Detection of microcalcifications in digital mammograms

<sup>1</sup>MJ Board, <sup>1</sup>SM Astley and <sup>2</sup>S Mak

*<sup>1</sup>University of Manchester, Manchester, UK and <sup>2</sup>Nightingale Centre, Manchester, UK*

**PURPOSE:** Automated detection of microcalcifications is fundamental to the success of computer-aided detection systems for mammographic screening. The detection process usually comprises several steps, the first of which identifies the positions of potential calcifications. In subsequent stages false positives are removed and clusters are identified. Ideally, detection methods for the first stage should be simple, so that computing resources can be directed at the more difficult task of distinguishing between malignant and benign calcifications. **MATERIALS AND METHODS:** In this paper we describe an investigation of different detection algorithms and compare our morphologically based method with two competing techniques. Comparison is made by FROC analysis, which describes both the true positive fraction and the number of false positive detections per image. In addition, we use a novel transportation-based method that outputs a measure of the accuracy of detection. The evaluation was performed on a set of 180 images from the Nightingale Breast Centre, including 57 films containing 89 clusters of malignant calcifications. **RESULTS AND CONCLUSIONS:** Our results show that even simple techniques can detect a large proportion of microcalcification clusters. However, for an algorithm to be effective in a clinical system the false positive rate needs to be low. Many false positive detections appeared near the edge of the breast, and whilst these can be removed automatically, there is a risk of removing genuine detections. The two methods of evaluating the detection algorithms yielded different but complementary information about their performance.

**1720 Assessment of accuracy of marker clip placement after Mammotome breast biopsy**

S Harish, R Sinnatamby, PD Britton, JG Cahir, RML Warren, AH Freeman and V Taylor  
*Addenbrooke's Hospital, Cambridge, UK*

**PURPOSE:** To estimate the accuracy of clip placement following Mammotome biopsy by measuring 3D spatial coordinates on stereotactic images and final relative positions on two-view mammography. To determine whether the accuracy of clip placement can be predicted during the biopsy procedure. **METHOD:** We conducted a prospective study of 115 consecutive stereotactic-guided Mammotome biopsies of breast microcalcifications on a prone biopsy unit. Of these, 69 had a marker clip inserted. Spatial coordinates in x-, y- and z-axes of the biopsy site and the clips were recorded on the stereotactic unit. Two-view mammograms were obtained before and after the procedure. The differences in position of the microcalcification and the clip on both the stereotactic images and on the films were determined. **RESULTS AND CONCLUSIONS:** The degree of difference in the z-axis between the clip and the calcification was found to be the most significant predictor of accurate clip placement. If there was a difference of >5 mm in the z-axis between clip and calcium, 41% of clips were 15 mm or more away from the calcium on final mammographic position. If there was a difference of <5 mm on the z-axis between clip and calcium, only 12% of clips were 15 mm or more away from the calcium on final position. Evaluation of the 3D coordinates of the clip-deploying device is important. Accordingly, adjustments made prior to clip deployment, particularly in the z-axis, should result in a more accurate marking of the biopsy site.

**1730 A comparative study of indicated breast dose in conventional and digital mammography systems**

<sup>1</sup>H Cole, <sup>1</sup>CP Lawinski and <sup>2</sup>DA Goodman

<sup>1</sup>King's College Hospital, London, UK and <sup>2</sup>Addenbrooke's Hospital, Cambridge, UK

**PURPOSE:** NHS Breast Screening Programme (NHSBSP) guidelines recommend that regular dosimetry surveys are performed to estimate mean glandular breast dose (MGBD) for a range of women undergoing mammography screening. A number of mammography systems now feature a post-exposure indication of MGBD. The strategies and algorithms used to compute MGBD in these systems are reviewed. **MATERIALS AND METHODS:** This study compares mammography systems from four different manufacturers. Three were conventional film-screen systems; the fourth was a full-field digital mammography (FFDM) system, based on an amorphous silicon (a-Si) flat panel detector (FPD). Some film-screen systems have a small-field digital mammography (SFDM) attachment for stereotactic work. Indicated MGBD in these SFDM systems was also investigated. **METHODS:** The precision and accuracy of indicated MGBD values were assessed for each system, using Perspex phantoms to simulate a range of breast thickness. Measurements were made under automatic and manual exposure control and the displayed doses were compared with those calculated by published methods. Sources of errors and inaccuracies were investigated for each system. **CONCLUSION:** The suitability of post-exposure display of MGBD as a reliable indicator of breast dose is discussed.

**1740 Clinical evaluation of mammography equipment**

A Bates

*KCARE, Kings College Hospital, London, UK*

**PURPOSE:** To develop a clinical evaluation protocol for mammography systems that complements the established technical evaluation of these systems. This protocol would enable the clinical evaluator at the King's Centre for the Assessment of Radiological Equipment (KCARE) to conduct a full clinical evaluation of any new mammography equipment in association with the NHS Breast Screening Programme (NHSBSP). **METHOD:** A draft evaluation protocol was devised by a radiographer with mammography and equipment evaluation experience. The initial evaluation was conducted on a mammography system used in a breast screening department. Key features of the system that impacted on patient care, dose and manual handling issues were addressed, as well as the ability of the system to undertake specialized procedures such as magnification and stereotactic examinations and digital spot imaging. Radiologists and mammography film readers from the evaluation department were asked to assess a core batch of

mammograms, taken by the system under evaluation, for image quality. The department mammographers were asked to comment on the suitability and ease of use of the system. **CONCLUSION:** This protocol has been used to evaluate a mammography system and a small-field digital imaging system. The resultant clinical evaluation reports have been published in conjunction with the technical reports by the Medical Devices Agency. This comprehensive report format provides information to assist purchasers with equipment selection and users with performance data. Further refinements to the protocol are expected following its use on subsequent evaluations.

**1750 Discussion****1645–1815****History Session****1645 Invited review: 1939–45: radiology goes to war**  
IJ Kenney

*Royal Alexandra Hospital for Sick Children, Brighton, UK*

Although used in the Greco-Turkish war of 1897, and every major conflict since, WW2 would be the first where provision of X-rays was under direct control of radiologists. The manpower position in radiology was arguably worse than most other specialties. The BMA controlled the allocation of doctors to both the armed forces and civilian emergency medical services via the Central Medical War Committee and Local Medical War Committees based on the Divisional structure. Once war began, those few radiologists already serving were essential for planning and strategy roles. Territorials and reservists were rapidly absorbed, volunteers quickly used up, and a crisis of radiology manpower emerged for both the armed forces and civilian services. The solutions draw interesting parallels with today's shortages: extending the age range acceptable for service; inducing retirees back into service; allowing women radiologists to serve; cross-practice cover arrangements; forced allocation (the Draft); accepting lesser standards (the graded specialist); using Aliens and POW's to allow redeployment of indigenous doctors; intensive rapid conversion courses to radiology; and, a last resort, asking the Americans for help. These measures provided barely enough radiologists to get by. By December 1940, approximately 20% of the total doctors in civilian practice had been recruited to the armed services. Radiologists served in military General Hospitals and (early war) in Casualty Clearing Stations (CCSs). The CCS would be 10–15 miles behind the front line in a convenient position for road and or rail links.

**1705 Invited review: Marie Curie and Poland**

RF Mould

*Surrey, UK*

Maria Salome Sklodowska was born on 7 November 1867 in Freta Street, Warsaw, where her mother lived and worked as the principal in charge of a primary school. Her father was also a teacher, but of mathematics and physics. In 1868 he became Professor and Deputy Director of one of the high schools in Warsaw and the family moved from Freta Street, which now after the Warsaw Uprising in World War II has been reconstructed and is owned by the Polish Chemical Society and houses the Maria Skłodowska-Curie Museum. Maria was the youngest in the family, with an elder brother, Jozef, and three sisters, Zofia, Bronislawa and Helena. The Russian empire had annexed Poland at the end of the 18th century and there followed two major uprisings: of November 1830, in which Maria's grandfather took part; and of January 1864. They were turbulent times into which Maria was born, and her family were closely involved with her father's brother escaping to France, her mother's brother being exiled in Siberia and Maria's father being sacked from his post as Deputy Director because of the clampdown on Polish intellectuals and their replacement in high positions by Russians. Maria's father lost not only his job but also his home and had to live on very reduced finances. Maria still managed to be educated and indeed received diplomas but was then forced, because of the necessity for her to save, into the job of a governess (1886–89) to a family living in a small manor house in Szuciki. Maria finally left for Paris in 1891 when she was 24 years old, assisted financially by her sister Bronya who had moved to Paris a few years earlier. However, her links with Poland did not cease, but continued for the remainder of her life, although now the strength of her Polish roots are often forgotten and many think only of the years in Paris: the



discovery of radium in December 1898 and the founding in 1910 and the continuing direction of the Institut du Radium until her death in 1934. Thus, in July 1898, prior to the discovery of radium, the first radionuclide discovery of Maria and Pierre was named polonium; they visited Poland, Pierre's first ever visit, in 1899 and took a holiday in the Tatra mountains and Zakopane to which Maria was later to return with her children; and with the assistance of her sister Bronya, the Warsaw Radium Institute was founded in 1932 and Maria provided some of the Institute's first radium sources. During World War II the radium sources of the Institute were ingeniously saved, part of the story involving the then Director of the Institute, Franciszek Lukaszczuk, bribing a German soldier with his wife's jewellery so that he could "borrow" a tank. The Warsaw Radium Institute in Wawelska Street was greatly damaged during the War, some of the staff and patients murdered by firing squad, and the bronze statue of Maria was used for target practice by the German soldiers: the statue still stands with the bullet holes clearly visible. After Maria's death the Curie family were still associated with Poland and in 1936 Irene and Frédéric Joliot-Curie donated part of their Nobel Prize award for the purchase of an electromagnet for the Physics Department: this electromagnet is now in the Museum in Freta Street. The Wawelska Street buildings inevitably became too small and have now been replaced by those in Ursynów, a district of southern Warsaw, as the Maria Skłodowska-Curie Memorial Cancer Centre & Institute of Oncology. Thus in June 2002 the 70th Jubilee of the founding of the Radium Institute could be celebrated and this took place in the Great Assembly Hall of the Royal Palace: a fitting celebration to Maria, to the oncological work in Warsaw starting with radium in 1932 but now encompassing brachytherapy remote afterloading with  $^{192}\text{Ir}$  and  $^{137}\text{Cs}$  and external beam therapy with  $^{60}\text{Co}$  teletherapy and X-ray linear accelerators and nuclear medicine; and to the rebuilding of Warsaw after the World War II Uprising and the virtual total destruction of the Old City and of the Wawelska Radium Institute buildings.

#### 1725 Invited review: History of neuroradiology

S Vaz Fernandes  
Birmingham, UK

This presentation will chronicle the discovery and development of radiological techniques, their influence on the diagnosis of neurological disorders and will reflect on future developments in the field of neuroradiology, namely positron emission tomography (PET). The research involved the use of secondary sources in Birmingham and Toronto, combined with primary sources in the form of clinical placements in Canadian hospitals. Medical students today are still taught that diagnosis will be made from the history in most cases, with investigations serving merely to confirm or refute any one hypothesis. During the seventeenth and eighteenth centuries, this was indeed the case. The discovery of the X-ray in 1895 by Roentgen, however, changed the emphasis in diagnosis. The first use of X-rays in neuroradiology was for the evaluation of brain tumours by skull radiographs in the early 1900s. Further developments between 1918 and 1927 included ventriculography, pneumoencephalography and angiography. In the last half century there have been vast neurological developments. The introduction of computed tomography (CT) in the 1970s altered diagnostic neuroradiology by making the brain visible, while the development of magnetic resonance imaging (MRI) shortly thereafter provided more precise anatomical information in addition to the ability to perform vascular and physiological functional imaging. The focus of the future lies on MRI and PET scanning, which allows functional studies by mapping the metabolic activity of the brain. Over a century, neuroradiology has progressed from simple conventional radiographic examinations to modern sophisticated studies but we should not forget the humane aspect of medicine.

#### 1745 Invited review: The art and science of medical biography

C Gardner-Thorpe  
Exeter Neurosciences & the Peninsula Medical School,  
Exeter, UK

No abstract supplied.

#### 1805 Discussion

## 1700–1800

### Radiation Protection Scientific Session

#### 1700 Local diagnostic reference levels in paediatric fluoroscopy

$^1\text{M}$  Small,  $^2\text{D}$  Grier,  $^2\text{D}$  Dimond,  $^2\text{S}$  Dunphy and  $^1\text{E}$  Pitcher  
 $^1$ Medical Physics and Bioengineering, United Bristol  
Healthcare NHS Trust, Bristol, UK and  $^2$ Paediatric Radiology,  
United Bristol Healthcare NHS Trust, Bristol, UK

Bristol Royal Hospital for Children moved to a new building in Spring 2001, providing Paediatric Radiology with an opportunity to re-equip their department and to create a "filmless" environment. Techniques were modified to take advantage of dose-saving features on the new equipment, such as pulsed fluoroscopy and digital spot imaging. An on-going audit was established to monitor doses from fluoroscopic procedures. Data have been collected over the past 18 months for 125 MCUs and 298 barium studies. This has shown a significant reduction in patient dose compared with the old department. Corrections for patient size were based on NRPB Report 318 and modified to take into account additional copper filtration. Measured dose-area product values are well below the national diagnostic reference levels for these examinations. Typical effective doses have also been estimated for these studies. There is little guidance on typical doses for paediatric surgical procedures under fluoroscopic guidance. This audit was extended to include these, with a view to establishing typical local doses. This is a long-term project owing to the small numbers of children undergoing each type of procedure, particularly once divided by age. To date we have collected data on 84 long line insertions and 54 hip arthrograms, plus smaller numbers of other procedures. Our experiences of these audits will be presented here together with a summary of the dose levels observed. The need for local diagnostic reference levels and our solution to using these in practice will be discussed.

#### 1710 The radiation dose burden in multislice CT. Why is it higher? Does it matter?

P Dawson  
UCL Hospitals, London, UK

Computed tomography (CT), always a "high dose" technique, is now, with multislice systems, an intrinsically even higher dose technique. Additionally, the power and flexibility of the new technology has led to a greater general use of CT, to the development of new applications and to the growth of screening procedures. The increasing radiation dose burden associated with all this has generated not a little anxiety on both sides of the Atlantic and has attracted the attentions of various regulatory authorities. The underlying assumption is the validity of the "linear no threshold" (LNT) hypothesis regarding radiation harm, which implies that no dose of radiation is safe. However, there is a growing body of evidence that this LNT hypothesis may not be valid, that thresholds do exist and that, indeed, below the thresholds radiation exposures may actually be positively beneficial in a variety of ways. This evidence will be reviewed.

#### 1720 In vitro image quality and dose comparisons in 4 and 8 slice spiral CT

$^1\text{HO}$  Nwume,  $^1\text{IE}$  Evangelou,  $^{1,2}\text{NJ}$  Nicklin,  $^{1,2}\text{SJ}$  Golding and  
 $^2\text{SR}$  Watt-Smith

$^1$ University of Oxford, Oxford, UK and  $^2$ John Radcliffe  
Hospital, Oxford, UK

**PURPOSE:** To study *in vitro* imaging parameters in order to make comparisons between 4 and 8 slice CT imaging based on image quality and dose. **MATERIALS AND METHODS:** An anthropomorphic head phantom mounted in a Perspex case filled with contrast medium underwent CT using both a 4 slice and an 8 slice system. The scanning protocol used was 140 kV, a range of 10–80 mA tube currents in incremental steps of 10, two pitches (HQ and HS),  $512 \times 512$  matrix, bone and soft tissue reconstruction algorithms and FOV of  $21 \times 21$  cm. Images were surface rendered in 3D using software developed in house. Image quality of both sectional images and 3D reconstructions was evaluated both objectively and subjectively by an expert panel. **RESULTS:** Subjective assessment was given a mark out of 4 for overall impression, whereas objective assessment was given a mark out of 10 for the success of the image in reproducing five anatomical landmarks present on the real phantom. Questionnaires were completed for all the images in a random order. Comparisons between dose and

image quality for the two studies have been made and the results have been plotted in respective graphs for comparisons. **CONCLUSION:** There is a great potential for dose sparing in multislice CT provided that the imaging parameters are chosen correctly. The ultimate goal is to produce images with adequate diagnostic image quality whilst minimizing radiation dose. Although this is an *in vitro* study, based on our results there is sufficient evidence to justify and apply this *in vivo*.

### 1730 Radioadaptive responses in cultured human lymphocytes induced by doses of X-rays in the range received in common diagnostic X-ray examinations

<sup>1</sup>S Mortazavi and <sup>1</sup>T Ikushima

<sup>1</sup>Kyoto University of Education, Kyoto, Japan and <sup>2</sup>Rafsanjan University of Medical Sciences, Rafsanjan, Iran

**PURPOSE:** Medical exposure from diagnostic X-ray examinations in Japan is estimated to be as high as 2.2 mSv per capita, which is the highest rate in the world (UNSCEAR 1993). Over the past years we have investigated the induction of radioadaptive responses induced by low doses of X-rays in the range usually received in common diagnostic radiology examinations. Early reports showed that an adapting dose of 5 cGy X-rays, which is the maximum entrance surface doses per single view received in some common radiographic procedures, produced the highest magnitude of adaptive response in cultured human lymphocytes. It has also been shown that a dose of 10 cGy X-rays, which is equal to the reference dose for only a 1 min fluoroscopy procedure, can produce a significant adaptive response in human lymphocytes or human fibroblasts. **MATERIALS AND METHODS:** To investigate whether diagnostic X-ray procedures can induce an adaptive response, cultured human lymphocytes were pre exposed to an adapting dose of 5 cGy or 10 cGy X-rays (70–150 kVp) and then irradiated with a 2 Gy or 3 Gy challenge dose of X-rays. **RESULTS:** Despite the observed inter-individual variability, it was shown that 5 cGy or 10 cGy X-rays could induce a radioadaptive response. **CONCLUSION:** Pre exposure of the cultured human lymphocytes to doses of X-rays in the range received in diagnostic examinations can decrease the radiosensitivity of the cells to subsequent irradiation with a high dose.

### 1740 Patient doses during interventional cardiac procedures at the North Staffordshire Hospital

J Eatough

Department of Radiology Physics, Stoke-on-Trent, UK

This paper summarizes the doses received by patients at The North Staffordshire Hospital during interventional cardiac procedures over a 3-year period from November 1999 to August 2002. A total of 6744 individual patient records were analysed. Arteriographic procedures were performed in a Siemens Laboratory installed in 1997, and device insertion and electrophysiological procedures were performed on an SMR mobile image intensifier. For the arteriographic procedures dose-area product values were recorded and for the mobile image intensifier screening times were noted. Procedures were identified according to their OPCS (Office of Population, Censuses and Survey) codes. Mean doses were established for the 34 procedures regularly performed within the cardiology department. For the six most common angiographic procedures and each of the most common electrical and device insertion procedures, local guidance levels were established. The dose levels found in this survey are similar to or lower than other published data where available and, for the two examinations where national diagnostic reference levels exist, North Staffordshire doses were well below these values. Various factors that affect patient dose were also investigated. Patient size was a major factor, giving dose variations of up to a factor of six between different patients. A factor of six was also found between doses delivered by different operators, indicating that there remains scope for dose optimization by reducing operator variability.

### 1750 Discussion

1700–1800

## Service Delivery Scientific Session

### 1700 Time-line analysis: the patient journey

DM Stelmach

St James's University Hospital, Leeds, UK

**PURPOSE:** The experience of the patient as they travel through systems of care is under increasing scrutiny. Frustration is felt by clinicians, administrators and patients as they seek to improve the journey through interlinked systems that are necessary to gather information required to develop a care plan that is unique to every patient. A system is necessary to identify way-points in the journey that cause blockages or delays in the system. This paper serves as an introduction to a method that is thorough and will provide detailed analysis of the patient journey. Resources may then be adjusted to provide input at stages in the journey that require improvement. Detailed analysis is also required to justify bidding for additional resources to improve the experience of the patient and staff involved in the process. **METHODS:** The patient journey can be analysed as a time-line that is interrupted by incidents. Incidents may then be classified separately into groups, the largest of which will invariably be waiting times preceding clinical or administrative inputs. Further analysis will subdivide time-lines into areas of hiatus for particular incidents, and these provide information for further research to identify solutions. The research method would be an action research, observational model. Action research is a difficult method to implement as it is, by definition, designed to generate further research during the observational cycle as problem areas are identified. This method is commonly used to develop quality cycles that seek to develop continuous improvement processes.

### 1710 An evaluation of MRI patient information on the Internet

<sup>1</sup>S Brown and <sup>2</sup>RK Harrison

<sup>1</sup>Nuffield Orthopaedic Centre, Oxford, UK and <sup>2</sup>RAFT Institute of Medical Research, London, UK

**PURPOSE:** Many patients attending for MRI are poorly pre-educated about their scans, which has recently been proven to be correlated with high peri-scan claustrophobia rates and scan aborts. Many of the 500 million users are increasingly utilizing the Internet as an information source, but this frequently contains misleading medical information, which can be non-peer reviewed, anecdotal or commercially biased. We aimed to analyse the quality and utility of web-based patient information. **MATERIALS AND METHODS:** 30 websites were selected, 10 from each of the three most popular search engines using the search term "mri scan". Each website was scored by two independent observers according to 24 criteria assessing the quality and completeness of information and 3 assessing layout, navigability and ease of use. **RESULTS:** 63% of the sites discussed indications for MRI, 43% listed alternative imaging modalities and only 39% mentioned the possibility of injection being required. 36% of the sites mentioned whether food and drink could be consumed, and only 10% stated that X-rays may be performed prior to the scan. Whilst 73% of the sites described the procedure, only 46% had pictures, and only 56% and 46% mentioned the noise and possible claustrophobic nature of the scan, respectively. Only 50% mentioned possible contraindications, *e.g.* pregnancy or implants. **CONCLUSION:** We have determined that much of the information regarding MRI scans available to patients on the Internet is incomplete, thus not fully informing and preparing the MRI patient. We suggest that patients should be directed towards approved websites or provided with comprehensive information from the radiology department.

### 1720 Reminder messages are effective in reducing inappropriate requests for knee and spine examinations

MG Wallis, A Ashley and S Wright

University Hospitals Coventry & Warwickshire NHS Trusts, Coventry, UK

**PURPOSE:** Circulation of guidelines has little effect on reducing unnecessary exposure but reminder messages based on these guidelines have been shown to be beneficial using before and after point measurement. However, this fails to take into account potential natural variation in rates of referral. The aim of this study was to prospectively measure the effect of reminder messages on spine and knee referrals. **MATERIALS AND METHODS:** After discussion with General (family) Practitioners (GPs), reminder messages were appended to the reports of all knee and spine films from GPs in Coventry and Rugby. Monthly activity data were collected from the Radiology Management System for 12 months (October 2000–November 2001) prior to introduction and for 9 months (December 2001–August 2002) after. Activity from Accident and Emergency

(A&E) departments and hospital consultants were used as comparison groups. RESULTS: Referral activity for consultant or A&E departments did not change. GP referrals were significantly ( $p < 0.0005$ ) different across the two periods. Mean GP activity decreased by 31% (548 before to 367 after) for knees and by 34% (728 before to 483 after) for spines, equating to almost 0.5 WTE radiographer activity. The difference detected is likely to be attributable to the reminder message. Monitoring will continue to determine whether the effect declines with time. CONCLUSION: Analysis confirms that reminder messages are an effective way to encourage good practice.

#### **1730 The role of the radiographer in child protection**

MDJ Davis

*UCD Dublin, Dublin 4, Ireland*

PURPOSE: A qualitative study: (i) to devise a holistic picture of the diagnostic radiographer's approach to child protection; and (ii) to explore the profile of radiographers within the radiography profession and amongst other agencies regarding their role in the chain of evidence relating to child protection issues with children who present at the Imaging Department with non-accidental injury. METHODS: Five focus group were conducted from various parts of the British Isles.

Trigger questions devised by the researcher were used to promote discussion. These were refined following each focus group following an inductive research process. The focus groups were used to formulate issues and potential areas of investigation. An 18-month participant observation study was undertaken to gather an insight into social work values. An interview schedule was developed from the findings of the focus groups and used as a basis for a semi-structured individual interview with radiographers. A snowball sampling technique was utilized. Interviews were conducted with child protection social workers and police officers. RESULTS: The results are currently being analysed using a qualitative data analysis program (Winmax). Early indications suggest radiographers' perceptions of their role are based on technical aspects. All radiographers studied claimed to have a role in this area, although uncertainty existed as to the parameters of that role. The social workers and police interviewed had a different perception of the radiographers role. CONCLUSION: The work suggests that other professionals have an expectation of the radiographer's role in child protection different to the radiographers perception.

#### **1740 Discussion**

# Notes

0830–0945

## Organization of Services

**0830 Invited review: Planning services for the future: an experience of the PFI process**

M Viner

*Barts & The London NHS Trust, London, UK*

**PURPOSE:** This presentation aims to outline the key steps of the PFI process and to discuss some of the potential problems faced when planning clinical services for the future. **MATERIALS AND METHODS:** The St Bartholomew's and The Royal London Hospitals PFI scheme is the largest NHS PFI scheme to date, aiming to deliver the redevelopment of one of the country's largest University Teaching Hospital Trusts. The scheme will secure the redevelopment of The Royal London Hospital as a major teaching and general hospital and trauma centre with 905 inpatient beds and a major dental hospital as well as the redevelopment of St Bartholomew's Hospital as a specialist Cardiac and Cancer Centre with 343 inpatient beds. Together with a design and build solution, private sector partners are invited to manage the procurement and maintenance of equipment together with "hard" and "soft" facilities management. **RESULTS:** The scale of the project, with a resultant longer time-scale than other PFI schemes, together with the pace of change in the healthcare and technological environment, presents significant challenges for the planning of radiology services to meet the future needs of these two hospitals. **CONCLUSION:** The presentation will outline the key steps of the PFI process from an end-user perspective and will discuss the potential problems faced when planning radiology services for the future in a complex hospital redevelopment scheme. It will outline some of the clinical planning approaches adopted to date to secure the provision of modern flexible imaging departments to serve the changing healthcare needs of East London and the City.

**0900 Invited review: The role of the primary care Trust in imaging provision**

A Dun

*Alliance Medical, Oxon, UK*

The Government's determination to deliver access targets is proving to be a significant lever for change in how the NHS operates patient pathways. The emergence of Diagnostic and Treatment Centres and the focus of primary care Trusts (PCTs) to deliver more locally based services provides added impetus to ensuring that diagnostic services, including imaging, are more accessible. This presentation will address the role of PCTs in commissioning diagnostic services, their role in supporting and developing them, and the challenges presented.

**0930 Discussion**

0830–1000

## Electronic Patient Record: integrating radiology I

**0830 Invited review: Electronic Patient Record: the Government agenda**

P Drury

*Department of Health, Leeds, UK*

This presentation will give an up-to-date assessment of the development of the Government's agenda for "Delivering 21st Century IT". In particular, it will consider the development of Electronic Patient Records within the context of delivering Integrated Care Record Services. A selection of the particular issues concerning radiology will be addressed and used to illustrate some of the leading edge issues that are being raised in areas such as e-health and information governance. The informed engagement of stakeholders, such as those attending UKRC, is going to be vital in ensuring successful implementation.

**0910 Invited review: Linking radiology into the wider picture: Integrating the Healthcare Enterprise**

SC Horii

*CARS 2002*

Through the 1990s, the growth of digital picture archiving and communications systems (PACS) was very rapid, with such systems beginning to be implemented in smaller hospitals and even (in the USA) into private practices. However, as many implementers discovered, the use of PACS alone did not result in appreciable improvements in technologist or radiologist productivity. While reduction film and associated costs could be demonstrated, the expected improvements in productivity have been more elusive. The technological bottlenecks of network speed and storage capacity have largely been removed, but there remains a major area that needs to be addressed: that of integration of PACS with other information systems. To this end, an effort started in the USA by the Radiological Society of North America (RSNA) and the Healthcare Information Management Systems Society (HIMSS), called "Integrating the Healthcare Enterprise", directed efforts at removing the barriers to integration of systems. Since PACS tend to interface via DICOM, and other information systems "speak" HL7, the majority of the work was making these two standards interoperable. In this talk, the speaker will briefly discuss DICOM and HL7, the growing USA and international role of the IHE, and the clinical scenarios reflecting the value of the integration effort. Aside from radiology, all members of the healthcare enterprise benefit from wider information systems integration and the speaker will also address these aspects.

**0950 Discussion**

0830–1000

## Gastrointestinal: imaging the bowel

**0830 Invited review: CT of the gut**

D Balfe

*Washington University School of Medicine, St Louis, MO, USA*

Cross-sectional imaging has inherent disadvantages in assessing the luminal gut compared with contrast fluoroscopy or endoscopy: its reduced spatial resolution makes it insensitive to superficial mucosal lesions (ulcers, granularity), and it is unable to evaluate gut motility. The major advantage of CT is its ability to depict the gut wall and mesenteric structures. Fundamental observations include wall thickness, symmetry and attenuation, mesenteric infiltration, vascular pattern and nodes/masses. Examples of each fundamental observation and potential pitfalls will be illustrated. There are a number of gut-related problems to which CT has been successfully applied, and the talk will include examples of the following conditions. (1) Urgently ill patients with clinical suspicion of (a) appendicitis, (b) diverticulitis, (c) mesenteric or colonic ischaemia, (d) small intestinal obstruction, potentially with strangulation and (e) perforated viscus. (2) Patients with known gastrointestinal disease, in whom there is suspicion of a complication, or in whom knowledge of extent will influence management: (a) inflammatory bowel disease and (b) known gastrointestinal cancer. Some of the above applications require special attention to technical details, including the choice of oral contrast material, need for and rates of intravenous contrast medium injection, and scanning parameters. These will be briefly discussed. There is ongoing interest in utilizing the increasing speed of modern scanners for other uses in the gastrointestinal tract. This talk will conclude with a discussion of the use of CT in (1) detection of colonic polyps (virtual colonoscopy), (2) angiography of mesenteric arteries and veins and (3) assessment of activity in granulomatous ileocolitis.

**0910 Improvement of parenchymal and vascular attenuation in abdominal multi-detector-row CT using saline solution flush after low dose contrast material bolus: double-power injector vs single-power injector**

H Schoellnast, M Tillich, HA Deutschmann, MJ Deutschmann, U Stessel and M Uggowitzner  
University Hospital Graz, Graz, Austria

**PURPOSE:** To determine the potential of a saline solution flush following contrast material bolus on parenchymal and vascular attenuation during abdominal multi-detector-row computed tomography (MDCT). **MATERIALS AND METHODS:** 41 patients underwent abdominal MDCT receiving 100 ml of non-ionic contrast material (300 mg I ml<sup>-1</sup>) alone as well as pushed with 20 ml of saline solution. 78 patients were assigned randomly to two groups receiving 120 ml of non-ionic contrast material (300 mg I ml<sup>-1</sup>) alone or 100 ml of the same contrast material pushed with 40 ml of saline solution. Mean attenuation values were measured in the liver, spleen, pancreas, portal vein, inferior vena cava and abdominal aorta. **RESULTS:** The 20 ml saline solution flush improved mean parenchymal attenuation by 8 ± 12 HU, mean attenuation of the portal vein by 10 ± 17 HU, mean attenuation of the inferior vena cava by 7 ± 13 HU and mean attenuation of the aorta by 10 ± 17 HU (*p*<0.05). There was no significant difference in mean parenchymal and vascular enhancement between 120 ml contrast material administration without saline solution flush and 100 ml contrast material administration followed by a 40 ml saline solution flush (*p*>0.05). **CONCLUSION:** A saline solution flush following the contrast material bolus significantly improves parenchymal and vascular attenuation during contrast-enhanced abdominal MDCT and thus allows an iodine dose reduction of approximately 17% without impairing mean parenchymal and vascular enhancement.

#### 0920 Intensive colorectal cancer follow-up using CT scanning and ultrasound

C Tam, N Scott and DA Nicholson  
Hope Hospital, Salford, UK

**AIMS:** To describe our experience of intensive follow-up imaging for post-operative colorectal cancer (CRC). **METHOD:** 335 patients with curative CRC (80% Duke C, 18% Duke B, 2% Duke A) underwent an intensive regimen of post-operative follow-up over a 5-year period, which consisted of ultrasound scans at 6, 18, 48 and 60 months and CT scans at 12, 24 and 36 months. Numbers and time intervals from initial operation to when metastatic disease occurred were recorded. **RESULT:** 68% of patients completed the exact protocol. There were 37 cases of liver metastases (11%) and 31 cases of lung metastases (9.3%) detected radiologically, 13 cases of which had both lung and liver metastases. 22 cases (6.6%) of local recurrence were detected, 13 of which had other areas of metastases. The distribution of recurrence was as follows:

Pattern of distribution	Duke B = 17	Duke C = 40
Liver only	7	6
Liver + local	1	5
Liver + lung	1	8
Liver + lung + local	1	1
Lung only	4	7
Lung + local	1	2
Local only	2	4
Others (e.g. bone metastases)	0	7

The mean interval for detection of liver metastases was 9.7 months (range 4–60 months), for lung metastases 10 months (range 8–72 months) and for local recurrence 24 months (range 6–72 months). Clinical follow-up showed that although further adjuvant treatments were used in 78% of cases, only 4 cases of hepatectomy with curative intent were performed and only 1 case was referred for consideration of thoracic resection. **CONCLUSION:** CRC follow-up is an expensive undertaking. Although the detection of recurrent disease often leads to change of management strategy, it only occasionally detects early liver or lung metastases that are suitable for curative resection.

#### 0930 Pre-operative thin section MR staging of rectal cancer: how accurate is the technique?

FW Poon, C Rodger, DC Chong and F Stockdill  
Glasgow Royal Infirmary, Glasgow, UK

An 18-month review of MR staging of rectal cancer was performed. 33 patients with primary rectal cancer underwent pre-operative MRI

and the radiological results were correlated with the pathological staging of the resected specimen. **METHOD:** All patients were scanned using a 1.5 T Philips MR scanner with a pelvic phase-array coil. 3 mm thin section sagittal and oblique axial images were obtained and the images were read by a single radiologist with an interest in colorectal imaging. MR T-staging was compared with the pathological staging from the resected specimen. **RESULT:** No T1 tumours were found in this study. For pathological T2 tumour, the sensitivity is 75% (9/12) and the specificity is 47%. For T3 tumour, the sensitivity is 53% (10/19) and the specificity is 75%. There were two pathological T4 tumours, however only one was correctly staged. 5 of the 33 patients underwent pre-operative radiotherapy. Predicted T-staging was 100% accurate in the subsequent MR scans. **CONCLUSION:** In our experience, T-staging of rectal cancer using thin section MRI is not as accurate as previously reported, with particular difficulty in distinguishing T2 from early T3 tumours. MRI is, however, useful as part of the overall staging process and can help to identify patients who may benefit from radiotherapy.

#### 0940 A novel contrast medium for MR enteroclysis

D McKenna, N Gough, CJ Roche and P McCarthy  
UCHG, Galway, Ireland

**AIMS:** Magnetic resonance (MR) enteroclysis imaging is emerging as a useful imaging modality in the investigation of small bowel pathology. However, a prerequisite for proper evaluation of the small bowel is adequate distension with contrast medium. A multitude of different preparations have been used, apparently with no diagnostic differences between them. We aim to use a novel preparation that can be taken over a short period and that is easily tolerated. **MATERIAL AND METHODS:** Patients were fasted from midnight the night before the examination and administration of oral contrast medium was started 20 min prior to imaging. The oral contrast was one Norgine (Kleanprep, Middlesex, UK) sachet reconstituted in 1 l of water, with the patient taking between 500 ml and 750 ml. Norgine is a balanced mixture of polyethylene glycol and electrolytes producing a clear, colourless, iso-osmotic solution. The MRI sequences used were a T2\* localizer and then a true FISP sequence in coronal planes. **RESULTS:** The preparation was well tolerated by the majority of patients without significant side effects. The fact that it was given orally negated the complications of nasogastric administration. The short period of administration allowed for flexibility in scheduling patients. Images obtained showed excellent bowel distension and a low level of artefacts. **CONCLUSIONS:** Norgine used as an oral contrast medium for MR enteroclysis is appropriate and shows advantages compared with other intraluminal contrast agents.

#### 0950 Changes in planar and quantified SPECT <sup>99m</sup>Tc-labelled white cell scans in inflammatory bowel disease

SD Heenan, AG Irwin, M Dearing, S Bassingham, J Gane, AJ Britten, A Poullis, W Vennart, P Soni and JD Maxwell  
St George's Hospital, London, UK

**PURPOSE:** To compare planar and quantified SPECT sequential white cell scanning for response to treatment with anti-inflammatory drugs in patients with inflammatory bowel disease (IBD). **MATERIALS AND METHODS:** Planar and SPECT <sup>99m</sup>Tc white cell scanning was performed immediately prior to and 2 weeks after initiation of standard anti-inflammatory drug therapy in 15 patients with active IBD of varying degrees of severity. 1 hour planar scans were scored for total bowel activity by two reporters blinded to the identity of the subjects using a validated visual grading system. SPECT images were quantified by comparing the most intense regions in the bowel to those in the vertebral marrow. The changes in the two scores were compared. **RESULTS:** There was an improvement in 12/15 of the SPECT scores compared with an improvement seen in 7/15 of the planar scans. Thus, 5/15 (33%) subjects had an improvement demonstrated on the SPECT scores not seen on planar imaging, which is conventionally used to assess the extent and activity of disease. SPECT, which has previously shown to correlate with histology, can accurately quantify the absolute severity and changes in activity of a specific site of disease. **CONCLUSION:** The quantified SPECT score demonstrated an improvement after treatment not seen in planar scoring in 33% of subjects and may be a useful adjunct in assessment of patients with IBD. This combined technique may be helpful both in diagnosis and follow-up of such patients.

0830–1000

## Imaging Treatment of Thoracic Aortic Disease

### 0830 Invited review: Imaging the thoracic aorta

P Guest

*Queen Elizabeth Hospital, Birmingham, UK*

**PURPOSE:** To review the use of plain films, CT and MRI in the non-invasive assessment of the thoracic aorta. **MATERIAL AND METHODS:** Sourced from archive and current departmental imaging studies; knowledge of current imaging with reference to the medical literature. **RESULTS:** Pathologies discussed and illustrated will include aortic aneurysms, dissection, trauma, congenital abnormalities including coarctation, and normal and abnormal post-operative appearances. The relative merits and deficiencies of the different imaging modalities will be discussed, with particular reference to multislice CT and cardiovascular MR techniques. **CONCLUSION:** The use of modern imaging allows an accurate and timely assessment of thoracic aortic pathology and is essential for post-operative management and/or follow-up.

### 0900 Invited review: Surgical treatment and follow-up

R Bonser

*Queen Elizabeth Hospital, Birmingham, UK*

No abstract supplied.

### 0930 Invited review: Diseases of the thoracic aorta

PA Gaines

*Sheffield Vascular Institute, Sheffield, UK*

Disease of the thoracic aorta is varied, is associated with considerable morbidity and mortality, and is not infrequent. Moreover, some of the important pathology has only recently been characterized and new insights into recognized conditions are continually being developed; radiologists drive the management of many of these patients. Surgery for thoracic aortic aneurysms is the current standard care but is being challenged in many units by the placement of stent-grafts for which the peri-procedural mortality rate is probably significantly reduced. The mortality of Type B aortic dissection is less than that of Type A but is still around 6–22%. Imaging is required not only to make a confident diagnosis but also to plan the radiological management of those patients with complicated dissection (rupture, branch vessel ischaemia, continued pain). Penetrating ulcers break through the internal elastic lamina into the media causing pain, rupture and death. Intramural haematoma appears to be the precursor to frank dissection and aggressive management is required.

0830–1000

## Oncology: lymph node imaging

### 0830 Invited review: Ultrasound of neck nodes

R Evans

*Morrison Hospital, Swansea, UK*

No abstract supplied.

### 0900 Invited review: Imaging nodes in the abdomen and pelvis

J Husband

*Royal Marsden NHS Trust, Surrey, UK*

The presence of lymph node involvement in malignant disease is a powerful adverse prognostic indicator in many different tumour types, and pre-treatment detection of metastases determines patient management, frequently distinguishing surgical candidates from those best suited to non-surgical management. CT and MR have proven to be the most reliable techniques for tumour staging, but overall their results have been disappointing compared with surgical staging. To provide the best possible assessment of nodal status with CT and MR, the radiologist therefore needs to use all possible information available, including detailed knowledge of the primary tumour, patterns of lymphatic spread and incidence of nodal involvement according to stage. Knowledge of the imaging findings of nodal involvement in different tumours is required as well as knowledge of the common pitfalls in diagnosis, accuracy of imaging and the impact of positive and negative results on patient management in the tumour being assessed. These

issues will be discussed taking different pelvic cancers as examples. Finally, the evolving new technique of MR lymphography will be considered in relation to the detection of pelvic and abdominal lymph node metastases.

### 0930 Invited review: MR lymphography: techniques and possibilities

T Vogl

*Klinikum and Fachbereich Medizin, Frankfurt am Ma, Germany*

Intravenous MR lymphography using ultrasmall superparamagnetic iron oxide particles is based on the physiological effect of particle extravasation in the peripheral vascular bed and their passage into the interstitial space, which occurs as a result of their small size. The potential of iron oxide particles is to achieve opacification of all lymph nodes of an organism through a single systemic intravenous injection of contrast medium. The mechanism through which metastases are identified within lymph nodes is the same as that already known from the administration of iron oxide particles in liver imaging: The contrast medium is taken up by intact lymph nodes and results in a signal loss, whereas the signal of metastatic tissue remains unchanged. Many problems still have to be solved in continuing studies on the role of MR lymphography using ultrasmall iron oxide particles in the diagnostic assessment of lymph node metastases from squamous cell carcinomas of the head and neck area. The diagnostic challenge is currently the detection of very small metastases in small lymph nodes, local overdose artefacts and motion artefacts. If these problems can be overcome in the future, intravenous MR lymphography using ultrasmall iron oxide particles will develop into a routine diagnostic procedure with a role in therapeutic decision-making.

0900–1030

## New Imaging Systems PET/CT

### 0900 Invited review: PET detector technology: current and future perspectives

D Visvikis

*Middlesex Hospital, London, UK*

No abstract supplied.

### 1000 Invited review: PET tracer production and distribution: where are we now with service delivery?

B Holmgren

*PETNet Pharmaceutical Services Inc., Middlesex, UK*

No abstract supplied.

1015–1115

## Imaging Services Debate

**Invited review: This house believes that the future of imaging services lies in site specialization**

1015 B Tonello

*The Royal London Hospital, London, UK*

No abstract supplied.

1025 I Henderson

*South Bank University, UK*

No abstract supplied.

1035 C Ferris

*Sheffield Hallam University, Sheffield, UK*

No abstract supplied.

1045 JA Bates

*St James's University Hospital Trust, Leeds, UK*

No abstract supplied.

1055 N Skivington

No abstract supplied.

1105 D Adrian-Harris

*University of Portsmouth, Portsmouth, UK*

No abstract supplied.

1020–1120

**Thoracic Imaging Scientific Session****1020 3D volume gadolinium MRI of the thoracoabdominal aorta using a moving table top**JA Whalley, C Sampson and A Rashid  
*The Cardiothoracic Centre, Liverpool, UK*

**PURPOSE:** Patients with aneurysmal disease or dissection of the thoracoabdominal aorta require interval assessment. Although multislice CT angiography is a good technique in the emergency situation, MR angiography (MRA) is preferable for surveillance to avoid ionizing radiation. 3D volume gadolinium MRA with two-station acquisition is an efficient imaging method. We present our experience of this technique. **METHOD:** 19 patients with thoracoabdominal aortic disease (11 male, 8 female; age range 31–80 years) were studied. Axial, sagittal oblique and coronal cardiac-gated fast spin echo images were obtained initially. 3D gadolinium MRA using 30 ml of contrast medium infused at  $2 \text{ ml s}^{-1}$  via a pump injection was performed at two stations, with two breath-holds using fluoroscopic triggering and a moving table. MIP reformats were obtained at  $10^\circ$  intervals. The base data were imaged in coronal slices. **RESULTS:** The scan time for 3D gadolinium MRA was 15 min. 11 patients had aortic dissections (7 Type A, 4 Type B). Six patients had thoracic aortic aneurysms. One dissection extended to the abdominal aorta and two extended to the iliac arteries. Two aneurysms contained thrombus. Four had abdominal aneurysms and two had common iliac artery aneurysms. Information from the 3D gadolinium base images was comparable with the spin echo images. **CONCLUSION:** 3D volume gadolinium MRA is an effective non-ionizing radiation method for the routine surveillance of thoracoabdominal aortic disease.

**1030 The ongoing impact of a contrast-enhanced MRA service**GH Roditi, F Lau and AW Reid  
*Glasgow Royal Infirmary, Glasgow, UK*

**PURPOSE:** To assess the ongoing impact of offering a contrast-enhanced (CE)-MRA service and its effects on diagnostic and interventional vascular workload in a large UK teaching hospital. **MATERIALS AND METHODS:** Ongoing retrospective review of diagnostic and interventional vascular procedures from 1997 to 2002 compared with the number of CE-MRA examinations performed. A marginal costs analysis was also performed for the procedures. **RESULTS:** A year-on-year decrease in the number of catheter angiograms (870 in 1997–1998 vs 469 in 2001–2002), while the number of interventional vascular procedures has shown little change (296 in 1997–1998 vs 272 in 2001–2002). The total number of diagnostic investigations (catheter angiography plus MRA) increased over the first years but has now plateaued (883 in 1997–1998 vs 1208 in 2001–2002). The total number of studies for various indications is similar except for a markedly increased number of renal investigations (20 renal arteriograms in 1997–1998 and now 326 renal MRA in 2001–2002). MRA costs are cheaper at £150 compared with £520 for catheter angiography. **CONCLUSIONS:** The introduction of a CE-MRA service has resulted in significant reduction in catheter angiography workload, replacing a large number of day-case or inpatient procedures with outpatient MRA. This has accelerated since the introduction of a moving table technique for lower limbs. The cost analysis showing MRA to be significantly cheaper than catheter angiography means that this more than negates the overall increase in investigational workload.

**1040 Use of magnetic resonance angiography in the management of thoracic outlet syndrome**JE Lloyd, PF Thomas, ST MacSweeney and CN Ludman  
*Queen's Medical Centre, Nottingham, UK*

**PURPOSE:** Development of dynamic contrast-enhanced magnetic resonance angiography (CE-MRA) represents a major advance in vascular imaging. It has been shown to be effective in a number of important vascular territories, although its wider clinical use continues to be explored. Thoracic outlet syndrome (TOS) is a significant clinical problem causing discomfort, disability and the risk of both venous thrombosis and arterial embolism. We have used CE-MRA to investigate and manage these patients and we report our series of 49 cases over a 5-year period, correlating imaging findings with clinical

management and outcomes. **METHODS:** Case notes were studied for all patients with symptoms of TOS referred for CE-MRA. CE-MRA sequences were acquired with the patient's arms in both abduction and adduction. Images were examined using the source data and were post processed using MIP and MPR algorithms. **RESULTS:** Of the 49 cases, CE-MRA was normal in 30 and abnormal in 18, with 1 case being indeterminate due to artefact. In 29/30 cases with normal CE-MRA, the patient was discharged with symptomatic advice and did not re-attend. One patient with normal CE-MRA underwent transaxillary resection of the first rib on symptomatic grounds and obtained a good result. Following abnormalities on CE-MRA, six patients underwent successful surgery, two were referred for angioplasty and two declined surgery. Intervention was not thought to be appropriate in the remaining eight cases. **CONCLUSION:** Our results suggest that CE-MRA is a powerful technique for the diagnosis and management of patients with TOS.

**1050 Magnetic resonance venography of the lower extremities and pelvis using a blood pool contrast agent: preliminary results in 12 patients**H Schoellnast, HA Deutschmann, M Aschauer, R Stollberger, KA Hausegger, A Obernosterer and F Ebner  
*University Hospital Graz, Graz, Austria*

**PURPOSE:** To determine the value of a blood pool contrast medium (NC100150; Nycomed, Oslo, Norway) for evaluation of deep vein thrombosis of the pelvis and lower extremities. **METHODS:** 12 patients were prospectively evaluated with conventional X-ray phlebography (XRV) using 60 ml non-ionic contrast medium injected via the foot as well as magnetic resonance venography (MRV) after injection of NC100150 ( $2 \text{ ml kg}^{-1}$  body weight) into a cubital vein. Source images and 3D maximum intensity projections (MIP) were interpreted on an independent workstation. **RESULTS:** XRV revealed a thrombus in 28 out of 84 veins (33.3%). There was agreement regarding disease state (absence or presence of thrombi) in 83/84 veins (98.8%). In one patient, thrombus of the popliteal vein was diagnosed in MRV but not in XRV. Differences between XRV and MRV were mainly in the locations that were rated as non-diagnostic by the readers. **CONCLUSION:** NC100150 allows prolonged and improved visualization of the peripheral vasculature and may overcome some limitations of gadolinium contrast media. A more complete examination of the proximal venous tree seems possible. Enhancement of arteries and veins and motion artefacts can limit image interpretation. Acquisition and subtraction of a first-pass arterial image from the equilibrium phase image may improve diagnosis in the calf veins.

**1100 Multislice CT angiography of the entire length of the carotid and vertebral systems in TIA patients**E Teasdale  
*Institute of Neurological Sciences, Glasgow, UK*

**BACKGROUND:** Multislice CT has expanded the role of CT angiography by improving the temporal and spatial resolution, allowing long areas to be covered with a sufficiently thin slice width to enable examinations of the aortic arch beyond the Circle of Willis. We have applied such a technique in patients attending a one-stop TIA clinic. **TECHNIQUE:**  $2.5 \text{ mm} \times 4$  helix; pitch 0.875; 0.5 s rotation; 120 kVp; 200 mAs giving 30 cm coverage in 17.5 s. The scan was triggered automatically from contrast medium concentration in the ascending aorta, or in the pulmonary artery for those patients under 55 years. **RESULTS:** Anatomical and pathological appearances were documented in the great vessels, and the carotid, vertebral, basilar and circle of Willis arteries in over 75 patients with suspected TIA. In 20% no useful data on the thoracic vessels were obtained, mostly owing to shoulder artefact. Reflux of contrast medium in the jugular system occasionally obscured a vertebral origin, and swallowing artefact obliterated the carotid bifurcation in five cases. Significant carotid stenosis was present in a minority of patients but none required Doppler or angiography. The intrapetrous and intracavernous carotids were best assessed on the base images. Bifurcation and great vessel disease were assessed by volume rendered cuts, using MIP or MPR to clear dense calcification and to accurately measure any stenosis. **CONCLUSION:** Multislice CT angiography offers an effective assessment of the entire carotid, vertebral and cerebral vasculature in patients with suspected TIA.



**1110 Multidetector computed tomography for venous and arterial coronary bypass grafts**

JB Partridge, J Chambers, R Raipanchoia, M Bustami, K Griffiths and D Kent

*Royal Brompton & Harefield NHS Trust, Middlesex, UK*

This study examines the role of contrast-enhanced multidetector CT (MSCT) with retrospective ECG-gated image reconstruction in the evaluation of arterial and venous coronary artery bypass grafts. 40 symptomatic patients (31 men, 9 women; mean age 61 years, range 44–82 years) were studied by MSCT (SOMATOM Volume Zoom, Siemens) and the results were compared with conventional coronary angiography. A total of 131 grafts (40 left internal mammary artery, 5 right internal mammary artery, 9 radial artery grafts and 77 venous grafts) were studied. MSCT defined 39 of 42 arterial grafts as patent with 93% sensitivity and 100% specificity (12/12). MSCT defined patency of 29 of 31 left internal mammary arteries (sensitivity 94%, specificity 100%). MSCT visualized the anastomotic site of the left internal mammary artery graft in 71% of cases (22/31). 35 of 36 venous grafts were identified as patent with a sensitivity of 97% and specificity of 97%. In venous grafts, 8 of 10 high-grade stenoses were correctly detected by MSCT (sensitivity 80%). These results suggest that MSCT is a promising modality for non-invasive imaging of both arterial and venous coronary artery bypass grafts and will develop into a reliable clinical technique. This presentation will concentrate on the technical and anatomic aspects of graft MSCT and will analyse the errors in this preliminary study.

**1030–1200**

**Electronic Patient Record: integrating radiology II**

**1030 Invited review: Radiology and the Electronic Patient Record: where does IHE fit in?**

D Kalra

*CHIME, London, UK*

Interoperability to enable secure, distributed access to comprehensive electronic health records (EHRs) has been an important challenge for research and standardization for over a decade. Significant work internationally has now validated the requirements, information models and middleware services that are required to deliver many aspects of this challenge. Examples of this work include the open EHR Foundation and the CEN EHRcom Task Force, which is presently defining a new EHR Communications standard. However, limited progress has so far been made on specifications for the inclusion within the EHR of multimedia reports arising from specialist departments such as radiology. This is partly because standards do not yet exist for such multimedia reports, and partly because few EHR pilots have attempted to include multimedia reports. The IHE organization is actively fostering interoperability between health information systems and radiology systems. In collaboration with EHR research and standardization groups, IHE has the potential to help specify the interoperability required to enable multimedia reports to be integrated within EHRs in a generic way, meeting the established medicolegal requirements for EHR information

**1100 Invited review: The Electronic Patient Record in clinical practice**

<sup>1</sup>J Rose and <sup>2</sup>J Sanjay

*<sup>1</sup>Cerner Corporation, Kansas City, KS and <sup>2</sup>IHE Planning Committee*

**PURPOSE:** To review the importance of integration of information and management of clinical culture in the world of electronic medical records, with emphasis on the use of standards for clinical images and information in enhancing practice safety and service for radiologists and their colleagues. **MATERIALS AND METHODS:** Experience in multiple environments with implementation and use of RIS/PACS/EMR. **RESULTS:** Management of standards and culture are key essentials in addition to good strategy and use of standard protocols for success with information technology in healthcare. **CONCLUSION:** The future of radiology is dependent upon more facile and accurate clinical communication between radiologists and clinicians, and only through well structured information technology solutions using standards and architecture can such needed communications safely and reliably occur.

**1145 Discussion**

**1030–1200**

**Oncology: imaging the previously treated patient**

**1030 Invited review: Post-treatment imaging: the neck**

H Lewis-Jones

*University Hospital Aintree, Liverpool, UK*

The last 20 years have seen major surgical advances in the treatment of head and neck cancer. Imaging assessment of the post-operative neck by CT and MR requires a thorough knowledge of the major free flap techniques employed and their subsequent unusual imaging appearances. Routine neck dissections for lymph node resection are often combined with radiotherapy, and these treatments also produce specific imaging changes, which are presented. Recurrence of head and neck cancer usually occurs within the first 12 months following treatment and will often be apparent clinically, but in 20% of patients recurrence is clinically occult and is detected only by imaging. In a further 25% imaging will influence the post-operative salvage plan. A review of the literature comparing CT and MR features in post-operative recurrence is presented and the common features of recurrence are illustrated. PET scanning has also been shown to have specific value in this clinical situation and the role of this scarce modality is discussed in relation to conventional imaging. Routine post-operative baseline imaging has been advocated as this makes the subsequent diagnosis and extent of recurrence easier to identify. The appropriate timing of such baseline imaging in relation to surgery and in particular to radiotherapy is considered. Video fluoroscopy has a role in the evaluation of the function of complex flaps in relation to speech and swallowing, which have major influences on quality of life outcomes in this group of patients.

**1100 Invited review: Post-treatment imaging: the pelvis**

B Carrington

*Christie Hospital NHS Trust, Manchester, UK*

No abstract supplied.

**1130 Invited review: The role of PET in post-treatment imaging**

WL Wong

*The Paul Strickland Scanner Centre, Hertfordshire, UK*

No abstract supplied.

**1030–1230**

**Gastrointestinal: imaging the bowel**

**1030 Invited review: MRI of the small bowel**

P Prassopoulos

*University Hospital of Alexandroupolis, Medical School of Thrace, Greece*

MRI has recently been introduced for the evaluation of small bowel (SB) anatomy and pathology. The presentation will be devoted to MRI examination techniques, normal appearances, clinical applications and limitations of SB MRI. Adequate bowel distension, homogeneous opacification of the lumen, short acquisition times permitting breath-holding,  $T_1$  and  $T_2$  weighted imaging and contrast enhancement are fundamental for state-of-the-art MRI of the SB. Administration of 1.5–2 l of isosmotic water solution through a nasojejunal catheter ensures distension of the bowel and facilitates identification of wall abnormalities. Oral contrast medium administration has been also proposed to avoid patient discomfort. True FISP, HASTE and post-gadolinium  $T_1$  weighted three-dimensional fast low-angle shot sequences can be employed in a comprehensive MRI examination protocol to overcome specific disadvantages of each of the sequences involved. Initial clinical experience shows that MRI performs well in the demonstration of the wide spectrum of imaging findings in Crohn's disease, in assessing disease activity, in the detection and definition of disease extent, in the characterization of tumorous lesions and in determining the presence, level and usually the cause of SB obstruction.

**1100 Invited review: CT virtual colonography**  
C Kay*Bradford Royal Infirmary, Bradford, UK*

Computed tomographic colonography (CTC) or virtual colonoscopy (VC) has emerged as a new technique for colorectal evaluation—but is all the excitement justified? This new imaging tool employs advanced imaging software to volumetric CT data to produce both two- and three-dimensional images of the colon. The aim of this presentation is to describe techniques used for CTC acquisition and interpretation, to review published results of the performance of CTC and to propose potential applications of this technique in clinical practice. Specific aspects of scanning protocols to be discussed include patient preparation, CT scanning parameters and the use of both supine and prone data acquisition. The range of techniques available for image interpretation will be discussed. A simple and rapid interpretation technique utilizing predominantly 2D images for primary interpretation, with selected 3D endoluminal perspective views for problem-solving, will be described. Published results of CTC in patients with known or suspected colorectal masses, following incomplete colonoscopy and as a screening technique for polyps and cancers will be reviewed. Examples of a variety of lesions identified at CTC will be demonstrated along with endoscopic correlations. The potential use of CTC immediately following failed colonoscopy, and as the primary method of colorectal evaluation in elderly and infirm patients, will be discussed. Finally, the potential use of CTC as a screening test for the detection of colorectal polyps and cancer will be discussed, with particular reference to existing proposed screening methods. If ongoing and future trials confirm previously published results of the effectiveness of CTC, this technique may have a significant impact on colorectal screening by virtue of high patient acceptance, safety and the immediate opportunity to proceed to a therapeutic colonoscopic examination.

**1130 Invited review: The role of barium in examination of the small and large bowel**

A Chapman

*St James's University Hospital Trust, Leeds, UK*

Push and Sond enteroscopy and wireless capsule endoscopy are specialized techniques for examining the small bowel. They are most frequently used to investigate unexplained gastrointestinal blood loss but have their limitations, including failure to examine the whole of the small bowel, poor patient compliance, complications such as epistaxis and bowel perforation, and prolonged examination or video analysis time. In view of this, barium examinations remain the preferred method of imaging the small bowel. Although the first small bowel meals were performed in 1915 and the first small bowel enemas in 1929, there is still no consensus as to the best method of investigating the small bowel with barium. It is recognized that the small bowel enema offers certain advantages by virtue of luminal distension, often making it the preferred technique for patients suspecting of having a stricture or Meckel's diverticulum, and, as barium transit is faster, it is also preferred for malabsorption syndromes where prolonged studies can result in barium flocculation. The main drawback is that patients requires duodenal or jejunal intubation, thus radiologists continue to search for ways of improving the small bowel meal with a view to obtaining similar image quality. In recent years there has been interest in the use of effervescent agents to decrease transit time and improve proximal small bowel distension as well as in the use of the pneumocolon technique to improve distension of the distal small bowel. The mucosa of the colon is more accessible to endoscopy than that of the small bowel. Owing to its therapeutic potential, colonoscopy is often the preferred technique for imaging the colon. Nevertheless, large numbers of barium enemas are still performed, largely because of a shortage of skilled endoscopists. Gastroenterologists select for colonoscopy those cases where pathology is likely to be found and refer the remainder to radiology together with frail, the elderly and their colonoscopy failures. This makes the performance of high quality, double contrast barium radiology a challenge. Nevertheless, the examination continues to be refined. In recent years, Scholz has stressed the importance of active drainage to minimize the volume of residual barium and, by using this modification, has been able to achieve superb double contrast results. In the UK approximately 50% of barium enemas are currently performed by radiographers, and the sensitivity and complication rate are similar to those of radiologist-performed examinations. Recruiting young radiologists into consultant posts with job plans that involve fluoroscopy lists is becoming increasingly

difficult because of the attraction of cross-sectional imaging and to a lesser extent interventional radiology. As radiographers become skilled in fluoroscopy, as a result of performing barium enemas, it is likely that they will expand their practice to include most basic fluoroscopic procedures.

**1200 Detecting higher risk subjects in a virtual colonoscopy screening programme improves advanced colorectal neoplasia yield**RG Scott, J Edwards, RM Mendelson and GM Forbes  
*Royal Perth Hospital, Perth, Australia*

**PURPOSE:** A cost effective colorectal neoplasia (CRN) screening programme should provide a reasonable yield. Targeting a programme at those at increased risk but previously uninvestigated may result in an increased yield of CRN. **METHOD:** Over 50 years, subjects randomly selected from the electoral roll were invited to participate in a screening programme using virtual colonoscopy. Those with a positive family history or symptoms were excluded (evaluation by colonoscopy being the standard care). Written advice regarding their increased cancer risk was given and GP consultation was recommended. Follow-up by written and/or telephone questionnaires after 12 months determined follow-up details and the yield of advanced CRN (adenoma >1 cm or cancer). **RESULTS:** Of 2000 subjects offered screening, 90 (4.5%) (65 symptomatic; 24 with family history) were identified as ineligible for screening and were uninvestigated. Information was available on 71 (82%) subjects. 35 (49%) had discussion with a GP. 19 (27%) subjects had colonoscopy, in which advanced CRN was present in 5 (26%). Primary reasons for not consulting a GP were: symptoms went away (12), otherwise well/good health (15) and did not see need for test (10). **CONCLUSION:** This study demonstrates in high-risk uninvestigated subjects identified within a screening programme: (1) a high yield of advanced CRN; (2) a lack of appreciation for the need to seek further health advice; and (3) a low level of colonoscopy referral. Perhaps this high-risk uninvestigated group should be targeted first before attending to screening average risk subjects for CRN.

**1210 Participation in colorectal neoplasia screening: virtual colonoscopy vs colonoscopy vs a choice**

RG Scott, JT Edwards, C Wood, I Fritschi, GM Forbes and RM Mendelson

*Royal Perth Hospital, Perth, Australia*

**INTRODUCTION:** Our previous experience using virtual colonoscopy (VC) as a community-based colorectal neoplasia screening tool showed a participation rate of 27%. Our aim was to compare participation in screening using either VC or colonoscopy (CY), and to determine whether a choice increases participation. **METHOD:** 1400 subjects randomly selected from the state electoral roll (m=f; age cohorts 50–54 years and 65–69 years; equal mix of socioeconomic suburbs) were randomly allocated into one of three groups to receive written invitation with an accompanying information leaflet to have CY (Group A), VC (Group B) or the choice of either VC or CY (Group C). Those with symptoms or family history of colorectal cancer were excluded. General Practitioners or a publicity campaign were not involved in recruitment. **RESULTS:** 1063 (76%) of 1400 were eligible for screening. The overall unadjusted participation rate was 17.3%. Participation in Groups A, B and C were 16.3%, 18.1% and 17.5%, respectively. Men were more likely to participate than women (22% vs 13%, unadjusted rates;  $p=0.001$ , Fishers exact test). High socioeconomic region subjects were more likely to participate than low or medium regions (21%, 16% and 16%, unadjusted rates for high, medium and low regions, respectively). Age made no difference (17.7% for 50–54 years and 17.6% for 65–69 years, unadjusted rates). **CONCLUSION:** This study suggests that providing a choice of VC or CY does not increase participation over offering either test alone. Participation was equal in individual VC and CY groups. These participation rates are favourable for a screening programme based on VC or CY without facilitation by General Practitioners or media advertising.

**1220 Bowel visualization and patient preference at virtual colonoscopy: CO<sub>2</sub> or air insufflation**

DA Nicholson, J Johnson and F Noden

*Hope Hospital, Salford, UK*

**PURPOSE:** We have performed virtual colonoscopy (VC) using manual air distension or CO<sub>2</sub> pump insufflation using the Ezem "Protocol

Inflator" to compare the degree of bowel visualization and patient symptoms. METHODS: A standard imaging protocol was followed with the only variable being type of bowel distension: manual air or CO<sub>2</sub> using the Ezem "Protocol" insufflator. Patients were scanned prone and supine and the images were reviewed and scored for bowel distension using six anatomical areas. Patients completed a questionnaire regarding symptoms before and after VC (1= no symptoms to 5= worst symptom). RESULTS: Distension scores were good for both air and CO<sub>2</sub>. In the "air" group the prone scans, performed first, showed better distension than the supine, largely owing to improved distension of the sigmoid colon on prone imaging. With pump CO<sub>2</sub> insufflation, better distension was seen on the second supine scan compared with the prone scan.

	Air (37 patients)	CO <sub>2</sub> (77 patients)	p-value
Prone	2.7	3.3	$p = 0.11$
Supine	3.6	2.6	$p = 0.061$

In comparing symptoms, patients experienced less swelling (air group = 1.26, CO<sub>2</sub> group = 0.58;  $p < 0.005$ ) and pain (air group = 1.13, CO<sub>2</sub> group = 0.9;  $p = 0.077$ ) when using CO<sub>2</sub>. COMMENTS: At VC, air and CO<sub>2</sub> give satisfactory bowel distension. It appears that better bowel distension is achieved on the first prone scan with air and on the second supine scan with CO<sub>2</sub>. Patients present for VC in a degree of discomfort, presumably owing to the bowel preparation. Patients experience more symptoms when air was used compared with CO<sub>2</sub>. Further results will be presented as well as the techniques of CO<sub>2</sub> insufflation using the Ezem "Protocol" CO<sub>2</sub> insufflator.

## 1115–1245

### New Imaging Systems PET/CT

#### 1115 Invited review: Hybrid imaging: SPECT/GC-PET/CT—technology and applications

WB Tindale, PG Hillel, EJ van Beek, M Hanney, S Matthews and S Mitchell

Sheffield Teaching Hospitals NHS Trust, Sheffield, UK

Hybrid imaging offers the advantage of combining functional and anatomical information by acquiring both sets of data during one examination. Gamma cameras (GCs) are available with integral low dose/quality CT units, providing options for SPECT/CT and GC-PET/CT. The CT scans are inherently registered to the emission images and can be used for attenuation correction (AC) and for mapping the functional information onto anatomy. Technical performance of the hybrid GC and practicalities of image acquisition will be discussed. Radiation burden is low; the CT sequence typically adds 0.8 mSv per bed position. SPECT/CT can be applied to any study where interpretation may be assisted by AC or functional anatomic mapping (FAM) for localization. Our experience using <sup>111</sup>In Octreoscan, <sup>123</sup>I-MIBG, radiolabelled leucocytes, <sup>67</sup>Ga citrate and <sup>99</sup>Tc<sup>m</sup>-MIBI in 50 consecutive patients investigated with SPECT/CT showed that FAM established or changed the location of at least one lesion in 70% of abnormal studies and resulted in altered patient management in 44% of cases where follow-up is available. GC-PET/CT capability enables coincidence imaging using <sup>18</sup>F<sup>18</sup>FDG, with the CT unit providing both anatomical detail and low noise transmission images for AC, which is particularly important for PET. GC-PET has known limitations; however, our experience with GC-PET/CT has shown better sensitivity (82%) and specificity (92%) for lung cancer staging compared with conventional CT. CT data from hybrid gamma cameras can also be used as a gateway to enable the use of emission data in other applications. Examples will be provided in the context of radiotherapy planning.

#### 1135 Invited review: Hybrid imaging: PET/CT—technology and applications

J Clarke

Royal Victoria Hospital, Belfast, Ireland

No abstract supplied.

#### 1155 Invited review: Software fusion: from design to implementation

C Behrenbruch

Mirada Solutions, Oxford, UK

No abstract supplied.

#### 1215 Invited review: PET and PET/CT in radiotherapy planning

A Hounsell

Belvoir Park Hospital, Belfast, UK

No abstract supplied.

## 1235 Discussion

## 1130–1200

### Service Delivery Scientific Session

#### 1130 Sharing the success of a whole systems approach to radiology redesign

<sup>1</sup>SM Mylne, <sup>2</sup>K Kishan, <sup>3</sup>M Fox and <sup>2</sup>R Hulse

<sup>1</sup>Cancer Services Collaborative, Norwich, UK,

<sup>2</sup>James Paget Healthcare Trust, Great Yarmouth, UK and

<sup>3</sup>Access, Booking & Choice Programme, Great Yarmouth, UK

The James Paget Hospital Radiology Department has recently undertaken a whole systems redesign to deliver innovating change across the department. This work was possible through a Cancer Services Collaborative and Access, Booking & Choice project that supported modernization of radiology services for all patients and has encouraged the department to be a Radiology Beacons Site for Service Improvement. This redesign has greatly benefited both patients and staff of the James Paget Healthcare Trust. This modernization encompassed several elements: (1) gaining "buy in" and support from the whole department (and maintaining it through good communication); (2) examining patient flow through the department and individual modalities (process mapping and patient shadowing); (3) ensuring equal access for all patients (*i.e.* reduction in waiting times and queues); (4) individual modality redesign (referral-examination) to primarily benefit patients, but also to benefit staff through work around skill mix and role extension; (5) redesigning the reporting process (examination-report) to ensure timely reporting of examinations; (6) careful data collection to show evidence of improvement (capacity and demand, waiting time monitoring, snap shot audits); (7) offering certainty and choice to patients (access, booking and choice programme) through redesigning the booking processes; (8) monitoring departmental capacity for all modalities and learning to flex capacity to meet demand (to maintain waits); (9) linking redesign to the radiology information system implementation plan, to maximize the benefits of the new system and to minimize too many changes in a period of time; and (10) linking redesign to patient pathway redesign.

#### 1140 Day-case interventional radiology: the Oxford experience

MC Uthappa and J Phillips-Hughes

The John Radcliffe Hospital, Oxford, UK

PURPOSE: To present and evaluate day-case interventional radiology procedures as a safe and effective form of patient care. There is a growing demand for access to day-case interventions owing to increasing use of non-invasive diagnostic tests and significant bed/nursing shortages. MATERIALS AND METHODS: Over the past 2 years and 9 months we have performed 418 day-case interventional procedures; 161 vascular cases (including angioplasty/stenting), 57 oesophageal dilations for achalasia and 200 liver biopsies. Follow-up included 24-h telephone calls and patient questionnaires. RESULTS: All procedures were technically successful. The overall admission rate was 2.87%. One of the patients undergoing liver biopsy required admission (1/200 = 0.5%), one was admitted following oesophageal dilatation (1/57 = 1.7%), whilst 10 were admitted following PTA/stenting (10/161 = 6.2%). Of these 10 patients, 3 had complications requiring surgery (3/161 = 1.8%) and 7 required overnight observation only (7/161 = 4.3%). Data from questionnaires revealed a very high level of patient satisfaction. CONCLUSION: Where the clinical and social circumstances are appropriate, a number of interventional procedures can be performed as day cases, avoiding the need for an

inpatient bed in the vast majority. Patients find this approach highly acceptable. However, both patients and referring clinicians must be aware of the need for admission and further treatment in a very small number of cases.

### 1150 The International Fellow Scheme: how to decide whether you want one and how to go about getting one

A Troughton and J Henson

*Great Western Hospital, Swindon, UK*

The government has initiated a high profile scheme to attract overseas doctors to the post of International Fellow in the UK for a period of up to 2 years. The aim was to attract up to 1000 doctors at the level of consultant in shortage specialties including radiology. At this time only 50 have been recruited, with 2 in radiology. We were successful in filling one of these posts in our institution. For the candidates there is an attractive financial package and the opportunity to sample a different lifestyle and work culture. For the radiology department there is the possibility of filling a consultant post with a high-class candidate at this time of great shortage of home-grown applicants. Full details of the scheme and the methods of applying are described. Advice on the programme's pleasures and pitfalls is also given.

1130–1215

## Vascular Imaging Scientific Session

### 1130 Arterial occlusive disease: assessment of quality of life in 200 patients after endoluminal therapy

HA Deutschmann, G Bohdal, P Schedlbauer, H Schoellnast, G Schwantzer and KA Hausegger  
*University of Hospital Graz, Graz, Austria*

**PURPOSE:** To assess the impact of PTA or stent placement on quality of life in patients with ischaemic peripheral artery disease. **METHODS:** Changes in quality of life were prospectively evaluated in 200 patients before and up to 12 months after treatment. Physical, emotional and general health components were determined using the RAND-36 item survey. Multivariate analysis was performed to assess short- and long-term effects of treatment in multiple subgroups. 6- and 12-month follow-up data were available for 135 and 70 patients. **RESULTS:** All measured components of quality of life improved significantly after the intervention. Reduction of bodily pain was the most evident effect of treatment. Best benefit was observed in claudicants, patients with femoropopliteal lesions and stent patients. Significant short- and mid-term effects were observed for combined PTA of femoral and crural arteries and isolated PTA of crural arteries. **CONCLUSION:** PTA and stent placement proved to increase health-related quality of life in patients with arterial occlusive disease. Certain subgroups of patients seem to have a better benefit from the interventional treatment than others. This may significantly influence patient management.

### 1140 Comparison of gadolinium-enhanced MRA and intra-arterial DSA in renal artery stenosis in 60 patients

JM Farrant, C Hartigan, J Tibballs, A Platts and A Watkinson

*The Royal Free Hospital, London, UK*

**PURPOSE:** To compare gadolinium-enhanced MRA (Gd-MRA) and intra-arterial DSA (IA-DSA) in the diagnosis of renal artery stenosis (RAS). **MATERIALS AND METHODS:** Between January 1999 and September 2002, 60 patients underwent Gd-MRA (three-dimensional gradient echo technique on a 1.0 T Philips Gyroscan Interna) and IA-DSA (flush aortogram, 12 ml Omnipaque, 20 ml s<sup>-1</sup>) within a 3 month period. **RESULTS:** 34 males and 26 females were studied, with an age range of 36–87 years (average 74 years). The MRA findings were: 9 normal, 24 unilateral RAS, 21 bilateral RAS, 4 unilateral occlusion and 2 bilateral occlusion. Comparison with the gold standard IA-DSA revealed an accuracy of 72% (45), overestimation of RAS in 23% (14) and underestimation in 5% (3). In the 20 patients who had normal IA-DSA, MRA overestimated in 11 patients (8 unilateral RAS and 3 bilateral RAS). The sensitivity of MRA was 94% and the specificity was 40%. The detection rate of accessory renal arteries was 48%. 40% (24) underwent intervention (10 angioplasties and 14 stent insertions). **CONCLUSION:** Gd-MRA is a very useful, non-

invasive imaging technique to evaluate RAS, a curable cause of secondary hypertension. MRA frequently overestimates the severity of RAS. The negative predictive value is high and MRA is used to demonstrate normality; if normality is not demonstrated we will now proceed to IA-DSA.

### 1150 Radiographic assessment of peripherally inserted central venous catheters: are current protocols adequate?

MG Murphy, S Benton, D White and R McWilliams  
*Royal Liverpool University Hospital, Liverpool, UK*

**PURPOSE:** Peripherally inserted central venous catheters (PICCs) are becoming increasingly popular in the UK for venous access. Arrhythmias and cardiac tamponade are rare but important complications associated with catheter tip position and may occur secondary to change in line tip position with arm movement. The purpose of our study was to assess the usage of PICCs and to evaluate existing radiographic protocols for the assessment of line tip position. **MATERIALS AND METHODS:** A questionnaire was forwarded to the radiology departments of 360 hospitals in the UK. **RESULTS:** A 56% (204/360) response rate was achieved, with 77% (159/204) of these hospitals utilizing PICCs. Only 55 radiology departments had a specific protocol in place regarding the post-procedural CXR to assess line tip position; of these only 1 included recording the position of the patient's arm at the time of exposure on the radiograph. The mean distance that respondents felt the line tip might migrate with arm movement was 2.85 cm, with four respondents indicating that it should not move. **CONCLUSION:** There appears to be a degree of lack of awareness of PICC tip migration with arm movement. Current radiographic protocols do little to highlight this fact to the clinicians and a new protocol is suggested to help alleviate this.

### 1200 Aortoiliac enhancement during CT angiography with single and double power injector: influence on magnitude and uniformity of the contrast column

H Schoellnast, M Tillich, MJ Deutschmann, HA Deutschmann, GJ Schaffler and HR Portugaller  
*University Hospital Graz, Graz, Austria*

**PURPOSE:** To compare the magnitude and uniformity of aortoiliac contrast enhancement obtained from uniphasic contrast material injections versus contrast material injections with reduced iodine dose followed by a saline flush in aortoiliac CT angiography (CTA). **MATERIALS AND METHODS:** 26 patients with abdominal aortic aneurysms underwent aortoiliac CTA using a single power and a double power injector. With the single power injector 120 ml contrast material (300 mg I ml<sup>-1</sup>), and with the double power injector 100 ml contrast material followed by 40 ml saline solution flush, were administered at a flow rate of 4 ml s<sup>-1</sup>. Mean aortoiliac attenuation, mean plateau deviation and mean difference between maximum and minimum attenuation value were measured for both groups. **RESULTS:** The mean aortoiliac attenuation with the single power injector was 291 ± 62 HU, and with the double power injector it was 282 ± 62 HU. The difference of 9 HU was not statistically significant ( $p=0.17$ ). Mean plateau deviation was significantly smaller using the single power injector than with the double power injector (18 ± 10 HU vs 23 ± 10 HU;  $p=0.04$ ). Also, the mean difference between the maximum and minimum attenuation value was significantly smaller with the single power injector than with the double power injector (64 ± 29 HU vs 33 HU;  $p=0.01$ ). **CONCLUSION:** In aortoiliac CTA a saline solution flush after contrast material bolus allows an iodine dose reduction of approximately 20% without impairing the magnitude of contrast enhancement, but degrades the uniformity of the contrast column.

1200–1300

College of Radiographers

## William Stripp Memorial Lecture

### Eponymous Lecture: Why take it lying down: a comparison of traditional and alternative radiography of the spine

A Wood

*Anglo-European College of Chiropractic, Bournemouth, UK*

This presentation compares the traditionally taught positioning of the spine for plain film radiography with alternative positioning techniques

utilized by professions such as chiropractic and osteopathy. In particular, positioning of the lumbar spine and pelvis, which in chiropractic especially is usually considered to be a single area, will be examined. Consideration will be given to several aspects of this positioning, including ease of positioning for both the patient and radiographer, practical considerations, changes in patient dose and the reasons for this type of view. The overall intention is to present alternative techniques for consideration and to help radiographers understand the requirements of other professionals, and to begin to answer some of the "frequently asked questions".

1245–1345

British Institute of Radiology

### Kodak Mayneord Memorial Lecture

**Eponymous Lecture: PET/CT: the best of two worlds**  
G von Schulthess

*Zurich University Medical School, Zurich, Switzerland*

PET is excellent for tumour staging but reveals few anatomical landmarks. Furthermore, PET transmission scanning for attenuation correction is lengthy. Therefore, integrating PET and CT into a single system makes sense: CT demonstrates excellent anatomical landmarks for PET findings on the "hardware co-registered" images, and imaging speed is improved by replacing PET with CT transmission scans. Using the first worldwide clinical integrated PET/CT system (Discovery LS; GEMS, Milwaukee, USA), we have been able to scan more than 3000 patients so far. The data show that the procedure provides high quality co-registered PET/CT images even using CT scans at 40 mAs. Technical results include: respiration mismatches are minimized by using an adequate breathing protocol; quantification of PET/CT data works; lesion size and activity are not altered by CT transmission correction; and bowel contrast does not interfere with attenuation correction. Clinical data show that co-registration is excellent, and the mismatch problems around the diaphragm are hardly relevant. Routine image co-registration has led to some surprising findings. There is, for example, FDG uptake into fatty tissues of the neck in 3–5% of tumour patients. The sensitivity and specificity of PET/CT is better than that of PET alone or PET and CT. There are numerous reasons for this. Most importantly, precise anatomical localization of a lesion prevents staging errors and facilitates the distinction between pathological and physiological FDG accumulation. Finding FDG lesions with an anatomic correlate improves certainty of diagnosis. Furthermore, interpretation of PET scans appears to be more consistent. As a result, interobserver variability decreases.

1400–1500

### Developing Teams and Skills

**1400 Invited review: Developing the team**  
Speaker from the British Olympic Association: to be confirmed

1445 Discussion

1400–1500

### New Digital Imaging Systems

**1400 Invited review: Testing new digital systems**  
M Lewis

*Master Misericordiae Hospital, Dublin, Ireland*

**PURPOSE:** The type of display system chosen for soft-copy primary reporting and for image review throughout a hospital has significant cost implications. Testing and quality control of these systems is vital if we are to optimize their use and protect investment. Standard protocols for quality assurance and acceptable performance levels of soft-copy systems are still being formulated. This talk aims to outline some practical and cost effective methods for testing display systems and to outline some of the pitfalls that may be encountered in set-up and maintenance of these systems. **METHODS:** Methods described

will include the use of a standard SMPTE phantom, along with a light meter, to examine perceptual linearization. Standard X-ray phantoms, available in most centres, can be used to determine baseline low contrast detectability and spatial resolution. The DICOM part 14 Grayscale Standard Display Function and the various software packages available for calibration will be discussed. **RESULTS AND CONCLUSIONS:** The specification of display system depends on the imaging modality. High quality monochrome display systems are suitable for CR hard-copy, while the specifications for other imaging modalities can be slightly lower. Careful selection of display system and QA software at purchase can ensure that limited resources are appropriately allocated and that quality of the soft-copy is comparable to that of hard-copy. Display systems with self-calibration functions can considerably reduce routine QA workload for diagnostic quality monitors. Lower cost packages may be more suitable for less frequent calibration of review systems distributed throughout the hospital.

**1430 Invited review: New digital systems**

A Mackenzie

*KCARE, London, UK*

The uptake of digital imaging systems in radiology departments has been increasing over recent years. Computed radiography (CR) is now common and direct digital radiography (DDR) systems are no longer confined to digital chest units but also digital rooms. KCARE has been developing techniques to evaluate digital systems and to produce useful comparative data. The testing has used a variety of test objects to test threshold contrast resolution. Other tests look at image retention and artefacts such as stitching artefacts. KCARE also undertakes quantitative analysis such as pre-sampled Modulated Transfer Function (MTF) and Detective Quantum Efficiency (DQE). Many of these techniques are transferable to quality assurance systems for individual departments. KCARE has tested a range of systems using different technologies such as CR, amorphous silicon flat panel detectors (FPD), amorphous-selenium FPD and scanning CCD. These are used for a variety of applications in general radiography, chest imaging, mammography and fluoroscopy. This presentation will cover some of the techniques used by KCARE and those that are applicable to routine quality assurance.

1400–1515

### Thoracic Imaging

**1400 Invited review: The idiopathic interstitial pneumonias made simple**

J Reynolds

*Birmingham Heartlands Hospital, Birmingham, UK*

The idiopathic interstitial pneumonias are a group of lung disorders characterized by varying degrees of alveolar and interstitial inflammation and fibrosis. Usual interstitial pneumonia (UIP) is probably the most common interstitial pneumonia and manifests clinically as cryptogenic fibrosing alveolitis. High resolution computed tomography (HRCT) appearances are characteristic and in most cases the diagnosis can be made without recourse to lung biopsy if clinical features are typical. Non-specific interstitial pneumonitis (NSIP) is a relatively recent addition to the classification of interstitial pneumonias and refers to cases where the histopathological features do not correlate with any other interstitial pneumonia. Desquamative interstitial pneumonitis (DIP) and the closely related respiratory bronchiolitis interstitial lung disease (RB-ILD) are both related to cigarette smoking. Acute interstitial pneumonitis (AIP) is characterized by the sudden onset of dyspnoea progressing to respiratory failure in previously well individuals. The American Thoracic Society/European Respiratory Society have recently recommended the inclusion of cryptogenic organizing pneumonitis (COP) and lymphocytic interstitial pneumonitis (LIP) in the classification of idiopathic interstitial pneumonias. Radiology and particularly HRCT is complementary to histopathological information in the assessment of diffuse lung disease. HRCT gives an overview of gross morphology of both lungs but lacks resolution. Histopathology provides much greater detail but can be subject to sampling errors and can be "overruled" by clinical or radiological data. The patient is best served by correlation and discussion of clinical, radiological and pathological data.

1440 Discussion

**1450 The intermediate lung scan: what factors influence successful clinical management?**

NW Garvie and S Chilab

*Royal London Hospital, Whitechapel, London, UK*

**PURPOSE** Patients with an intermediate lung scan (ILS) have a 30% incidence of embolism (PE). Given the high mortality and recurrence rates of PE, all patients with ILS should undergo pulmonary angiography (CTPA), with anti-coagulant therapy (ACT) as appropriate. This management strategy is widely promoted but frequently ignored. This study investigates the factors that may influence compliance.

**METHODS:** A group of 53 patients with ILS were investigated. The clinical management strategy was deemed successful if it included CTPA ± ACT. The factors selected were: patient age/sex/D-Dimer level; referring specialty; and whether a recommendation for CTPA was included in the nuclear medicine report.

**RESULTS:** Only 27/53 patients (51%) received CTPA, of which 11/27 (40%) were positive for PE. All 11 then received ACT. However, 4/15 (27%) patients with normal CTPA were also given ACT (1 CTPA was non-diagnostic). 11/25 males (44%) and 16/28 females (57%) received CTPA. Average age of the CTPA group was 59 years compared with 65 years in the non-CTPA group. When graded according to specialty, referral rates for CTPA ranged from 88% (General Medicine) to 17% (Gastroenterology). Referrals from Surgery for initial V/Q scans were under-represented in proportion to total beds. D-Dimer levels did not affect referral for CTPA or subsequent ACT in the non-CTPA group. More patients received CTPA if this was advised in the nuclear medicine report.

**CONCLUSION** The ILS patient is still poorly managed and at high risk of recurrent PE.

**1500 Low dose computed tomography of the thorax in the septic immunocompromised patient**<sup>1</sup>NS Paul, <sup>1</sup>T Chung, <sup>2</sup>M Minden and <sup>1</sup>GL Weisbrod*<sup>1</sup>University Health Network and Mount Sinai Hospital, Toronto, ON, Canada and <sup>2</sup>Princess Margaret Hospital, Toronto, ON, Canada*

**OBJECTIVE:** To evaluate low dose computed tomography of the thorax (LDCTT) as the first line radiological investigation in the septic immunocompromised patient.

**BACKGROUND:** Immunocompromised patients are at risk of bacterial and fungal pneumonias. The current first line investigation is chest radiography (CXR).

**METHOD:** A prospective study (June 2002–current), recruiting 50 immunocompromised patients presenting with PUO. Two-view digital CXR and LDCTT are performed concurrently. The examinations are independently read by two chest radiologists blinded to the findings of the corresponding examination. Each examination is scored for image quality and findings: no focus of infection (NFI), consolidation, nodules and ground-glass opacities (GGO). The radiation dose from these examinations and any recent CT thorax (<3 months) is recorded.

**LDCTT TECHNIQUE:** 4 row multi-detector CT (Lightspeed Plus, General Electric): 140 kV, 50 mA, 2.5/1.25/1.3 mm, HS mode, GR = 0.8 s and TS = 15 mm s<sup>-1</sup>.

**RESULTS TO DATE:** 11 patients with AML (7 males; 19–73 years, mean 50 years). All the examinations are of diagnostic quality. The number of abnormal studies on CXR and LDCTT, respectively; NFI 7 and 4; consolidation 1 and 7; GGO 1 and 1; nodules 2 and 3. Radiation dose: LDCTT range 82.8–120.7 mGy cm, average skin absorbed dose = 2.46 mGy (0.6 mGy CXR, 15.2 mGy CTT).

**CONCLUSION:** Early results indicate that LDCTT in the immunocompromised patient detects a larger number of significant lesions than CXR at a radiation dose typically 17% of a regular chest CT.

**1510 Kco as the preferred measure of gas exchange in fibrosing alveolitis: HRCT insights**

SM Ellis, MB Rubens, DM Hansell and AU Wells

*Royal Brompton Hospital, London, UK*

**PURPOSE:** The standard functional measure of gas transfer, Kco (DLco adjusted for alveolar volume), is regarded as an excellent measure of the severity of fibrosing alveolitis but, despite its widespread adoption, the failure of Kco to predict outcome has called into question its robustness. The purpose of this study was to identify HRCT features that might account for this discrepancy.

**MATERIALS AND METHODS:** 212 consecutive HRCT examinations (76/212 had co-existent emphysema) on patients with clinically diagnosed idiopathic pulmonary fibrosis were evaluated by two experienced radiologists. Each HRCT examination was scored in terms of extent of fibrosis,

coarseness of reticulation and extent of co-existent emphysema. Kco levels were examined in relation to HRCT findings.

**RESULTS:** There was a poor overall correlation between Kco and extent of fibrosis ( $R^2=0.17$ ). Reasons were apparent on multivariate analysis where powerful independent relationships with the coarseness of reticulation ( $p=0.007$ ) and extent of emphysema ( $p<0.0005$ ) were major confounders. In the 136 patients with no co-existing emphysema on HRCT, coarseness of fibrosis remained an important independent confounder ( $p<0.005$ ).

**CONCLUSION:** In patients with fibrosing alveolitis, the presence of emphysema and, more particularly, honeycombing were major confounders and these account for the very poor overall relationship between Kco and the extent of interstitial fibrosis as seen on HRCT.

**1400–1530****Interventional Radiology: vascular****1400 Invited review: Carotid intervention**

P Gaines

*Sheffield Vascular Institute, Sheffield, UK*

No abstract supplied.

**1420 Invited review: How to do the basics: subintimal PTA**

A Bolia

*Leicester Royal Infirmary, Leicester, UK*

The technique of subintimal angioplasty has been around for over 15 years and was initially developed for the superficial femoral and popliteal arteries. It has since been extended to other territories and has made a substantial impact on the treatment of critical limb ischaemia with the use of its application in the tibial arteries.

**SUPERFICIAL FEMORAL ARTERY:** A 4 F pre-dilating catheter (Van Andel type; Cook Limited) is introduced antegradely up to the origin of the occlusion. 5000 units of Heparin and 12.5 mg of Tolazoline are injected prior to crossing the lesion. The Tolazoline vasodilator helps to dilate the distal vessels and reduces the possibility of spasm during the procedure. A curved hydrophilic wire (Terumo, Japan) is then introduced and the tip of this wire is directed towards the wall of the artery, away from any important collaterals. The tip is then advanced into the occlusion, followed by the Van Andel catheter. The two together usually enter the dissection space without much difficulty. The catheter/wire combination is then advanced through the length of the occlusion, usually with the wire manipulated into a large loop that helps in extending the dissection, followed by the pre-dilating catheter that helps to support one limb of the wire. The same loop in the guidewire is then advanced beyond the length of the occlusion and it is this loop in the guidewire that allows re-entry back into the lumen in the majority of the cases. A disease-free distal segment is favourable and allows the loop to re-enter quite easily. Once the lesion has been crossed with a wire, the pre-dilating catheter is substituted by a balloon catheter, usually 5 mm in diameter and 4 cm length. The balloon is dilated throughout the length of the dissection space using 10–12 atmospheres of pressure with 5–10 s allowed for each inflation. Two inflations are usually done at any particular site. Post-angioplasty images usually indicate a very smooth neolumen, which quite often shows a spiral ribbon appearance as would be seen in any dissection. A further dose of 12.5 mg of Tolazoline is given at the conclusion of the procedure to encourage enhanced flow, which helps maintain patency of the neolumen. Aspirin, if not contraindicated, is prescribed to patients who have had a successful recanalization, the usual dose being 150 mg daily for 3 months.

**TIBIAL OCCLUSIONS:** Short occlusions are usually crossed easily intralumenally, but subintimal recanalization is applicable in long occlusions of 3 cm or more in length. The technique for crossing the lesion is basically similar to the approach used in the femoro popliteal occlusions, except that the procedure is carried out using a 5 F balloon catheter, 3 mm in diameter and 2 cm long, from the beginning of the procedure (no pre-dilating catheter is used). The lesion is crossed in a similar fashion, with the help of a hydrophilic guidewire, pre-formed into a loop. Usually the loop has no difficulty in re-entering the tibial arteries distally, as the intima in these small vessels is very thin and therefore facilitates easy re-entry. Once again, the balloon is inflated up to 10–12 atmospheres of pressure and 5–10 s inflations are done at least twice in each position throughout the length of the occlusion. Tolazoline is used generously pre and post procedure. Nitroglycerine is only administered if spasm occurs, in

boluses of 100 µg. The technique of subintimal angioplasty in the femoro popliteal and tibial artery occlusion has allowed a large number of patients to be treated, particularly those who have critical limb ischaemia. It is useful in patients who would otherwise have had to have femoro popliteal or femoro distal bypasses or even amputations. Subintimal angioplasty is a relatively simple procedure requiring minimum materials and is easily learned by operators who have had some experience in vascular radiology.

#### 1445 Invited review: Renal PTA/intervention

A Belli

*St George's Healthcare Trust, London, UK*

Renovascular disease is associated with deteriorating renal function and hypertension. Renal artery angioplasty and stenting has a high technical success rate and stenting has become the treatment of choice for stenoses involving the renal artery ostium. The technique varies between operators but the main principles will be described. Complications can be very serious and include renal artery rupture, cholesterol embolisation and acute thrombosis of the artery. Some complications are specific to stenting. The best clinical outcome is in patients with hypertension due to fibromuscular dysplasia. For all other patients the clinical benefits of this treatment are less certain.

#### 1505 Invited review: Endovascular aortic stent-grafting

DA Gould

*Broadgreen Hospital, Liverpool, UK*

Endovascular aortic aneurysm repair (EVAR) is currently the subject of national UK randomized trials and its role has therefore not been established with clarity. Technical success in excluding the aneurysm requires assessment of the neck configuration as well as careful measurement of the neck diameter, the distance from the renals to the internal iliac origin, and the common and external iliac diameters. This is performed using contrast-enhanced CT examination, sometimes augmented by calibrated catheter angiography. The stent-graft body is sized to this CT anatomy, being oversized for the neck by 20%, and by 2 mm in the iliac arteries. Where there is common iliac aneurysm, limb extension into the external iliac artery excludes the aneurysm, although internal iliac embolisation must be performed to prevent collateral reperfusion of the sac. Features such as excessive angulation of the neck or iliacs, particularly with very heavy calcification, may preclude graft placement, although tortuous iliac arteries may be successful, if non-calcified. A short, wide or conical neck will increase the risk of complications in the follow-up period. Endoleak is the commonest failure following EVAR and close surveillance for this and other complications (device disruption, migration, distortion, occlusion) is performed by ultrasound and contrast-enhanced CT after endografting in order to evaluate: the position of the graft for migration; neck and aneurysm sac diameter; the endograft lumen for patency; and the presence of any endoleak within the sac. Abdominal radiographs are simple to perform annually and yield valuable information regarding the integrity of the endograft endoskeleton. Strut fracture has been described in many devices, as has fabric perforation, and stent-graft design must address these failures as well as factors such as fixation in the neck and iliacs. Suprarenal bare stents can help to secure the upper end of the endograft, and hooks may add to this security. Rigidity of the body and limbs of these devices may also contribute to prevention of migration and may also prevent graft kinking, which has been a problem with some devices. At the same time, the technology is still developing and new techniques such as fenestration and side branch grafting are being promoted. In conclusion, imaging is vital to satisfactory measurement and product ordering for EVAR, and also underpins surveillance in the follow-up period. Whilst not an insignificant radiation burden, these CT studies will continue to be essential for safe planning and follow-up for some time yet.

1400–1530

### Nuclear Medicine

#### 1400 Invited review: Nuclear cardiology: that will do nicely

R Underwood

*Royal Brompton Hospital, London, UK*

No abstract supplied.

#### 1420 Myocardial SPECT in male patients with end-stage renal disease

G Gopinath, JR Buscombe and AJW Hilson

*Royal Free Hospital, London, UK*

**PURPOSE:** Coronary artery disease is more prevalent in patients with end-stage renal disease and in patients on haemodialysis. It has been seen that it is more difficult to diagnose and treat because of non-classical presentation of symptoms. The pathophysiology and prognosis appear to be different from non-renal patients. The aim of the study was to validate the role of myocardial perfusion scintigraphy in assessing the distribution pattern of the disease in patients with end-stage renal disease. **METHOD:** 74 male patients had a pharmacological stress test with adenosine or dobutamine using the standard protocol. All patients were imaged with a 1-day stress rest protocol using <sup>99</sup>Tc<sup>m</sup> tetrofosmin/MIBI. The tomographic slices were reconstructed using iterative reconstruction with a Wiener smoothing filter. They were later quantified using an Emory bull's-eye system. **RESULTS:** In a total of 74 patients, 61 (82.4%) had abnormal scans and 13 (17.6%) had normal scans. Of the 61 patients reported abnormal, 40 (65%) had reversible and 21 (35%) had irreversible defects. 16 (26.24%) patients had perfusion abnormality involving a single territory, 32 (52.45%) patients had perfusion abnormality involving two or more territories and 13 (21.31%) patients had diffuse and patchy perfusion abnormalities. Of the 61 patients, 45 (73.76%) had disease involving more than one territory. **CONCLUSION:** Myocardial perfusion SPECT imaging with <sup>99</sup>Tc<sup>m</sup>-labelled MIBI or Tetrofosmin is very good technique to determine the severity of coronary artery disease. It is also seen that the majority of patients with end-stage renal disease have disease involving more than one territory at presentation.

#### 1430 Should myocardial perfusion gated SPECT be acquired with 8 or 16 frames per cycle?

DO Hall

*United Bristol Healthcare Trust, Bristol, UK*

**PURPOSE:** Using 8 frames per cycle (fr/cy) in gated myocardial perfusion SPECT under-samples the volume-time curve, causing errors in determination of volumes that are propagated into calculations of ejection fraction. Using 8 fr/cy is, however, assumed to be more reproducible than using 16 fr/cy owing to the greater count density of the images. This study was carried out to test this assumption. **METHODS:** 20 patients were administered 400 MBq <sup>99</sup>Tc<sup>m</sup>-Sestamibi with exercise. Images were acquired with 16 fr/cy on a 2-headed GE DST-XLI camera, with LEHR collimator, 1.33 zoom (pixel size 6.77 mm), 16 angles (32 views), 30 s per angle, with a 40% R-R interval acceptance window. Studies were reconstructed using filtered back-projection with Metz pre-filter, FWHM 0.4 cycles/pixel, order 8. End diastolic volume (EDV), end systolic volume (ESV) and left ventricular ejection fraction (LVEF) were calculated with the GE program Multidim, which uses the Stanford method. Studies were processed twice by the same operator. All acquisitions were rebinned to 8 fr/cy and all processing was repeated. **RESULTS:** Three studies could not be processed reliably, and these were excluded from analysis. EDV reproducibility was mean (±SD) 6.0 (±14.8) ml for 8 fr/cy and 0.9 (±14.8) ml for 16 fr/cy; ESV reproducibility was 2.8 (±7.9) ml with 8 fr/cy and 0.2 (±4.7) ml with 16 fr/cy. Reproducibility for LVEF was 0.0 (±3.1)% for 8 fr/cy and 0.1 (±3.1)% with 16 fr/cy. **CONCLUSION:** Quantitative results from gated myocardial SPECT using 8 fr/cy are no more reproducible than those acquired using 16 fr/cy.

#### 1440 Invited review: V/Q vs CTPA: who scans wins? Speaker to be confirmed

#### 1500 Efficacy of Leukoscan in the diagnosis of bone and joint infections

R Jayan, K Iyengar and S Vinjamuri

*Royal Liverpool University Hospital, Liverpool, UK*

**AIM:** The aim of this study is to assess the relative clinical efficacy of <sup>99</sup>Tc<sup>m</sup>-Sulesomab (Leukoscan) as part of a retrospective study of 50 patients referred with a clinical suspicion of bone or joint infection. **METHODS:** The study included 26 male and 24 female patients (age range 19–87 years). Referrals were made for suspected infection of long bones (15), joints (5) and prosthetic joints (18) as well as possible foot infections (12). All patients had a positive <sup>99</sup>Tc<sup>m</sup>-MDP bone scan prior to the Leukoscan. The dose used was 650 MBq of <sup>99</sup>Tc<sup>m</sup>-

Sulesomab. The suggested scintigraphic diagnosis was compared with the final clinical diagnosis by case note review. We also collected information regarding routine blood tests, plain X-ray, microbiology, culture and histology where available. The final diagnosis was determined by conclusive microbiology, culture and/or histology, intraoperative findings and long-term follow-up. RESULTS: 18 patients had an abnormal Leukoscan (32 normal). Outcome classification revealed 15 scans as true positive, 3 as false positive, 31 as true negative and 1 as false negative. The overall sensitivity was 93.75% and the specificity was 91.42%. This compares favourably with the previously reported figures from our group. We previously reported on 29 patients and <sup>99</sup>Tc<sup>m</sup> Leukoscan had a sensitivity of 100% and a specificity of 90%. CONCLUSION: We found that <sup>99</sup>Tc<sup>m</sup> Leukoscan has a high sensitivity and specificity in a heterogeneous group of orthopaedic infections. Further work pertaining to a larger group of patients in different subgroups is underway.

#### 1510 Use of Leukoscan in soft tissue infections

A Quigley, G Gopinath, JR Buscombe and AJW Hilson

Royal Free Hospital, London, UK

INTRODUCTION: Leukoscan (Sulesomab) is a new technetium-labelled radiopharmaceutical that consists of an anti-granulocyte (neutrophil) antibody Fab' fragment, the epitope of which is directed to a granulocyte surface glycoprotein. Whilst the product's indication is for investigation of patients with suspected bone infections, this project evaluates Leukoscan in patients suspected of having soft tissue infection. METHOD: We reviewed 79 Leukoscans performed between 1/1/2000 and 30/8/2002, 15 of which were performed for suspected soft tissue infection. The patient's notes, microbiology reports and other imaging were reviewed to determine clinical outcome and impact on patient management following the scan. The scans were regarded as being true positives if uptake correlated anatomically with the site of abnormality reported on other imaging and/or the site from which the infected fluid was obtained, or if there was clinical correlation with the referring clinician's evaluation of the patient. RESULTS: Of these 15 patients, 10 Leukoscans were regarded as being true positives. Two patients had true negative scans (no uptake, negative microbiology and other imaging). One patient had a false positive scan (uptake with negative microbiology). Two patients had false negative scans (infection confirmed). CONCLUSION: In suspected soft tissue infection, Leukoscan has a sensitivity of 83%. As it uses <sup>99</sup>Tc<sup>m</sup> as the radioisotope and no cell labelling procedure, it provides fast, accurate and convenient imaging of soft tissue infection.

#### 1520 Invited review: Interventional nuclear medicine in liver cancer

J Buscombe

Royal Free Hospital, London, UK

No abstract supplied.

1400–1530

### PACS: system design I

#### 1400 Invited review: Planning PACS: how to develop a specification

D Plummer

University College London Hospitals NHS Trust, London, UK

Planning for PACS is essential if successful implementation is to be achieved. This involves an analysis of current facilities and also of the way that these are used. The opportunities for change need to be considered early on. The first stage is a full audit of existing equipment for image acquisition and display, including an assessment of data volumes and key flows. It is also important to build up a picture of information systems and how they relate to one another. Key IT development plans such as EPR and Order Communications need to be identified at this stage. Next, workflow practices must be examined and opportunities to enhance the processes identified. PACS can enable new beneficial ways of working but these will only be realised if the groundwork has been done. It is vital that all those potentially involved are aware of the process and have the opportunity to contribute their knowledge and experience. Involving people in the planning process should ensure that their expectations are managed. The local IT team will generally be the primary source of IT knowledge, but in any case they must be fully aware of the proposals and the scope. A

full PACS implementation will have more significant impact outside radiology than within. Most of this activity will take place before an actual specification is produced. There is scope for change later, but a set of clear objectives developed in the early planning stages will facilitate smooth progress towards a solution and its implementation.

#### 1430 Invited review: Writing a contract for PACS: equipment purchase or managed service?

J Pilling

Norfolk & Norwich University Hospital NHS Trust, Norwich, UK

Within the contract the legal definitions define terms, for example "diagnostic workstation". The Terms and Conditions are the legal "meat" of the contract. The Schedules define precisely what the contract will provide. Equipment purchase provides hardware and software, but not upgrades. There is an initial capital cost and annual service charges. A managed service spreads the cost over 7–10 years, including all upgrades and replacements. The regular payments will inevitably be more than the service cost of purchased equipment but may not vary over the contract lifetime. Politically, the Private Finance Initiative still has some life in it and a managed service is still a viable route for PACS provision. It is now common to be able to achieve VAT relief on part or all of the managed service fee, which enhances the financial case. Operational considerations will need evaluation; an equipment purchase may suit particular local circumstances. Some Trusts will be able to support the servicing of PACS more than others. Where performance is critical and a system is large enough, a managed service with an on-site engineer is advantageous. There are some contracting issues that affect a contract, for example risk transfer, insurance, warranties and links to other IT systems. PACS are being installed in the UK by both procurement routes. The size and nature of the installation and the financial circumstances of the Trust will determine which route to follow.

#### 1500 Invited review: Practical design features for a PACS department

SG Davies

Royal Glamorgan Hospital, Cardiff, UK

Much of the effort in PACS procurement is rightly focused upon the configuration, technical performance, support and financial process. However, there is a danger that the practical design features required for optimum use of the system are overlooked or not given sufficient priority. Experience of PACS installation and several years of operation provide the background for outlining a number of important design features that should ideally be considered at the time of PACS procurement and implementation. It is considered particularly important that there are appropriate environmental considerations for the working environment of radiologists, radiographers and the IT team. Ergonomic factors need to be considered to avoid work-related injury. It is also important that the images are viewed in optimum conditions. Contingency should be made for downtime, with appropriate back-up systems. The siting of the PACS and mom PACS systems will have important effects on departmental workflow.

1530–1700

### Developing Teams and Skills

#### 1530 Invited review: Modernizing the clinical ultrasound service

MJ Lovegrove

South Bank University, London, UK

No abstract supplied.

#### 1600 Invited review: Reorganizing the skills ladder

K Powdrill

Hinchingbrooke Hospital, Huntingdon, UK

No abstract supplied.

#### 1630 Invited review: Vision of skills escalation

MJ Lovegrove

South Bank University, London, UK

No abstract supplied.



1530–1730

## New Digital Imaging Systems

### 1530 Invited review: New developments in imaging technologies

E Morton

University of Surrey, Surrey, UK

No abstract supplied.

### 1600 Invited review: Ultrasound techniques

Speaker to be confirmed

### 1630 Invited review: Imaging for skin cancer diagnosis

J Bamber

Royal Marsden Hospital, Surrey, UK

No abstract supplied.

### 1700 Ultrafast dynamic ventilation MRI of hyperpolarized helium-3 using short echo time radial projection sequence with sliding window reconstruction

<sup>1</sup>EJR van Beek, <sup>2</sup>L Kasusoski, <sup>1</sup>MNJ Paley, <sup>1</sup>A Swift,

<sup>1</sup>S FICHELE, <sup>1</sup>N Woodhouse and <sup>1</sup>JM Wild

<sup>1</sup>University of Sheffield, Sheffield, UK and <sup>2</sup>Philips Medical Systems, Cleveland, OH, USA

**PURPOSE:** To develop an MRI sequence capable of detecting airflow dynamics for use in hyperpolarized <sup>3</sup>He MRI. **MATERIALS AND METHODS:** Hyperpolarized <sup>3</sup>He was produced on site using the rubidium exchange technique (Amersham Health, Princeton, NJ). Gas was administered in a 30/70 mixture of <sup>3</sup>He/N. Imaging was performed on a 1.5 T MR system (Philips, Cleveland, OH), adapted for use of 48 MHz. A quadrature RF coil was used (Medical Advances, Milwaukee, WI). A sequence was developed with TE = 2 ms, TR = 5.4 ms, 128 views per frame and a radial projection image with sliding window reconstruction. Initial experiments used medical bubble tubing, and subsequent experiments used normal volunteers, smokers and patients with a variety of lung diseases. **RESULTS:** Dynamic imaging was capable of demonstrating the flow of the He/N mixture at an effective frame rate of 5.4 ms and a spatial resolution in the order of 5 mm. There were obvious differences in airflow pattern between normals and patients with obstructive lung diseases. Furthermore, time curves of airflow pattern within the lungs can be obtained, which demonstrated regional differences in patients with lung diseases. **CONCLUSION:** Ultrafast ventilation MRI using hyperpolarized <sup>3</sup>He can be achieved. This gives information on airflow dynamics, which is more detailed than has been possible with conventional technology thus far.

### 1710 Hyperpolarized helium-3 imaging using gas transported by air courier from Germany to England

<sup>1</sup>EJR van Beek, <sup>1</sup>JM Wild, <sup>2</sup>J Schmiedeskamp, <sup>1</sup>GM Mills,

<sup>2</sup>F Knitz, <sup>1</sup>N Woodhouse, <sup>2</sup>F Filbir, <sup>1</sup>S FICHELE, <sup>1</sup>M Paley,

<sup>2</sup>W Heil, <sup>2</sup>M Wolf and <sup>2</sup>E Otten

<sup>1</sup>University of Sheffield, Sheffield, UK and <sup>2</sup>University of Mainz, Mainz, Germany

**PURPOSE:** To prove the concept that a central production facility with a distribution network for hyperpolarized <sup>3</sup>He gas on a European scale is feasible. **MATERIALS AND METHODS:** Hyperpolarized <sup>3</sup>He gas was produced at Mainz using the metastability exchange technique. Shipping was performed by air courier. Each shipment contained three Supramax (Schott, Mainz, D) glass cells with a total of 5.7 l of <sup>3</sup>He at a pressure of 2.7 bar. Polarization was maintained by a 0.8 mT permanent magnet encased in a mu-metal box. Transport time was 10–15 h. Imaging was performed using a 1.5 T MR system (Eclipse; Philips, Cleveland, OH) at the appropriate frequency of 48 MHz. A dedicated quadrature RF coil was used (Medical Advances, Milwaukee, WI). The sequences consisted of static and dynamic ventilation imaging, apparent diffusion coefficient and oxygen partial pressure measurements. **RESULTS:** Transport has been successfully performed on four occasions thus far. Polarization levels were consistently in the range of 30%. Each shipment allowed 15–20 MR

sequences, which is sufficient for three subjects. Effective costs were approx. £50–60 per dose. Six healthy volunteers, two patients with emphysema and one asthmatic were studied. Examples of findings will be presented. **CONCLUSION:** It is feasible to produce hyperpolarized <sup>3</sup>He on demand using a distribution network. This should enable more widespread introduction of this technology.

### 1720 A novel approach for assessing image quality in CT

<sup>1</sup>IE Evangelou, <sup>1</sup>SJ Golding, <sup>1</sup>NJ Nicklin, <sup>1</sup>HO Nwume,

<sup>2</sup>SR Watt-Smith and <sup>3</sup>AA Lazakidou

<sup>1</sup>University of Oxford, Oxford, UK, <sup>2</sup>John Radcliffe Hospital, Oxford, UK and <sup>3</sup>University of Piraeus, Piraeus, Greece

**PURPOSE:** To present a novel approach for assessing image quality in CT for dose/quality comparisons in multislice CT. **MATERIALS AND METHODS:** A novel approach for assessing image quality in CT based on statistical measurements from the images is proposed. It takes into account both contrast-to-noise, signal-to-noise and luminance variability. We have tested the proposed approach on a head skull phantom that underwent CT in both a 4 slice and an 8 slice system using a protocol of 140 kV in 4 and 8 slice and 120 kV in 8 slice alone, using eight incremental steps of 10 from 10 mA to 80 mA in two pitches (HQ and HS) in both bone and soft tissue reconstruction algorithms, 512 × 512 reconstruction matrix, FOV 21 × 21 cm and 125 slices per series for 96 series, for a total of 9600 axial slices. We were able to assess the image quality quantitatively per slice and to make comparisons between series, scanners and scanning parameters. Results have been plotted on the same graphs to illustrate correlation. **RESULTS:** Statistical measurements directly from the images can be easily calculated and provide a more objective way of measuring quality for comparisons at different dose levels. Taking into account all measurements into a single Quality Metric (QM) we have a simple description of the quality of each image. **CONCLUSION:** Assessing image quality in CT, although difficult, can be assessed quantitatively therefore providing a good index for comparisons at different dose levels.

1600–1700

## Interventional Radiology: non-vascular

### 1600 Invited review: Biliary intervention

I Renwick

Scarborough Hospital, Scarborough, UK

No abstract supplied.

### 1620 Invited review: Gastrointestinal intervention

A Grundy

St George's Hospital, London, UK

The interventional radiologist plays an important role in the management of obstructing lesions in the gastrointestinal tract. This ranges from balloon dilatation of benign oesophageal strictures through to management of complex malignant oesophageal disease and fistulae, particularly malignant tracheo-oesophageal fistulae. The interventional radiologist can help in the management of gastric outlet obstruction due to benign disease and also intrinsic and extrinsic malignant disease. This can be done either via an oral route or via percutaneous gastrostomies. Radiologists are also increasingly being asked to site percutaneous gastrostomies. A close cooperation with the endoscopist is important and the endoscopist and radiologist need to have a close working partnership. In patients requiring duodenal stenting in our institution these are done as a combined procedure. In the colon, as in the oesophagus, balloon dilatation of strictures can be readily performed. Colonic stent placement for malignant obstruction is becoming increasingly employed. Gastrointestinal intervention is not, however, without risks and complications. An awareness of the potential complications is essential to safe interventional practice.

### 1640 Invited review: Uro-intervention

A Pollard

Stepping Hill Hospital, Stockport, UK

No abstract supplied.

1600–1700

**Nuclear Medicine****1600 DMSA vs ultrasound in the assessment of renal scarring in paediatrics: a 5-year retrospective study**

I Moorthy, D Wheat and I Gordon

*Great Ormond Street Hospital, London, UK*

**PURPOSE:** DMSA is the reference technique for assessing renal scars. Recent advances in ultrasound suggest that ultrasound could replace DMSA for this purpose. This study assesses the validity of this claim in a tertiary referral paediatric centre. **MATERIALS AND METHODS:** Data relating to all children who had undergone DMSA and ultrasound examinations on the same day, between January 1995 and December 1999, at this institution were extracted for analysis from the radiology computer system. Focal and diffuse cortical deficits on ultrasound and DMSA were recorded. A diffusely abnormal kidney was present if differential renal function was <45% and/or there was >10% difference in renal length or global cortical thinning on either DMSA or ultrasound. **RESULTS:** The records of 465 children were included. The analysis utilized comparison data from a total of 930 kidneys: 465 right kidneys and 465 left kidneys. Focal renal scarring (comparing ultrasound with DMSA): sensitivity 51.9%; specificity 98.3%; positive predictive value 50%; negative predictive value 75.8%. Diffuse renal scarring (comparing ultrasound with DMSA): sensitivity 47.2%; specificity 91.8%; positive predictive value 60.8%; negative predictive value 86.6%. **CONCLUSION:** Ultrasound using state-of-the-art equipment and operators of varying levels of expertise is not sensitive in the detection of renal scarring, but has reasonably good specificity. Therefore, a normal renal ultrasound does not exclude renal scarring.

**1610 Invited review: Has it worked doctor? Monitoring response of chemotherapy to PET**  
Speaker to be confirmed

**1630 Initial comparative study using carbon-11-choline and fluorine-18-methyl- $\alpha$ -tyrosine vs FDG PET for detection of musculoskeletal tumours**

<sup>1</sup>H Zhang, <sup>2</sup>M Tian, <sup>2</sup>T Higuchi, <sup>2</sup>N Oriuchi, <sup>1</sup>S Tanada and <sup>2</sup>K Endo

<sup>1</sup>National Institute of Radiological Sciences, Chiba, Japan and <sup>2</sup>Gunma University School of Medicine, Gunma, Japan

**PURPOSE:** Accurate assessment of tumour status is critical for determining treatment strategy of musculoskeletal tumours. This is an initial study to investigate the ability of novel tumour-seeking agents, carbon-11-choline (choline) and fluorine-18- $\alpha$ -methyl tyrosine (FAMT) in the diagnosis of musculoskeletal tumours compared with FDG PET. **MATERIAL AND METHODS:** Whole-body PET was performed on 33 patients with musculoskeletal tumours using all the three agents choline, FAMT and FDG within 2 weeks. Imaging findings were visually inspected in combination with CT and/or MRI, and standardized uptake values (SUVs) for the three agents in lesions were generated and compared with histological findings. **RESULTS:** Significant correlations between choline and FDG SUVs ( $r=0.601$ ,  $p<0.05$ ) and between FAMT and FDG ( $r=0.683$ ,  $p<0.05$ ) were found for all lesions, and mean values for malignant tumours were significantly higher than those for benign lesions on choline, FAMT and FDG PET. The diagnostic sensitivity and specificity for malignancy were 91.7% and 71.4%, respectively, using choline with a SUV cut-off of 2.69. The sensitivity and specificity of FAMT for malignancy were 75% and 57.1%, respectively, using a SUV cut-off of 1.0. For FDG, the sensitivity and specificity were 83.3% and 71.4%, respectively, using a SUV cut-off of 2.77. According to ROC analysis, the area under the ROC curves for choline, FAMT and FDG were 0.855, 0.734 and 0.847, respectively. **CONCLUSION:** Choline, FAMT and FDG appear equally effective at detecting musculoskeletal tumours, while choline may be superior to FAMT and FDG in differentiating between benign and malignant tumours with high contrast imaging.

**1640 Invited review: Training requirements for PET and PET/CT**

M Prescott

*Manchester Royal Infirmary, Manchester, UK*

No abstract supplied.

1600–1700

**Thoracic Imaging Scientific Session****1600 Prognostic determinants on HRCT in patients with fibrosing alveolitis**

SM Ellis, MB Rubens, DM Hansell and AU Wells

*Royal Brompton Hospital, London, UK*

**PURPOSE:** We have previously shown, in a group of patients with a histologically established diagnosis of UIP or NSIP, that HRCT characteristics are more powerful prognostic indicators than the histological distinction. We have now extended the study to evaluate the prognostic information derived from HRCT of the chest in a larger cohort of patients with fibrosing alveolitis. **MATERIALS AND METHODS:** 180 consecutive HRCT examinations of patients with clinically diagnosed fibrosing alveolitis (including patients with UIP and NSIP) were scored by two experienced radiologists blinded to any clinical or prognostic information. Semi-quantitative scores of disease extent, proportions of ground-glass opacity and reticulation, and coarseness of reticulation were recorded. **RESULTS:** The greatest influence on prognosis was disease extent on HRCT ( $p<0.0005$ ). However, when the data were controlled for disease extent, an increase in proportion of ground-glass opacity as opposed to reticulation corresponded with a reduction in mortality ( $p<0.005$ ) and increased coarseness of reticulation corresponded with an increase in mortality ( $p<0.05$ ). **CONCLUSION:** The original conclusion that HRCT characteristics provide valuable prognostic information, reported in a small cohort of patients with biopsy-proven fibrosing alveolitis, has been replicated and shown to be applicable to patients with clinically diagnosed fibrosing alveolitis.

**1610 HRCT of the lungs: reading efficiency of tiled vs stacked display formats**

<sup>1</sup>SM Ellis, <sup>2</sup>X Hu, <sup>2</sup>L Dempere-Marco, <sup>1</sup>AU Wells,<sup>1</sup>DM Hansell and <sup>2</sup>G Yang

<sup>1</sup>Royal Brompton Hospital, London, UK and <sup>2</sup>Imperial College of Science, Technology and Medicine, London, UK

**PURPOSE:** To compare the viewing efficiency of stacked vs tiled display formats for soft-copy reading of thin section CT of the lungs. **MATERIALS AND METHODS:** Four experienced chest radiologists read 16 HRCT examinations displayed as either four images (tiled display) or one image (stacked display) on screen at a time. Eye movements were recorded and analysed in terms of saccade distance, fixation point number and duration and, through spatial mapping onto a normalized lung template, areas on the images viewed. **RESULTS:** A greater rate of fixation point formation was recorded for the stacked display compared with the tiled display (5 vs 4.5 fixation points/100 data points;  $p<0.001$ ). This was associated with a greater proportion of short saccades (97% vs 94%;  $p<0.005$ ) and consistency in spatial approach (mean kappa 0.45 vs 0.36;  $p<0.05$ ). **CONCLUSION:** Thin section CT examinations are more efficiently read, as judged by time and eye movements, when displayed in a stack as opposed to a tiled display format.

**1620 Volumetric assessment of small pulmonary nodules**

SA Sohaib, S Kula and J Husband

*Royal Marsden Hospital, London, UK*

**PURPOSE:** The aim of this study was to compare area and volumetric changes in small pulmonary nodules (<1 cm diameter) in patients with cancer. **MATERIALS AND METHODS:** All studies were performed on a GE CT/i scanner with 1 mm acquisition through selected small lung nodules on two serial scans. Images were assessed on an Advantage Windows 3.1 workstation using the advanced lung analysis software package (GE Medical Systems, Milwaukee, USA). Long and short axis diameters were measured and the area was calculated for each nodule. Volumetric measurements were evaluated using the software designed for lung nodule analysis. **RESULTS:** A total of 30 lung nodules were assessed in 12 patients with multiple nodules (assumed to be metastases). The median (range) change in cross-sectional area was 25% (5–278%) and for volume it was 45% (0–685%) ( $p<0.005$ , Wilcoxon rank test). 5 (17%) of the 30 nodules showed a volume increase of at least 40% compared with 3 (10%) of the 30 nodules that showed an area increase of 25%. **CONCLUSIONS:** Volumetric assessment was more sensitive in determining change in size of the small lung nodules and may be able to determine disease progression earlier than conventional cross-sectional area assessment.

**1630 The bulky hilum: how good are we at detecting hilar pathology on chest radiographs?**

<sup>1</sup>S Desigan and <sup>2</sup>D Murray

<sup>1</sup>University College London Hospitals NHS Trust, London, UK and <sup>2</sup>The Whittington Hospital NHS Trust, London, UK

**PURPOSE:** To determine the accuracy of radiologists in detecting hilar pathology on chest radiographs. **MATERIALS AND METHODS:** A retrospective analysis was performed of the chest radiographs and CT findings of 15 patients who had been referred for investigation of a bulky hilum. 15 radiologists (7 consultants and 8 specialist registrars) blinded to the CT findings were asked to assess the chest radiographs for the presence or absence of a hilar mass and their recommendations for clinical follow-up in each case were recorded. They were then scored for accuracy compared with chest CT findings. **RESULTS:** Results show significant interobserver variation. The group detected only three of five hilar masses confirmed by CT. Positive predictive values: registrars 34%, consultant radiologists 45%. Negative predictive values: consultants 76%, registrars 67%. This probably reflects the increased confidence of consultants in reporting an investigation as "normal". **CONCLUSION:** The wide range of responses demonstrates the very subjective nature of interpretation of the lung hila on chest radiographs, and the difficulty of correctly identifying or excluding hilar masses on chest X-rays. One of the most useful aspects of this study has been to provide feedback to individuals for educational purposes and personal audit.

**1640 Comparison of perfusion MRI and nuclear imaging in suspected coronary disease**

<sup>1</sup>RM MacMillan and <sup>2</sup>MR Rees

<sup>1</sup>Hahnemann University Philadelphia, Philadelphia, PA, USA and <sup>2</sup>University of Bristol, Bristol, UK

**PURPOSE:** MRI has broad clinical applications for diagnosis and evaluation of cardiac disorders. Until recently, detection of chronic myocardial infarction (MI) using MRI was determined by thinning of the left ventricular wall and abnormal segmental wall motion on cine. We evaluated a new pulse sequence using gadolinium injection to detect new infarction in patients with known coronary artery disease. **MATERIALS AND METHODS:** Using a segmented inversion recovery gradient echo pulse, we studied 11 patients using contrast-enhanced MRI (CE-MRI) who presented with chest pain. With this method, chronically infarcted myocardium appears white against black normal myocardium. We used this method to distinguish non-transmural MI from transmural MI and to detect multiple chronic infarction in different segments. Images were obtained in short and long axis projections. Cine MRI was also obtained for segmental wall motion analysis. Studies were compared with nuclear perfusion and in four abnormal cases with cardiac catheterization. Per cent infarcted LV mass, LV volumes and LVEF were measured. Infarcted segments were directly compared with coronary arterial stenoses at catheterization. **RESULTS:** Infarcted segments were sharply demarcated, permitting measurement of infarct mass. Infarcted mass was determined by subtraction of the non-infarcted segments from total LV mass. All of the studies showed excellent agreement with the other cardiac modalities. Four of these patients were shown to have chronic infarction. **CONCLUSION:** CE-MRI has an important application for detecting and evaluating the significance of chronic MI. Infarcted segments can be compared directly with cardiac catheterization and may yield important information on myocardial viability.

**1650 Discussion**

1600–1800

**PACS: system design II**

**1600 Invited review: PACS system architecture: current and future design**

FW Prior

Eastman Kodak Company, Freemont, CA, USA

As healthcare institutions transition from radiology imaging to enterprise "infoimaging", the requirements placed on PACS technologies are rapidly evolving. In response, PACS vendors are re-defining system architectures, core technologies and business models. To better understand these changes this lecture will first enumerate key market trends and then present a case study to explore how one vendor's PACS

offering and business is adapting. The case study will look at the ramifications of this transition both for institutions that are just now adopting PACS and, more importantly, for institutions with existing systems. Managing the migration of a functioning clinical PACS to a new hardware and software base is a daunting task that must be carefully planned and executed.

**1640 Invited review: Networking: what do you need for PACS?**

D Hicks

Hicks Associates, Bartestree, UK

CR, DR and every other DICOM imaging modality create significant levels of network traffic, which requires a large network bandwidth to deliver images quickly and efficiently to workstations and archives. It is not exaggerating to state that the network is one of the most significant components in delivering an efficient PACS system, but it is one of the most overlooked. A PACS network has to have four essential properties. It must have a large capacity to carry data, and it must be reliable, resilient and secure. If the network fails then retrieval and storage of data fails, soft reporting stops, work lists are not compiled and hard-copy printing may not be possible. The paper will present strategies for designing PACS networks including the concept of primary users (X-ray and A&E) and secondary users (wards etc.). Methods of integrating PACS networks with hospital networks will be explored, particularly for integrating RIS data and transmitting images to remote locations on and off campus. Routers, switches, firewalls and VLANs will be discussed. The performance of these devices will be explored and their function within the network will be illustrated with practical examples. Methods of keeping the network secure, both at the device level and at its boundaries, will also be discussed.

**1700 Invited review: The importance of RIS-PACS integration**

D Lloyd

University Hospital Cardiff, Cardiff, UK

Integration between the Radiology Information System (RIS) and the PACS is essential for the success of any PACS project. This should be considered early in the planning of a PACS implementation. Despite the presence of industry standards and the availability of sophisticated brokers to ease the linking of systems, this remains a cause of frustration in several PACS projects. The importance of RIS-PACS integration in project planning, implementation and the day-to-day use of a PACS will be discussed.

**1730 Going filmless in a new hospital using the big bang approach: victories gained and lessons learnt**

A Troughton, N Matcham, R Craven and A Davies

Great Western Hospital, Swindon, UK

In December 2002 we moved into a new PFI funded hospital. The Radiology Department is, with the exception of mammography, completely filmless. A digital archive of between 15 months and 3 years had previously been accumulated allowing a big bang approach to implementation. There is distributed viewing around the Trust on two different sites using web-based technology on PCs through an Electronic Patient Record. Controversies and difficulties have occurred in several areas. The adequacy of viewing images via PC in outpatients, A&E and theatres has been questioned by some clinicians. Request form scanning has been used as an interim measure prior to electronic requesting coming online within the next 2 years. We describe the first 6 months of life in this digital age, the victories won, the lessons learnt and the issues that remain outstanding.

**1740 Overview of a PACS procurement project within south-west London**

TP Corkett

South West London LIS, Mitchum, UK

PACS as the future of radiology is generally accepted, but how to deliver this technology to meet the needs of the changing NHS and to support the evolving patient care packages is the challenge. Within south-west London there was also the challenge of affordability, as PACS is not a cost neutral solution and requires substantial funding support from both secondary and primary care. It was to overcome these issues that a new approach was taken within south-west London.

The six service providers formed a consortium to procure a single sector-wide PACS system to meet the needs of the sector as a whole and to deliver the system at the most affordable cost. The solution will be a single database of all radiological images across all providers and covering over 1 million examinations a year, allowing any member clinician with authorization to see the images on any connected PC within the sector. The project is due to begin implementation early March. There are challenges remaining including: ongoing funding of the project; the fit to the new National Strategy; networking to support the project; and patient identification within a multi-PAS/RIS environment.

## 1750 Discussion

## 1710–1745

### Service Delivery Scientific Session

#### 1710 A feasibility and evaluative study of the implementation of the four-tier radiographic career structure

S Bull

*Northumbria University, Newcastle upon Tyne, UK*

**PURPOSE:** To investigate and evaluate the appropriateness and effectiveness of the four-tier career structure with emphasis on the introduction of assistant practitioners. Changes in skill mix in diagnostic imaging departments have been under discussion since the early 1990s. A “helper” grade has been in existence since that time. At a Downing Street Cancer summit in 1999, agreement was reached on the development of a new model of service delivery within radiography. National projects led by the Department of Health are underway, with the declared objective of expanding the available workforce to deliver the service based on a four-tier career framework underpinned by National Occupational Standards. **METHODS:** Survey of independent local initiatives. Evaluation of the introduction of assistant practitioners via the Department of Health’s Clinical Imaging Project. Academic evaluation of existing research literature. **RESULTS:** Success of implementation varies according to local conditions and requirements. Significant issues include training and education and supervision, effects on existing workforce and students, and impact on work capacity. **CONCLUSIONS:** Current Government policy endorses a commitment to the effective use and deployment of staff and the education and training of staff who deliver the service. The four-tier structure is intended to address a staffing crisis by providing a new group of “workers” and to improve career opportunities for practitioners. It is popularly viewed as a “quick fix”. Methods of implementation and approaches to dealing with issues such as training are piecemeal. Successful implementation must be guided by an evidence base drawn from both independent and national initiatives. Evaluation must continue.

#### 1720 Specialist radiographers: bridging the gap to consultant practice

BA Snaith, A McGuinness and S Yunis

*Mid Yorkshire Hospitals NHS Trust, Wakefield, UK*

At the moment we see a void between current advanced radiographic practice and the vision of consultant practice and it is expected that there are currently few people with the skills and experience to fulfil the requirements of consultant posts. So how do radiographers achieve this experience? This paper will share the experience of one Trust, which took the step of employing three radiographers in innovative roles in early 2002 to “bridge the gap”. A radiologist shortage may have been a key driver but this gave an opportunity to develop the specialist skilled radiographer in a new role. The new post holders had significant experience of extended role and skill mix and each took responsibility for an area of practice. The “flexibility” of the posts meant that new roles, continuing education and clinical governance activities could be explored more widely and new benefits could be realized. The experience of developing advanced practice and practitioners and of working across the multidisciplinary team will be shared, together with some of the issues of developing new roles. This includes the interaction with local management structures and expectations of staff groups. One of the steepest learning curves is the 50% non-clinical component and working alongside clinical colleagues on a new level. This shows one example of development to ensure that we have staff with the necessary skills for consultant practice and can develop advanced practice roles with adequate support. The future will show whether this is a transition or a long-term strategy for staff development.

#### 1730 Radiographer participation in hospital-wide multidisciplinary education

P Morris, A Thomas and S Nash

*Bromley Hospitals NHS Trust, Kent, UK*

The introduction of radiographer reporting of skeletal examinations has resulted in radiographers with a recognized level of expertise in this field. In our hospital Trust reporting radiographers now lead teaching sessions for junior casualty doctors and emergency nurse practitioners in the interpretation of skeletal and other examinations. In the past these teaching sessions were taught by a radiologist. Although other healthcare professionals in the clinical environment routinely carry out a teaching role, radiographers have been less involved in this area. The junior medical staff have accepted the radiographer-led teaching with enthusiasm. We believe that the involvement of radiographers in the education of other healthcare professionals enhances interdepartmental relationships as well as drawing on the combined skills of the radiographer as interpreter as well as producer of the radiographic image. The junior medical staff will now show problem films to the reporting radiographer, often in preference to senior medical staff. The standard of examination requesting is improved and the teaching skills of the radiographers involved are enhanced. Involvement in interspecialty education should be an integral part of the radiographer’s role as a core member of the multiprofessional team.

0830–0945

## Radiographic Training and Education

### 0830 Invited review: Demonstrating competence through CPD

<sup>1</sup>S Henwood and <sup>2</sup>S Kelly

<sup>1</sup>South Bank University, London, UK and <sup>2</sup>C/o Society of Radiographers, London, UK

The Allied Health Professions Joint Project on Demonstrating Competence through Continuing Professional Development explores the feasibility of assessing ongoing competence to practice using a professional outcomes model. This model, based on earlier work by the Chartered Society of Physiotherapists, evaluates CPD activity against a set of six generic professional outcomes. The model was tested by 13 allied health professions in the UK. It was funded by the Department of Health and it was envisaged that the project findings would inform the Health Professions Council's approach to determining competence and CPD as a future condition of state registration. In this paper the authors report on the project's findings and consider some of the implications for radiographers working in the UK.

### 0855 Invited review: QA issues for interprofessional postgraduate routes in breast imaging

GS Morgan

Kingston University and St George's Hospital Medical School, Kingston-upon-Thames, Surrey, UK

Providing a quality service in breast imaging, diagnosis and care relies on a suitably qualified workforce. Expansion of the provision has enabled radiographers to extend their roles into areas such as image interpretation and reporting. Further opportunities continue to emerge into the domains occupied by medically qualified practitioners. Evolving national occupational standards relating to the functions of practitioners mapped across this field will define expectations to be met by all those undertaking similar activities in the workplace irrespective of the practitioner's designated title or role. This service, and in particular breast screening, provides a multidisciplinary environment that includes radiologists, breast clinicians, surgeons, radiographers and nurses. Many activities acknowledged as advanced practice are suitably embedded within postgraduate programmes awarded by higher education institutions. Such activities requiring advanced knowledge, skills and other attributes should concur with Masters level educational descriptors. The combination of the need for further education and training and recognition of greater interprofessional association where there is potential role boundary overlap will lead to increased student diversity on postgraduate education and training programmes. Meeting the learning needs of individuals owing to this diversity on courses is a challenge compounded by the various educational and professional experiences and cultures of the different professional groups. Ensuring the quality of the programmes meet individual and service needs is imperative. This is emphasized where there are clinical competency components to modules. Current and potentially controversial developments in further broadening those opportunities to other healthcare professionals also arise.

### 0920 Invited review: Return to practice

M Gradwell

South Bank University, London, UK

The Government, the Department of Health and the NHS are committed to encouraging more members of the allied health professions back into employment. Great attention has been given to local initiatives to identify returners and to facilitate their re-entry to the professions. The Return to Radiographic Practice Course at the Division of Allied Health Professions, South Bank University, supported by South West London Workforce Development Confederation, is designed to meet the needs of the NHS in encouraging qualified radiographers back into clinical work after a break in their radiographic careers. The course provides academic update and an opportunity to refresh the participant's clinical competency. The distance learning nature of the course enables it to be primarily clinically based, with only an initial 2 days

spent in the university. A nominated mentor from the participating Radiography Department undertakes the supervision of the clinical aspect of the course. Aims of the course are: (i) to provide the returning radiographer with the necessary skills and updating to smoothly integrate into a modern imaging department; (ii) to promote critical understanding of diagnostic imaging and allied topics in the current environment; (iii) to re-establish skills of communication and understanding to enhance client care, both as an individual working in the field and as a member of the healthcare team; (iv) to promote reflective practice and forward thinking to encourage effective response to current situations and future changes in healthcare; and (v) to promote an ethos of continuing professional development and life-long learning. To date the course has run six times and 24 radiographers have successfully returned to practice through the use of this innovative programme. This presentation will explore the issues surrounding the inception and developments of this programme and will discuss the broader aspects of returning experienced radiographers to the clinical environment and workforce.

0830–1000

## Musculoskeletal: the spine

### 0830 Invited review: Imaging in scoliosis

V Pullicino

RJAH Orthopaedic Hospital, Shropshire, UK

No abstract supplied.

### 0900 Invited review: Spondylolysis: current imaging and management

P Mayor

Mid Cheshire Hospital Trust, Shropshire, UK

No abstract supplied.

### 0930 Invited review: Imaging the post-operative spine

R Kerslake

Queens Medical Centre, Nottingham, UK

If you are going to image the post-operative spine, you need to understand the normal or anticipated radiological findings following any of the ever increasing range of surgical spinal procedures, which include the commonplace (micro)discectomy, newer "minimally invasive" techniques and major surgery with implants/internal fixation. The commonest reasons for post-operative spinal imaging include: (i) assessment of the many and varied potential complications that can occur either soon after the procedure or at a later stage; (ii) identifying causes for poor clinical progress after surgery; and (iii) resolving the question of recurrent/residual disc vs "scar". In this circumstance, a common concern is when to administer intravenous contrast material. In this talk, I will illustrate some of the main practical points relating to these issues. In most circumstances, a tailored approach is needed and this may require use of the full range of imaging techniques including radiography, CT, MRI and, occasionally, invasive procedures.

0830–1030

## Genitourinary Investigation of Haematuria

### 0830 Invited review: Investigation of haematuria: a clinician's viewpoint

M Wallace

Queen Elizabeth Hospital, Birmingham, UK

No abstract supplied.

### 0855 Invited review: The role of intravenous urography in investigating haematuria

JAW Webb

St Bartholomew's Hospital, London, UK

For many years, intravenous urography (IVU) has been the gold standard for imaging the kidneys and ureters in patients with haematuria,

with cystoscopy being used to examine the bladder. IVU is a good "catch-all" imaging technique for the upper tracts because it can detect renal masses (adenocarcinomas), transitional cell tumours, calculi and a variety of other pathologies (e.g. papillary necrosis, medullary sponge kidney, TB). In recent years, ultrasonography (US) has been used with IVU, either together or in sequence, because US has better sensitivity for renal masses and bladder tumours than does IVU. CT detects renal masses and urinary tract calculi better than IVU and/or US, and early reports suggest that new methods of CT urography can also show subtle pelvicalyceal and ureteric pathology. Looking to the future, CT urography has the potential to be the best "catch-all" imaging method in haematuria and the role of traditional IVU is likely to diminish.

**0920 Invited review: Ultrasound in the investigation of haematuria**

P Riley

*University Hospital Birmingham, Birmingham, UK*

No abstract supplied.

**0945 Invited review: Multislice CT in the investigation of haematuria**

N Cowan

*The Churchill Hospital, Oxford, UK*

No abstract supplied.

**1010 Invited review: MR urography in the investigation of haematuria**

J Spencer

*St James's University Hospital Trust, Leeds, UK*

No abstract supplied.

**0830–1030**

**Head and Neck**

**0830 Invited review: Intervention in benign salivary gland obstruction**

J Brown

*GKT Dental Institute, London, UK*

Salivary gland obstruction is the commonest complaint to affect the salivary glands and requests for investigation are frequent. Obstruction presents as recurrent painful swelling of the gland in response to food, and may be due to development of a stone, viscid mucous plug or duct stricture. Many calculi are shed spontaneously, but those developing symptoms may present to a range of specialists. The radiologist, however, often provides a common point for diagnosis and contact between the surgical specialties. Imaging includes plain films, contrast studies such as sialography, ultrasound, CT, MR and MR sialography, and radioisotope studies. Sialography is the traditional investigation and is accurate in determining duct architecture, in distinguishing small stones under 2 mm in diameter and in diagnosing strictures. Fluoroscopy allows dynamic sialography and digital subtraction imaging. CT is used for its sensitivity to calcified stones but is less good at demonstrating detailed ductal anatomy and strictures. Ultrasound is rapidly becoming a first-line investigation for its simplicity, accessibility and avoidance of ionizing radiation. MRI and MR sialography may demonstrate obstruction in addition to masses and parenchymal disease and may represent the way forward. Radioisotope investigations play a supplementary role, showing both the presence of inflammatory or neoplastic disease within a gland and allowing estimation of function by interglandular and intraglandular comparison. Two-thirds of salivary obstructions lie in the proximal duct and gland and present a difficult management problem. Traditional treatment in these cases has been by sialadenectomy, but complications arise such as nerve damage, facial scarring and post-operative infection, as well as the risks and costs of inpatient surgical treatment under general anaesthesia. Interventional techniques have developed rapidly over the past 20 years offering significant advantages to traditional options. Many of the newer techniques allow removal of the stone or stricture under local anaesthesia on an outpatient basis, avoiding the need for expensive and invasive surgery under general anaesthesia, with its concomitant morbidity. Modern alternatives include extracorporeal and intracorporeal salivary stone lithotripsy, radiologically guided stone retrieval and balloon ductoplasty and intraductal endoscopy. Salivary lithotripsy uses dedicated equipment

capable of delivering a finely focused shock wave to the surface of the stone as identified by ultrasound. Stone retrieval by Dormia basket is possible under fluoroscopic or ultrasound guidance as an adjunct to sialography, and similarly stricture dilatation may be performed by angioplasty balloon. Intraductal endoscopy and intracorporeal and laser lithotripsy are being developed. The role, advantages and disadvantages of these alternatives will be reviewed.

**0900 Invited review: Evidence-based imaging of the thyroid**

R Evans

*Morrison Hospital, Swansea, UK*

No abstract supplied.

**0930 Invited review: Inside the skull base: the ENT surgeon's perspective**

P Anslow

*Radcliffe Infirmary, Oxford, UK*

As specialists who see the pathology for the first time, we forget how blinded our clinical colleagues are when it comes to assessing pathology related to the skull base. In the case of ENT surgeons assessing benign and malignant disease of the skull base, the history may be limited, the clinical examination fruitless but the radiology pivotal to management. The radiologist is the first to see the full extent of disease, and it is extent that defines management, whether that be surgical, radiotherapy or chemotherapy—or perhaps nothing at all.

**1000 Invited review: Oral cavity and oropharynx: perineural spread and bone invasion**

JW Casselman

*A.Z. St.-Jan a.v. Brugge, Brugge, Belgium.*

Detection of osseous involvement and perineural spread in patients with squamous cell carcinoma (SCCa) of the oral cavity and oropharynx can change the staging (T4) and treatment. CT is best suited to evaluate osseous involvement, although MR is sometimes needed to recognize the exact tumour extension in the bone marrow. MR is the method of choice to evaluate perineural spread, which can best be seen on high-resolution Gd-enhanced  $T_1$  weighted images with or without fat suppression. ORAL CAVITY: Floor of the mouth, oral tongue, lower lip and retromolar trigone tumours most often invade the mandible. In the mandible they can follow the inferior alveolar nerve and grow in a retrograde or antegrade direction toward the lingula or mental foramen, respectively. From the lingula, the masticator space, oval foramen and eventually the cavernous sinus can be reached. Lesions of the inferior surface of the palate tend to follow the greater and lesser palatine nerves until the pterygopalatine fossa is reached, and then cavernous sinus involvement is possible via the maxillary nerve. OROPHARYNX: The mandibular angle and the ascending ramus of the mandible are the nearest osseous structures that can get involved. Tonsillar pillar/tonsillar fossa SCCa can invade the posterior part of the hard palate. Then the pterygopalatine fossa and the sphenopalatine ganglion can be involved and intracranial extension along the maxillary or vidian nerve can occur. Tongue base tumours can follow the hypoglossus and lingual nerve in a posterior direction.

**0830–1045**

**PACS II: beyond the radiology department I**

**0830 Invited review: NHS information strategy: the way forward**

J Thorp

*NHS Information Authority, Devon, UK*

No abstract supplied.

**0915 Invited review: Delivering PACS to the hospital: Web-based image distribution**

L Sutton

*Calderdale Royal Infirmary, Halifax, UK*

This presentation explores the role of Web-based image distribution within the hospital environment, drawing upon the experience of the new PACS system at The Calderdale Royal Hospital and the plans for future development when upgrading the current PACS system and

rolling out the PACS project to the neighbouring hospital in Huddersfield. Issues around the various solutions provided by workstations and PC-based Web browsers are discussed. A demonstration of a typical Web browser interface will be provided.

**0955 Invited review: Web-based imaging**

<sup>1</sup>RM Pritchard and <sup>2</sup>C Bull

<sup>1</sup>Powys NHS Trust, Welshpool, Powys, UK and <sup>2</sup>Ferrania UK, Bracknell, UK

A new hospital build allowed a re-think of the technology to be used to support the Minor Injuries Unit and local GPs. It was decided to make the hospital filmless and to use CR technologies for conventional image capture along with digital input from a screening room and ultrasound. This is stored locally on a Ferrania OnNet Web server for image distribution, with the primary data being stored and reported 34 miles away at the Wrexham Maelor Hospital using other Ferrania PACS products. The Ferrania OnNet Web allows secure access to users, providing high quality images linked with reports via the RaDis RIS across the Welsh Assemblies WAN - DAWN II. This includes three GP practices in and around the Welshpool area.

**1015 Invited review: Workflow issues and lessons learnt**

P Knight

Hereford County Hospital, Hereford, UK

The procurement and implementation of CR and PACS into a radiology department will have a major impact upon all staff working therein. It is therefore important to maintain effective communications with the entire radiology team throughout the life of the project and beyond. What is equally as important, but often overlooked, is to engage in such communications with staff working outside radiology. This presentation examines some key issues associated with CR and PACS beyond the radiology department.

**0900–1100**

**New/Current Issues in MRI**

**0900 Invited review: Ultrashort TE developments**

MD Robson

John Radcliffe Hospital, Oxford, UK

Compartments with T2 below 1–2 ms are not visible on conventional clinical MRI scans. Here we have implemented methods that enable compartments with T2 as short as 100  $\mu$ s to be imaged at high resolution. Once signal from ultrashort T2 components has been detected, different pulse sequences can be used to determine increases or decreases in T1 and T2 and to study contrast enhancement, which is impossible when the tissues have zero intensity. This method can be performed safely on standard clinical hardware, using standard RF coils, in practical imaging times and with online reconstruction, and so is easily integrated into current imaging practice. Further, this approach can be combined with conventional methods for acquisition and contrast manipulation, such as fat suppression, T<sub>1</sub> weighting, cardiac gating, MTC, and non-proton and multiple echo acquisitions. Imaging short T2 species presents new technical challenges that will be discussed. Using these approaches, signals have been detected from normal tissues with a majority of short T2 components such as tendons, ligaments, menisci, periosteum, cortical bone, labri, dentine and enamel. Certain diseases such as chronic fibrosis, gliosis, haemorrhage and calcification may increase the signal from short T2 components. Other diseases may result in a decrease in the T2 components and this has been demonstrated in tendonopathy, intervertebral disc disease, ligament injury, haemachromatosis, pituitary perivascular fibrosis, gliomas, multiple sclerosis and angiomas. The patterns of behaviour of the short T2 components are still to be mapped out, but already they are likely to demonstrate changes in disease that are not apparent with conventional heavily T<sub>2</sub> weighted sequences.

**0945 Invited review: Recent advances in neuroimaging**

JH Gillard

Addenbrooke's Hospital, Cambridge, UK

No abstract supplied.

**1020 Invited review: High-field MRI: clinical applications and safety issues**

P Gowland

University of Nottingham, Nottingham, UK

No abstract supplied.

**1055 Discussion**

**1015–1215**

**Radiographic Training and Education**

**1015 Invited review: Assistant practitioner training course**

C Wicksted

Anglia Polytechnic University, Cambridge, UK

No abstract supplied.

**1040 Invited review: Breaking the mould? New ways of working and Health Professions Council registration**

R Klem

University of Central England, Birmingham, UK

The NHS Plan for England and subsequent publications highlight expansion in numbers of professional staff working within the NHS as well as changing roles as being keys to delivery of a modern health service. New ways of working are envisaged for delivery of service within the "New" NHS. Current boundaries between professional groups are perceived as barriers to delivery of healthcare to meet the needs of patients and clients. Focusing on tasks and skills and moving them along a uniprofessional ladder or expanding across professional boundaries are seen as means of creating greater flexibility in the workforce. The broader modernization agenda also includes modernization of professional regulation. Following review of the 1960 PSM Act, the Health Professions Council (HPC) has been established but is on a continuum of development. This presentation explores both opportunities for, and challenges to be faced by, the HPC as a regulatory body during this period of change. Key changes in registration resulting from establishment of the HPC are examined in relation to skills mix and the development of a ladder of progressive roles within diagnostic imaging and radiotherapy.

**1105 Recording CPD effectively: thoughts on developing and using a portfolio to facilitate career enhancement**

SM Henwood

South Bank University, London, UK

The idea of having to do CPD is now well accepted by most radiographers and across the allied health professions. In practice, though, it appears that relatively few radiographers are recording their CPD activity in a reflective portfolio and not all are making the link between CPD and clinical practice. This may be for a number of reasons, such as lack of time, fear of something new, unsure of the worth of such a portfolio or just unable to make a start. This paper looks at what makes a good portfolio, based on a review of a number of examples of portfolios available across healthcare. As each element is raised and discussed, the relevant skills required to use that section effectively will be explored and suggestions will be made as to where those skills could be acquired. The aim of this paper is to give radiographers who have not yet started recording CPD in a portfolio the confidence to make a start.

**1115 Careers and destinations of radiography students from the University of Hertfordshire**

LA Ashmore, M Vosper and R Price

University of Hertfordshire, Hatfield, UK

PURPOSE: Vacancy rates have increased for diagnostic and therapeutic radiography over the past 2 years, with the 3-month rates standing at 5.5% and 8.8%, respectively, in March 2002 for both disciplines. Anecdotal evidence suggests that retention of radiographers is poor, but there has been little empirical research into why this is the case. This study conducted by the University of Hertfordshire investigates the career progression of past students. METHODS: A questionnaire was sent to all graduates for whom a contact address was

available ( $n=303$ ). The questionnaire included questions seeking information on current employment and grading, any problems or barriers encountered in pursuing a radiographic career and reasons for leaving radiography or the NHS if applicable. RESULTS: 128 (42%) questionnaires were returned: 114 (89.1%) were employed in radiography and only 18 (15.7%) of those respondents planned to leave the profession in the next 5 years. The main motive for choosing a radiography career was the combined interaction with patients and technology. The majority of respondents would recommend radiography as a career, stating the varied role of the radiographer as a key factor. Increasing pay and improving the working environment were stated as the most important factors in improving retention. CONCLUSION: The response rate was encouraging, although consideration must be given to the bias of the sample and the situation of the 58% who did not respond. Overall, however, respondents were positive towards radiography and the results were reassuring for the profession in an apparent period of low morale.

### 1125 Developing a dedicated radiological image database within a university virtual learning environment

DM Carr and C Shields  
*University of Derby, Derby, UK*

Recent curriculum developments within the field of image interpretation and film reading/reporting have recognized the important place of image databases to support teaching and learning. With increasing use being made of a wide variety of different media to support teaching and learning, *e.g.* through distributed learning approaches, the ability to incorporate images in teaching and learning materials is seen as an essential aid to effectively supporting learning. DIDO (Derby Image Database Online) is a purpose-built radiological database that sits within a dedicated university virtual learning environment. Although a number of commercial image management and database solutions are currently available, the choice of developing an image database from scratch represents an alternative option worthy of consideration. This presentation seeks to provide an overview of how DIDO was developed and implemented to support teaching and learning strategies across a range of educational programmes. Specifically, the presentation will focus on how the project team: (i) evaluated available options; (ii) identified key design features; (iii) undertook the development process; and (iv) worked through issues surrounding implementation. The presentation will emphasize the outcome of the project from a non-technical standpoint, stressing both the educational objectives and the outcomes on teaching and learning. In particular, a key outcome arising from this project identifies the need for a close working relationship between subject specialists and developers in order to provide a final product with the intended functionality.

### 1135 Cross-cultural clinical curricular development in the radiation sciences

N Hopwood  
*On behalf of the EU/Canadian Consortia, University of Hertfordshire, UK*

PURPOSE: To improve the quality of transatlantic student mobility by promoting transparency, mutual recognition of qualification and periods of study and training and to encourage the exchange of expertise in e-learning and open and distance education. MATERIALS AND METHODS: The two key professions of Diagnostic Radiography and Radiotherapy, while radically different, are traditionally educated in the same higher education institution. A recent global shortage of these professions, with an increased desire of individuals to travel, has emphasized the need to provide international experience that contributes to the regular education of the student. The project provides the opportunity to link three Canadian and three European institutions that educate student radiographers with the following aims: to enhance the clinical education experience for student radiographers by implementing exchanges; to investigate the viability and implementation of European credit transfer in identified subjects; and to promote the use of e-learning and the virtual environment by developing a virtual mobility programme for students in identified subject areas. RESULTS: This presentation/poster will report on the initial project, arising issues and the progress to date. This project has been carried out with the support of the European Community. The content of this project does not necessarily reflect the position of the European Community, nor does it involve any responsibility on the part of the European Community.

### 1145 Teaching radiography students: is problem-based learning the answer?

SL McFadden  
*University of Ulster at Jordanstown, Belfast, UK*

PURPOSE: To assess the effectiveness of problem-based learning (PBL) in teaching undergraduate radiography students with the aid of the Honey and Mumfords learning styles questionnaire. MATERIALS: The study consisted of 29 third year undergraduates at the University of Ulster at Jordanstown, Belfast. METHOD: All 29 students filled out a Honey & Mumfords learning styles questionnaire prior to commencing PBL, which determined the individual learning styles of the students. The students were divided into three groups of 7 and one group of 8, with an equal distribution of different learning styles among the groups. Case studies were addressed covering common clinical presentations in the cardiovascular and nervous systems. The learning style questionnaires yielded: 12 reflectors, 8 theorists, 5 pragmatists and 4 activators. The four small groups were made up of 2 theorists, 3 reflectors, 1 pragmatist and 1 activator. The single group of 8 had an extra pragmatist. On completion of the PBL, a questionnaire was distributed to assess student perceptions of the PBL and whether it enhanced their learning experience. RESULTS: 20 out of 29 questionnaires were returned (response rate 69%). 95% of students are in favour of PBL yet find the workload difficult. 75% of students felt they had achieved the intended learning outcomes, whilst 25% felt that non-attendance of group members made group work difficult. CONCLUSION: PBL is here to stay. Students felt that although PBL was hard work, it encouraged them to do more research and proved itself to be a valuable learning tool.

### 1155 Development and implementation of an e-based Objective Structured Clinical Examination (e-OSCE) in diagnostic imaging

MT Griffiths and TW Palarm  
*University of the West of England, Bristol, UK*

AIM: This paper discusses the design, implementation and evaluation of an electronic version of an Objective Structured Clinical Examination (e-OSCE) for undergraduate student assessment in diagnostic imaging. Specialized Web-authoring software and multimedia manipulation tools were used to design an electronic assessment environment. Use of this software, in addition to the authors' experience of assessment, permitted the creation of a dynamic environment rather than cross-application switching between various software packages. METHOD AND DATA COLLECTION: A study involving action research was undertaken over a 6-month period. Researchers participated as facilitators in three action research cycles of problem-solving, which involved 2 lecturers and 23 undergraduate students. Data were collected using the following: reflective diaries, invigilators' notes and observations during the assessment process, student evaluation forms and other secondary sources. RESULTS: This form of assessment has been administered and evaluated on five occasions. Each action research cycle resulted in enhancement of the overall design in terms of user friendliness, interactivity and navigation facilities. Reflective diaries chronicled the changes that were made to the physical and electronic environment, as well as the overall assessment process. From the feedback forms, students expressed initial anxieties, however the overall experience was positively evaluated. Despite the initial investment in terms of time and resources, this form of assessment was considered to be cost effective in the long-term. CONCLUSION: The use of e-OSCEs are recommended as valid and reliable means of assessing various learning outcomes, at differing academic levels, in undergraduate imaging-related programmes.

### 1205 Discussion

## 1030–1215

### Musculoskeletal: the spine

#### 1030 Invited review: Spine interventional techniques: how I do it?

D Wilson  
*Nuffield Orthopaedic Centre, Oxford, UK*

Radiologists may intervene in the spine in a variety of ways. They may attempt to provoke pain thereby determining the origin of symptoms. A positive result would lead to more definitive therapy, including



surgery. A negative result might lead to other investigations. Discography is the best example of this type of investigation. Alternatively, the intent may be to block symptoms with the same outcome pathways (facet injection, root block, nerve block). A procedure may be intended to alleviate pain for some time; facet injections sometimes fulfil this need but image-guided epidural anaesthesia, cryo-therapy and radiofrequency rhizolysis may be more effective and longer lasting. Pain from vertebral collapse may be treated by cement injection with or without correction of deformity (vertebroplasty, kyphoplasty). Biopsy might be regarded as an interventional technique even though it is diagnostic in intent. The efficacy of techniques such as intradiscal electrothermal therapy, percutaneous disc therapy and percutaneous cement injection is not fully proven and there are important issues of consent, audit and medical indemnity to consider.

#### 1115 Objective spinal motion imaging assessment: measuring intervertebral angles in passive motion using fluoroscopy

<sup>1</sup>A Breen, <sup>2</sup>J Muggleton, <sup>1</sup>F Mellor, <sup>3</sup>A Morris, <sup>4</sup>S Eisenstein and <sup>1</sup>L Thomas

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**PURPOSE:** Assessment of lumbar spinal fusion is commonly made using plain film radiographs in flexion and extension. However, the accuracy of plain film assessment is only 68%. In addition, the use of metal implants to aid graft stability impedes radiographic assessment, as bony trabeculae are often obscured by overlying plates or rods. It has been noted that a frank pseudoarthrosis may exist without any obvious abnormality on radiographs, hence the only true method of detecting pseudoarthrosis is further investigative surgery. Objective spinal motion imaging assessment (OSMIA) is a new technique that uses low-dose fluoroscopy to image the lumbar spine in passive side bending and flexion-extension. Each image is digitized and the position of each vertebra is registered using computer-tracking software. The fine movements between vertebrae during this motion are measured and intervertebral angles for the whole motion sequence are produced. **MATERIALS AND METHODS:** Patients lie on a passive motion table that fits existing fluoroscopy units. The lower half of the table has a range of +40/-40° and patients are imaged in the supine and lateral positions. Images are captured in real time (25 frames s<sup>-1</sup>). **RESULTS:** Intervertebral angles are displayed graphically, showing the amount of movement between vertebrae during the sequence. Typical motion is characterized by a sine wave. A straight line demonstrates no movement and indicates a solid fusion. Deviation from this straight line in fusion patients indicates pseudoarthrosis. **CONCLUSION:** OSMIA is now operational in the Spinal Unit at Salisbury District Hospital. Its limitations are determined by the quality of the images from the intensifier.

#### 1125 Imaging the back: limited sequence MRI instead of plain radiographs of the lumbar spine

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**BACKGROUND:** In January 2003, 42 patients with non-traumatic low back pain were studied comparing plain lumbar spine radiographs (AP and lateral view) with limited MRI ( $T_2$  weighted sagittal and a non-invasive myelogram). **METHODS:** Patients presenting to the GP with low back pain were assessed by the physiotherapist who decided those patients who needed imaging. Lumbar spine radiographs and limited MRI were performed. The reporting is a radiographer-led service. **RESULTS:** MRI had a significant advantage over plain radiography. Besides detecting degenerative changes in vertebral bodies and facet joints; MR could detect disc herniations, their extent and nerve root impingement. Significant abnormalities were detected in 17 out of 42 patients. These included marked canal stenosis due to severe disc herniation in 4 patients, nerve root impingement in 11 patients, tear in the annulus fibrosis in 1 patient and multiple metastatic deposits in 1 patient. In all these patients the plain film had minimal changes. **CONCLUSION:** Significant abnormalities were detected in 40% of patients with MRI. Single sequence MRI was also shown to be cost effective. It was only £10 more than that of plain lumbar spine radiographs. However, it was far superior in detecting abnormalities.

#### 1135 Quantitative CT assessment of the knee joint line for primary and revision knee arthroplasty

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**PURPOSE:** CT is increasingly important for planning knee arthroplasty and revision surgery. Essential pre-operative information can be provided by radiologists when the joint line relationships of the femur and tibia from constant landmarks are identified and measured on CT images. **METHOD:** CT scans of 40 normal knees were examined to identify the medial and lateral epicondyles and the most prominent aspect of the fibula (coronal images). The distances of these points from the femoral and tibial joint line, respectively, were measured. Medial and lateral femoral epicondyles were located and the relationship to the posterior condylar line was assessed (axial images). The tibial tubercle to tibial joint line was also quantified. **RESULTS:** The landmarks described could be consistently and reproducibly identified on CT. From these points, both medial and lateral femoral epicondylar-femoral joint line distance and also fibular-tibial joint line are measured. On the axial images the tibial tubercle to tibial joint line, and both medial and lateral epicondylar-posterior condylar line are measured. The axial epicondylar distance is also identified and quantified. **CONCLUSION:** This method enables reproducible CT measurements to be made from defined landmarks around the knee in order to characterize the position of femoral and tibial joint lines. The radiologist can provide important quantitative information about definition of bone loss in relation to the joint line, both in severe primary knee arthritis and in revision knee surgery.

#### 1145 The Perth CT protocol for evaluation of computer-assisted vs conventional knee replacement

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**PURPOSE:** To fully assess the accuracy of the increasingly popular computer-navigated system for knee replacements (CAK) compared with the conventional jig based technique (JBK), a CT method is described that can fully define the mechanical axis and analyse the relative alignment of the femoral and tibial components. **METHOD:** A GE Light Speed multislice CT scanner performed a highspeed helical scan from the acetabular roof to the talus in 50 limbs post knee replacement (JBK and CAK). The knees were scanned in a supine position with the legs in a neutral position. Scan time was 45 s and calculated radiation dose was 2.7 mSv. The images were reformatted in coronal, sagittal and axial planes. **RESULTS:** The centre of the femoral head and ankle are identified and the true mechanical axis is defined. Femoral varus/valgus, tibial varus/valgus, femoral flexion/extension and tibial posterior slope can be established. Tibial rotation and femorotibial coupling are also calculated. The alignment characteristics in the CAK group could be accurately assessed and compared with those of the JBK group. **CONCLUSION:** The Perth CT protocol for total knee replacement provides the only currently available technique for measuring all the alignment characteristics required to fully assess the quality of a knee replacement. It will provide the radiologist and orthopaedic surgeon with quantitative information in assessing both the painful and malaligned knee replacement as well as being important in the planning of revision surgery. Lastly, it will provide use to basic scientists requiring standardized knee arthroplasty measurements.

#### 1155 Preliminary report on clinicoradiological correlation of MRI-diagnosed isolated bone bruising of the acutely injured knee

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**AIM:** To study the significance and clinicoradiological correlation of MRI-diagnosed isolated bone bruising in the acutely injured knee. **MATERIAL AND METHODS:** Patients presenting to the A&E Department with an acute knee injury were subjected to MRI examination within 48 h of injury. Patients with osteoarthritis, bleeding disorder and previous injury or surgery to the injured knee joint were excluded. Patients with bone bruising (study group) were randomized

into weight-bearing and non-weight-bearing groups and followed up for clinical and MRI examination at 6 weeks, 3 months, 6 months and 12 months. Patients without bone bruising (control group) were similarly followed up for clinical examination. RESULT: A total of 25 patients have been recruited into this study so far, 12 in the study group and 13 in the control group. Average age of the patients is 30 years. At 6–12 months follow-up, patients without bone bruising did better clinically. Of the patients with bone bruising, the non-weight-bearing group did better clinically. MRI did show early resolution of the bone bruising in the non-weight-bearing group. CONCLUSION: Non-weight-bearing in patients with bone bruising on MRI is important for healing of microfractures. This is supported both clinically and radiologically, the resolution of bone bruising on MRI correlating with clinical improvement.

### 1205 MRI of patella alta and baja

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PURPOSE: To assess the accuracy of MRI in the diagnosis of patella alta and baja. MATERIALS AND METHODS: Patella alta (high riding) and patella baja (low lying) are associated with chondromalacia, patellar instability, surgery and knee injuries. Four different methods are currently available to assess patella to patellar tendon height ratio. However, these techniques were designed for plain X-rays. We test the accuracy of one of the commonly used techniques (Insall-Salveti) by applying it to sagittal MR images and comparing it with plain films. 26 patients who were diagnosed by two musculoskeletal radiologists with patella alta or baja were included in the study. The sagittal  $T_1$  weighted MR images and the lateral plain X-ray of the same knee were compared independently by two musculoskeletal radiologists for consistency, and measurements were made manually and on a workstation. Thus, the accuracy, and interobserver and intraobserver variability were assessed. RESULTS: Consistency is seen between plain films and MRI in achieving the diagnosis. However, significant interobserver and intraobserver variability can occur just based on the Insall-Salveti technique. The slices need to be selected carefully. At least four images need to be analysed to measure the longest patellar length and the shortest tendon length, preferably on a workstation. By using this technique more consistent results were obtained. CONCLUSION: Diagnosis of patella alta and baja needs careful consideration of the technique before being made. To prevent under and over diagnosis, the longest patellar length and the shortest tendon length need to be selected.

## 1100–1215

### Genitourinary Scientific Session

#### 1100 Single-phase CT urography: initial experience

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PURPOSE: To investigate the reliability of single-phase multislice CT urography in imaging of the upper urinary tract. PATIENTS AND METHODS: 20 patients (mean age 55 years, range 28–85 years) underwent multislice CT urography for haematuria (7), abnormal IVU or ultrasound (4), recurrent urinary tract infection (7) or pre-urinary diversion surgery (2). TECHNIQUE: Contiguous scanning (2.5 mm collimation) of the abdomen 15 min after intravenous injection of 50 ml of 300 mg I ml<sup>-1</sup> iopromide and 10 mg of frusemide. Contiguous axial images (5 mm slice thickness) of the whole abdomen and pelvis, and coronal (3 mm slice thickness) and sagittal (3 mm slice thickness) images of the upper urinary tract are provided on hard copies (20 frames/film). Consensus reporting was undertaken and a scoring system was used for quality of examination and confidence in making the diagnosis (1 = poor, 2 = satisfactory, 3 = good, 4 = very good and 5 = excellent). RESULTS: Of the 40 kidneys imaged, 19 (47.5%) were normal and 21 (52.5%) were abnormal (cysts (12), scarring (7), stones (2); confidence score >4). The pelvicalyceal system was normal in 27 (67.5%) and abnormal in 13 (32.5%) (dilated (10), deformed (3); confidence score >3). The ureters were normal in 30 (75%) and dilated in 10 (26%) (confidence score >3). Good to excellent visualization of the upper urinary tract was observed in 19 patients (95%) (mean score = 3.6). One study was considered poor, as the patient was unable to lie supine. CONCLUSION: Adequate demonstration of the urinary tract was possible with single-phase multislice CT urography without

exposing the patient to a higher radiation dose that is associated with multiphase CT urography.

#### 1110 Multidetector CT urography for urothelial imaging

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PURPOSE: To evaluate multidetector CT urography (MD-CTU) for the detection of urothelial pathology by comparison with retrograde ureteropyelography (RUP). MATERIALS AND METHODS: MD-CTU and RUP were performed in patients with haematuria or unexplained hydronephrosis following non-diagnostic IVU or ultrasound. MD-CTU consisted of unenhanced, nephrographic and excretory phase images. Axial and reformatted images were reviewed. RUP was performed on an outpatient basis under sedoanalgesia using a flexible cystoscope and digital C-arm fluoroscopy. RESULTS: Over a 27-month period 106 adult patients were studied. Indications included haematuria, hydronephrosis or both. Intrinsic pathology detected included transitional cell carcinoma (TCC) ( $n=37$ ), calculi ( $n=18$ ), bladder polypoid lesions ( $n=2$ ), PUJO ( $n=7$ ), benign ureteral strictures ( $n=6$ ) and congenital abnormalities ( $n=6$ ). MD-CTU determined the correct diagnosis in 99% of intrinsic urothelial pathology and in 67% of extrinsic mass lesions, of which histological confirmation was required in 33%. RUP was technically successful in 92% ( $n=97/106$ ). RUP correctly diagnosed 86% of intrinsic lesions. There were two false negative results for TCC (multifocal tumour and circumferential wall thickening) and three positive results (stones and vascular impression). CONCLUSION: In this series MD-CTU was superior to RUP, IVU and ultrasound for the detection of urothelial pathology, suggesting the position and role of MD-CTU in the investigation of urothelial pathology should be redefined.

#### 1120 Audit of contrast-mediated nephropathy

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INTRODUCTION: Contrast media are the third leading cause of hospital-acquired renal failure. Baseline information on the prevalence of renal impairment is needed to generate measures of quality and to identify areas of improvement in the quality of care provided for prevention of contrast-mediated nephropathy. This will aid in the development of clinical guidelines for the prevention of contrast-induced nephrotoxicity. METHODOLOGY: Renal function of patients who underwent CT scans or angiography in the Radiology Department at QEHS was reviewed. CT scans were undertaken between 15 February and 22 February 2002 (1 week) and angiograms between 1 February and 15 February 2002 (2 weeks). RESULTS: CT scans in non-renal patients: total number 278; exclusions (owing to inadequate data) 56, leaving 222 remaining; non-contrast studies 115, contrast studies 107; no U&Es at all 27 (25%), thus 80 remaining; creatinine levels <150 76, 150–250 4, >300 0. Contrast nephropathy occurred in 3 (3.75%) patients: creatinine levels before contrast, after contrast and number of days after: 229, 324 and 5 days; 105, 185 and 4 days; 90, 226 and 3 days. Angiograms in non-renal patients: total patients 54; exclusions (owing to inadequate data) 4, leaving 50 remaining; no U&Es at all 6 (12%); no results after investigation 2 (4%); creatinine levels <150 38, 150–250 2, >250 2. Contrast nephropathy occurred in 1 patient (2.38%): creatinine levels before contrast, after contrast and number of days after: 98, 468 and 4 days. CONCLUSIONS: 25% of non-renal patients did not have U&Es checked before CT. Clinical guidelines have been formed after the audit in the management of contrast-mediated nephropathy. Re-audit in 1 year to determine improvement.

#### 1130 Percutaneous nephrostomy: a prospective audit

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INTRODUCTION: Percutaneous nephrostomy is a well established technique for providing temporary or permanent drainage of an obstructed urinary system. There are no recently published data from British centres on complication rates. We therefore performed a prospective audit of percutaneous nephrostomies at a teaching hospital in the UK. METHOD: Two different techniques for nephrostomy insertion were used: the Seldinger technique (ultrasound-guided

puncture with a 19 G sheathed needle followed by guidewire insertion and track dilatation to accommodate 8–12 F nephrostomy catheters) and an ultrasound-guided “one-stab” technique using a 6 F Bonanno catheter. We examined our success and complication rates from January 2002 to December 2002. RESULTS: To date a total of 218 percutaneous renal nephrostomies performed in 153 patients by operators of varying experience. There were 163 procedures using the Seldinger technique and 55 using the one-stab technique. The Seldinger technique and the one-stab technique were compared: primary technical success rate was 98% vs 94%, major complication rate was 4.3% vs 3.6% and minor complication rate was 5.5% vs 12.7%, respectively, for the two techniques. CONCLUSION: Data from the USA suggest a target for primary technical success rate of 88–99%, major complications of 4–8% and minor complications of 3–15%. Our performances are within the target guidelines. The audit is in progress for 12 months and the complete data will be presented. We hope that our performance data may help to form a baseline for targets in the UK.

#### 1140 Assessment of a GP-based ultrasound service in the diagnosis of benign prostatic hyperplasia

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PURPOSE: The aim of this project was to compare the clinical outcomes in patients who had GP ultrasound-aided diagnosis of benign prostatic hyperplasia (BPH) with that of patients in a control group who were referred directly to the hospital. The project findings have demonstrated the value of early diagnosis and treatment of BPH in improving patient management, leading to a reduction in waiting time owing to appropriate and authoritative referrals to the urologist. METHOD: The clinical outcomes of 50 patients in the experimental group scanned by the GP were compared with that of 50 patients in the control group waiting for urology outpatient appointments. The outcome measurements with regards to enhancement of clinical judgement, availability of immediate results, appropriate referrals leading to early treatment and measurement of the impact on quality of life were addressed. RESULTS: The results demonstrated a reduction in waiting time for treatment owing to in-house ultrasound examinations in comparison with 26 weeks waiting time for a urology outpatient appointment. There was a cost saving on GP and urologist time owing to timely referrals, and saving on drugs owing to early and focused treatment. High-risk patients were identified and referred directly to one-stop urology clinics for immediate treatment. CONCLUSION: A GP-based ultrasound service supervised via a tele-ultrasound link has benefited GPs, patients and urologists in managing patients presenting with BPH. This improved service has reduced waiting time, made savings on costs owing to early diagnosis and treatment, with a significant impact on improving patients' quality of life.

#### 1150 Use of modern communication technology in training and supervision of GPs in ultrasound

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PURPOSE: The project aim is to demonstrate the merits and limitations of tele-ultrasound in training GPs to carry out ultrasound examinations safely. It is apparent from the results that tele-ultrasound interactions are instrumental in developing key ultrasound skills. MATERIALS: A tele-ultrasound system utilizing off-the-shelf Intelproshare and Sony Videoconferencing software, using a high-resolution ultrasound machine linked to an ISDN2 line. METHOD: After the initial familiarization period with the tele-ultrasound system and procedure, the GP was able to carry out a total of 50 supervised scans on patients presenting with symptoms of benign prostatic hyperplasia (BPH) over a period of 6 months. In total 300 images were transferred via the ISDN2 link. Real-time mode was used to instruct the GP on the technique of scanning the abdominal and pelvic anatomy, whilst whiteboard tutorials facilitated detail interpretation of anatomical landmarks and areas identified as suspicious of abnormality. CONCLUSION: The use of “dynamic imaging” and “whiteboard tutorials” have been valuable in demonstrating a variety of clinical skills such as: manipulation of machine controls to produce optimum images, correct technique, interpretation of images, communication and care of the patient. Real-time mode is satisfactory for training GPs in the ultrasound techniques and whiteboard tutorials are excellent for building interpretational and report writing skills.

#### 1200 Spiral 3D angiography in the diagnosis of renal tumour neovascular pattern and connected vessel anomalies

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PURPOSE: To determine the value of 3D-CT angiography in assessing renal vessel (arteries and veins) abnormalities and neovascular pattern in patients with renal cancer. MATERIALS AND METHODS: Multiphase (three-phase) helical CT angiography with 3D image reconstructions using post-processing algorithms (MPR, SSD, MIP) were used in 78 patients with different types of morphologically proven renal tumour (renal cell carcinoma (RCC) clear cell type 66; papillary RCC 7; chromophobic RCC 2; cystic RCC 2; leiomyosarcoma 1). Age range 36–72 years; 36 female and 42 male. Helical CT angiography was performed using the following parameters: slice thickness 2 mm, pitch 1.5, RI 2 mm, collimation 5–7.5 mm, with IV injection of contrast medium (100 ml Ultravist, 3.5 ml s<sup>-1</sup>). The multiphase (three-phase) enhancement protocol included: unenhanced, corticomedullary (delay 25 s) and nephrographic (delay 80 s) phases. Nine patients underwent nephron-sparing surgery and 69 radical nephrectomy. RESULTS: Neovascularity of peripheral type was revealed in 36 patients, central in 3 patients and entire in 27 cases. The following vessel anomalies were revealed: segmental renal artery aneurysm inside the renal leiomyosarcoma ( $n=1$ ); accessory renal artery in cases of RCC ( $n=3$ ); renal artery aneurysm ( $n=1$ ); renal artery stenosis ( $n=2$ ); renal vein thrombosis ( $n=11$ ); inferior vena cava (IVC) thrombosis ( $n=6$ ); and collaterals from thrombotic IVC ( $n=2$ ). CONCLUSIONS: 3D-CT angiography is an accurate diagnostic method for the precise vascular evaluation of renal tumours, giving valuable information prior to nephron-sparing surgery and avoiding the possible complications of radical nephrectomy.

#### 1210 Discussion

### 1100–1315

#### Neuroradiology

##### 1100 Invited review: The impact of the International Subarachnoid Aneurysm Trial

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Over the last 10 years there have been dramatic developments in endovascular techniques for treatment of intracranial aneurysm. In 1994, 2 years after the introduction of the Guglielmi detachable coil device into clinical use, we started a pilot phase of a prospective randomized trial to compare the clinical outcomes of the use of this device in patients with ruptured intracranial aneurysm, comparing it with standard surgical treatment. The trial was funded by the Medical Research Council in 1997, to continue to 2007 for long-term follow-up. A target recruitment of 2500 patients was set, but in May 2002 recruitment was stopped because a highly statistically significant reduction in the incidence of death and disability following allocation to endovascular treatment policy compared with the surgical treatment policy was found. At that time, 2143 patients had been entered in the trial. There was a relative reduction in the risk of poor outcome of 22.6%, with an absolute risk reduction of 6.9%, leading to the stopping of the trial. Long-term follow-up will continue. A dramatic shift in practice has been observed in the UK, with up to 90% of patients now undergoing coil treatment as opposed to surgery in some centres. Similar changes in practice have also occurred in Europe and to a lesser extent in North America. The implications for provision of neuroradiological and neurosurgical services will be discussed.

##### 1130 Invited review: New developments in CT imaging in neuroradiology

LN Tanenbaum

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No abstract supplied.

##### 1215 Multislice CT angiography in the assessment of acute vertebrobasilar ischaemia

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**BACKGROUND:** Multislice CT has expanded the role of CT angiography (CTA) by improving the temporal and spatial resolution, allowing long areas to be covered with a sufficiently thin slice width to enable examinations of the aortic arch beyond the Circle of Willis. We have applied such a technique to the increasing number of patients presenting with suspected acute vertebral occlusion. New therapeutic approaches necessitate a timely diagnosis and CT is usually used first to exclude haematoma or other surgical emergency. Including a diagnostic CTA would be advantageous if it was accurate. **TECHNIQUE:** 2.5 mm × 4 helix; pitch 0.875; 0.5 s rotation; kVp 120; mAs 200; giving 30 cm coverage in 17.5 s. The scan was triggered automatically from contrast medium concentration in the ascending aorta or, for those patients less than 55 years, in the pulmonary artery. **RESULTS:** 25 patients have been examined. All examinations were of diagnostic quality despite the inability of many of the patients to cooperate. The very short acquisition time offers an important advantage over MR in the sickest patients and in those in whom therapeutic intervention is time restricted. The majority of patients also had MR or catheter angiography that corroborated the CT findings. The images were analysed using a proprietary volume rendered technique with base images reviewed, with the occasional use of MIP and MPR analysis. 13 patients had vertebral dissection, 5 thrombosis or stenosis of the vertebral or basilar artery, and in 7 no vessel pathology was found. The correct diagnosis was made independently on all the CTA examinations.

### 1225 Three-dimensional CT angiography (3D-CTA): pre-treatment detection and evaluation of intracranial aneurysms in acute subarachnoid haemorrhage

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**PURPOSE:** To assess the role of 3D-CTA in the pre-treatment detection and evaluation of intracranial aneurysms in patients with acute subarachnoid haemorrhage (SAH). **METHODS AND MATERIALS:** 100 patients diagnosed with acute SAH either on plain CT or lumbar puncture underwent CTA as the first direct imaging method of cerebral vasculature. The scan was performed on a Toshiba Aquilion multislice CT scanner using the following scan conditions: voltage 120 kV; current 300 mA; slice thickness 0.5 mm; scan speed 0.5 s/cycle; scan pitch 2; range from the level of atlas to the body of the ventricles. 100 ml of niopam 370 was injected using a pump at 3 ml s<sup>-1</sup>. Three-dimensional images were reconstructed using multiple image projections and integral volume rendering algorithms on an independent workstation. **RESULTS:** Our initial experience compares well with previous reported studies, with a sensitivity of 98–100% and a specificity of 100%. Advantages of CTA are the ability to demonstrate three-dimensional aneurysm morphology, delineation of the vessels around the aneurysm complex and provision of information on calcification and thrombus within the aneurysm. Furthermore, it is non invasive and has better spatial relationship with multi-angle view. The short scan time is useful especially in moribund patients with SAH compared with MRA, which is limited by motion artefact and is prohibited in patients with clips or pacemakers. **CONCLUSION:** 3D-CTA provides a one-stop, fast and reliable technique for the detection and evaluation of intracranial aneurysms in patients with SAH prior to selecting the most appropriate treatment modality.

### 1235 Time-resolved MR angiography for the assessment of paediatric head and neck vascular abnormalities

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**PURPOSE:** Paediatric head and neck vascular abnormalities are common but are difficult to assess. Conventional catheter angiography with its associated complications has been the mainstay for the evaluation of these lesions. We present our early experience of time-resolved MR angiography (TR-MRA) as a non-invasive method for assessment of these abnormalities. **PATIENTS AND METHOD:** A total of 11 patients (age range 2 days to 16 years; 4 male, 7 female) with a range of known or suspected vascular abnormalities were studied. Routine MRI and MR angiography was supplemented with TR-MRA, which is a thick slice (6–10 mm) selective RF spoiled fast gradient echo sequence (RF-FAST). 60 frames (1 s<sup>-1</sup>) 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:** Two patients with Sturge–Weber syndrome were shown to have ipsilateral choroidal angioma. In one child with a suspected low-flow vascular lesion of the scalp, TR-MRA showed the presence of a high-flow lesion. In three children with suspected low-flow abnormalities (two eyelid, one parotid), TR-MRA demonstrated high-flow vascular lesions instead. Low-flow lesions can also be confirmed on TR-MRA (a suspected scalp venous malformation and a lid haemangioma). TR-MRA was also able to demonstrate tumour blood flow (a highly vascular occipital tumour initially thought to be a myelomenigeocele; a large highly vascular palatal tumour; a relatively avascular nasopharyngeal mass). **CONCLUSION:** Our early experience suggests that TR-MRA allows accurate assessment of paediatric head and neck vascular abnormalities.

### 1245 Metabolic cerebellar abnormalities in gluten ataxia on H-MRS

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**PURPOSE:** Gluten sensitivity can be associated with a diverse range of clinical manifestations including enteropathy, skin disorders and neurological dysfunction. This study investigates the cerebellar metabolic status of patients with gluten-related ataxia investigated by proton magnetic resonance spectroscopy (H-MRS). **METHODS:** MRS was performed at 1.5 T (Eclipse; Philips Medical Systems) on 11 patients and 8 matched controls. Proton spectra were obtained from a single cerebellar voxel using short (STEAM: TE = 20 ms, TR = 300 ms) and long (PRESS: TE = 135 ms, TR = 1600 ms) echo-time techniques. Long TE results are expressed as ratios under the three prominent resonances: choline (Cho), creatine (Cr) and N-acetyl (NA) groups. Short TE results are expressed as the areas under the Cho, Cr, NA and *myo*-inositol resonances relative to that of unsuppressed water. **RESULTS:** Statistically significant differences were found between patients and controls in NA/Cho (1.29 ± 0.24 vs 1.67 ± 0.32; *p* < 0.01) and NA (0.63 ± 0.09 vs 0.78 ± 0.10; *p* < 0.01). **CONCLUSIONS:** NA groups have been shown to be largely confined to neuronal cell bodies and axons and thus cerebellar neuronal physiology appears to differ between patients with gluten ataxia and normative controls.

### 1255 Is there a role for plasma D-dimer in acute intracranial venous thrombosis?

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**PURPOSE:** In this study we investigate patients with possible intracranial venous thrombosis (ICVT) using MRI and plasma D-dimer levels. **MATERIALS AND METHODS:** 26 patients with raised intracranial pressure and suspected ICVT were recruited prospectively. All patients had a venous sample for plasma D-dimer (VIDAS, Biomerieux-France) and conventional T1/T2 with post-gadolinium coronal T1 MR imaging and 2D time of flight (TOF) MR venography of the brain. A normal range for D-dimer was determined for 19 age-matched volunteers (54–361 ng ml<sup>-1</sup>, mean 189 ng ml<sup>-1</sup>, standard deviation (SD) 88.5 ng ml<sup>-1</sup>). D-dimer levels above 538 ng ml<sup>-1</sup> (2 SD above the normal upper range) were considered abnormal. Seven patients with non-thrombotic conditions or on anticoagulants were excluded (431–1683 ng ml<sup>-1</sup>). **RESULTS:** Three patients had confirmed ICVT on MRI/venography (951 ng ml<sup>-1</sup>, 900 ng ml<sup>-1</sup> and 837 ng ml<sup>-1</sup>, more than 4 SD above the upper normal range). In nine patients no specific cause was found for the patient's symptoms. MRI and venography were normal (106–410 ng ml<sup>-1</sup>). Seven female patients were diagnosed with idiopathic intracranial hypertension (IIH). The D-dimer results for these patients ranged between 18 ng ml<sup>-1</sup> and 803 ng ml<sup>-1</sup>, with three having abnormally high levels. **CONCLUSION:** It should be noted that the three highest D-dimer levels were in cases with confirmed ICVT. A low and non-significant D-dimer level suggests that ICVT is unlikely. Some patients with IIH and significantly raised levels of D-dimer and normal MRI/venography may have thrombus in small intracranial veins. D-dimer (VIDAS) has a potential role in the diagnostic work-up of patients with suspected ICVT.

1115–1230

## **PACS II: beyond the radiology department II**

### **1115 Invited review: PACS: future horizons**

R Passariello

*Policlinico Umberto 1, Roma, Italy*

An up-to-date PACS system aims at: (i) archiving, retrieving and easily distributing, as fast as possible, all images produced in a Radiology Department; and (ii) becoming efficiently integrated with the Radiology Information System (RIS). All must be obtained, besides the utmost operating functionality, by means of a minimum economic investment since the PACS/RIS system, if not adequately configured, may weigh heavily upon the budget in respect of the economic benefit that can be determined either directly (personnel reduction, film saving) or indirectly (higher efficiency). To achieve this purpose, it is sufficient that images and alphanumeric data run on the department and hospital LAN at 100 Mbit/s. As far as image archiving is concerned, two different strategies may be associated: (i) initial archiving on RAID suitable for keeping images online for 2–4 months; and (ii) historical image archiving on DVD in configurable juke box, sized on the number of images produced. In our more than 2-year experience, the Web-based PACS/RIS technology appears most suitable: (i) to easily and inexpensively distribute alphanumeric data and images within the department and hospital; (ii) to reduce personnel and material costs; (iii) to use any hardware type; (iv) to allow easy access to reporting and PACS management with voice recognition systems; (v) to easily allow access to the system for consulting and referring physicians also from other hospitals; and (vi) to reduce overcrowding in the Radiology Department. This Web-based technology will rapidly allow us to fully make use of all 1500 Web addresses existing in our hospital.

### **1150 Invited review: PACS: the clinician's perspective**

G Shaw

*Queen Alexander Hospital, Portsmouth, UK*

In the last year, PACS has entered the general medical vocabulary. In the next year these systems will move into most clinical areas of hospitals. PACS has been developed for use in the radiology department. The use of PACS in clinics, on wards and in operating theatres presents new problems and challenges. This presentation highlights the areas for particular attention when planning the roll-out of a PACS into the main hospital departments. As an Orthopaedic Surgeon the main focus is on my specialty. This should still be of general interest because orthopaedics is probably the specialty that stretches PACS the most. The presentation follows a multiple trauma patient through the hospital, examining the demands on the PACS at each stage.

### **1220 An open source medical image distribution how to**

LP Cram

*Royal Alexandra Hospital, Paisley, UK*

**PURPOSE:** To develop a Web-distributed viewing system using open source software. **MATERIALS AND METHODS:** Any standard PC plus the following software: Gnu/Linux, Zope, Apache, Mysql, ImageMagick, CTN Libraries, Java, HTML, java viewer applet by Takahiro Katoji. Any DICOM compliant modality. The software was compiled and configured and a new product written for Zope to serve the data and images. A small shell script was written to map/convert DICOM images to JPEG. **RESULTS:** The functioning server was connected to the modalities and tested with images being transmitted to it and stored. Patient information was queried through a standard Web browser (using password-protected access) and images were recovered and viewed through the browser. **CONCLUSION:** It is possible to develop a DICOM to Web-based viewing system using open source licence-free software. Image can be viewed as native DICOM or as JPEG images of predetermined compression and image depth.

1130–1245

## **New/Current Issues in MRI**

### **1130 Invited review: Current issues in pelvic MR**

N DeSouza

*Hammersmith NHS Trust, London, UK*

No abstract supplied.

### **1205 Invited review: New acquisition techniques: marketing hype or useful clinical tools?**

A Jones

*Christie Hospital NHS Trust, Manchester, UK*

Diagnostic magnetic resonance (MR) technology seems to constantly advance at an amazing pace. Each year we see changes and developments in MR hardware that, as a result, appear to turn what were relatively newly installed systems into out of date technology. Hand in hand with hardware advances has been the introduction of previously advanced research-based acquisition strategies into standard clinical applications. The role of the manufacturer is clearly to sell systems. The role of marketing is to inform potential customers of the new products available to users, expounding the virtues and strengths of these advances to their clinical routine if purchased. Unlimited pots of money are clearly something healthcare does not have the luxury of and therefore effective use of resources and inevitable compromises are the norm. It is essential that balanced arguments are produced as to the realistic benefits of the new acquisition strategies available. Indeed, it is likely that these arguments will vary between different users, as clinical applications and patient characteristics will be in some ways unique to individual users. Examples of these new acquisition strategies include parallel imaging linked to new coils advances, free-breathing navigator echo techniques, moving table applications and a variety of new sequences including rapid dynamic acquisitions for angiographic and perfusion-based measurements. The basic physics of these various techniques will be explained, along with an exploration of the realistic clinical benefits that they can produce for the user. Consideration will be given to immediate direct benefits as well as to future improvements as these latest advances mature.

### **1240 Discussion**

1300–1400

## **Institute of Physics and Engineering in Medicine**

### **Douglas Lea Lecture**

#### **Eponymous Lecture: The future of cancer therapy**

P Selby

*St James's University Hospital, Leeds, UK*

Scientific advances over the last two decades have dramatically increased our knowledge of the biology and pathogenesis of malignant disease. The role of oncogenes and tumour suppressor genes in familial and sporadic cancers has been significantly clarified. The interaction of genes with the environment and the role of genetic polymorphism in determining both the aetiology and outcome of cancers are active fields of enquiry. All of these have generated new insights and targets for cancer therapy. We can expect to see continued progress with established existing modalities of treatment. Cancer surgery is becoming more precise in its patient selection, and reconstructive techniques have significantly reduced the morbidity of procedures. Radiotherapy technologies have advanced, with reductions in toxicity, and new knowledge of the molecular biology of DNA repair may provide a basis for further improvements in therapeutic index. New chemotherapeutic agents that are active against specific targets, identified by advances in molecular biology, are becoming available, and early signs suggest they may be effective and relatively non toxic. Immunotherapy and vaccine strategies are showing considerable promise, with a small established clinical role and considerable activity in new experimental systems using cytokines, polypeptides and cellular vaccines, particularly antigen presenting cells. All new treatment approaches require careful evaluation of their effectiveness against the tumour. Conventional tumour measurements using cross-sectional imaging or tumour markers remain the mainstay of such assessments. In future, our ability to assess the impact of new treatments against the tumour by directly imaging changes in the function of tumours, particularly with PET- and MRI-based technologies, will become evermore important. Treatments at present are chosen for populations of patients depending on their clinical well being, the extent of their disease and on histological subtypes. In future, the molecular profile of the tumour and the molecular profile of the patient will be established using expression arrays, and genotyping will help to individualize patient care. As these new approaches become available, organization of care will become evermore demanding. Treatment will be

based on increasingly demanding technologies but patients will also expect that care is delivered in a patient-centred way as close as possible to home. Effective service networks and information systems will have to be developed to underpin the best use of new approaches to cancer treatment.

1330–1500

### Student Conference

#### 1330 Invited review: A learning age in health and social care: the role of NHSU

R Fryer

*NHS University, London, UK*

No abstract supplied.

1350–1500 Further student work will be presented.

1400–1445

### Musculoskeletal: the pelvis

#### 1400 Invited review: Imaging the pelvis in trauma

PM Hughes

*Derriford Hospital NHS Trust, Plymouth, UK*

Pelvic trauma is a common associate of rapid deceleration injuries, which include falls and motor vehicle accidents. There are two major categories of pelvic injuries that require consideration, namely pelvic ring injuries and secondly acetabular fractures. An accurate radiological assessment of such injuries is important to establish the potential for instability, which is directly related to the risk of pelvic haemorrhage. The latter can be an important determinant in clarifying the risk of management of patients who are haemodynamically unstable. The presentation will concentrate on the important patterns of pelvic injury and the parameters that determine levels of stability. Acetabular injuries will be separately addressed. Discussion will also focus on the requirements for specialist plain film views, cross-sectional imaging and reconstructions in both the pelvic ring and acetabular injury.

1400–1545

### Investigation and Treatment of the Pelvic Mass

#### 1400 Invited review: Ultrasound as the first diagnostic tool in gynaecology: a practical approach

J McHugo

*Birmingham Women's Hospital, Birmingham, UK*

Ultrasound is the first diagnostic investigation for pelvic pathology. It has been shown to be more accurate than bimanual examination in excluding masses, which is particularly true in the woman with a high body mass index (BMI). To date, some radiology departments and senior radiologists in particular consider transvaginal scanning as a specialist investigation. Transvaginal scanning is, however, essential in all cases to improve diagnostic accuracy and should be routine unless there is a specific contraindication. The aim is to demonstrate clearly the ovaries, adnexal region, uterus and endometrium in all cases. The sensitivity of transvaginal ultrasound has been shown to be reasonable but the specificity is relatively low for specific diseases. This specificity can be improved by using a more dynamic examination than is often performed using the bimanual transvaginal technique. This employs the operator's hand to palpate the abdomen to assess mobility and pain of the pelvic organs while scanning. This technique is also useful to bring a relatively high ovary into view. A structured approach to gynaecological ultrasound and an understanding of the most likely diagnosis in the clinical setting will increase the specificity of the test. It is therefore essential to know the patient's age, menstrual status and drug history in all cases to increase the accuracy of pelvic ultrasound. This presentation will outline a practical approach to the subject.

#### 1430 Invited review: MRI of the indeterminate adnexal mass

R Reznik

*St Bartholomew's Hospital, London, UK*

Transvaginal or transabdominal ultrasound remains the first imaging

investigation for the evaluation of adnexal masses, partly because its sensitivity for the detection of malignant ovarian masses is extremely high. Its specificity is substantially lower, as numerous false positives do occur. MRI also has an extremely high sensitivity while maintaining a high specificity with benign pathology such as endometriomas, desmoids and pedunculated fibroids, less frequently causing a false positive interpretation. An evidence-based role for MRI will therefore be defined in this presentation together with the MRI technique and potential pitfalls in interpretation. The features with the strongest predictive value for malignancy will be illustrated. In the presence of a malignant ovarian mass, MRI is important in the detection of spread, a role more usually fulfilled by CT. A comparison will be discussed between CT and MRI in staging disease and planning management.

#### 1500 Invited review: Imaging-guided treatment of pelvic lesions

N Cowan

*The Churchill Hospital, Oxford, UK*

No abstract supplied.

#### 1530 Discussion

1400–1545

### PACS II: beyond the hospital

#### 1400 Invited review: Writing a specification for teleradiology

M Pickering

*Kodak Ltd, Hertfordshire, UK*

The placement of teleradiology systems has expanded continuously over the years and has moved from the pure point-to-point, single modality connection to multimodality, multisite systems. The aim in all cases is for teleradiology to provide an easy to use, clinically relevant and clinically adequate system. It therefore follows that the specification for any equipment needs to be in line with these requirements to ensure that the system (i) can be tailored to the individual's requirements and (ii) provides the appropriate image quality to match the clinical need. The purpose of the presentation is to review the specific elements of the imaging chain and the specification of equipment required in the areas of acquisition, data compression, transmission, integration and display.

#### 1420 Invited review: Teleradiology—the impact on UK radiology practice: current and future perspectives

D Hadley

*Institute of Neurological Sciences, Glasgow, UK*

No abstract supplied.

#### 1440 Invited review: Medicolegal issues in teleradiology

G Panting

*Medical Protection Society, London, UK*

Telemedicine is simply another means of delivering healthcare, removing geographical obstacles to access to services but introducing a new set of technological constraints. Many of the legal issues raised by telemedicine are accommodated by existing legal principles. Clinicians owe their remote patients the same duty of care as those who consult face to face. Failure to provide an adequate standard of care resulting in harm to the patient will result in a traditional law suit, and the principles of consent and confidentiality remain the same. But there are new problems, predominantly jurisdictional issues. If a doctor in England has a teleconsultation with a patient in another country, providing poor advice resulting in harm, did the negligent act occur in England or where the patient was located? Jurisdictional issues may be further complicated by a product liability claim against manufacturers or distributors of faulty equipment. Nothing to date has indicated that the application of telemedicine is unusually hazardous, but consideration must be given to risk management procedures, including policies, to protect the security and confidentiality of medical data, limiting advice and medical management to the limits of the practitioner's expertise and the constraints imposed by the equipment, proper allowance for time delays, as well as audit and adverse incident management.

**1500 Invited review: Wide area PACS**

S Gately

*Sybermedica Limited, Cambridgeshire, UK*

Although digital (filmless) imaging is rapidly becoming the mainstay of the modern hospital X-ray department, most digital systems are left wanting when it comes to ensuring that images follow the patient "journey", especially where this involves community-based or multi-hospital care. This paper will present a new radiology e-Referral (teleradiology) system based on Internet technology that is designed to solve this problem. The new radiology e-Referral system allows images to be communicated via a shared, encrypted e-Referral server, from where they can be viewed and reported by authorized users from virtually any location. Server access from the hospital is via NHS-net and from the consultant's home via ISP (Internet Service Provider), making the system ideal for on-call reporting. The system also incorporates a DICOM interface for communication with PACS networks, allowing interhospital communication of PACS/digital images using the e-Referral server as a bridge.

**1520 An audit of on-call teleradiology usage in an inner city teaching hospital**

M Dhillon and AK Banerjee

*Birmingham Heartlands Hospital, Birmingham B9 5 SS, UK*

Birmingham Heartlands Hospital is a large, 900 bed inner city teaching hospital with a large A&E/Trauma Unit. Over the years, the demand for out-of-hours radiology has increased and, to cope with this demand, there has been greater use of teleradiology facilities. There are few studies on the volume and pattern of teleradiology usage in UK hospitals. We have audited our usage of the Radworks teleradiology system (Amersham Medical Systems) for remote access to our multislice CT scanner over a 3-month period and we present our findings. A total of 137 out-of-hours scans were reviewed remotely by the on-call radiologist at home from a PC. The majority were head scans (115), and others were cervical spine (10), thoracic (10), abdomen (2) and pulmonary angio (1). All scans were reported both from the remote monitor (PC) and from hard copy the following day. No major discrepancies were observed on reporting the hard copy. 60% of the head scans were abnormal (mainly subarachnoid, intracerebral and subdural haemorrhages) and these scans were available for review immediately by the regional neurosurgical unit, thus speeding up clinical management. On-call teleradiology is an accurate and quick method of assessing radiological images remotely and is likely to become a routine service in all departments in the future.

**1530 Use of telecommunication links to establish a nuclear medicine service between the UK and Tblisi, Georgia**<sup>1</sup>F Todua, <sup>2</sup>T Vakhtangadze and <sup>2</sup>MR Rees<sup>1</sup>*Institute of Radiology, Tblisi, Georgia and* <sup>2</sup>*University of Bristol, Bristol, UK*

AIMS: To develop a low cost teleradiology link for exchange of nuclear imaging data between Bristol, UK, and Tblisi, Georgia. METHODS: Exchange of information was facilitated by a visit to Georgia to discuss links with radiologists and clinicians. This was followed by agreement on formats for image exchange and transmission of data by e-mail together with relevant clinical information. RESULTS: Images were sent from Georgia to the UK using the agreed formats, and clinical comments were returned including comments on methodology. Images and comments were sent un-encrypted from Georgia. Standard views for cardiac imaging were obtained with development of exchange of imaging for other systems. There was good agreement for subjective interpretation of images. The use of more objective data charts such as POLAR mapping was found to be very useful in establishing common ground for image interpretation. CONCLUSION: E-mail communication can be effective in establishing image exchange for clinical decision-making and review. Useful developments of this type of exchange would be an agreed method of image and data encryption or the use of a secure server.

**1430–1600****Neuroradiology****1430 Invited review: Imaging the orbit**

JE Kabala

*Bristol Royal Infirmary, Bristol, UK*

The orbit is essentially a bony funnel with its apex posteriorly. The

globe lies anteriorly with the lacrimal gland superolaterally. The apex of the orbit consists of the region around the optic canal and the superior orbital fissure (SOF). The optic canal runs from the middle cranial fossa to the optic foramen in the posterior orbit and contains the optic nerve and ophthalmic artery. The inferolateral aspect of the SOF is continuous with the inferior orbital fissure (IOF). The IOF communicates posteriorly with the pterygopalatine fossa and anterosuperiorly with the orbital floor. It contains the maxillary nerve. MRI is maximally sensitive for the extent of soft tissue abnormality, particularly with regard to intracranial extension. CT, however, plays a complementary role and is indicated where assessment of fine bone detail is required. Pathological processes include: neoplasia; inflammatory lesions; vascular abnormalities; trauma; developmental; and a number of other conditions including benign processes of the adjacent bone. Tumours may arise from within the orbit, from the paranasal sinuses and adnexae, from the cranial cavity or from the bony walls themselves. The relationship of the tumour to its probable organ of origin and its imaging features will provide a high probability of accurate diagnosis but the radiologist's particular role will be the determination of tumour extent, especially with respect to intracranial involvement. This is also of particular concern with inflammatory lesions and both infective and non-infective inflammatory processes may extend intracranially.

**1500 Invited review: The skull base: the neurosurgeon's perspective**

P Anslow

*Radcliffe Royal Infirmary, Oxford, UK*

No abstract supplied.

**1530 Invited review: Imaging of the inner ear and central auditory pathways: anatomy and pathology**

JW Casselman

*A.Z. St-Jan a.v. Brugge, Brugge, Belgium*

High-resolution MR allows routine visualization of the four nerve branches inside the internal auditory canal (IAC), the scala tympani and vestibuli. New 3D-CT and MR software enable us to travel inside the labyrinth, or IAC. This has led to better detection of inner ear pathology. Gd-enhanced MR and  $T_2$  weighted (T2W) GE or TSE imaging can discover pathology inside the membranous labyrinth that could not previously be diagnosed *in vivo*. Acute (enhancement) and chronic (fibrotic obliteration) labyrinthitis and intralabyrinthine schwannomas and congenital malformations are the best known examples. Small schwannomas can be identified on a certain branch, leading to a different surgical approach and to better prediction of clinical outcome. Absence of fluid between an acoustic schwannoma and IAC fundus and lower signal intensity of the fluid inside the labyrinth on GE T2 images are indications that hearing preservation will be difficult. T2W GE or TSE images make the pre-operative work-up of cochlear implant candidates more accurate. Fibrotic obliteration of the cochlea or one of the scalas can be predicted and aplasia/hypoplasia of the cochlear branch of the vestibulocochlear nerve can be detected. A combination of high-resolution T2W GE and MRA sequences can demonstrate neurovascular conflicts. MRA is also used to look non invasively for causes of tinnitus. The acoustic pathway inside the brainstem can be visualized using thin long TR T2W images. Lesions involving the cochlear nuclei, trapezoid body, lateral lemniscus, inferior colliculus, medial geniculate body and auditory cortex can be recognized. Finally, functional MR can verify whether stimulation of the cochlear nerve reaches the cortex.

**1430–1630****New/Current Issues in MRI****1430 Invited review: What's new in abdominal MRI?**

DJ Lomas

*Addenbrooke's Hospital, Cambridge, UK*

No abstract supplied.

**1505 Invited review: Cardiovascular MRI**

M Graves

*Addenbrooke's NHS Trust, Cambridge, UK*

In recent years, improvements in MR hardware and software have led to robust imaging techniques capable of providing high quality morphological and functional imaging of the cardiovascular system. MRI

now offers the potential to provide, in a single investigation, more accurate and repeatable data than could be obtained using a combination of other tests, with the added advantage of providing some unique methods for the qualitative and quantitative evaluation of cardiac function. This presentation will review the recent progress and continued challenges of cardiovascular MRI.

**1540 Invited review: Exploring MR data: an introduction to visualization and post-processing techniques**

A Jackson

*Manchester Royal Infirmary, Manchester, UK*

No abstract supplied.

**1615 Discussion**

1500–1700

**Musculoskeletal: the pelvis**

**1500 Invited review: Radiology of hip replacement**

I McCall

*RJAH Orthopaedic Hospital, Oswestry, UK*

The increasing longevity of the population as well as major technical advances have resulted in an explosion in the number and variety of joint replacements being performed. Also, there are now a large number of people in whom the prosthesis has outlived its expected lifespan and which require revision. This increases the complexity of the prosthesis and the surgery, whilst also increasing the risks. Initial evaluation of the prosthesis is undertaken by plain radiography, and evidence of lucency between bone, cement and prosthesis or of prosthesis migration and bone resorption especially in uncemented prostheses remain the key findings. Granulomatous reaction leading to bone resorption is easily recognized, and wear of the acetabular components can be evaluated. Non union of the greater trochanter is often seen but its clinical significance is unclear. The isotope bone scan remains a useful screening tool for loosening of hip prosthesis. Infection is usually low grade with few overt radiological features and three-phase bone scans supplemented by Tc-99 leucoscan or Indium-111 cell labelling may be of value in making the diagnosis and in monitoring therapy. Computed tomography may be of value in assessing bone stock and extent of bone destruction prior to revision to assist the surgeon in planning further reconstruction. The presence of metal artefact limits the value of MR but it may occasionally be useful in prosthesis related to tumours.

**1530 Invited review: MRI of the hips**

M Cobby

*Frenchay Healthcare NHS Trust, Bristol, UK*

No abstract supplied.

**1600 Invited review: Imaging the pelvis in the sportsman**

P Robinson

*St James's University Hospital, Leeds, UK*

The pelvis is an extremely common site for sporting injury particularly in soccer, rugby and athletics. The high incidence of injury in this anatomical area is due to the presence of multiple joints and the confluence of powerful muscle groups. These different functional units produce and experience large forces, which often exceed multiples of body weight. Therefore the bones, joints, ligaments, tendons and muscles can experience forces that either produce acute failure or with time lead to overuse injuries. The pattern and severity of injury produced depends on the type and direction of such forces (e.g. compression, tension or shearing), which also depends on the type of sport performed. Equally important contributing factors include the maturity of the skeleton and the presence of pre-existing disease (e.g. tendinopathy, previous tear). Processes reviewed will include stress fractures, and apophyseal, inguino-femoral, muscle and tendon injuries. This talk will discuss a range of sporting injuries of the pelvis and try to put in perspective the relevance of imaging techniques in their diagnosis and management.

**1630 Plantar plate of the foot: ultrasound assessment and correlation with MRI**

JM Gregg

*Mayne Health Diagnostic Imaging, Windsor, Australia*

**PURPOSE:** To describe the normal and torn plantar plate at the lesser metatarsophalangeal joints using ultrasound, with MRI correlation on patients and cadavers. When patients proceeded to surgery, correlation with surgical findings was achieved. **MATERIALS AND METHODS:** Ultrasound and MRI were performed on 20 symptomatic feet and 30 asymptomatic feet (200 plantar plates of the lesser toes). Ultrasound of the plate in longitudinal and transverse sections, with static and dynamic scanning, was performed. MRI of the forefoot in sagittal, coronal and axial planes using T2 fat saturated and proton density sequences was obtained. Six cadaveric feet were imaged and dissected for direct correlation of findings; plantar plate insertional fibres were sent to histology for assessment. **RESULTS:** The plantar plate appears in the longitudinal and transverse planes on ultrasound similar to MRI in contour. The plantar plate, like all fibrocartilage, is homogeneously hypoechoic on ultrasound with its high number of collagen fibres. The average dimensions of the plantar plate are 20 mm × 2 mm. Tears are seen on ultrasound as a loss of this homogeneity in two planes. MRI tears are identified by T2 hyperintense signal within the plantar plate. Ultrasound achieved a sensitivity of 96% and a specificity of 63% compared with MRI. Improvement in scan techniques resulted in increased accuracy as the study progressed. **CONCLUSION:** Ultrasound offers itself as a superb alternative to MRI in the assessment of plantar plate dysfunction of the lesser metatarsophalangeal joints.

**1640 Audit of the diagnosis and management of the non-traumatic acute hot joint in the A&E department**

<sup>1,2</sup>DM Quinn, <sup>2</sup>AJ Rohr, <sup>2</sup>EJ Tunn, <sup>1</sup>Z Hussain and

<sup>2</sup>DA Ritchie

*<sup>1</sup>The University of Liverpool, Liverpool, UK and <sup>2</sup>The Royal Liverpool and Broadgreen University Hospitals NHS Trust, Liverpool, UK*

**PURPOSE:** To demonstrate the role of plain film radiography in the diagnosis and management of the non-traumatic acute hot joint. **METHOD:** Medical staff and radiographers prospectively identified 51 A&E admissions with a non-traumatic acute hot joint in a 6-month period. Customized questionnaires were completed from each patient's case notes. Radiographs of the 47 patients X-rayed were analysed for the presence of arthropathic features. **RESULTS:** Clinical features presenting most frequently included swelling, pain and heat. The mean duration of onset of features was 3.8 days, with the knee and elbow commonly involved. Radiographs were performed on 92.2% of patients, arthrocentesis on 17.6% and laboratory examinations on 74.5%. Correlation tests indicated a negative relationship between clinical and radiological features, possibly attributed to recognized opinion that radiological findings lag clinical features. Clinical features raised clinical suspicion, evidenced by a highly significant positive correlation ( $p < 0.01$ ). Clinical and radiological diagnoses displayed a significant difference ( $p < 0.05$ ) and negative correlation. **CONCLUSION:** The acute hot joint with distinguishable clinical features did not produce the corresponding magnitude of plain film radiological evidence. Clinical diagnosis was made based on the presenting clinical features and results of investigations performed, with clinical features precipitating the level of investigations. The factors that supported the clinical diagnoses did not have radiological counterparts owing to the acuteness in presentation of the hot joint. Therefore, the role of radiography is questionable in view of its usefulness in clinical decision-making.

**1650 Are Trusts replacing the red dot? A Trauma Imaging Group research project**

BA Snaith

*Mid Yorkshire Hospitals NHS Trust, Wakefield, UK*

**PURPOSE:** To investigate the development of radiographer comments schemes as a development of the red dot in relation to A&E radiography. **METHOD:** Questionnaires were distributed to all departments that indicated the use of a radiographer comments scheme in the 2001 Trauma Imaging Group (TIG) survey. **RESULTS:** Results will be presented showing the extent to which departments have moved on from the red dot scheme, their justification, what training was provided and whether protocols are in place. **RECOMMENDATIONS:**



The results of this research will allow the TIG to produce guidance for departments wishing to initiate radiographer comments schemes, including protocol development, templates for proformas and risk management proposals. **ACKNOWLEDGMENT:** This research was funded by the Trauma Imaging Group.

1530–1700

## Thoracic Imaging

### 1530 Invited review: Smoking-related interstitial lung disease

S Desai

*King's Healthcare NHS Trust, London, UK*

There is now an increasing awareness of the association between cigarette smoking and a variety of interstitial lung diseases. Over 90% of patients with Langerhans' cell histiocytosis will give a history of smoking. The entities of desquamative interstitial pneumonia and respiratory bronchiolitis-associated interstitial lung disease are also recognized smoking-related lung diseases. Finally, there is a growing consensus that smoking itself may be an aetiological factor in the development of pulmonary fibrosis. The presentation will review the histopathological and radiological (particularly HRCT) features of the smoking-related interstitial lung diseases.

### 1600 Invited review: Detection errors in lung cancer and prognosis

F Gleeson

*Churchill Hospital, Oxford, UK*

No abstract supplied.

### 1630 Invited review: Staging lung cancer

L Gomersall

*Aberdeen Royal Infirmary, Aberdeen, UK*

No abstract supplied.

1615–1700

## Genitourinary Scientific Session

### 1615 Congenital uterine anomalies: a pictorial review of their MRI appearances

AF Scarsbrook and NR Moore

*John Radcliffe Hospital, Oxford, UK*

**PURPOSE:** In the developing female embryo, the uterus, Fallopian tubes and upper two-thirds of the vagina arise from paired paramesonephric or Müllerian ducts. Müllerian duct abnormalities can result from failure at any stage of this developmental process. These manifest themselves as a variety of abnormalities of the uterus and upper vagina. Congenital anomalies of the uterus are a well documented cause of subfertility and in some cases can be successfully treated to preserve fertility and to prevent complications. We discuss the various types of abnormality and present a pictorial review of their appearances as viewed by MRI. MRI provides an excellent non-invasive method of differentiating between the different types of anomaly and defining their suitability for surgical treatment.

### 1625 Characterization of giant ovarian masses with CT and correlation with surgical pathology

TM Wah, LM Clarkson, A Oboh, G Lane and JA Spencer

*St James's University Hospital, Leeds, UK*

**PURPOSE:** Historically, a size greater than 10 cm has been considered to be an adverse feature in complex ovarian masses. These women are typically treated with radical cytoreductive surgery. However, giant unilocular ovarian masses are often benign and can be cured by resection alone. We evaluated the CT findings of giant ovarian masses and correlated these with the surgical pathology. **METHODS:** We studied 42 women (age range 24–92 years, mean 55 years) with giant ovarian masses (range 10–33 cm) without evidence of peritoneal or nodal metastasis by CT criteria. Pre-operative CT examinations were analysed on a computer console by a single radiologist blinded to both clinical details and histology. Masses were assessed for all solid elements including wall, septal or nodular dimensions, calcifications, cyst densities and lesion size. **RESULTS:** Histology of the mass was

benign (25), borderline (12) and malignant (5). Solid elements were measured: wall thickness ranged from 1–31.3 mm, nodule dimension from 5–85 mm, septa thickness from 1–14.6 mm, and presence of fine or coarse calcifications noted from 2–31 mm. The HU for the ovarian masses varied from 7–71. **CONCLUSIONS:** If CT shows no evidence of metastasis with a giant ovarian mass there is an 88% chance of a benign or borderline lesion that can be treated by resection alone. Currently, on logistic regression analysis only HU values were discriminant between benign and malignant lesions, but with increased sample size in this ongoing study other parameters may prove significant discriminators.

### 1635 Accuracy of MRI in cervical carcinoma: preparation for the onset of trachelectomy

MLA Schofield, A Gillespie and RA Nakielny

*Royal Hallamshire Hospital, Sheffield, UK*

**INTRODUCTION:** The use of MRI in aiding cervical carcinoma staging is well established. With the potential of trachelectomy for fertility-retaining treatment, we performed a retrospective study to re-assess the accuracy of visualizing and measuring small tumours, assessing parametrial extension and myometrial invasion on MRI. **METHODS:** Cases included those who were due to have surgery at the tertiary referral centre. The pathological technique for assessing tumour size was reviewed and the size from the histological specimen was correlated with the MRI report. If there were large discrepancies between size, films were reviewed and potential causes were identified. **RESULTS:** 21 patients were included. Primary tumour was not seen in 9/21. 5/9 had no tumour on histology. 4/9 had a 5–6 mm plaque of tumour. 3/21 cases were difficult to distinguish tumour from inflammatory change from recent biopsy but showed no tumour on histology. 7/21 had measurable disease. In 5/7 the dimensions on the MR scan were within 36% of the actual histological specimen. No cases had myometrial involvement on MRI or histology. PPV for no parametrial invasion = 95%. **CONCLUSION:** The study highlights the problems of visualizing small disease, particularly in a plaque-like configuration. Recent biopsy can limit interpretation of possible tumour. Current experience suggests we are in a satisfactory position for imaging if trachelectomy procedures were to be performed in our hospital.

### 1645 Accuracy of ultrasound imaging in the detection of recurrent gynaecological cancer

<sup>1</sup>R Phillips, <sup>2</sup>N Johnson and <sup>3</sup>F Ralli

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**PURPOSE:** Assessment of gynaecological recurrence disease status in the evaluation of patients during follow-up, using a reliable non-invasive imaging technology that can detect early recurrences regarding the presence and size of clinically undetectable recurrent tumour deposits, is vital for the selection of appropriate management. This may reduce the need for surgical diagnostic procedures and possibly improve long-term prognosis and survival of these women. The aim of the study was to investigate the accuracy of routine ultrasound imaging as part of a gynaecological oncology surveillance programme. **MATERIALS AND METHODS:** A prospective study was carried out over 14 months. 132 consecutive patients with previously diagnosed gynaecological cancer were recruited. Transabdominal and transvaginal pelvic ultrasound scans were performed at regular intervals along with vaginal examinations. Interobserver variation was calculated. **RESULTS:** Ultrasound imaging showed a sensitivity of 70% and a specificity of 93% in the detection of recurrent gynaecological cancer. There was good agreement between the ultrasonographers, with a weighted kappa score of 0.62. **CONCLUSIONS:** Routine pelvic ultrasound imaging is effective in this surveillance programme, having identified 7 out of 10 women with recurrent disease and probably improved outcome in these asymptomatic women. This imaging technique is also particularly good at excluding the presence of recurrent disease. With a positive predictive value of 46%, further tests such as CT, MRI and vaginal biopsies are still required to confirm the diagnosis before further patient management can be planned. Ultrasound, with its relatively low cost and easy availability, proves to be a useful tool for this purpose.

# Notes

# Posters

## Audit

### POSTER 101

#### **Error review in radiology: a successful working model**

CA Melvin

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**PURPOSE:** To establish a robust mechanism for reviewing radiological errors in a non-threatening environment, which combines a useful teaching component and feeds back into the governance process. **METHOD:** A 30-min weekly meeting attended by all radiologists is chaired by a nominated convenor. Errors noted by radiologists or other clinicians are recorded on a specific form drafted on the principles of "To Err is Human", literature review and local experience. Cases are reviewed, with original clinical details, by a radiologist not previously familiar with the case, and following group discussion a judgement is made on how the error should be categorized. A monthly report is included in the hospital Governance Report. **RESULTS:** The number of meetings and attendance figures will be presented. The number of cases reviewed, errors and categories will be analysed. **CONCLUSION:** The process has strengthened the department's ability to handle errors, is popular with radiologists and provides a mechanism to address errors referred from other departments.

### POSTER 102

#### **Radiology errors meeting: a useful clinical governance tool? A 1-year DGH experience**

R Evans and P Peddu

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**INTRODUCTION:** Reporting of adverse healthcare events and near misses is an important component of risk management as outlined in "An Organisation with a Memory" (DoH 2000). Application of these principles to radiology is outlined in "To Err is Human — the Case for Review of Reporting Discrepancies" (RCR 2001). The aim of this study was to establish whether a radiology errors meeting can be effective in identifying adverse incidences and implementing changes in practice. **MATERIAL AND METHODS:** A retrospective study of six errors meetings over a 1-year period in a District General Hospital. Key issues leading to errors were identified and subsequent action was recorded. **RESULTS:** 56 "errors" were reported, of which 29 were confirmed "errors", 19 were no "error" and 7 had insufficient evidence to decide. Inconclusive cases were mainly caused by lack of availability of patient notes and X-ray packets. Common key issues were: abnormal reports not being acted upon by referrers; non-availability of previous films; inadequate clinical details on requests; and unreported procedures showing significant findings. Changes in practice were initiated by the majority of key issues. **CONCLUSION:** Introduction of an errors meeting is an effective risk management/clinical governance tool in a busy DGH environment. Lack of availability of patient records and images diminishes the value of the errors meeting process.

### POSTER 103

#### **Audit of time from stroke to CT: the district general experience**

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**PURPOSE:** Royal College of Physician (RCP) Guidelines recommend all cases of clinical stroke should have CT brain scans within 48 h. We used this as our audit gold standard and evaluated possible delays to CT examination at our district general hospital. **MATERIALS AND METHODS:** In a retrospective audit, all patients admitted with stroke in June and July 2002 were included in the study ( $n=61$ ). We reviewed: (1) total time from admission to CT being performed; (2) time from admission to date on request form; (3) time from date on request to receipt in CT department; and (4) time from request receipt in CT to examination being performed. **RESULTS:** Median time from admission to CT was 96 h. Only 28/61 were examined within the RCP Guidelines. Approximately 25% (15/61) did not have their examination requested

within 48 h and one-third (20/61) have a delay of more than 48 h between receipt of the request and CT examination. There was little delay between request date and receipt in the CT department. Nearly 25% (13/61) are scanned on same day as the request is received. **CONCLUSION:** To reduce the average time from stroke to CT in our institution, several changes have been made. The stroke co-ordinator nurse specialist has been authorized to request CT brain scans in cases of stroke under IRMER 2000. EPR has been introduced. Finally, protocolling radiologists have altered their prioritizing of stroke. We intend to re-audit following implementation of these changes.

### POSTER 104

#### **Reporting of ultrasound for pleural effusions: an audit**

AD Calder

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**PURPOSE:** To evaluate the quality of radiologists' reports of ultrasounds of the pleural cavity in patients with suspected pleural effusion at a District General Hospital. **METHODS:** A literature search was performed to establish what useful information should be included on a report of an ultrasound of a pleural effusion. This included measurement of size, comments on internal echoreflectivity, marking of sites for drainage, an indication of the patient's position at time of marking and a measurement of the depth of fluid from the skin surface. 31 consecutive reports from an 8-month period were then evaluated according to these criteria. **RESULTS:** Effusions were mostly measured using subjective labels only. Effusion volume was not estimated numerically. Comments on the internal structure of effusions were only given in one-third of cases. The patient's position at the time of marking was not given in the majority of cases where the effusion was marked, and the skin-to-pleura depth was only given in two cases. **CONCLUSION:** Information given on pleural ultrasound reports was incomplete compared with a gold standard of reporting. A poster has been placed in the ultrasound room giving guidance on reporting, with a view to re-auditing in a few months time.

### POSTER 105

#### **Audit of catheter specimen urine results from percutaneous nephrostomy and antegrade ureteric stent insertion**

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Antibiotic prophylaxis is a significant part of the pre-procedural work-up of patients undergoing percutaneous nephrostomy or antegrade ureteric stent insertion. It is important to target antimicrobial therapy appropriately. It is policy in our Centre to administer 1.5 g Cefuroxime 1 h before the procedure. This study was performed to see whether this was the appropriate antibiotic in relation to organisms isolated from catheter specimen urine (CSU) samples taken during procedures. Data prospectively recorded for all patients undergoing percutaneous nephrostomy or stent insertion for the year 2001 were reviewed and details of any microorganisms isolated were recorded. For the year, 93 procedures were performed (79 nephrostomies, 14 stents). CSU records were found in only 31 (33%) cases. Of these cases, 20 (64.5%) showed no growth, 3 (9.7%) grew a mixed culture and 4 (12.9%) grew Coliforms. The rest were single cultures of various organisms. None of the positive cultures were resistant to Cefuroxime. A review of the cases with no samples registered revealed that peri-procedural CSU samples were taken by the Radiology Department but were not received by the site Microbiology Department from the wards. This trend was most marked for emergency procedures performed out of normal business hours. It is now policy to send the procedural CSU samples direct from the Radiology Department. This review is part of a prospective study to assess the efficacy of current antibiotic prophylaxis, and it emphasizes the importance of microbiological follow-up, particularly in "on-call" work where sepsis may have the most clinical relevance.

**POSTER 106****An audit of CT pneumocolon in routine practice: a comparison of outcomes with accepted standards**

G Soo, RR Misra and P Shorvon

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**PURPOSE:** CT pneumocolon (CTP) studies have been performed at this DGH for 3 years. The last 2 years were audited (a) to compare results with accepted standards produced by tertiary centres in the research setting and (b) to establish a baseline before implementing virtual colonoscopy in our image analysis. **MATERIALS AND METHODS:** Consecutive CTP radiology reports (June 2000 to June 2002) were retrospectively compared with clinical outcome using corresponding patients' notes. Where notes were unavailable, endoscopy and histopathology databases were accessed. CTP technique involved bowel cleansing, rectal air insufflation, supine/prone examination (post IV contrast and hyoscine) using a twin-beam scanner (5 mm collimation, 2.5 mm reconstruction) and workstation review with multiplanar (axial, sagittal, coronal) reconstructions. **STANDARDS:** From a literature review, we aimed for 95% detection rate of colonic carcinomas and 85% detection rate of colonic polyps >5 mm diameter. **RESULTS:** Of 159 patients (70 male, 89 female; median age 76 years), 22 were excluded (16 awaiting or declined follow-up, 4 non-diagnostic studies (faecal residue), 2 missing records). 55/137 underwent direct colonic visualization (colonoscopy/surgery). 126/137 (92%) had concordant CT results with 8 false positives and 3 false negatives (95% sensitivity, 89% specificity). 14/14 (100%) colonic carcinomas and 11/13 (85%) benign polyps were detected (2/5 polyps less than 5 mm diameter were undetected). When suboptimal studies ( $n=42$ ) were omitted from analysis, no significant difference in results was found. All carcinomas and polyps >5 mm diameter were detected. **CONCLUSION:** CTP is replacing barium enema in many situations. This audit reassures us that we are meeting current standards and provides baseline data prior to refinement of the technique.

**POSTER 107****Are lateral views essential in trochanteric fractures? Results of an audit study**<sup>1</sup>D Sunderamoorthy and <sup>2</sup>G Zafiropolous<sup>1</sup>Royal Gwent Hospital, Newport, UK and <sup>2</sup>Prince Charles Hospital, Merthyr Tydfil, UK

**AIM:** Anteroposterior and lateral radiographs are routinely performed to diagnose and assess trochanteric fractures. The purpose of the study was to compare the results of the adequacy of the lateral radiographs performed in intertrochanteric fractures between the 2 years July 1998 to June 1999 and January 2000 to December 2000. **METHOD:** We retrospectively reviewed the lateral radiographs of patients who had trochanteric fracture during the period January 2000 to December 2000. 56 X-rays were available for review from the 79 patients who were admitted with trochanteric fractures during the above period. The lateral view and the time at which it was performed were reviewed. **RESULTS:** 50% of the lateral views were found to be inadequate compared with 30% inadequate in the previous audit. Of the lateral views performed in normal hours and out-of-hours, 57% and 40%, respectively, were inadequate compared with the previous audit that showed that 40% and 25% of the lateral views performed during normal and out-of-hours, respectively, were inadequate. **CONCLUSION:** The above audit study shows that there had not been any improvement in the standards of the lateral radiographs performed for patients with trochanteric fractures. Patients with such fractures are routinely screened in the operating theatre prior to surgery and this raises the question as to whether lateral views are really necessary in patients with intertrochanteric fractures.

**POSTER 108****An audit of the number of radiographs during intravenous urography**

A Jegadeesapandian and JN Perry

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**PURPOSE:** Intravenous urograms (IVUs) are one of the common investigations involving radiation exposure. We reviewed the number of radiographs per IVU and compared our current practice with the recommendations of the NRPB. These recommendations are to exclude 1-min film and post-micturition film and to take no more than six films in total. **MATERIALS AND METHODS:** 50 consecutive routine

IVUs referred for loin pain, suspected stone, haematuria, etc. were evaluated from 28.05.02 to 4.07.02 and the number of films for each examination was counted. **RESULTS:** Out of 50 patients, 32 were male and 18 were female. The age range was 19–86 years. The number of films obtained for each examination varied between 2 and 12. 46% had more than six films; 82% had immediate (1-min) film; and 90% had post-micturition films. Of 16 patients who were having repeat IVUs, 10 had six or more films. Tomography was the main reason in increasing the number of films. **CONCLUSION:** When an IVU is indicated, there is no universally accepted film sequence in the UK. Limiting the number of radiographs will significantly reduce the collective dose to the patient. A cost effective film sequence without impairing the diagnostic efficacy of the IVU will result in efficient use of radiographer's and radiologist's time. We have changed the protocol for renal colic and haematuria to reduce the number of films. The use of ultrasound is also emphasized for diagnosing renal masses. We will re-audit the new protocol in 6 months time.

**POSTER 109****Outcome of parenchymal deformities recalled for assessment**

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**AIMS:** To assess the outcome of parenchymal deformities (PDs) (architectural deformity) on all age screening mammograms over a 1-year period. To calculate the recall rate and positive predictive value (PPV) for the unit and for each reader anonymously and to display the data as a PPV of referral chart. To analyse the outcome of genuine PDs, the histological size and the grade for malignant lesions. **METHOD:** Cases included those PDs from all screening films where at least one reader recalled the patient for a PD. **RESULTS:** 12,650 patients screened. 130 cases recalled for PD. 23/130 (17.7%) are genuine. 12 confirmed as malignant, including 2 tubular carcinomas. PPV for PD = 10%. 25% of screen-detected carcinomas are PDs. Of 23 genuine PDs, only 3 had radial scars and 1 of these was associated with a tubular carcinoma. 9/23 (39%) genuine PDs had open biopsy, with a benign:malignant ratio of 2:1. Invasive cancer detection rate in women recalled for PD = 1.04 per 1000. **CONCLUSION:** PPV for malignancy is an indication of the success of the diagnostic process. There is no gold standard for the PPV of PDs and direct comparison with those in the literature is limited. From the Sheffield screening programme, 4–5 malignancies per 1000 are detected and so if 1 per 1000 is from a recalled PD, the mammographic feature of a PD is important. 25% of the malignancies detected are small (<15 mm). US is an effective first-line method of biopsy but with greater experience mammatome biopsies are likely to have a greater role in the future.

**POSTER 110****I'll have that again: an audit of patients' response to and complications from prostate biopsy**

RR Misra, J Shah, Z Debbagh and C Allen

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**INTRODUCTION:** The number of prostate biopsies being performed increases every year. Some men need multiple repeat biopsies. Traditionally, the procedure has been performed as an outpatient with no analgesia. Studies have shown that 96% of patients find the biopsy painful and 20% unbearably so. Our department has modified the technique of prostate biopsy to try and improve the patient's perception of the procedure. This involved giving the patients a detailed information sheet, explanation and using local anaesthetic during the procedure. **MATERIALS AND METHODS:** 350 patients undergoing prostate biopsy were given a form to complete for 1 week following biopsy. This form consisted of an analogue pain scale, a diary of common complications, e.g. haematuria and PR bleeding, an analgesia diary, and they were asked whether they had needed to contact a doctor and for any other comments including whether they would have the procedure performed again. **RESULTS:** 290 men responded. Over 70% scored the procedure as almost painless and would have it done again. Less than 5% found the procedure painful. 80% had mild haematuria, 50% mild PR bleeding. Less than 1% developed symptomatic infection. **CONCLUSION:** Prostate biopsy performed optimally is a well tolerated procedure that the majority of men would have repeated if necessary.

**POSTER 111**

**Introducing investigative protocols for venous thromboembolic diseases**

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**ABSTRACT:** The diagnosis of venous thromboembolic disease (VTE), including DVT and PE, has significantly altered in the last decade. Introduction of non-invasive assessment has led to increased demand for imaging for DVT and there also has been an increased demand for imaging in suspected PE. Although contention remains regarding the best method for investigation, a combination of risk probability assessment, D-Dimer testing and radiological investigations provides a cost effective, rapid and reliable method for diagnosis of VTE. Some institutions have introduced protocols for investigation of thromboembolic disease and others intend to, but have not, often owing to time constraints. We present our experience in the implementation of an evidence-based protocol in the following five steps: (i) objectives of protocol (which include improvement in clinical assessment, moderation in D-Dimer and radiology requests, and reduction in hospital waits); (ii) evidence supporting these protocols; (iii) design of a form combining risk probability assessment, D-Dimer testing and radiological investigations. (iv) audit looking into the negative predictive value of D-Dimer and reduction in radiological investigations; and (v) changes made and the implementation of a new protocol that has helped us save a significant number of ultrasound scans for probable DVT as well as V/Q scans and spiral CT scans for probable PE in our institution, with evidence of reliability and safety of these protocols.

**POSTER 112**

**Audit of the utility of pre-test probability scoring for acute lower limb DVT**

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**PURPOSE:** To assess the utility of pre-test probability scoring in the selection of patients for US investigation of acute lower limb DVT. **MATERIALS AND METHODS:** Prospective audit of patients undergoing US for possible acute DVT. Clinicians were asked to complete a pre-test probability score for each patient according to the method developed by Wells et al, in accordance with established hospital guidelines. D-dimer testing was also undertaken if indicated by guidelines. The patient was then independently re-scored by the examining radiologist according to the same system. **RESULTS:** In 2 months, 180 patients attended the US Department for acute DVT assessment. Pre-test probability scores were completed for 88 patients. Complete data were available at the end of the study period for 66 patients. In total, 17/66 (26%) patients were confirmed to have acute DVT. Of these, 8/66 (12%) underwent US despite not falling within the guidelines as assessed from the pre-test probability score derived by the referring clinician. This rose to 26/66 (41%) according to the score derived by the radiologist. A positive D-dimer test was present in 40 patients, and 9 (22%) had a DVT. Of 31 with a negative US, only 20 (62%) were followed up appropriately with repeat US. **CONCLUSION:** There is significant discrepancy between clinician-derived and radiologist-derived pre-test probability scores. The clinician-derived score significantly overcalls the need for US examination, resulting in many unnecessary examinations. Possible reasons are discussed.

**POSTER 113**

**Interpretation of trauma radiographs by nurses and radiographers in the UK: a comparison study**

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**PURPOSE:** To identify the number of hospitals employing nurses and radiographers to formally interpret trauma radiographs, the education undertaken by these professions to support this role extension and any practice limitations placed upon them. **METHOD:** A questionnaire survey of nurse and radiographer managers responsible for A&E services within the UK was undertaken in January 2002. 526 questionnaires were distributed in total. **RESULTS:** Response rates of 75.2% and 69.2% were received from radiographer and nurse managers, respectively. 96 (53%) nurse managers indicated that nurses

were formally interpreting trauma radiographs within their departments, whereas only 68 (34%) radiographer managers indicated that radiographers were undertaking this role. Education to support this role extension varied markedly between the professions, with 93% of radiographers interpreting trauma radiographs having undertaken a postgraduate qualification in radiographic image interpretation. In contrast, nurse education was generally less specific or formal. Intraprofessional and interprofessional variation in working practice was also noted. **CONCLUSIONS:** Radiographic interpretation of trauma radiographs is undertaken both by nurses and radiographers. However, there is marked intraprofessional and interprofessional variation in working practices and in the level of education undertaken to support this role extension. Consequently, it can be summarized that there is national variation in service delivery and quality with respect to the interpretation of trauma radiographs, and a review of current service delivery strategies is recommended to optimize patient care.

**POSTER 114**

**Audit of accuracy of interpretation of A&E radiographs by A&E junior staff**

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**PURPOSE:** The aim of this study was to look at the accuracy of interpretation of A&E radiographs by A&E junior staff and the time taken for the A&E department to be informed where the subsequent radiology report differs from the original interpretation. **METHODS:** 300 radiographs taken in A&E were audited. Each radiograph was marked with a chinagraph mark. An "N" indicated a normal film; an arrow indicated an abnormality; an arrow + ? indicated a possible abnormality. The median time for radiological reporting was recorded in terms of working days. **RESULTS:** 59% of all radiographs were marked with a chinagraph. Of those marked as normal, 15% had missed an abnormality, which was mainly chest pathology. Of those thought to have an abnormality and marked with an arrow, 45% were, in fact, normal. The most common over-calls were normal variants in lower limb films (bipartite patellae) and vessels on chest films. Upper limb films were most accurately interpreted. For those films where a subsequent radiological report differed from the original interpretation in A&E, the A&E department was informed of this within a median of 1 working day. **CONCLUSION:** This audit shows that radiological reporting of A&E films is meeting the standard recommended by the RCR. However, it also shows that teaching in A&E should be geared towards looking at chest films and normal variants.

**POSTER 115**

**Radiographer reporting accuracy of double-contrast barium enema examinations**

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**PURPOSE:** Previous literature has confirmed that most lesions missed on the double-contrast barium enema (DCBE) are due to perception errors. Double reporting of studies has been widely recommended, but with the national shortage of radiologists this practice is difficult to implement. The number of radiographers performing DCBE examinations has been increasing since the first pilot project in 1990-1 and there is now a significant body of experienced radiographers. These experienced practitioners are ideally placed to provide part of this double reporting service. Against this background, the accuracy of the post-examination comments provided by radiographers at a large teaching hospital were evaluated for accuracy. **MATERIALS AND METHODS:** This is a retrospective review of radiographer comments provided at the time of the examination, comparing accuracy against the final radiologist report, and pathology results or medical follow-up where there are discrepancies. **RESULTS:** Preliminary results focused on significant (*i.e.* malignant) pathology indicate that experienced radiographers are able to accurately characterize lesions shown at DCBE. **CONCLUSIONS:** There is a ready workforce of experienced practitioners able to participate in double reporting of DCBEs. This will enable diagnostic imaging departments to benefit from the practice of double reporting of these studies despite the chronic lack of radiologists. Patients will benefit from the increase in sensitivity that this practice promises.

**POSTER 116****Radiographic interpretation by accident and emergency staff: an audit of 2198 X-ray films**Z Husamaldin, F Almallah, K Mirza, N Brarley and J Gray  
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**INTRODUCTION:** It is believed that misinterpretation of X-ray films is common among junior staff in accident and emergency (A&E) departments and it is important to detect these errors to implement the necessary alternative management. On the other hand, the usefulness of re-examining a large number of mostly normal radiographs by radiologists with heavy workloads has been questioned. Therefore, the aim of this audit was to investigate the diagnostic accuracy of radiographic interpretation in the A&E department. **METHODS:** Over a period of 3 months, interpretation of trauma X-ray films by A&E staff, SHO's, staff grade doctors and nurse practitioners was compared with the final report issued by the radiology department. The diagnostic accuracy was assessed and any significant alteration to patient management was recorded. **RESULTS:** Interpretation of 2198 trauma X-ray films was examined. There were 703 (32%) films with abnormal findings. 141 (6.4%) films were misinterpreted by A&E staff, of which 85 (3.8%) were false negative interpretations. 38 (1.7%) were significant errors that meant the patients were recalled for altered management. The most common errors were in the interpretation of ankle and foot films. No improvement in interpretation accuracy was noted over the 3-month period. There was no significant difference in the error rate between day and night or weekends. **CONCLUSION:** The overall diagnostic accuracy of radiographic interpretation by A&E staff was relatively good, however, staff training, supervision and/or formal reporting of films is still required.

**POSTER 117****Optimizing material management and work flow in interventional radiology departments**<sup>1</sup>D Clevert, <sup>1</sup>E Jung, <sup>1</sup>R Krause, <sup>2</sup>D Clevert and <sup>1</sup>N Rupp  
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**PURPOSE:** Cost reduction by smart organization of purchasing material. **METHODS AND MATERIALS:** After compilation of a comprehensive stock list of all disposable materials necessary for our interventional radiology department, an ABC analysis was performed with focus on high priced and high turnover materials (A-articles). Data were processed by a new stock management and ordering program (Boston Scientific, Germany). Based on ordering frequency, all A-articles were subjected to XYZ analysis, which is based on predicting the probability of requirement of the article. On this basis, capital binding costs were considered, with an annual interest rate of 8% assumed. **RESULTS:** The overall stock handling costs of the hospital were curbed. The reduction in warehouse size saves \$2700 each year. The smaller amount of capital tied up in inventories brings about another annual saving of \$14,500. The total reduction in costs is thus \$17,250 per year. The PC-based program automates ordering, records expiry dates and assigns the consumption to patients, allowing further annual cost cuts of \$37,500. The maximum total saving is thus \$54,750, equivalent to 15.5% of our interventional radiology department expenses. **CONCLUSION:** Flexible just-in-time purchase of medical articles and the application of Boston Scientific's new stock management can help to reduce stock and capital binding, especially of cost sensitive A-articles, without impairing medical quality.

**POSTER 118****A review of referral policy for limited resource or potentially harmful procedures**PJ Mullaney and DBL Findlay  
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Since the publication of the Calman Report, the drive for a more consultant-led practice across all medical and surgical specialties has been emphasized. This has theoretical benefits for improved patient care and for the more efficient use of medical resources, both in clinical diagnosis and management. This philosophy has relevant implications for radiology where manpower and technical resources are struggling to keep up with increasing demands. The use of departmental policies regarding the referral of patients for expensive or high demand investigations may provide a way to address both issues of quality control and cost effectiveness. This Trust is currently reviewing referral policies for expensive or potentially harmful investiga-

tions performed by the radiology department, specifically nuclear medicine investigations, musculoskeletal MRI and musculoskeletal interventions. In an effort to standardize care across the Trust, departmental practice across the region was appraised by questionnaire. Trusts were asked whether these investigations had to be requested by consultant, or specifically approved by the consultant after discussion with junior staff. Preliminary results show that across Trusts overall, 50% of these procedures need a consultant signature, or documentation that the consultant has approved the procedure as appropriate. This varied from 20% for nuclear medicine investigations to 70% for musculoskeletal interventions. This has implications for the Trust in terms of cost, specialist training and risk management, all important elements of clinical governance.

**Breast and Oncology****POSTER 201****Time course comparison of MultiHance (gadobenate dimeglumine) and Magnevist (gadopentetate dimeglumine) in magnetic resonance mammography**I Salerio and M Kirchin  
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**PURPOSE:** To compare MultiHance- and Magnevist-enhanced MRI for signal intensity (SI)-time curve evaluation of breast lesions. **MATERIALS AND METHODS:** Malignant breast lesions on coronal 3D-GRE-T1w MR images acquired at 0, 2, 4, 6 and 8 min after 0.1 mmol kg<sup>-1</sup> MultiHance or Magnevist were compared quantitatively by two blinded assessors on the basis of SI-time curves generated from the placing of up to three regions-of-interest (ROIs) for each identified lesion. The most representative curve for each lesion was described according to the SI enhancement rate (on a 3-point scale: 1 = slow; 2 = intermediate; 3 = fast) and the time course for SI enhancement (on a 3-point scale: 1 = steady increase; 2 = plateau; 3 = wash-out). **RESULTS:** In patients with confirmed malignant lesions (MultiHance *n*=27; Magnevist *n*=34), a total of 38 and 51 ROIs were placed by one assessor and 25 and 33 ROIs by the other. The percentage increase in SI enhancement from pre dose was higher for MultiHance for both assessors (+120.4% and +54.7%). Assessors 1 and 2 described the enhancement rate as "fast" in 31/33 (94%) and 20/23 (87%) lesions after Magnevist and in 24/27 (89%) and 22/23 (96%) lesions after MultiHance. The SI-time course was "wash-out" for 27/33 (82%) and 17/23 (74%) lesions after Magnevist and for 22/27 (81%) and 21/23 (91%) lesions after MultiHance. "Wash-out" was the predominant curve for all other malignant lesion types. **CONCLUSION:** The SI increase of malignant lesions is markedly greater after 0.1 mmol kg<sup>-1</sup> MultiHance compared with 0.1 mmol kg<sup>-1</sup> Magnevist, and no differences in time course are apparent.

**POSTER 202****Quality assurance of open, low field MRI in adjuvant breast radiotherapy planning**<sup>1</sup>TPE Wells, <sup>1</sup>J Carroll, <sup>2</sup>P Goddard, <sup>3</sup>M Halliwell, <sup>1</sup>B Khoudi, <sup>2</sup>C Wakeley and <sup>1</sup>EC Whipp  
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**PURPOSE:** To investigate the use of open MRI in breast radiotherapy planning and to assess intraperson and interperson agreement for scan analysis of radiation coverage. **MATERIALS AND METHODS:** An open MRI scanner (0.2 T Siemens) with image distortion correction, loop coil, positional lasers, treatment wedge and custom-made arm pole enabled women with early stage breast cancer to be scanned in the conventional radiotherapy treatment position prior to planning. Radiation coverage of the post-surgical area, breast, nodes and organs-at-risk was examined with reference to the 50% dose line on axial images of a series of 19 anonymized MRI scans. Analyses were performed independently by a non-clinical scientist, a consultant clinical oncologist and a consultant radiologist. **RESULTS:** Interperson agreement for scan analysis was excellent. Kappa values were 0.820 (axillary incision), 0.820 (heart), 0.840 (lung), 0.698 (lymph nodes) and 0.746 (tumour bed). Intraperson agreement was also good. Kappa values were 1.00 for all measurements made by the non-clinical scientist, and 0.600 (heart) to 1.00 (tumour bed) for measurements made by the consultant oncologist. **CONCLUSION:** Advantages of MRI over CT are excellent soft tissue contrast in the breast and axilla,

the ability to scan in the treatment position and a better 3D perspective because of having images in three planes. Quality control shows good intraperson and interperson agreement for analysis. Using the MRI scan information, radiotherapy coverage can be improved by optimizing treatment margins. There is potential to use 3D treatment techniques to improve radiotherapy targeting further, although issues such as image segmentation of MRI need attention.

**POSTER 203**

**Stellate lesions detected at screening mammography: how good is 14 G core biopsy at excluding malignancy?**

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**PURPOSE:** Mammographic stellate lesions pose a diagnostic challenge. On excision histology they most commonly represent either a benign radial scar/complex sclerosing lesion or *in situ* or invasive malignancy. We set out to assess the accuracy of 14 G core biopsy (CB) for stellate lesions identified at screening mammography. **MATERIALS AND METHODS:** We reviewed the records of 82 patients with screen-detected stellate lesions who had image-guided CB (ultrasound or stereotactic) followed by surgical excision. **RESULTS:** The final surgical histology of the 82 cases showed 35 patients (43%) with benign radial scars, 30 (36%) with malignancy alone, 9 (11%) with both radial scar and malignancy and 8 (10%) with a benign diagnosis other than radial scars. When the inadequate CBs were excluded (7/82 (8%)), CB missed 2/27 cancers in the group with malignancy alone, but 5/9 cancers in the group with both radial scar and malignancy. The overall absolute sensitivity for all cancers was 80% (29/36) and for invasive cancers it was 90% (27/30). In the 46 cases with a benign CB result, 7 turned out to have malignancy at surgical excision, a false negative rate of 15%. The type of image guidance did not influence the accuracy of CB. **CONCLUSION:** CB was not sufficiently accurate to exclude the presence of malignancy in screen-detected stellate lesions. In patients with a final diagnosis of radial scar, 20% have a co-existing tumour. It is in this group of patients that CB is most likely to miss malignancy.

**POSTER 204**

**CT-guided biopsy in the management of lung malignancy**

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**PURPOSE:** Increasingly aggressive chemotherapeutic management of patients with lung cancer means that patients undergo biopsy procedures to establish the diagnosis of malignancy and to differentiate small cell lung cancer from non-small cell lung cancer. The need for patients to give informed consent for procedures necessitates audit of yields and complication rates. **MATERIALS AND METHODS:** All procedures were performed under CT guidance on a Siemens Somatom Plus 4 helical scanner. Samples were taken either by 18 G Temno cutting needle (54% patients) or 22 G Westcott cytology needle (46%). Needle selection depended on the size of target lesion, depth in lung and whether previous histology was available for comparison in cases of suspected lung metastases. **RESULTS:** 71 consecutive biopsy procedures were reviewed. In the majority of cases the expected diagnosis was cancer, either primary or secondary. 97% of specimens were adequate for diagnosis. The sensitivity and positive predictive value for diagnosis of cancer were 90%. Pneumothorax occurred in 14 patients (20%). Two patients required aspiration and one required a chest drain. Minor haemoptysis occurred in three patients (4%), all of whom had procedures performed with a cutting needle. **CONCLUSION:** Percutaneous lung biopsy under CT guidance gives a high yield of satisfactory specimens, high sensitivity and positive predictive value for malignancy, and an acceptable rate of generally minor complications. Increasing use of chemotherapy for lung tumours will ensure a continued demand for this procedure.

**POSTER 205**

**Haematological malignancies: appearances in the breast and axilla**

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Haematological malignancies are rare entities in the breast and account for less than 1% of all patients with breast neoplasms. The radiological appearances of these malignancies on mammograms, ultrasound and at MRI are highly variable and will be described and illustrated. We report a series of 28 female patients with haematological malignancy in the breast and axilla presenting over an 11-year interval (1990–2001) to the Breast Screening Units at the Royal Victoria Infirmary and the Queen Elizabeth Hospital. Of the 28 patients, 11 had disease within the breast (10 cases of non-Hodgkin's B-cell lymphoma, 1 case of multiple myeloma) and 17 presented with axillary lymphadenopathy (14 cases of non-Hodgkin's B-cell lymphoma, 2 cases of small cell lymphocytic lymphoma/CLL, 1 case of Hodgkin's disease). 16 cases were detected by breast screening, 11 of which had axillary lymphadenopathy on routine screening mammograms, for which they were recalled from screening. In two cases non-Hodgkin's lymphoma was an incidental finding in lymph nodes excised in routine axillary surgery for screen-detected breast carcinomas. We conclude that breast screening may be useful in the detection of haematological malignancy, particularly in cases of non-Hodgkin's lymphoma presenting with axillary lymphadenopathy. We suggest the diagnosis of a haematological malignancy should be considered when a breast lump or mammographic abnormality develops in a patient with a known lymphoma, or when a breast mass develops in a patient with lymphadenopathy in the axilla or at another site.

**POSTER 206**

**Benign vascular lesions in the breast**

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Benign vascular lesions in the female breast are uncommon, but may be detected in the context of breast screening and may also present clinically to breast symptomatic services. To date there is no documentation in the literature of a series of vascular lesions within the breast. The radiological appearances of seven vascular lesions within the breast (four cavernous haemangiomas, two venous angiomas and an unusual case of multiple breast aneurysms presenting symptomatically) are described and illustrated. Recognition of some of the typical mammographic features of these rare lesions may be useful to the breast radiologist in differentiating vascular abnormalities from other benign breast disease and malignancy.

**POSTER 207**

**A national research programme on facilities for breast and cervical cancer screening and associated services**

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Advances in the management of cancer combined with developments in national cancer care policy have a significant impact on facilities for cancer services. In 2001, NHS Estates (DoH) published guidance on the design of the built environment for modern cancer care. The second part in this series, "Facilities for screening and cancer services related to the CancerPlan", describes facilities designed to accommodate efficient, modern cancer services focused on the needs and wishes of all involved. This guidance looks at the breast and cervical screening programmes from an Estates perspective, giving design advice for many aspects of the screening process and patient journey. The document embraces the philosophies of evidence-based care and describes many significant innovations originated in the cancer care community. One typical example, a novel design for mammographic, ultrasound and FNA services to breast patients all provided in one location, will be described in detail. The room layout is designed largely around the patient and also emphasizes the importance of multidisciplinary team (MDT) work. The importance of mobile mammography for screening is reflected in sections on site accommodation for vehicles. Other key developments described include the requirements of Cancer Network MDTs, such as facilities for regular meetings, use of digital images and computerized pathology data. The importance of sufficient provision of enhanced data networks at local and wide area levels will be considered in light of operational analysis and related to advances in IT and communication infrastructures.

**POSTER 208****Assessment of disease volume in pseudomyxoma peritonei by spiral CT**

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**PURPOSE:** To assess disease response in pseudomyxoma peritonei by volumetric measurement of intraabdominal disease. **METHODS AND MATERIALS:** A retrospective review of serial CT of four patients with pseudomyxoma peritonei was performed. Image assessment was carried out on a workstation. The volume of mucinous ascites was calculated by selecting pixels of between 5 Hounsfield units (HU) and 45 HU. Change in volume of disease was correlated with visual assessment. **RESULTS:** Four patients were included (3 female and 1 male; median age 51 years, range 42–63 years). The scans were performed over a 40-month period (December 1998 to March 2002). All showed progressive disease, with a median change in volume of disease of 56.2% (range 19.1–140%). Two patients had minimal change and two moderate as assessed visually. This correlated with change in volume of disease; those with minimal change had change in volume of 19.1% and 20.0% and those with a moderate change 45.8% and 140%. **CONCLUSION:** This technique is sensitive for following burden of disease in pseudomyxoma peritonei and would provide an important way assessing diseases that are not easily assessed using conventional (WHO) or RECIST criteria.

**POSTER 209****Meningeal carcinomatosis on imaging: a pictorial review**

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Meningeal carcinomatosis is the diffuse infiltration of the meninges by metastatic carcinoma. This type of spread occurs in an estimated 20% of patients diagnosed with cancer and is most commonly seen in patients with breast carcinoma, small cell carcinoma of the lung and melanoma. It is also seen in the paediatric age group in patients having haematogenous malignancies and primitive neuroectodermal tumour. Although patients usually have a known underlying malignancy, primary presentation may be with symptoms of meningeal involvement. Neurological disease is a well recognized presentation of metastatic involvement of the leptomeninges in carcinomatosis. This pictorial review depicts the appearances of this condition on various imaging modalities and compares the accuracy of various methods of diagnosing leptomeningeal metastases. We show cases of meningeal carcinomatosis affecting the cerebral hemispheres, cranial nerves, spinal cord and nerve roots and we demonstrate the value of contrast enhancement and FLAIR sequences when looking for diffuse malignant infiltration on MRI scans of the brain. We show the relative poor sensitivity of CT compared with MRI for imaging this condition.

**POSTER 210****Gastrointestinal stromal tumours: a pictorial review of the spectrum of radiological manifestations**

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Gastrointestinal stromal tumours are a group of mesenchymal neoplasms that arise from precursors of the connective tissue cells of the gastrointestinal tract. Recent major advances in effective therapy for unresectable or metastatic gastrointestinal stromal tumour, in the form of the tyrosine kinase inhibitor STI-571, have increased the importance of cross-sectional imaging for distinguishing these tumours from other small bowel neoplasms and for the assessment of the impact of this new treatment. Using the latest in multiplanar reformatted computed tomography, a pictorial review of the radiological manifestations in 14 cases of metastatic gastrointestinal stromal tumour before and after treatment with STI-571 is presented.

**Cardiovascular****POSTER 301****Accurate diagnosis of renal artery stenosis with multislice CT**

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**PURPOSE:** Non-invasive angiography of the renal arteries may be achieved using helical computed tomography (CT), which was initially assessed with single slice acquisition. We studied multislice CT angiographic data in comparison with invasive angiographic data (gold standard) to establish the accuracy of this technique. **MATERIALS AND METHODS:** We analysed retrospective data from 18 patients assessed for possible renal artery stenosis. All patients had undergone both forms of renal angiography. Multislice CT was acquired using a collimation of 4 × 1.0 mm, increment 0.6 and a pitch of 1.25 with appropriate z-axis coverage. Evaluation was completed prior to invasive angiography using axial data, maximum intensity projections and 3D reconstructions. Findings from invasive angiography were then compared with the original multislice CT for the presence or absence of ≥50% and ≥70% stenoses. **RESULTS:** CT acquisition and evaluation were rapid and there were no complications. A total of 58 main and accessory renal arteries, with 18 lesions and 16 lesions of ≥70% stenosis, were diagnosed with invasive angiography. Of these vessels, 98% (57/58) had been correctly identified with CT. For the accurate detection of ≥50% stenoses, sensitivity = specificity = 100%. For ≥70% stenoses we found a sensitivity of 94%, a specificity of 100%, a negative predictive value of 98% and a positive predictive value of 100%. Four total occlusions were correctly identified. **CONCLUSION:** Multislice CT renal angiography is sufficiently accurate that invasive diagnostic renal angiography is no longer necessary and invasive procedures can be reserved for planned intervention. Furthermore, aortic imaging and three-dimensional visualization may facilitate interventional procedures.

**POSTER 302****The application of CTA for peripheral angiography in a cardiothoracic institute**

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Currently we are utilizing a Siemens Somatom volume zoom plus 4 multislice scanner to produce peripheral angiograms in a tertiary referral centre for cardiac and thoracic surgery. At present we also provide a service for the interventional team at an associated teaching hospital that as yet does not possess multislice technology. The aim of this presentation is to outline the practice of CTA peripheral angiograms and to show how post processing can affect the resulting diagnosis. We aim to produce images showing different types of pathologies using MIP and MPR reformats plus the use of surface rendering. The main aim of the presentation is to produce evidence that the use of CTA in preference to brachial approach conventional angiography is an acceptable alternative. **CONCLUSION:** CTA peripheral angiography should be an acceptable alternative to conventional peripheral angiography for the investigation of peripheral vascular disease in patients who would otherwise need a brachial approach.

**POSTER 303****CT sinography in cardiac surgical patients**

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We describe our experience with a known but often under utilized technique for delineating chronic sinus tracts occurring in post-operative patients. Our study was specific to cardiac patients, however the technique is appropriate to all surgical specialties. Imaging was performed using a Siemens Somatom Volume Zoom Plus 4 scanner. The scanning protocol comprised a topogram of 128 mm at 100 mA, 120 kV, 1 mm slice thickness with a metallic marker over the cutaneous sinus site, which took 1.28 s. Then, a pre-contrast scan was performed through the marker at 165 mA, 120 kV, 2.5 mm quad spiral reconstructed to 5 mm. The marker was then removed and a narrow bore catheter was inserted into the sinus tract and advanced until any resistance was encountered. OPTIRAY 320 (Ioversol) was injected down the catheter until leakage occurred at the cutaneous site. A post-contrast scan was then performed using the same parameters as the pre-contrast scan with a pitch of 4. Axial and 3D multiplanar reconstructed images were then acquired. We include images of our most interesting cases demonstrating narrow tortuous tracts extending to retrosternal collections, infected foci of bone and an intra-abdominal nidus related to the gallbladder. This technique has advantages over both conventional sinography and CT as it delineates the sinus tract and displays its relationship to the surrounding anatomy. It is also cheaper, faster and more widely available than MR of the sinus.



**POSTER 304**

**Multislice computed tomography coronary artery imaging**

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**PURPOSE:** Multislice CT has been proposed for imaging the coronary artery. In two studies (A and B) we evaluated CT coronary angiography and coronary artery calcium (CAC) assessment. **MATERIALS AND METHODS:** In both studies patients had undergone invasive coronary angiography. Study A: 30 patients underwent multislice CT (Philips MX8000) coronary angiography (retrospective ECG gating, 4 × 1.0 collimation). Each of seven segments of coronary artery was evaluated, initially for "assessability", by two blinded assessors. Assessable segments were judged for the presence or absence of a significantly (=70%) stenotic lesion with invasive quantitative coronary angiography as gold standard. Study B: 22 patients underwent multislice CT for CAC assessment (prospective ECG gating, 4 × 2.5 collimation). A density of 130 HU was used for calculation of the total CAC score. **RESULTS:** Study A: Overall, 68% of the coronary artery segments were assessable. The sensitivity and specificity of four-slice CT coronary angiography in assessable segments for detecting the presence or absence =70% stenoses were 72% and 86%, respectively (PPV 53%, NPV 93%). Study B: Mean CAC scores increased with associated coronary risk factors, male sex and age. CAC scores were significantly higher in the presence of significant coronary artery disease (1483 ± 1349 vs 386 ± 695; *p*<0.001). 18% (4/22) had no CAC and no significant coronary artery disease. **CONCLUSION:** Multislice CT coronary angiography is a promising technique but further evaluation should be with 16- or 32-slice acquisition. A CAC score of zero may negate the need for coronary angiography and further evaluation is merited.

**POSTER 305**

**Retrospectively electrocardiographic gated computed tomography of the thoracic aorta**

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**PURPOSE:** ECG gating may reduce motion artefact in CT of the thoracic aorta. This study assessed retrospectively ECG-gated CT in patients with a spectrum of pathologies of the ascending aorta and arch. **MATERIALS AND METHODS:** 12 patients (mean heart rate 65, range 50–102) underwent multislice CT (Philips MX8000) of the thoracic aorta (variable collimation). The studies were retrospectively ECG gated with multiphase reconstruction and subsequent selection of the optimal diastolic reconstruction phase for evaluation. Motion artefact was scored by consensus of two investigators using a 5-point scale (1 = nil; 2 = mild; 3 = moderate; 4 = moderate-severe; 5 = severe) at five levels of the aorta (three axial sections (A = aortic valve, B = left main stem, C = right pulmonary artery), one coronal section of ascending aorta (D), and one sagittal section of arch ± descending aorta (E)). Subjective assessment was made from volume rendered 3D reconstructions. **RESULTS:** The mean motion artefact scores were: level A, 1.8 ± 0.9; level B, 1.7 ± 0.9; level C, 1.2 ± 0.5; level D, 1.5 ± 0.7; level E, 1.1 ± 0.3; overall, 1.4 ± 0.7. In all cases clear diagnostic images were obtained and 3D reconstructions gave excellent visual information of spatial relations. Pathologies included ascending aneurysm, dissection, arch anomalies and patent ductus arteriosus. **CONCLUSION:** Retrospectively ECG-gated multislice CT of the thoracic aorta provides high quality images, with negligible motion artefact, across a wide range of pathologies and heart rates. Further studies comparing ECG-gated and non-gated acquisitions are required.

**POSTER 306**

**Vascular anomalies on CT scanning: a pictorial review**

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**PURPOSE:** To review vascular anomalies incidentally detected on routine chest and abdominal CT scans. **DESCRIPTION:** Although most vascular anomalies do not have significant clinical implications, a small percentage of them do give rise to clinical signs and symptoms and hence their recognition on routine CT is important. We present a pictorial review of vascular anomalies encountered on routine CT with

some of the more uncommon variants such as circumaortic renal vein, left sided SVC and aberrant right subclavian artery as well as the more common venous anomalies.

**POSTER 307**

**Relationship between coronary calcification and left ventricular wall thickening during the cardiac cycle using electron beam computed tomography**

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**BACKGROUND:** Coronary calcification (CC) of the heart, measured with electron beam computed tomography (EBCT), correlated highly with coronary stenosis. Additionally, it was known that there was a disorder of contraction of the left ventricular wall during the cardiac cycle in patients with ischemic heart disease (IHD). In this study, the relationship between CC and left ventricular wall thickening dynamics during the cardiac cycle was evaluated. **PATIENTS AND METHODS:** 100 patients (63 ± 10, 37–83a) with IHD were examined. Depending on density and size of the calcific lesion, a score was determined according to an international standard. The peak of contraction and relaxation of the left ventricular wall during the cardiac cycle were evaluated using differential method. **RESULTS:** Depending on the calcium score, the peak of contraction decreased from 2.17 ± 0.49 to 1.55 ± 0.75 (*p*<0.05) and the peak of relaxation from 1.65 ± 0.58 to 1.42 ± 0.70 mm 100 ms<sup>-1</sup> (*p*=NS). **CONCLUSION:** Using EBCT, the results showed a relationship between CC and the peak of left ventricular wall thickening dynamics during the cardiac cycle.

**POSTER 308**

**Use of linear and centric k-space filling for contrast-enhanced spinal MRA**

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**PURPOSE:** To attempt to produce CE-MRA of sufficient quality for planning of formal catheter angiography for patients with spinal AVF. **METHODS AND MATERIALS:** All five patients were imaged with a Gyroscan Intera (Philips) 1.5 T MR system with master gradients using a synergy array spine coil. 3D fast field echo sequences were performed before and after rapid bolus infusion of double dose contrast medium, delivered by automatic injection. The dynamic series was triggered as the bolus reached the pulmonary artery using a linear profile. A further three dynamics were obtained using centric profiles. The dynamics were subtracted from the initial acquisition and maximum intensity projections were created. **RESULTS:** In one patient, a feeding artery was identified with CE-MRA and conventional angiography was limited to two levels. In another case where no feeding artery was demonstrated on MRA, the arterial supply remained occult at conventional angiography. Two patients have been imaged after treatment for their fistula and no fistula could be demonstrated with CE-MRA. This correlated with improvement of their cord myelopathy. One further more complex case in which the vascular abnormality appears to be a spinal AVM with a fistulous component on the MR examination is awaiting formal angiography. **CONCLUSION:** Our early experience with the use of combined linear and centric elliptical k-space filling suggests promising results for demonstration of the arterial and venous components of spinal AVF that can potentially reduce the time taken for conventional catheter angiography and consequently patient radiation exposure.

**POSTER 309**

**Role of MRA in the diagnosis of multiple aortopulmonary collateral arteries and partial anomalous pulmonary venous drainage**

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**BACKGROUND:** Accurate diagnosis of multiple aortopulmonary collaterals (MAPCAs) and partial anomalous pulmonary venous drainage (PAPVD) in adult patients with congenital heart disease is important but problematic. Magnetic resonance angiography (MRA) provides a minimally invasive technique to allow detailed studies in a single breath-hold. **METHODS:** We assessed the role of MRA in 29 consecutive adult patients with a diagnosis of MAPCAs (*n*=16) or PAPVD (*n*=13) made by echo, cardiac catheterization or surgical

inspection. RESULTS: In both types of pathology there was complete correlation between MRA and the cardiac catheterization, echo or surgical inspection (100% sensitivity and specificity). Additional information was gained for patients with MAPCAs on confluence and size of pulmonary arteries (14 had central arteries), pulmonary artery stenosis ( $n=3$ ), aneurysmal dilatation of the pulmonary artery ( $n=1$ ) and additional anomalous vascular abnormality ( $n=3$ ). Shunt assessment where present (8/16) showed patency in all cases (100%). For adults with PAPVD, further information was obtained on drainage origin ( $n=11$ ). There were no complications. CONCLUSIONS: MRA provides a fast, non-invasive, radiation-free method of accurate and comprehensive diagnosis of MAPCAs and PAPVD in adult patients.

**POSTER 310****Spectrum of ultrasound diagnoses in patients presenting via the fast-track DVT service: a pictorial review**

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A fast-track DVT ultrasound service has been established at our hospital for 5 years. Most patients are GP referrals, with a smaller number of hospital-based referrals. All patients are assessed in the DVT clinic before undergoing leg ultrasound. The symptomatic leg is scanned from groin to lower calf with, if necessary, examination of the pelvic veins. Patients with proven DVT are referred back to the DVT clinic for appropriate treatment, while patients with negative scans are sent back to the GP or referring doctor with an explanatory letter. A significant number of patients have unexpected alternative or coexistent pathology to explain the leg symptoms and it is these patients that form the subject of this review. The wide range of possible pathologies should be anticipated given the non-specific nature of leg pain and swelling and should be taken into account when performing ultrasound of the leg veins to exclude a DVT.

**POSTER 311****Relative table time and diagnostic accuracy of three methods of US examination for suspected acute lower limb DVT**J Walker, L MacKenzie, B Langroudi and S Padley  
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PURPOSE: To determine the relative yield and duration of three methods of ultrasound assessment for suspected acute DVT. MATERIALS AND METHODS: 66 consecutive patients were examined with compression US. Initially, three-point compression testing was undertaken at the groin, mid thigh and popliteal vein. Compression US of the deep veins of the whole thigh was then undertaken to the division of the popliteal vein. The calf was examined to the ankle. Timings were derived from hard-copy images recorded at pre-determined points during the examination. If acute thrombus was detected, a further image was recorded. RESULTS: The average duration of three-point compression, complete thigh and complete limb examination was 57 s (range 12–108 s), 93 s (range 30–291 s) and 185 s (range 58–491 s), respectively. A total of 17/66 (26%) patients were diagnosed with a DVT. Of these, 11 (65%) were diagnosed by three-point compression. An additional 1 (6%) was detected by complete thigh examination, with a further 5 (29%) patients had thrombus detected only within the calf. CONCLUSION: Complete leg US examination adds an average of 2 min and 53 s to three-point compression and 1 min and 32 s to complete thigh examinations. There is a significant additional yield for complete leg examination over of the faster yet less thorough techniques. We conclude that the diagnostic gain of complete leg examination considerably outweighs the relatively small increase in overall table time and should be adopted as the technique of choice.

**POSTER 312****Venous ultrasound for the diagnosis of deep vein thrombosis in intravenous drug users: clinical audit**

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PURPOSE: To collect demographic data for IV drug users with a suspected diagnosis of DVT and to evaluate the usefulness of venous

compression/Doppler ultrasound as a diagnostic tool as well as its impact on patient management. METHODS: Retrospective and prospective data were collected over 6 weeks for intravenous drug users who had a suspected diagnosis of lower limb DVT. Information was gathered from clinical case notes regarding the clinical outcome. RESULTS: A total of 20 patients were studied. Ages ranged between 21 years and 42 years and 85% were male. 70% of the scans were positive for DVT while 10% were inconclusive because of chronic venous changes. In addition to this, 35% of patients had concurrent findings suggestive of infection. All the patients with positive scans had a raised D-dimer result, with 93% showing a significantly raised value. The majority of patients showed poor compliance to the treatment or follow-up. CONCLUSION: Intravenous drug users constitute a difficult group of patients to diagnose and manage appropriately. Although compression/Doppler ultrasound is the first-line non-invasive test for diagnosing DVT, the recurrent DVTs and soft tissue infective complications often make ultrasound a time consuming and sometimes inconclusive investigative tool.

**POSTER 313****Cutting balloon angioplasty**

KS Blanshard

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AIMS: The Ultra cutting balloon (Boston Scientific UK Ltd) is a novel device for the treatment of vascular stenoses. We have used the device in five cases to date. The aim was to establish the efficacy of cutting balloon-assisted angioplasty in stenoses in the peripheral vascular tree. METHODS: Two patients with left thigh loop grafts placed for dialysis had stenoses resistant to angioplasty with pressures of 24 atmospheres. One patient had an 18 cm restenosis within an SFA initially treated with subintimal angioplasty and four subsequent dilatations for restenosis. One patient had a stenosis at the distal anastomosis of a femorodistal synthetic graft. One patient had an occlusion at the right common iliac artery origin resistant to dilatation only. RESULTS: In four patients a satisfactory initial outcome was achieved with no immediate complications. In one patient (Case 5 above) there was no response to cutting balloon angioplasty and we proceeded to stent deployment without further complications. At mean follow-up of 4.5 months all treated segments remain patent. In Case 3 (the 18 cm SFA restenosis), the treated segment remains patent with no restenosis at 8 months. CONCLUSION: Initial results in lesions resistant to conventional angioplasty are promising. It appears a safe device. Durability requires further investigation.

**POSTER 314****5-year follow-up in patients undergoing below knee percutaneous transluminal angioplasty**

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PURPOSE: Below knee (BK) percutaneous transluminal angioplasty (PTA) is performed uncommonly and is frequently reserved for patients with critical limb ischaemia (CLI) in whom the risk-benefit ratio is favorable. Often no surgical revascularization is possible. We present up to 5 years follow-up in a series of patients undergoing BK PTA. MATERIALS AND METHODS: Retrospective analysis was performed of all lower limb angioplasties performed over a 6-year period at our institution. 11 cases were identified where PTA was performed either on the BK popliteal artery (*i.e.* below the joint line) or on tibioperoneal vessels. Long-term outcome in these patients was established. RESULTS: Five patients underwent distal popliteal PTA and six had PTA to more distal vessels. Eight patients were diabetic and ten patients presented with CLI. Two patients required BK amputation and one died after 2 weeks from complications of peripheral vascular disease. The remaining eight cases were both technically and clinically successful; ulcers healed or symptoms improved in every case. The median survival time was over 17 months; six patients died by the end of the study. All three cases with poor outcomes were BK popliteal PTAs with either single vessel or no vessel run-off. CONCLUSIONS: BK PTA is most often performed in diabetic patients with CLI. In this small series, PTA was associated with poor outcome when performed on BK popliteal lesions with single vessel run-off; however, selected patients can derive great benefit from this procedure. Best outcomes are seen in patients with more than one vessel run-off.

**POSTER 315**

**Intentional management of dysfunctional haemodialysis fistula and grafts using an arterial approach**

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**PURPOSE:** Malfunctioning haemodialysis fistula/grafts is a common problem. Radiological intervention achieves results comparable with surgery. Traditionally, access to the site of thrombosis/stenosis is via the venous side of the fistula, although an arterial approach has recently been used and here we review our results. **METHODS:** We report a series of interventional procedures performed for the management of dysfunctional haemodialysis fistula/grafts in our department between April 1999 and September 2002, highlighting those utilizing arterial access. **RESULTS:** 47 interventions were performed, which included 25 percutaneous transluminal angioplasties (PTAs) for stenoses and 22 thrombectomy/lysis (some with additional PTA). 11 (5 PTA and 6 thrombectomy) of these procedures were performed using arterial access (7 antegrade brachial, 4 retrograde radial). We report a success rate of 100% (5/5) for PTA using arterial access and 95% (19/20) for PTA using venous access. 50% (3/6) of thrombectomy procedures were successful using arterial access compared with 62% (10/16) of those using venous access. Successful arterial procedures even included three patients with stenosis at the venous origin of the fistula. There were no failures to access the target site or any complications with the arterial approach. The 50% failure of thrombectomy was owing to the nature of the thrombus rather than failure to access the site of problem. **CONCLUSION:** Arterial access to dialysis fistulae is safe, effective and can be performed on an outpatient basis. The arterial approach gives access to the entire fistula from a single puncture site and spares the complication of fistula thrombosis seen owing to compression of the venous puncture site.

**POSTER 316**

**A novel agent of <sup>99</sup>Tc<sup>m</sup>-N-NOET in myocardial perfusion imaging compared with <sup>99</sup>Tc<sup>m</sup>-MIBI**

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**PURPOSE:** <sup>99</sup>Tc<sup>m</sup>-N-NOET is a new <sup>99</sup>Tc<sup>m</sup>-labelled myocardial perfusion imaging agent. This study was to evaluate the clinical value of <sup>99</sup>Tc<sup>m</sup>-N-NOET myocardial perfusion imaging and the relationship between the tracer uptake in the lung and left ventricular function. **MATERIAL AND METHODS:** 18 patients were divided into two groups (Group 1 (*n*=12), LVEF>50%; Group 2 (*n*=6), LVEF<50%). All the patients underwent gated SPECT imaging at 30 min and 120 min after injection of 925 MBq <sup>99</sup>Tc<sup>m</sup>-N-NOET at rest. 3 days later five patients in Group 2 also underwent <sup>99</sup>Tc<sup>m</sup>-MIBI imaging at 120 min after injection under the same condition as <sup>99</sup>Tc<sup>m</sup>-N-NOET. The left ventricle of the five patients was divided into 45 segments, and a 4-point coring system was used to evaluate tracer uptake in the segments. **RESULTS:** Imaging quality was good in Group 1 but poor in Group 2. There was a significant difference in H/L and LVEF between Groups 1 and 2 (H/L, *p*<0.01; LVEF, *p*<0.001). No significant difference was observed in LVEF, EDV and ESV between 30 min and 120 min imaging. There was also no significant difference between NOET and MIBI imaging, although more abnormal segments were depicted with NOET (2.4 + 0.84 vs 1.8 + 0.92, *p*>0.10). **CONCLUSIONS:** (1) <sup>99</sup>Tc<sup>m</sup>-N-NOET image quality was good if the left ventricular function was normal. (2) Compared with <sup>99</sup>Tc<sup>m</sup>-MIBI, the image quality of NOET, and the myocardial abnormal area and defect degree, were more severe with NOET imaging than with MIBI.

**POSTER 317**

**Endoleak as a complication of endoluminal grafting of abdominal aortic aneurysms: pictorial review of management**

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**PURPOSE:** Endoleak is recognized in 10–20% of patients undergoing endoluminal grafting for abdominal aortic aneurysms. We report our experience in the management of endoleaks. **METHOD AND**

**RESULTS:** 5 endoleaks were identified among 40 endoluminal grafts performed in our department between September 1998 and September 2002. Case 1: Type 1 leak following dislocation of the iliac limb of the graft into the aneurysmal sac was treated with an iliac limb extension. Case 2: Type 1 leak due to the angulation of the proximal aneurysmal neck was treated with Palmaz stenting to straighten the neck. Case 3: A combination of Type 1 and Type 2 leaks in a patient with an AneuRx uni-iliac device with right common iliac artery (CIA) occluder; Type 1 leak from the CIA was treated by coiling alongside the occluder and Type 2 leak was treated by embolisation of the inferior mesenteric artery (IMA) from the superior mesenteric artery (SMA). Case 4: Type 2 leak was treated by coiling the IMA via the SMA. Case 5: Type 2 leak due to patent lumbar vessels; CT-guided translumbar aneurysmal sac puncture and pressure measurements were performed followed by injection of 0.75 ml of thrombin. The leak was eliminated and pressures in the aneurysmal sac dropped from 90/73 mmHg to 14/11 mmHg following thrombin injection. **CONCLUSION:** Endoleaks can be successfully treated with a variety of interventional procedures. Reasonably high pressure was documented in the aneurysmal sac in a Type 2 endoleak. We present a pictorial review of our experience, demonstrating a number of useful techniques.

**POSTER 318**

**Percutaneous ultrasound-guided thrombin injection for endoleaks: an alternative**

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Endoleaks are a well recognized complication of endovascular aortic aneurysm repair. An incidence of up to 46% has been reported in the literature. Both the proximal and distal ends of the graft are susceptible. These leaks, particularly at the proximal end, can result in rupture of the aneurysmal sac with potentially serious consequences. Various radiological options are available for the treatment of such endoleaks. The more common options include extension cuff placement and angioembolisation (coil placement). Sometimes these endoleaks can be difficult to treat by conventional methods, especially if endovascular access to the feeding vessel is not straightforward. We describe and pictorially illustrate percutaneous ultrasound-guided thrombin injection to treat aortic perigraft endoleaks. In appropriate patients, this technique is simple to perform and has low associated morbidity as well as satisfactory results.

**POSTER 319**

**Acute CT aortography at a DGH: a 2-year review**

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**PURPOSE:** To assess the increase in demand for acute investigation of suspected aortic pathology and if an abdominal aortic aneurysm is demonstrated whether satisfactory measurements had been taken. **METHOD:** CT aortogram reports for 2000–2002 were reviewed from the radiology management system. From the reports, the indication, urgency of study and diagnosis were assessed. For patients with an abdominal aortic aneurysm, the reports were reviewed for maximal aneurysm diameter, aneurysm neck length and unfavourable comments on the iliac arteries. **RESULTS:** 127 CT aortograms were performed in 123 patients with an average age of 70. 27 thoracic CT aortograms were performed, 19 for query acute thoracic dissection, with a 71% increase between 2000–1 and 2001–2. Six had Type A dissections (two with haemopericardium) and three had Type B dissections, the remainder being normal. 100 abdominal CT aortograms were performed in total, of which 23 were urgent, with an 88% increase between 2000–1 and 2001–2. 22 had full reports, 18 having abdominal aortic aneurysms, of which 4 were leaking. In this group of 18, 94% had maximal aortic diameter measured, 61% had aneurysmal neck length measured, with unfavourable comments on the right iliac arteries in 33% and on the left in 39%. **CONCLUSION:** Increased demand for urgent/on-call CT aortography has implications, as radiographers and radiologists may be unfamiliar with the technique. Hence, in addition to a standardized technique for CT aortography, we suggest an illustrated reference of measurement sites for abdominal aortic aneurysms to assist standardization of reports.

## Chest

## POSTER 401

**Elevated pulmonary artery:aortic ratio in patients with pulmonary arterial hypertension associated with systemic sclerosis**

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**PURPOSE:** Pulmonary arterial hypertension (PAH) occurs in approximately 15% of patients with systemic sclerosis (SS) and is associated with a poor prognosis. A number of screening regimens using non-invasive techniques are currently used to identify patients for cardiac catheterization. We have examined whether the pulmonary artery:aortic (P:A) ratio measured using CT may be useful non-invasive predictor of PAH in these patients. **METHOD:** 21 patients (3 male), mean age 60 years (range 45–70 years) with SS and suspected pulmonary hypertension were studied. Patients underwent HRCT and CTPA in addition to right heart catheterization (RHC). CT scans were interpreted by investigators blinded to the results of the other investigations. **RESULTS:** 19 of the 21 patients studied had PAH at rest (MPAP>25 mmHg). There was a significant correlation between MPAP measured at RCH and P:A ratio ( $r=0.5$ ,  $p=0.05$ ). All patients with an elevated P:A ratio >1 had PAH. Patients with a P:A ratio >1 compared with patients with a P:A ratio <1 had a significantly greater MPAP:  $43 \pm 13$  vs  $26 \pm 14$  mmHg (95% CI 2–31 mmHg;  $p=0.02$ ). Using a P:A ratio of >1 to identify patients with PAH at cardiac catheterization had a PPV of 1.0 and a NPV of 0.4, whereas a P:A ratio of 0.9 had a PPV of 1.0 and a NPV of 1.0. **CONCLUSION:** An elevated pulmonary artery to aortic ratio measured using CT scanning techniques predicts the presence of PAH in patients with systemic sclerosis. In these patients undergoing CT scanning of the thorax, an elevated ratio should alert the clinician to the possibility of pulmonary hypertension.

## POSTER 402

**An appraisal of the caudal angle technique in chest radiography**

N Rogers

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**PURPOSE:** Several techniques are in common usage for chest radiography. One technique utilizes a caudal angle of the central ray to facilitate tight collimation of the primary beam to the area of interest. This technique has been criticized for causing geometrical distortion of the image and for being unsuitable for the demonstration of fluid levels. **MATERIALS AND METHOD:** This claim was objectively and subjectively studied by a comparison of the following techniques. Centring of the primary beam to thoracic vertebra: (a) six with a horizontal beam; (b) four with a horizontal beam; and (c) four with a caudal angle. The study used an anthropomorphic phantom containing simulated lung material within a bony thorax encased in tissue-equivalent material (Perspex), which simulated the torso of a man of average build. Simulated fluid levels of various dimensions and positions were introduced to the field. A comparison of the techniques was made for the following: (1) dose to radiosensitive organs, measured using the fine external detector of a calibrated solid-state dosimeter; (2) geometry of image recording, plotted using computer simulation; (3) demonstration of fluid levels, with visualization of fluid levels being subjectively assessed for each size and position, and the magnitude of meniscus shadow measured objectively; and (4) diagnostic and technical quality—subjective review was undertaken of the anonymous images by experienced film reporters using rating scales. **RESULTS AND CONCLUSIONS:** The technique that utilized the caudal angle was found to be comparable or superior to the alternative techniques for all assessed criteria.

## POSTER 403

**HRCT technique: can we eliminate the supine examination?**

MB Crawford and JJ Curtin

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**PURPOSE:** To determine whether supine HRCT can be entirely replaced by prone HRCT. **MATERIALS AND METHODS:** We reviewed 50 consecutive HRCT studies in patients who had both prone and supine examinations. Each examination was reported twice, once

only on the basis of the supine images and once only on the basis of the prone images. The reporter was blinded as to the identity of the patients and the two reports were generated at least 3 weeks apart. **RESULTS:** Early indications are that the prone examination on its own is all that is required for HRCT studies of the lung.

## POSTER 404

**High resolution computed tomography of the thorax: an algorithmic approach to interpretation**

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*Central Middlesex Hospital, London, UK*

**AIM:** To provide an algorithmic approach to the interpretation of high resolution computed tomography (HRCT) of the thorax. **METHODS:** HRCT of the thorax has undergone many improvements and developments since its advent in the 1980s. It is now routinely performed in most radiology departments but is still viewed with trepidation by many radiologists. We aim to provide an approach to the interpretation of HRCT using simple algorithms based on the recognition of specific abnormal findings, supplemented by representative images. Subjects covered include an approach to (i) fibrosing lung disease, (ii) nodular lung disease, (iii) airways disease, (iv) cysts and emphysema and (v) pulmonary vascular disease.

## POSTER 405

**MRI of patients with carcinoma of the bronchus : 10-year follow-up**<sup>1</sup>L Chandratreya, <sup>1</sup>P Goddard, <sup>2</sup>M Cobby and <sup>1</sup>JR Catterall  
*<sup>1</sup>Bristol Royal Infirmary, Bristol, UK and <sup>2</sup>Frenchay Hospital, Bristol, UK*

**PURPOSE:** To determine the predictive value of MR staging in survival of patients with lung cancer. **MATERIALS AND METHODS:** A review of 50 patients with carcinoma of the bronchus was undertaken 10 years after surgery. Patients judged potentially resectable by conventional staging were also staged by MRI in 1991–92. MRI staging was performed immediately prior to thoracotomy, which was undertaken without access to the MRI results. Staging by CT, bronchoscopy, MRI, surgery and pathology were subsequently compared. **RESULTS:** In the 37 patients with staging agreement, 5-year survival was 13/23 (57%) for stages I and II, 0/7 for stage IIIa and 0/7 for stages IIIb and IV. Disagreement occurred in seven patients. Of the three staged operable by surgery, MRI staged two as borderline (IIIa), one of whom was alive at 98 months, and one patient as inoperable (IIIb) who died at 10 months. Four patients were judged borderline by surgical staging; MRI staged three as inoperable, none of who survived more than 15 months. One was staged operable and survived 54 months. All patients who survived >4 years were staged I or II by MRI, except one long-term survivor staged IIIa by MRI but I by surgery. No patient staged as inoperable by MRI (IIIb or IV) survived beyond 24 months. **CONCLUSION:** Correlation between surgical and MR staging showed 84% agreement and was significantly correlated with survival.

## POSTER 406

**Pictorial review of partial liquid ventilation**

MCK Hamilton

*Glenfield Hospital, Leicester, UK*

We aim to describe the technique of partial liquid ventilation and to outline its indications. We will outline our imaging experience in Leicester with this infrequently used therapy. To do this we will present a wide variety of radiographs from neonatal, paediatric and adult patients and will describe the imaging features that will be encountered. The appearance of white lungs due to the fluorocarbons used in partial liquid ventilation can be an advantage in diagnosing certain complications of mechanical ventilation and outline pathologies and normal anatomy in an unusual manner.

## POSTER 407

**Radiologist-initiated thoracic computed tomography in suspected lung cancer**S Snape, JH Reynolds, LC Morus and T Roberts  
*Birmingham Heartlands Hospital, Birmingham, UK*

As part of the government's modernization programme, the Radiology Directorate at Birmingham Heartlands and Solihull NHS Trust has

participated in initiatives aimed at improving the patient care pathway in cases of suspected lung cancer. To reduce delays for computed tomography (CT) staging studies, a system was introduced whereby patients referred by a general practitioner for a chest radiograph and whose radiograph suggested the presence of lung cancer were referred for CT by the reporting radiologist. The purpose of this audit was to assess the appropriateness of cases referred in this way. Between April 2001 and March 2002, 97 patients were referred for CT by this process and details of 86 patients were available for analysis. Of these cases, 44 (51%) were subsequently found to have a cancer and were regarded as appropriate referrals. 11 patients (13%) were found to have abnormalities on their CT study but need not have been referred by this "rapid access" process. 31 patients (36%) were found to have minor abnormalities only. Subsequent review of these cases suggested that 76% had been referred for CT inappropriately. This initiative has led to prompt, appropriate CT in approximately half of the cases referred, but in many of the remaining cases CT may have been inappropriate and this has implications for resources in radiology departments and chest medicine clinics. Patients referred inappropriately receive unnecessary radiation and undergo a period of considerable anxiety whilst results are awaited.

**POSTER 408**

**Imaging findings of superior vena cava obstruction: a pictorial review**

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Superior vena cava obstruction (SVCO) most often results from bronchial carcinoma and may occasionally be its presenting feature. Whilst SVCO is usually apparent clinically, subtle radiological signs can precede the physical signs, making early recognition on CT important. Furthermore, SVCO may produce a myriad of radiological signs, which are readily explained when there is a complete understanding of venous anatomy. We extensively illustrate the various angiographic and CT appearances of SVCO with a detailed description of the anatomy of the mediastinal venous system and the infradiaphragmatic azygos and hemiazygos systems.

**POSTER 409**

**A pictorial review of imaging of the pleura and related disorders**

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*<sup>1</sup>Churchill Hospital, Oxford, UK and <sup>2</sup>Chelsea and Westminster Hospital, London, UK*

Chest radiography (CXR), ultrasound (US) and computed tomography (CT) are able to illustrate both the normal and abnormal pleural surfaces. Recently, magnetic resonance imaging (MRI) and positron emission tomography (PET) have also been used to investigate pleural disease, and there has also been an increasing use of image-guided drain placement and biopsy both to investigate and aid management of pleural disease. This pictorial review will provide an overview of pleural investigation incorporating the most recent reports on the ultrasonic investigation of pneumothorax, the management of complicated parapneumonic effusions and empyema, and the investigation of suspected malignant pleural effusion and thickening.

**POSTER 410**

**CT evaluation of chronic thromboembolic disease: principles, techniques and clinical application**

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*Papworth Hospital, Papworth Everard, Cambridge, UK*

Acute pulmonary emboli are common, with up to 1% of patients going on to develop chronic thromboembolic pulmonary hypertension (CTEPH). With the introduction of surgical thromboendarterectomy, a cure is now possible for some of these patients. **LEARNING OBJECTIVES:** (1) To learn the technique of computed tomography (CT) in the demonstration of CTEPH using multidetector CT. (2) To assess the role of 3D imaging and CT pulmonary angiography. (3) To become familiar with the diagnostic features of CTEPH on CT, evaluating the extent of disease and suitability for surgery as well as common post-operative appearances.

**POSTER 411**

**MRI in lung cancer: a pictorial review**

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*Bristol Royal Infirmary, Bristol, UK*

**PURPOSE:** To outline the role of MRI in the management of patients with lung cancer. **MATERIALS AND METHODS:** Over 100 MRI chest examinations are performed in our institution each year using a standardized protocol. An average of 10 cases per year were performed to evaluate lung cancers. We retrospectively reviewed cases over the last 5 years to gather information about the benefit of these scans to patients. **RESULTS:** MRI provides superior contrast resolution and can display structures in various user-defined planes. It is also better than CT in the staging of bronchogenic carcinoma with regard to chest wall infiltration, mediastinal invasion and vascular involvement. MRI is also useful in determining the position of the tumour in relation to the neural foramina and spinal canal. Multiplanar imaging of mediastinal involvement is useful in guiding surgical approach. MRI provides an alternative mode of imaging in patients with allergy to iodinated contrast media. MRI also proved more sensitive than CT in the detection of hilar and mediastinal lymph node enlargement. Extrathoracic spread and brachial plexus involvement were other aspects that were better assessed by MRI. **CONCLUSION:** We have demonstrated various aspects of the benefit of MRI in lung cancer patients, which illustrate that MRI can be a very useful tool in the diagnostic work-up and follow-up of lung cancer patients.

**POSTER 412**

**ECG-gated cardiac CT: clinical applications**

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ECG-gated cardiac CT is an emerging imaging modality with much promise for evaluating cardiac disease. Our centre has the largest experience of this technique within the UK, with over 100 cases performed. This poster demonstrates a number of cardiac pathologies including cardiac tumours, coronary artery aneurysms, coronary artery disease and aortic pathologies. The principles of prospective and retrospective ECG gating are outlined and the technique, as refined in our institution, is presented with examples.

**Education and Training**

**POSTER 501**

**Dr JF Hall-Edwards, radiology and the Boer War**

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The contribution of the pioneer Birmingham radiologist JF Hall-Edwards (1858–1926) has been previously documented. In this presentation, previously unseen lantern slides taken by Hall-Edwards during the Boer War 1900–1901 are presented. Hall-Edwards was an accomplished photographer before turning his interests to medical photography or radiology following Roentgen's discovery of X-rays in 1895. Following the outbreak of the Boer War, Hall-Edwards secured an appointment on the staff of the Imperial Yeomanry Hospital in Delfontein, the largest military hospital in South Africa. There were 30 doctors, 60 nursing sisters, 300 assistants and over 1000 patients. Hall-Edwards oversaw the development of the X-ray department and in 14 months examined 280 patients. He helped establish the role of X-rays in military medicine and contributed important papers on the subject. This presentation will be illustrated by previously unseen photographic documents of his experiences in South Africa.

**POSTER 502**

**The expanding contribution of the radiology department in undergraduate medical student education**

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Radiology is pivotal to the investigation of most inpatients and the majority of hospital outpatients. As a result there is much interesting pathology to be seen within a radiology department, creating an excellent learning opportunity for medical undergraduates. However, traditionally, representation on academic boards that determine the

curriculum is usually restricted to academic departments, of which there are few in the UK. In our department one radiologist was included on the committee for the new curriculum development of the Royal Free and University College Medical School. The radiology department now hosts 50+ medical students/month in teaching activities. The range of teaching offered is varied and includes tutorials, half-day attachments and special study modules. The objectives are two-fold, both to learn medicine and to understand the relevance of the imaging investigations to the medical conditions seen. Many groups of staff are involved, including receptionists and radiographers. Radiographers also act as examiners in the end of year OSCE examinations. Even in busy departments it is possible for students to be taught. The range of teaching activities, the structure of the teaching and the methods of assessment are presented. The implication of resources and staff for teaching is discussed.

#### POSTER 503

##### **NVQs: are they worthwhile? The candidates' perspective**

SM Naylor

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**PURPOSE:** There has been recent interest in National Vocational Qualifications (NVQs) in the field of radiography. The purpose of this research was to examine the positive and negative aspects of the NVQ, both the structural and the contextual, from the candidates' perspective and to generate hypotheses that can be tested by further research. **METHOD:** Secondary sources such as personal accounts, or accounts of other people interviewing, were used for this qualitative research. An extensive literature search revealed five articles containing comments from assistants who have or are currently undertaking the NVQ in Care. Content analysis was undertaken on these comments. Triangulation of the results was obtained using a government report by Callendar in 1997, and from a satisfaction survey undertaken by South Nottinghamshire College. **RESULTS:** The analysis revealed five categories: how they valued the course; reasons for undertaking the course; comments on the structure of the course; the support needed; and the issue of age and progression. **CONCLUSION:** NVQs are viewed mainly in a positive light, with the candidates gaining confidence and improving their skills at work. Motivation to undertake this qualification was the desire to improve and progress, however there were perceived barriers to progression from the NVQ of age and financial implications. The fact that NVQs are work based was viewed as an advantage but the amount of work involved and the time consuming nature of this was highlighted. Support is vital to NVQ candidates, both in time and assistance.

#### POSTER 504

##### **A training phantom for ultrasound-guided intervention**

M Bradley and V Markos

*Southmead Hospital, Bristol, UK*

**PURPOSE:** Training of radiologists in ultrasound intervention is mainly through observation and guidance from senior colleagues whilst performing procedures on patients. Practising on an ultrasound phantom would contribute immensely towards reducing failure and complication rates. Our aim was to produce a phantom with: (1) needle track resistance to produce a realistic puncture, to avoid cheating; (2) self-healing medium so that repeated punctures are possible; (3) cheap material; and (4) ease of construction. **MATERIAL AND METHOD:** We looked at various ways of making a phantom. After testing various systems we created a gel-foam matrix. Our phantom is made of polyurethane foam similar to the foam used in furniture. The air trapped in the foam and its hydrophobic nature required trial of various gelling systems. The wetting agent used was sodium dodecyl sulphate, a safe and cheap product. Gelatin is used to solidify the medium. **RESULT:** The phantom is easy and cheap to make. It provides good quality imaging. It is durable and repeated probing with large bore needles or catheters does not leave a track of air. **CONCLUSION:** The ultrasound-guided freehand technique requires constant image hand co-ordination to simultaneously visualize the needle and the lesion. Our phantom facilitates accurate interventional technique with the potential of decreasing possible complications.

#### POSTER 505

##### **Is ability to identify fractures related to aptitude for three-dimensional spatial awareness?**

MJ Dow

*St Martin's College, Lancaster, UK*

22 student radiographers in the third year of a radiography degree programme were tested to determine whether there is a relationship between three-dimensional (3D) spatial awareness and ability to recognize/detect pathology. The "Thurstone Surface Development Test" was utilized to test mental rotation ability whereby 3D structures are created in the mind from 2D line drawings. In addition, the students were given a series of conventional X-ray images of the anteroposterior wrist shown on a monitor. Observers were to decide the presence or absence of a fracture or the possibility of a fracture. The prevalence of fractures was unknown by the students. Analysis of the data indicated a possible correlation and the need for further study of this relationship. It appears that these results may support Smoker et al (1984) and others who found a relationship between faculty member ratings and 3D spatial awareness ability. However, the research presented in this dissertation concludes that recognition of fractures on a radiograph may not be dependent primarily on 3D awareness (mental rotation) skills but involves other cognitive and perceptual skills.

#### POSTER 506

##### **Development and evaluation of an interactive electronic assessment in diagnostic imaging and radiotherapy**

MT Griffiths and KG Holmes

*University of The West of England, Bristol, UK*

**AIM:** This paper discusses the development and evaluation of an interactive electronic assessment as part of a science module from an undergraduate diagnostic imaging and radiotherapy programme. An interactive assessment environment was developed utilizing specialized Web authoring software and video streaming technology. Utilizing such technology permitted the creation of a virtual learning environment (VLE) and online resources such as video footage of a science experiment and online learning materials. **METHODS AND DATA COLLECTION:** Undergraduate students undertook the interactive electronic assessment whilst on clinical placement and accessed the information from a VLE or a CD-ROM containing specialized Web pages. The students submitted their assessments in the conventional paper-based manner. The researchers' collection of the students evaluation of this form of assessment is work in progress and will take the form of a questionnaire. **RESULTS:** This assessment format has been specifically developed for the foundation year science module as part of the diagnostic imaging and radiotherapy programme. Traditionally, large demands are placed on physical resources (*i.e.* staff and practical room) when undertaking scientific experiments as part of an assessment format. This is especially true with increasing student numbers. Utilizing an interactive electronic assessment has reduced the demands on physical resources and initial feedback from students has been positive, with the VLE providing a flexible and dynamic learning environment. **CONCLUSION:** Development of an interactive electronic assessment has provided undergraduate students with a flexible and self-based studying approach to a foundational level assessment.

## Gastrointestinal

#### POSTER 601

##### **Imaging in pseudomembranous colitis: a wide variety of abnormalities limits its use**

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*<sup>1</sup>Department of Radiology and <sup>2</sup>Department of Microbiology, Cheltenham General Hospital, UK*

**PURPOSE:** The main features of pseudomembranous colitis (PC) on abdominal radiography (AXR) and computed tomography (CT) have been described recently: bowel wall thickening, nodular haustral thickening and pericolic stranding. Publications using a combination of these criteria have claimed high diagnostic sensitivities; one has even suggested that the diagnosis can be made on imaging before positive cultures or the onset of diarrhoea. **MATERIALS AND METHODS:** We tested these hypotheses by examining AXR or CT of 53 patients. 39 patients had at least one AXR, 15 patients had CT and 7 underwent both. All imaging was performed within 6 days of a

positive stool culture for *C. difficile* toxin. 10 patients were excluded owing to incomplete data. RESULTS: Specific features on imaging allowing the diagnosis of PC to be raised in the differential were found in only 18%; imaging showed non-specific features in 40% and was normal in 42%. Thus, imaging was of very limited use in the majority. CONCLUSION: This wide spectrum of imaging features in PC implies that there is likely to be considerable radiological overlap with other conditions such as ischaemic colitis, acute inflammatory bowel disease, mesenteric venous thrombosis and neutropenic typhlitis. CT examples of these alternatives are also illustrated.

#### POSTER 602

##### **A pictorial review of CT features in abdominal tuberculosis**

MC Uthappa

*The John Radcliffe Hospital, Oxford, Northolt, Middlesex, UK*

PURPOSE: Timely diagnosis of tuberculosis (TB) is paramount because it is curable. There is growing concern with the increase in the number of cases worldwide and particularly in developed countries in immunocompromised patients. There is a wide spectrum of clinical manifestations in TB. Abdominal TB poses a particular challenge, as its presentation may be acute or chronic. Whilst ultrasound is very helpful in the investigation framework, CT is more sensitive and specific in the evaluation of abdominal pathology. With the advent of spiral CT and multislice scanners with better software it is possible to assess the abdomen and pelvis including the bowel more accurately. We would like to present a variety of cases to help radiologists familiarize with these CT findings in abdominal TB. MATERIALS AND METHOD: CT scans with oral and intravenous contrast medium were performed for a variety of clinical indications. The images were carefully evaluated on the workstation and the findings were noted. The CT features were analysed with the available clinical history, laboratory findings and in some cases operative findings. Tissue diagnosis was obtained in the respective cases. RESULTS: Cases to be presented in the poster are: gastric TB; small bowel TB (with and without associated obstruction); ileocaecal TB; large bowel TB; liver, spleen, adrenal and renal TB; lymphadenopathy and mesenteric TB; pelvic TB; vertebral and paravertebral TB; soft tissue TB and its complications. CONCLUSION: We hope that the above case mix will educate and familiarize radiological trainees and radiologists in the future evaluation of abdominal tuberculosis.

#### POSTER 603

##### **Comparative evaluation of side effects following gastrointestinal contrast media administration for CT imaging**

KC Potter, L Howarth and EJ Adam

*St George's Hospital, Tooting, UK*

We undertook a comparative evaluation of gastrointestinal contrast media used in CT imaging. Side effects and patient acceptability of our standard 3% Gastrografin with added blackcurrant flavouring were compared with unflavoured 3% Gastrografin and with two barium-based products (E-Z-Cat and Microcat) in a total of 143 patients. Diarrhoea occurred less frequently following Microcat than the other preparations ( $p=0.003$ ). E-Z-Cat did not have a statistically significant difference in diarrhoea rate compared with the Gastrografin preparations. Microcat appeared to have a longer transit time through the bowel. The barium products were more acceptable to patients. It was found that flavouring the Gastrografin decreased its acceptability to patients.

#### POSTER 604

##### **Computed tomography of the acute abdomen: a pictorial review**

RR Misra, MC Uthappa, D Baker, M Cresswell, G Condor and P Shorvon

*Central Middlesex Hospital, London, UK*

INTRODUCTION: Assessment of the acute abdomen often poses a diagnostic dilemma to the surgeon. Whilst examination and laboratory investigations reinforce clinical acumen, considerable diagnostic overlap between surgical conditions remains. As ultrasound is let down by poor specificity when faced with free fluid, abdominal CT is becoming important as the first-line investigation of the acute abdomen. Current spiral scanners allow rapid volume acquisition of data

with several benefits: imaging in a single breath-hold reduces discomfort and motion artefact; MPR allows better anatomical localization of pathology; and differential organ enhancement allows assessment of vascular insults. CT thus has a unique potential in aiding surgical planning and many surgeons now routinely request CT, particularly in patients not going to immediate laparotomy. PURPOSE: We present a pictorial essay of CT findings of the acute abdomen, both to act as a source of education for radiological trainees and as a focus of discussion for those familiar with the technique.

#### POSTER 605

##### **Ultrasound of splenic lesions: a pictorial review with CT comparison**

P Peddu, PS Sidhu and M Shah

*Kings College Hospital, London, UK*

Ultrasound is a useful imaging modality in the diagnosis of a wide variety of splenic abnormalities, including congenital malformations, focal lesions, benign tumours and malignant tumours. Ultrasound can demonstrate typical features of splenic infarction and splenic injury, with microbubble contrast media improving the diagnostic efficacy. Ultrasound may be used for the follow-up of splenic injuries that are managed conservatively. Although not generally useful in determining a specific cause of splenic enlargement, the degree of enlargement can be useful for targeting the differential diagnosis. We present a pictorial review of various splenic abnormalities seen on ultrasound, the CT correlation and a review the literature.

#### POSTER 606

##### **Tunnel vision requires an open mind, or what the endoscopist did not see**

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INTRODUCTION: Upper GI endoscopy (UGIE) ( $\pm$  biopsy) is the primary diagnostic modality for upper GI disease. However, the technique relies on a relatively small field of view and effective gaseous distension and suction of the gut, and it is important to understand its limitations. This poster illustrates with anecdotal cases scenarios where endoscopists may miss diagnoses. METHODS: Endoscopic "misses" demonstrated on other imaging have been collected over time. These cases have been used to illustrate a classification of the mechanisms behind UGIE limitations. RESULTS: UGIE has the potential to miss diagnoses in the following scenarios. Motility disorders: endoscopy cannot assess motility (especially oesophageal) with any accuracy. Subtle strictures: these require good distension and can be difficult to detect. Positional abnormalities: the lack of relational anatomical landmarks limits UGIE in positional assessment. Fistulae: the orifice is often small and difficult to see, and the track cannot be assessed. Submucosal and extrinsic lesions: overlying normal mucosa and difficulty in detecting indentation reduce accuracy. Sites of poor visualization: e.g. below the cricopharyngeus, beyond folds and beyond the superior duodenal angle. Large lesions: these are paradoxically sometimes difficult to diagnose because of the limited field of view. CONCLUSION: UGIE is the first-line investigative modality in many clinical situations. UGIE does have limitations and an understanding of these aids in both avoiding missing significant diagnoses and directing appropriate further investigation when UGIE is negative.

#### POSTER 607

##### **CT appearances of neoplasms of the small bowel as a cause of obstruction**

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PURPOSE: This poster presents a pictorial review of the CT appearances of primary and secondary tumours of the small bowel in patients presenting with obstruction, including neoplasms that are the lead point of an intussusception. MATERIALS: Patients presenting with small bowel obstruction in two district general hospitals over the last 12 months and who were subsequently investigated by CT were selected. The imaging features of those with a neoplastic aetiology were reviewed. RESULTS: The imaging reflects recent studies examining the incidence of primary small bowel tumours. Adenocarcinoma, non-Hodgkin's lymphoma, carcinoid and leiomyosarcoma comprise the

majority. Secondary tumour deposits also lead to small bowel obstruction. We demonstrate those that metastasize intraperitoneally (such as ovarian carcinoma), haematogenously (such as melanoma) or by local tumour extension (such as liposarcoma, oncocytoma and bladder carcinoma). **CONCLUSION:** It is well established that CT is a valuable diagnostic procedure in patients with acute small bowel obstruction. It is not only useful in distinguishing obstruction from ileus, but frequently establishes the cause of obstruction. Small bowel neoplasms are rare but have a high mortality since tumour-related symptoms occur late and are non specific. Endoscopy is not feasible in most cases as enteroscopy is limited to specialist centres. Small bowel contrast studies do not reach the high level of accuracy obtained in the evaluation of the upper and lower gastrointestinal tract. CT not only allows tumour detection but demonstrates possible complications and offers the possibility of pre-operative staging in the acute or elective situation.

**POSTER 608****Imaging of post-operative abdominal complications**

N Ramesh, N El Saeity, MO Dowd and WC Torreggiani  
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**AIM:** The aim of this poster is to demonstrate the role of imaging in the evaluation of the post-operative patient. **MATERIALS AND METHODS:** Post-operative complications of the abdomen are relatively common. Clinical assessment in such cases is difficult, as normal clinical parameters such as pain localization, bowel sounds and temperature record are unreliable. Imaging is therefore paramount in the assessment of the unwell post-operative patient. Ultrasound and CT are at the forefront in the assessment of such patients. In this poster we will focus on the role of these two imaging modalities in the assessment of such patients and indicate the relative merits of each modality. **CONCLUSION:** Modern imaging plays an important role in the diagnosis and management of post-operative abdominal complications.

**POSTER 609****CT patients with suspected acute appendicitis using 16 slice CT: radiation dose and outcome**

AJ Wainwright

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Abdominal CT for suspected acute appendicitis is accurate and has been well demonstrated to reduce negative laparotomy rates in this patient group. The use of CT remains controversial in paediatric patients owing to significant radiation dose. There is also continuing debate on optimum patient preparation and protocol prior to the CT study. Patients with an Alvarado score of 4–7 at a CT study with oral contrast medium, a pre-contrast abdomen and pelvic examination and a limited post-IV contrast study. We recommend scan parameters of 5 mm slice thickness, a pitch of 3.2, effective mAs of 140 using dose modulation, a kV of 120 and a multislice detector size of 1.5 mm. The post-contrast scan uses similar parameters. We discuss radiation dose, appendix identification rates and surgical correlation with outcomes.

**POSTER 610****Colonic stenting: the Bradford experience**

S Stephenson, JR Ausobsky, CG Beckett, JP Griffith and CL Kay

*Bradford Royal Infirmary, Bradford, UK*

**PURPOSE:** To evaluate the clinical and technical outcomes of colonic stent implantation either as a palliative method in patients with acute colonic obstruction or as a “bridge to surgery”. **METHODS:** A mixed retrospective and prospective review was conducted between October 2001 and December 2002. Patients presenting with symptoms of malignant colonic obstruction were reviewed. Age, sex, diagnosis and symptoms were recorded along with technical and clinical outcomes. 15 patients (9 male, 6 female) were treated by attempted placement of a colonic stent. A combined radiological/endoscopic approach was used in 14 cases, with 1 case performed by radiological placement alone. **RESULTS:** Clinical outcome was graded using pre- and post-stent scores for pain, degree of obstruction and Karnofsky score. Stent placement was successful in 13 of the 15 patients. In two patients it was impossible to pass the stricture. All mean scores showed

improvement following stent placement. Resolution of symptoms was seen in all successfully stented patients. Four patients went on to have elective surgery following stent placement. Complications arose in one patient who developed peritonitis 5 days post stent placement and required emergency surgery. The average hospital stay was 3 days following stent placement, with the majority of patients discharged home. Mean survival rate following stent placement is 102 days. Seven patients are still alive 10–234 days following stent placement. **CONCLUSION:** These early results would suggest colonic stent placement results in minimally invasive, successful palliation of acute colonic obstruction in patients with malignant disease.

**POSTER 611****Splenic abscess: is percutaneous catheter drainage safe?**

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**PURPOSE:** Splenic abscesses are uncommon and are traditionally treated by splenectomy if medical treatment fails. Unlike other abdominal abscesses where percutaneous catheter drainage (PCD) is an established and preferred first-line treatment, splenic abscesses commonly have not been subjected to PCD because of fear of complications. We report four cases of pyogenic splenic abscesses that were treated successfully by PCD. **MATERIALS AND METHODS:** Patients comprised three males and one female; age range 24–55 years. One patient each had chronic myeloid leukemia and diabetes mellitus, while the other two had no predisposing factors. Fever and pain left hypochondrium were the presenting complaints in all cases. Diagnosis was established by lab investigations, ultrasound and/or CT scan. A 10–12 F Pigtail catheter was introduced in the abscess cavity under ultrasound guidance using the Seldinger technique. A left lower intercostal approach was taken in all cases. **RESULTS:** All patients showed significant symptomatic improvement within 24–48 h. The drainage period ranged from 6 days to 11 days. Antibiotics were continued for 2–4 weeks. No procedure-related complications were encountered in any case. Follow-up by ultrasound or CT showed complete resolution of abscess in three patients 2 weeks after catheter pull-out, while in one patient a small residual cavity persisted for 3 weeks. **CONCLUSION:** PCD is a safe and effective procedure for treating splenic abscesses and, similar to other abdominal abscesses, PCD should be the first-line treatment. It not only obviates surgical morbidity and mortality but also allows splenic preservation.

**POSTER 612****An audit of success and complication rates in ultrasound-guided liver biopsies**

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**BACKGROUND:** Patients undergoing liver biopsy are at risk. Ultrasound-guided liver biopsy should ensure success in achieving an adequate tissue sample for diagnosis and in preventing complications. **THE STANDARD:** An adequate specimen should be provided for histology in at least 95% of cases, with zero mortality and morbidity. **ASSESSMENT OF LOCAL PRACTICE:** Indicators: (i) percentage of samples that are adequate (>95%); (ii) percentage of cases resulting in mortality (0%); and (iii) percentage of cases resulting in morbidity (0%). **Data items collected:** The medical notes of 60 patients who underwent ultrasound-guided liver biopsies between January 2002 and December 2002 (12 months) were reviewed. Data pertaining to the type of lesion, the type and size of needle, the number of biopsies taken, the size of each specimen, complications related to the procedure and the pathology results were documented. **RESULTS:** Biopsies were performed using an 18 G Tru-cut needle under ultrasound guidance. The lesions were focal in 24% and diffuse in 76%. The number of attempts made at each procedure ranged from one to three. The specimen size varied from 0.3 cm to 1.8 cm. Adequate tissue samples were achieved in all patients (100%). There was no mortality (0%) or morbidity (0%). **COMPARISON WITH THE STANDARDS:** We were well above the standards set by achieving 100% sample adequacy and 0% morbidity and mortality. **CHANGE:** The results of the audit will be presented in the audit meeting. Repeating the audit on a 12 monthly basis will close the audit loop.



**POSTER 613**

**Gastroduodenal stenting: the Bradford experience**

S Stephenson, CG Beckett, JC May and CL Kay

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**BACKGROUND:** Expandable metal stents are being increasingly used in the palliation of malignant gastric outlet obstruction as studies continue to show good results with regard to symptom control. Relief of obstruction combined with lower cost, reduced hospital stay and low complication rate show gastroduodenal stenting to have clear benefits over traditional surgery. We present our findings of one of the largest cohort of patients in a UK study. **METHODS:** A mixed retrospective and prospective review was conducted. Patients presenting with symptoms of malignant gastric outlet obstruction between April 1999 and November 2002 were reviewed. Age, sex, diagnosis and symptoms were recorded along with technical and clinical outcomes. 31 patients (13 female, 18 male) were treated by attempted placement of a gastroduodenal stent. A combined radiological/endoscopic approach was used in 26 cases, with 5 cases attempted by radiological placement only. **RESULTS:** The technical success rate was 29/31 (94%). Clinical outcome was graded using pre- and post-stent gastric outlet obstruction, gut function and Karnofsky scores. There was resolution of symptoms and commencement of oral and dietary intake in 25 patients (86%). There were no immediate complications demonstrated with regard to perforation or haemorrhage. One stent migrated distally requiring another stent to be deployed. The mean survival rate is 64 days post stent placement and a mean of 15 days after a failed procedure. The majority of patients were discharged home. **CONCLUSION:** Gastroduodenal stent insertion is a highly successful palliative method for patients with inoperable malignant gastric outlet obstruction.

**POSTER 614**

**Gd-BOPTA vs SH U 555A: two different MR contrast agents for the detection and differential diagnosis of hypervascularized liver tumours**

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*Universitaetskliniken des Saarlandes, Homburg/Saar, Germany*

**PURPOSE:** To compare Gd-BOPTA (MultiHance; Bracco, Italy) and SH U 555A (Resovist; Schering, Germany) for the detection and characterization of hypervascular hepatic lesions. **MATERIAL AND METHODS:** 32 patients with hypervascular hepatic tumours (15 HCC, 8 FNH, 1 NRH, 8 metastases) each received Gd-BOPTA and SH U 555A with an interval of 3–5 days between examinations. Unenhanced T1w and T2w images and enhanced T1w images in the arterial and portal-venous phase were acquired for both contrast media. Additionally, T1w images were acquired at ~90 min after Gd-BOPTA administration, while T2w and T1w images were acquired at ~15 min after SH U 555A administration. Two independent blinded readers evaluated the number, size and differential diagnosis of lesions. **RESULTS:** The two readers detected 61 and 65 lesions, respectively, in 32 patients. In two patients with cirrhosis, three well differentiated HCC were not detected after SH U 555A but were delineated on dynamic imaging after Gd-BOPTA. Small (<1 cm) FNH were not seen on SH U 555A-enhanced images in two patients with multiple FNH. Lesion characterization was preferred on dynamic images after Gd-BOPTA owing to greater increases of SI. Only slight increases of lesion SI were noted in the arterial phase after SH U 555A at the recommended dose and this did not permit an accurate diagnosis in the majority of lesions, although distinction between cystic and solid perfused lesions was possible. **CONCLUSION:** Delineation of liver tumours is possible with both contrast media although greater confidence for detection and characterization is achieved with Gd-BOPTA.

**POSTER 615**

**MnDPDP-enhanced liver MRI: the role in liver transplant assessment**

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**PURPOSE:** To examine the role of MnDPDP-enhanced MRI (MnMRI) in the transplant assessment of patients with cirrhosis and possible hepatocellular carcinoma (HCC). **METHOD:** A retrospective study of patients who underwent MnMRI for investigation of HCC over a 30-month period (63 patients). Case notes, radiological examinations (US, CT and MRI) and explanted histopathology were reviewed. **RESULTS:**

Of the 25 patients who underwent liver transplantation, 19 had a radiological diagnosis of HCC. There was one false positive and no false negative cases. **CONCLUSION:** MnMRI improved detection and staging of HCC diagnosis on a patient by patient basis.

**POSTER 616**

**Locoregional staging of rectal carcinoma: understanding the regional anatomy and MRI features**

VP Sukumar

*John Radcliffe Hospital, Oxford, UK*

**PURPOSE:** The aim of surgical treatment of rectal carcinoma is prevention of local recurrence. This is reduced significantly by resection of the tumour and total mesorectal excision leaving sufficient margin of clearance. The purpose of this exhibit is to illustrate the radiological anatomy of the rectum and mesorectum and to describe the MRI techniques and features of rectal carcinoma. **METHODS AND MATERIAL:** Patients with rectal tumours in our centre underwent axial T1 and T2 and coronal T2 W imaging of the pelvis followed by high-resolution axial T2 sections through the lesion using phased array coil. The scans were evaluated for T staging, N staging and the margin of clearance in relation to the outer boundary of the mesorectum. The mesorectum is a fibrofatty tissue surrounding the rectum and limited by the rectogenital fascia anteriorly, presacral fascia posteriorly and rectal fascia laterally. **RESULTS AND CONCLUSION:** The pre-operative assessment of the depth of extramural tumour extension is a major prognostic indicator and accurate locoregional staging of rectal cancer is essential for planning pre-operative treatment. Modern MRI techniques have made it possible to accurately evaluate the rectal tumour, mesorectum and adjacent organs.

**POSTER 617**

**Exploring the fistula-in-ano by MRI: what the surgeon needs to know?**

VP Sukumar and NR Moore

*John Radcliffe Hospital, Oxford, UK*

**PURPOSE:** Fistula-in-ano is a common condition in which accurate knowledge of the anatomy of the fistulous tract is essential in surgical management. Inadequate assessment may lead to recurrence, multiple unnecessary operations and may also render the patient incontinent. The purpose of this exhibit is to discuss the classification of fistula-in-ano and to evaluate the role of MRI in diagnosis and pre-operative staging. **METHODS AND MATERIAL:** Patients with clinical evidence or clinical suspicion of perianal fistulas underwent pelvic MRI (1.5 T) performed with phased array coil. Images were obtained in the coronal and axial planes using FSE T1 and T2 sequences with and without fat suppression. A compression band is applied over the lower abdomen to reduce respiratory artefacts. As radiologists, we should answer two key questions that the surgeon is interested in knowing: (1) the anatomical location of the primary fistula and any secondary extension, including abscesses; and (2) the relationship of the fistula to the levator complex. **RESULTS AND CONCLUSION:** MRI is an accurate technique to map anal and perianal fistulas. Moreover, with multiplanar capabilities and high contrast resolution, MRI shows the surgical anatomy accurately and identifies complex fistulas. MRI is helpful in pre-operative evaluation of fistulas, and is thereby able to predict the surgical outcomes and to reduce the recurrence rates.

**Genitourinary**

**POSTER 701**

**Imaging of transitional cell carcinoma of the upper urinary tracts**

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*AMNCH Hospital, Tallaght, Dublin 24, Ireland*

**AIMS:** To pictorially demonstrate the utility of various imaging modalities in the evaluation of transitional cell carcinoma (TCC) of the upper urinary tracts. **MATERIALS AND METHODS:** A literature search was conducted to quantify the relative sensitivities and specificities of radiographic techniques in diagnosis and staging of upper tract TCC. A subset of patients with upper tract lesions was retrieved from the Dept. of Urology's tumour database, listing biopsy and resected specimens with TCC diagnosed between 1 December 1998 and 31 December 2001. The study population is from an urban

teaching hospital and tertiary referral centre. Imaging studies relating to the patient group were collated and analysed. Selected representative images are displayed to illustrate the role of radiology in managing upper tract TCC. RESULTS: Of 371 patients with histologically proven TCC, 22 were upper tract lesions. Of these, 18 had IVP, 12 had retrograde pyelography, 13 had renal ultrasound, 15 had abdominal CT, 4 had contrast-enhanced 3D FLASH MR imaging and 3 underwent MRU. In over half of the cases diagnosis was based on either CT, IVU or retrograde pyelography. A small number had metastatic disease identified radiographically. CONCLUSIONS: In contrast to its role in bladder neoplasia, imaging continues to play an important role in managing patients with TCC of the upper tracts. Traditional contrast radiography such as IVP and retrograde studies still play the pivotal role. However, emerging technologies such as MR urography may help in difficult or equivocal cases and promise to improve the accuracy of diagnosis and staging.

#### POSTER 702

##### **Congenital anomalies in the renal tract**

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There is a wide spectrum of congenital anomalies in the renal tract, some of which are diagnosed *in utero* such as bilateral agenesis with a grave associated prognosis, and some of which are incidental findings of no clinical significance. Unilateral agenesis is well recognized in association with other anomalies (VATER) and should prompt thorough further investigation. Abnormal development of the ureters may result in insignificant bifid collecting systems or a ureteric diverticulum, which predisposes to urinary stasis and infection. Renal anomalies are associated with varying complications, including pelvi-ureteric junction obstruction, infection, stone disease and in some cases increased risk of malignancy. We illustrate varying anomalies in the urinary tract on IVU, ultrasound and CT. We highlight the salient imaging features and potential complications.

#### POSTER 703

##### **A pictorial atlas of retrograde ureteropyelography performed with state-of-the-art imaging**

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PURPOSE: To present a comprehensive pictorial review of the radiological signs of retrograde ureteropyelography. MATERIALS AND METHOD: Using a flexible cystoscope and digital C-arm fluoroscopy, procedures were performed on an outpatient basis under sedoanalgesia. The ureteric orifice was identified and a straight hydrophilic guidewire was inserted and passed into the renal pelvis under fluoroscopic guidance. A 4 F multipurpose catheter was passed over the guidewire and ureteropyelography was performed using non-ionic contrast medium. RESULTS: Over a 5-year period, 300 procedures were reviewed. Indications included haematuria, unexplained hydronephrosis, investigation of obstruction, fistulae, unexplained deterioration in renal function and loin pain. The technical success rate was 91% ( $n=275/300$ ). Failure was most commonly due to inability to visualize the ureteric orifice in cases of malignancy. Pathology demonstrated included benign and malignant strictures, renal cell and transitional cell carcinomas, arterio-ureteric fistula, stones, uroepithelial polyp, benign and malignant retroperitoneal fibrosis, pyeloureteritis cystica, PUJ obstruction, duplex ureters, horseshoe kidney, ureteroceles and pseudodiverticulosis. CONCLUSION: Retrograde ureteropyelography remains a useful technique in the diagnosis and management of urothelial pathology. Retrograde ureteropyelography may be diagnostic in cases of contrast allergy, metallic prosthesis causing artefact, renal failure and refusal to allow contrast medium injection, when MD-CT urography may be contraindicated or suboptimal.

#### POSTER 704

##### **Pictorial review of renal tract complications secondary to spinal cord injury**

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The majority of patients with neurological deficit following spinal cord injury have disturbed bladder emptying due to interruption of the normal micturition reflex. This may result in elevated bladder voiding pressures, ureteric reflux and frequently necessitates indwelling urethral and suprapubic catheters. These factors lead to an increased

incidence of renal tract calculi, severe urosepsis, reflux nephropathy and complications of the lower urinary tract such as fistulae. We present an image-based review based on patient presentation through a renal surveillance programme, acute admission with febrile episode or admission for increasing autonomic dysreflexia or for investigation of increasingly poor bladder emptying.

#### POSTER 705

##### **Haematuria screening: is a KUB necessary?**

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*<sup>1</sup>Department of Radiology and <sup>2</sup>Department of Urology, Northampton General Hospital NHS Trust, Northampton, UK*  
PURPOSE: Investigations for painless haematuria include ultrasound and a KUB radiograph, followed by flexible cystoscopy. An intravenous pyelogram is subsequently performed in patients with persistent undiagnosed macroscopic haematuria. We wished to establish whether diagnostic sensitivity could be retained if this protocol was streamlined by omitting the KUB. METHOD: For 5 months a comparison of the results of KUB and US examinations in patients attending the Haematuria Clinic was made prospectively. RESULTS: Of 148 patients referred, 92 had confirmed haematuria on urinalysis. 3/92 patients (3.3%) had calculi and 1 patient (1.1%) a calcified bladder tumour, all of which were identified by both examinations. In addition, KUB demonstrated one case of renal cortical calcification and two bladder calculi (one of which was confirmed at cystoscopy) that were not seen on US. Conversely, US identified a calcified renal tumour missed by KUB. CONCLUSION: Omitting the KUB would have resulted in one case of benign renal cortical calcification of dubious clinical significance being missed. Although KUB should be superior to US in detecting ureteric calculi, none were identified in this series. Indeed, review of the literature suggests that ureteric calculi are rare (0.6%) among patients with asymptomatic microscopic haematuria. This study does not support retention of the KUB in the routine diagnostic workup of asymptomatic haematuria, reflecting how the clinical characteristics of these patients differ from those of patients presenting with renal colic.

#### POSTER 706

##### **Imaging the retroperitoneum—pathologies of the perirenal and posterior pararenal spaces: a pictorial review**

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*University Hospitals Coventry & Warwickshire NHS Trust, Coventry, UK*  
AIMS: (1) To present the fascial anatomy of the retroperitoneum as seen by CT and MRI. (2) To understand the various pathological conditions that affect the perirenal and posterior pararenal compartments. The retroperitoneum is complex but generally divided into three fascial compartments. The anterior pararenal space contains the pancreas, duodenal loop and ascending and descending colon, and is continuous across the midline. The perirenal space contains the kidneys, adrenal glands and perirenal fat. The posterior pararenal space is a potential space usually only filled with fat. The contents and anatomical boundaries of each fascial compartment determine its pathologies and appearances on imaging. CT and MRI allow accurate cross-sectional imaging of the retroperitoneum. The perirenal space is affected by inflammatory, neoplastic, traumatic and vascular conditions, the majority of which arise from the kidney itself. The posterior pararenal space is usually affected by pathologies arising from its neighbouring structures such as the spine, muscles and major vessels as well as extension from the perirenal space. This pictorial review will illustrate the normal appearances and boundaries of these two spaces as seen on CT and on the various sequences of abdominal MRI. Common pathologies of the perirenal and posterior pararenal spaces will be discussed. Venous and arterial anomalies presenting in the posterior pararenal space will also be discussed.

#### POSTER 707

##### **Open access unenhanced CT for flank pain referred from primary care**

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*<sup>1</sup>John Radcliffe Hospital, Oxford, UK and <sup>2</sup>Stoke Mandeville Hospital, Aylesbury, UK*  
PURPOSE: To evaluate outcomes of a cohort of patients referred directly from primary care with flank pain suspicious of renal colic.

**METHODS AND MATERIALS:** A policy of changing both inpatients and outpatients with suspected renal colic from intravenous urography to unenhanced computed tomography was established in 1999. Patients with acute flank pain with a clinical diagnosis of suspected renal colic referred from the community underwent unenhanced spiral CT (UESCT) with reduced exposure factors (120 kV, 130 mA, slice width 5 mm, pitch 1.5). Patients with ureteric calculi less than 5 mm in size in the lower third of the ureter or with other significant abnormality were discharged. Patients with larger stones were referred to casualty for further management. **RESULTS:** Similar diagnostic rates for incidence of ureteric calculi and other pathology were detected compared with published series. **CONCLUSION:** UESCT is a rapid, non-invasive and cost effective tool for evaluation of patients with flank pain direct from primary care, which expedites patient management.

**POSTER 708**

**Imaging of renal trauma: pictorial review**

N Ramesh, NEL Saiety and WC Torreggiani

*Tallaght Hospital, Dublin, Ireland*

**AIM:** To demonstrate the spectrum of CT findings that occur following blunt trauma to the kidneys. **MATERIALS AND METHODS:** Renal injury is seen in approximately 8–10% of patients with blunt abdominal trauma. CT provides the cornerstone in the imaging evaluation of these patients allowing precise diagnosis and subsequent triaging of patients. This poster will pictorially demonstrate many of the CT findings that can be observed in blunt abdominal trauma. **CONCLUSION:** CT is the imaging modality of choice in the evaluation of blunt abdominal trauma.

**POSTER 709**

**Paediatric testicular pathology: a pictorial review**

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M Mashayekhi, V Meganathan and C Allen

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**INTRODUCTION:** The role of ultrasound (US) in the management of testicular disease is well established. US is pivotal in the diagnosis and follow-up of testicular pathology. However, it is customary to associate testicular diseases with an adult population, often overlooking the paediatric age group. Improved survival rates of premature infants have resulted in varying pathologies presenting themselves earlier for imaging and diagnosis. In paediatric centres this is dealt with as a matter of course. However, general radiologists are increasingly being asked to image such a patient cohort and may be presented with a potential unfamiliar spectrum of pathologies. **PURPOSE:** We would like to present a pictorial guide of both common and unusual conditions to familiarize radiologists with their appearances. Cases include: intra- and extra-abdominal undescended testes, trauma, torsion, neoplasia, hydrocoeles and hernias.

**POSTER 710**

**Painless scrotal swelling: sonographic features with pathological correlation**

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**PURPOSE:** (1) To describe the role of sonography in the diagnosis of patients presenting with scrotal swelling. (2) To illustrate the sonographic features of various extratesticular and intratesticular scrotal lesions. Scrotal swelling can be categorized into extratesticular and intratesticular lesions. The majority of extratesticular lesions are benign, while the majority of intratesticular lesions are malignant. Sonography is helpful in separating extratesticular from intratesticular lesions. Sonography can show whether a mass is cystic, solid or complex, and also associated calcifications, epididymal involvement, scrotal skin thickening and colour Doppler flow pattern. Extratesticular lesions include hydrocoele, spermatocele, varicocele, epididymal cyst, hernia and tumours of the epididymis and cord structures. Intratesticular lesions include primary tumour, metastases, lymphoma and leukaemia. Tuberculous epididymitis or epididymo-orchitis may also present with painless scrotal swelling. Sonographic features of

these disease patterns, with pathologic correlation, are illustrated.

**POSTER 711**

**A pictorial review of unusual testicular masses**

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The clinical finding of a scrotal mass is a common indication for investigation with ultrasound. Ultrasound is of proven benefit in distinguishing testicular pathology from that of adjacent structures, with a reported accuracy of 100%. Intratesticular lesions tend to be regarded as malignant until surgically proven to be otherwise; however, a false positive rate of 22% for sonographically suspected malignancy is quoted, with testicular infarction, epididymal tumour, organized haematoma and epididymo-orchitis often mimicking neoplasia. We present a pictorial review of the ultrasonographic findings of a series of unusual neoplastic and non-neoplastic testicular masses, some of which show characteristic features, and where, in the correct clinical context, orchidectomy can be avoided.

**POSTER 712**

**Prostate brachytherapy—what the radiologist needs to know: a pictorial review**

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Prostate brachytherapy using permanent radioactive implants is increasingly becoming an accepted form of treatment for early prostate cancer. The implant takes less than 2 h to perform and requires an overnight stay in hospital. Urinary incontinence and impotence are less likely than with other forms of treatment and the technique results in good disease control and quality of life. Patient selection is critical not only for a good implant result but also to avoid prolonged urinary symptoms. Radiologists need to be aware of the indications for the procedure and how to assess the prostate gland for suitability. The main constraints apart from the presence of organ-confined disease are gland size and the presence of a large median lobe. The methods for assessment and measurement of gland size using US, MR and CT are shown, and other complicating factors such as the presence of large cysts are discussed. Post treatment, the radiologist may be asked to assess the implant and the methods for this are also shown. Post-implant complications are reviewed together with post-implant biopsy technique.

**POSTER 713**

**Limitations of MR in prostate cancer staging**

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**PURPOSE:** The diagnosis and management of prostate cancer remains contentious, including the role of radical radiotherapy and prostatectomy for neoplasms confined to the prostate. Accurate local and lymph node staging is difficult and CT or MR is often recommended in treatment planning. This study was performed to determine the value of MR in patients being considered for radical therapy. **PATIENTS AND METHODS:** The pelvic MR reports of 207 patients with prostatic cancer performed over a 4-year period were reviewed retrospectively. 44 patients subsequently underwent radical prostatectomy. The MR appearances were compared with the histological findings. **RESULTS:** The overall specificity of MR for local extension was 86%, with 6 out of 41 patients with negative MR studies showing histological penetration of the prostatic capsule or seminal vesicles. 30 patients were considered to have local extension on MR (14% of the total studies), of which at least three were false positives. MR also revealed pelvic lymphadenopathy in 10 patients, each of whom had PSA levels greater than 20 ng ml<sup>-1</sup>. 12 patients had evidence of bone metastases on MR, some of which were not clearly shown on scintigraphy; each of these also had raised PSA levels. **CONCLUSION:** In patients selected for MR investigation, the overall number of abnormalities detected was low. At least three false positive studies were recorded in 30 patients suspected of having local extension on MR. All other abnormalities were associated with serum PSA values of greater than 20 ng ml<sup>-1</sup>. The impact of these findings on our clinical and imaging practice will be discussed.

**POSTER 714****The efficacy of local anaesthesia for pain relief prior to transrectal ultrasound and biopsy of the prostate**R Gadahadh  
*University Hospital of Wales, Cardiff, UK*

**PURPOSE:** The efficacy of local anaesthesia for pain control in patients undergoing transrectal ultrasound and biopsy of the prostate is unproven. We performed a case control study to evaluate the efficacy of priprostic local anaesthesia (10 ml of 1% lignocaine) during transrectal ultrasound-guided prostate biopsy. **MATERIALS AND METHODS:** The group of patients were those referred for transrectal ultrasound-guided biopsy for the first time as an outpatient. Patients were randomized to two groups, one receiving local anaesthesia and the other receiving no anaesthetic. Patients from both groups were asked to complete a visual analogue pain scale (0–10) up to 24 h following the procedure. **RESULTS:** A preliminary analysis of 40 patients was performed. Statistical analysis using one-way analysis of variance showed no significant difference in pain score between the groups ( $p=0.426$ ). The maximum mean pain perceived was 5 (moderate), which comprised one patient in the no local anaesthesia group and two patients in the anaesthesia group. The patients experienced maximum pain in both groups when the ultrasound probe was inserted. **CONCLUSION:** Our study shows that there is no significant reduction in pain control following administration of local anaesthesia prior to performing transrectal ultrasound-guided prostate biopsy. This is an ongoing study and data will be presented from a total of 100 patients.

**POSTER 715****Kidney length and volume assessment in patients with suspected renovascular disease using MRI**SJ Gandy, RM Blackley, K Armoogum, TAP Sudarshan, DG Sheppard and JG Houston  
*Tayside University Hospitals NHS Trust, Ninewells Hospital, Dundee, UK*

**PURPOSE:** To compare kidney length and volume measurements for assessing renovascular disease (RVD) using MRI. **MATERIALS AND METHODS:** 30 patients (mean age 69 years) were imaged. 3D coronal oblique MRA data were acquired before and after 20 ml Gadoteridol (Prohance, Bracco), and kidney lengths and volumes were calculated from venous phase images using analysis software. Renal artery stenoses (RAS) were also examined, and were graded as minimal (0–30%,  $n=26$ ), moderate (31–70%,  $n=14$ ) or severe (71–100%,  $n=20$ ) for each kidney. Volume analysis software was validated by comparing MRI volumes to actual volumes for eight porcine kidneys. **RESULTS:** Mean intraobserver and interobserver MRI coefficients of variation (CoVs) for porcine kidney volumes were, respectively, 2.14% and 3.29% (cortical) and 1.12% and 1.99% (total). The mean MRI volume was 2.14% lower than the actual volume. Mean intraobserver and interobserver CoVs for patient kidney volumes were, respectively, 3.2% and 6.0% (cortical) and 1.9% and 3.7% (total). The mean cortical volume was greatest for patients with moderate RAS ( $92.41 \pm 10.37 \text{ cm}^3$ ) relative to minimal ( $84.09 \pm 5.72 \text{ cm}^3$ ,  $p<0.49$ ) and severe RAS ( $51.80 \pm 8.07 \text{ cm}^3$ ,  $p<0.005$ ), and similar trends were observed for total kidney volumes. Mean kidney length was also greatest for patients with moderate RAS ( $10.66 \pm 0.37 \text{ cm}$ ) relative to minimal ( $10.28 \pm 0.25 \text{ cm}$ ,  $p<0.38$ ) and severe RAS ( $8.86 \pm 0.46 \text{ cm}$ ,  $p<0.01$ ). However, kidney length was poorly correlated with volume for all RAS groups (best correlation  $R^2 = 0.76$ ). **CONCLUSION:** MRI kidney length is commonly used to assess RVD, but the relationship of length to volume is poorly correlated. It may be more appropriate to use validated cortical volume measurements to characterize functional renal tissue with MRI.

**POSTER 716****Evaluation of magnetic resonance renography as a “one stop” investigation of suspected renovascular disease**1LA Kurban, 2A Murray, 1P Thorpe, 1J Webster and 1I Khan  
*1Aberdeen Royal Infirmary, Aberdeen, UK and 2Aberdeen University, Aberdeen, UK*

**PURPOSE:** To assess the feasibility of MR renography as a “one stop”, non-invasive outpatient investigation of patients with suspected renovascular disease compared with ultrasound (US), isotope renography (IR) and renal digital subtraction angiography (DSA).

**METHOD:** 19 patients with suspected renovascular disease who had undergone renal DSA in the previous 6 months were recruited. MR renography was performed on a 1.5 T General Electric system. Renal morphology was assessed using a  $T_2$  weighted coronal sequence. Renal perfusion was assessed using a dynamic gadopentetate dimeglumine (Gd) enhanced  $T_1$  weighted sequence. Renal artery anatomy was assessed on 3D breath-hold contrast-enhanced MRA. The findings were compared with US, IR and DSA by two consultant radiologists blinded to other investigations. **RESULTS:** Good correlation of renal size and morphology was obtained between US and MR, with better demonstration of cortical lesions on MR. The best approach for assessing renal perfusion was dynamic coronal  $T_1$  weighted imaging with analysis of signal intensity–time curves. There was good correlation between MR renography and IR in patients who had the latter. Respiratory movement during the dynamic acquisition was obvious, and timing of the acquisition was crucial to include the period of parenchymal enhancement. MRA correlated well with DSA, with 100% sensitivity and 71% specificity for occlusion or  $\geq 50\%$  stenosis. **CONCLUSION:** MR is a non-nephrotoxic and non-invasive technique that could replace US and DSA for the assessment of renal morphology and renal artery stenosis and shows promise in assessment of relative renal function.

**POSTER 717****Uterine leiomyosarcomas: MRI appearances**MR Venumbaka and S Scott-Barrett  
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Leiomyosarcomas of the uterus are rare but highly malignant tumours. Uterine sarcomas as a whole constitute approximately 2–3% of all uterine tumours, with leiomyosarcomas constituting about 35–40% of them. Uterine leiomyosarcomas are often quite difficult to diagnose pre-operatively. There is very little published literature on their imaging appearances in view of the rarity of the condition and limited experience with pelvic MRI. In the past it has been quite difficult to differentiate leiomyosarcomas of the uterus from their benign counterparts, leiomyomas. But now, with improved MRI techniques, there are some imaging features of leiomyosarcomas that help distinguish them from other tumours. We present a series of five cases of uterine leiomyosarcomas. We discuss the MRI techniques and interesting appearances of these highly malignant lesions and discuss their differential diagnoses.

**POSTER 718****Correlation of power Doppler with microvessel density in assessing prostate needle biopsy**1NMW Wilson, 1HBB Barsoum, 2FAT Tantawy, 3TAK Kamal, 3MMR Refaat and 4AMM Masoud  
*1Ahmed Maher Teaching Hospital, Cairo, Egypt, 2Zagazig Faculty of Medicine, Zagazig University, Zagazig, Egypt, 3Benha Faculty of Medicine, Zagazig University, Benha, Egypt and 4Cairo University, Bany Swef Branch, Cairo, Egypt*

**PURPOSE:** In this study we aimed to correlate hypervascular power Doppler with the histological evaluation of prostate microvasculature from TRUS needle biopsy. **METHODS:** 96 patients with a PSA value more than  $4 \text{ ng ml}^{-1}$  were evaluated with power Doppler prior to sextant biopsy, which yielded 58 benign, 33 malignant and 5 patients with suspicious small acinar proliferation. The vascularity of the peripheral zone was graded on a scale of PZ0 to PZ2. Core needle biopsies were immunostained with CD31 [DAKO] and counting was performed manually on separate HPF [ $\times 400$ ] in areas containing the highest number of vessels. **RESULTS:** The grading system of power Doppler we used correlates significantly with microvessel density (MVD) [PZ0,  $28.61 \pm 8.97$ ; PZ1,  $36.00 \pm 12.11$ ; PZ2,  $64.008 \pm 15.86$ ] ( $p$ -value less than 0.001). Also, there is a significant difference in MVD between benign, malignant and tissue cores with atypia ( $p$ -value less than 0.001 and 0.018). There is a significant correlation between malignant tissue with a higher Gleason score and increased MVD ( $p$ -value less than 0.001). Furthermore, cancer biopsies having high flow PZ2 have nearly two-fold likelihood (63.2%) of having a Gleason score of 7 or more compared with 36.8% having a Gleason score less than 7. **CONCLUSION:** The grading system of assessing the power Doppler flow signals appears to be of value as an indicator of MVD and also correlates with higher Gleason score, and this may reflect the clinical outcome in prostate cancer.

**POSTER 719**

**A pilot evaluation of saline instillation sonography to investigate post-menopausal bleeding in the DGH**

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Post-menopausal bleeding (PMB) is a common gynaecological presentation. The gold standard investigation is invasive inpatient hysteroscopy and biopsy, later replaced by uncomfortable outpatient hysteroscopy. Whilst transvaginal ultrasound can accurately measure endometrial thickness, it is not good at precisely locating polyps. Saline instillation sonography (SIS) allows precise localization and measurement. This paper looks at a pilot phase following the introduction of SIS at our institution; assessing its accuracy, patient acceptability, complications and effects on patient management. 24 women were referred for SIS in the first 6 months. 15 (65%) had polyps located and were referred directly for polypectomy; 3 (13%) had uniform thickening; 1 (4%) was abandoned. The lack of serious complications as well as overall patient acceptability, along with useful information to further direct patient management, has allowed us to accept this technique as a recognized procedure in the investigation of women with PMB.

**POSTER 720**

**How sensitive is MAG-3 renography in detecting renovascular disease in patients already receiving ACE inhibitor treatment for hypertension?**

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**PURPOSE:** Conventional MAG-3 renography is of little value in detecting renovascular disease (RVD) owing to compensatory vasoconstriction of the efferent glomerular arterioles, which increases filtration pressure and thereby maintains normal uptake despite diminished renal plasma flow. This effect is reversed, however, if renography is performed under ACE inhibition. The standard technique is to perform two studies (pre and post Captopril). This paper examines whether equivalent results can be obtained by performing a single MAG-3 study in those (many) patients already receiving ACE inhibitors. **METHODS:** Two separate protocols were compared against the angiographic outcome. Protocol 1 was the standard two-study technique (23 kidneys). Protocol 2 was a single study in patients already on ACE inhibitors (16 kidneys). Various derived functional parameters were also selected and compared for sensitivity of detection of RVD. **RESULTS:** The most sensitive parameter was found to be the configuration of the time-activity curve. Protocol 1 gave a PPA of 1.0 for RVD, with a sensitivity of 0.5. Protocol 2 yielded a PPA and a sensitivity of 0.75. **CONCLUSION:** In hypertensive patients receiving ACE inhibitors, a single positive MAG-3 study is a reasonable predictor of RVD.

**POSTER 721**

**3D-CT cystography in detecting vesicoureteral reflux: a preliminary study in adult patients with neurogenic bladder**

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**PURPOSE:** To highlight the ability of 3D-CT virtual cystography in detecting vesicoureteral reflux (VUR) in adult patients with neurogenic bladder. **MATERIALS AND METHODS:** Six paraplegic patients (five men, one woman; mean age 33.2 years) with known VUR, which had already been demonstrated by retrograde cystography, underwent 3D-CT virtual cystography. Spiral CT scans have been performed after retrograde filling of the urinary bladder with contrast medium through a Foley catheter. Image acquisition used a 3 mm collimator width, 1.0 pitch and 1 mm reconstruction algorithm. **RESULTS:** The findings of 3D-CT virtual cystography have been compared with those of retrograde cystography, which was the reference method of evaluation. In all cases both methods managed to depict the presence of VUR, although the classification of VUR was based only on retrograde cystography. There was one case of unilateral VUR (grade I), two cases with bilateral VUR (grade II), one case with bilateral VUR (grade III) and two cases with unilateral VUR (grade V). **CONCLUSION:** 3D-CT virtual cystography constitutes an alternative method of detecting VUR in adult patients with neurogenic bladder. The ability of virtual

cystography to evaluate VUR in combination with other complications of neurogenic bladder seems useful and needs to be further investigated.

**POSTER 722**

**Diagnostic assessment with non-contrast-enhanced helical CT of the clinical outcome and complications of extracorporeal shock wave lithotripsy**

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**PURPOSE:** To report our experience with non-enhanced helical CT after extracorporeal shock wave lithotripsy (ESWL) in patients considered being at high risk for complications. **MATERIAL AND METHODS:** A retrospective study was performed on 147 consecutive patients who had been treated with ESWL and subsequently evaluated with helical CT during the past 5 years (May 1997–May 2002). Lithotripsy treatments were outpatient procedures without anaesthesia. Non-contrast-enhanced helical CT scans were obtained in these patients following lithotripsy for residual renal calculi and possible complications. CT findings included cases of no retained calculi, insignificant fragments (1–3 mm), retained calculi and complications. **RESULTS:** No calculi were seen in 85 patients (57.8%) and retained calculi were identified in 45 (30.6%). Insignificant calculi were noted in 17 patients. Eight pararenal and perirenal haematomas were diagnosed. Retained calculi were identified in all patients that presented with severe low back pain immediately after they were treated with ESWL. Among the main risk factors for complications following ESWL, hypertension was present in 11 patients, clotting disorders in 3 patients and previous ESWL sessions were performed in 32 patients. **CONCLUSIONS:** Non-enhanced helical CT is an adequate diagnostic tool for the assessment of the clinical outcome and possible complications of ESWL. Non-enhanced helical CT is the best method to determine whether a patient is stone-free after ESWL, aiding in locating retained calculi or rare complications. Further therapeutic management of these patients may therefore be adequately designed.

**POSTER 723**

**A review of ultrasound appearances of complications in renal transplants**

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**PURPOSE:** To review the ultrasound appearances of complications seen in patients with a failing renal transplant. **METHOD:** Pictorial review. Early and late complications are presented under the broad categories of vascular, urological and parenchymal. **RESULTS:** Cases of vascular complications presented will include transplant arterial and venous thrombosis and stenosis, arteriovenous fistula and pseudoaneurysms. Important points regarding Doppler technique and spectral trace interpretation will be made. Urological complications presented will include urinomas, perirenal fluid collections and transplant hydronephrosis/urethral stricture. The limitations of ultrasound in diagnosing parenchymal complications such as acute tubular necrosis, rejection and cyclosporin toxicity are discussed and the role of renal biopsy is emphasized. **CONCLUSION:** Ultrasound is the mainstay of imaging in patients with a failing renal transplant and as this review demonstrates how it plays a vital role in the detection and exclusion of treatable complications.

**Musculoskeletal**

**POSTER 801**

**High resolution MRI of patella cartilage defects at 1.5 T**

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**INTRODUCTION:** In patients with cartilage degeneration, physical complaints can often occur before tissue disruption can be shown arthroscopically. Reliable information about cartilage quality as well as size and location of defects can therefore lead to earlier diagnosis. In this abstract we demonstrate high resolution quantitative  $T_2$  and diffusion weighted (DW) imaging of patellar cartilage defects on a clinical MR system in clinical scan times. **METHODS:** 12 patients

were referred with a clinical suspicion of patellar chondral defects. Imaging was performed on an Intera 1.5 T using the 47 mm microscopy coil. Anatomical imaging was performed with 3D T1wFFE and P.D.W TSE sequences with in-plane resolutions of 0.23 mm<sup>2</sup> and 0.23 mm<sup>2</sup>, respectively. A GRASE multi-echo sequence was used for T2 mapping with an in-plane resolution of 0.6 mm<sup>2</sup>. DW imaging (b 0,500) was obtained with an in-plane resolution of 0.75 mm<sup>2</sup>. As a research investigation, a 3D spiral sequence was also implemented. All sequences had a slice thickness of 2–2.5 mm with scan times of 4–5 min. RESULTS: The average patellar cartilage thickness for all subject was 4.5 ± 0.6 mm. T2 values from 20 ms near the subchondral bone through to 60 ms near the articular surface were seen in normal cartilage. In areas of cartilage damage, increased T2 values were observed. There was a strong correlation in the information content of the T2 maps and the ADC values of the DWI sequence. DISCUSSION: The GRASE multi-echo sequence showed T2 values consistent with those reported in the literature. The 3D T1wFFE sequence provided useful anatomical information, although the 3D spiral research sequence best demonstrated pathology.

#### POSTER 802

##### MRI of Hoffa's infrapatellar fat pad: a pictorial review

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Hoffa's fat pad can be the primary site of disease within the knee as well as being secondarily affected by other intra-articular processes. In this pictorial review we illustrate the normal magnetic resonance appearances of Hoffa's fat pad. In particular we demonstrate the predilection of intra-articular bodies for its superior and inferior recesses. Abnormalities of Hoffa's fat pad are most commonly the consequence of knee surgery and include arthroscopic portal scarring, post-operative inflammation ("Hoffitis") and arthrofibrosis (Cyclops lesion). Acute fat pad trauma in the form of shearing injuries and the appearances of chronic repetitive trauma in fat pad impingement are being increasingly recognized as sources of knee pain. The secondary effects of an inflammatory synovitis are not uncommon. Less commonly, pigmented villonodular synovitis and chondrometaplasia can involve the infrapatella fat pad.

#### POSTER 803

##### Pictorial review of the MRI characteristics of lower limb hibernoma

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Hibernoma is a rare benign tumour of the vestigial remnants of hibernol, or brown, fat. Characteristically the tumour occurs in the third decade of life and is found in the interscapular area. Other commonly described sites include the mediastinum, breast and axillary area. Peripheral sites are unusual and have rarely been described in the literature. Although the tumour is benign, it is often difficult to differentiate on imaging from liposarcoma, especially when sited in the periphery. We present three cases of hibernoma of the lower limb, and use these to illustrate the typical MR characteristics of this tumour.

#### POSTER 804

##### MR arthrography of the ankle for osteochondral lesions: does it influence management?

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PURPOSE: The aim was to evaluate whether MR arthrography of the ankle for osteochondral lesions influences clinical outcome. MATERIALS AND METHODS: 40 MR arthrograms of the ankle performed for suspected osteochondral lesions over a 2-year period were analysed retrospectively. There were 24 male and 16 female patients in the age group ranging from 27–68 years. Of the 40 scans, 17 were abnormal, 9 with osteochondral defect, 6 with focal cartilage loss or irregularity, 1 patient with a loose body and another patient with an osteochondral lesion in cuboid. Medical records of 39 patients both with normal and abnormal scans were reviewed regarding management. RESULTS: Arthroscopy was indicated and performed on 7 of the 9 patients (88%) with osteochondral lesion of the tibiotalar joint and 3 of the 6 (50%) patients with chondral defect or irregularity. Arthroscopy was not performed on a patient with loose body in the tibiotalar joint. One patient with osteochondral lesion of the cuboid

was not included in the results. Of the 23 normal scans, medical records were reviewed in 22 patients. Arthroscopy was performed on two of the patients with normal scans owing to the persistence of symptoms. One of the patients showed meniscoid lesion and another patient did not demonstrate any abnormality at arthroscopy. CONCLUSION: All patients with positive findings on MR had positive findings at arthroscopy. Only one patient with "normal" MR had abnormal arthroscopy. MR arthrography influences management in 75% of patients with suspected osteochondral lesions.

#### POSTER 805

##### MRI features of posterior ankle impingement syndrome in ballet dancers: a review of 25 cases

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PURPOSE: To describe the MRI features of posterior ankle impingement in classical ballet dancers. MATERIALS AND METHODS: A retrospective review of 25 MRI scans of the foot and ankle in 23 classical ballet dancers was performed. All patients presented with signs and symptoms of posterior ankle impingement. RESULTS: Anatomical variants that predispose to posterior ankle impingement were clearly depicted. The commonest in our series were a prominent superior calcaneal tuberosity ( $n=13$ , 52%) and posterior intermalleolar ligament ( $n=12$ , 48%). An os trigonum, Stieda process and prominent downsloping tibia were less common. The most common imaging feature of posterior ankle impingement was posterior synovitis ( $n=25$ , 100%). Thickening of the posterior capsule ( $n=13$ , 52%) and flexor hallucis longus tenosynovitis ( $n=17$ , 68%) were frequent findings. Bone marrow oedema, most commonly in the posterior talus ( $n=10$ , 40%) or in a patchy distribution ( $n=10$ , 40%), was often noted. 11 scans (44%) were performed in both the neutral position and in plantar flexion and all cases demonstrated soft tissue impingement at the posterior ankle. CONCLUSION: MRI is a useful diagnostic tool in posterior ankle impingement syndrome and clearly depicts the anatomical variants and range of osseous and soft tissue abnormalities.

#### POSTER 806

##### MRI of soft tissue trauma of the ankle and foot

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PURPOSE: Evaluation of the use of MRI in soft tissue trauma of the ankle and foot. METHOD AND MATERIAL: We have reviewed the MR images of all cases of ankle and foot soft tissue trauma over the last 5 years within our institution. RESULT: MR is able to exquisitely depict the complex anatomy of the foot and ankle in three orthogonal planes. It enables demonstration of acute ligamentous injuries surrounding the ankle, such as anterior talofibular and calcaneofibular ligaments or the deltoid ligament. These injuries can be difficult to diagnose with other imaging modalities. With the increasing trend towards acute surgical treatment within the current generation of sports enthusiasts and athletes, prompt and accurate diagnosis is imperative. MR can detect subtle and early changes in soft tissue injuries. It is particularly useful in ruptures of tendons like tibialis posterior and anterior, peroneals and Achilles. It also plays an important role in imaging of impingement syndromes and sinus tarsi syndrome. CONCLUSION: MRI is useful in characterizing soft tissue trauma of the ankle and foot and is able to depict early changes otherwise undetectable by other imaging modalities. With the continuous evolution of MRI and technological improvement, the time for imaging should considerably decrease, promoting more widespread use in the acute trauma situation. The advance in surgical management of the ankle and foot trauma makes the role of MR vitally important in foot and ankle trauma.

#### POSTER 807

##### Imaging of pelvic injuries in athletes

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The pelvis and hip are a region of complex anatomy comprising several bony structures, soft tissues and a number of powerful muscle groups that originate and insert in this area. Large forces have been demonstrated traversing this region during exercise, with at least six

to eight times body weight exerted during athletic activity, making the pelvis particularly prone to sporting injury. The symptoms of injury within this area can be vague and non-specific, and a wide range of differential diagnoses need to be considered. The type of injury will depend on the sporting activity, the maturity of the athlete and whether the injury sustained is due to an acute or overuse injury. Recovery from injuries within the pelvis and hip can be prolonged, especially if the diagnosis is incorrect or delayed. A thorough understanding of the anatomy of the pelvis, relevant function and aetiology of conditions associated with various mechanisms of injury are needed by the radiologist to establish which imaging modality should be used for diagnosis. This poster will review the commonest sporting injuries of the pelvis in athletes and the imaging modalities available in the diagnostic process. Injuries can be classified into bone and soft tissue, including pathology of muscles, tendons, acetabular labrum and the more complex abnormalities of the inguinal region. We propose an imaging algorithm to aid the radiologist in the assessment of pelvic sporting injury and will discuss the relevant imaging findings of the more common conditions.

#### POSTER 808

##### **Osteomyelitis of the pelvis: a diagnostic conundrum**

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**PURPOSE:** Pelvic osteomyelitis in children is uncommon but poses diagnostic difficulties. A review of the literature gives the impression that it is usually diagnosed late with increased rate of recurrence and morbidity. Hence, early diagnosis is imperative to reduce morbidity and mortality. **MATERIAL AND METHOD:** We present a variety of cases of pelvic osteomyelitis and pyogenic sacroiliitis that were referred as hip pain. Several imaging modalities were used. **RESULT:** Limb and referred pain were the most common presenting symptoms. *Staphylococcus aureus* is usually the most common organism. Initial investigation with ultrasound and plain films may be unhelpful, especially in the first 7 days. An ultrasound scan focused on the hip joint may miss the periarticular changes. Ultrasound can show deep soft tissue swelling and pelvic abscess, but a negative scan is unhelpful especially as changes may be subtle. Scintigraphy and MRI were useful for diagnosis. MRI is very sensitive for detecting bone marrow abnormalities, however it can be non-specific and cannot accurately differentiate osteomyelitis from sacroiliitis. **CONCLUSION:** Prevention of complications from pelvic osteomyelitis lies in early recognition and appropriate treatment of the disease. With early presentation and a short clinical course, diagnosis can be difficult. Plain X-rays are often abnormal but bone scan has been helpful in localizing early lesions. Ultrasound may evaluate hip joint effusions but is not otherwise helpful in our experience. MRI facilitates prompt diagnosis owing to its wide field of view and sensitivity to subtle soft tissue changes.

#### POSTER 809

##### **Introduction of an additional scatter reduction method to improve image quality of lateral plain film hip radiographs**

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Poor quality lateral hip radiography is a persistent diagnostic problem and provides challenges for the diagnosis of impacted or other subtle undisplaced hip fractures. **PURPOSE:** A pilot study was undertaken to assess the feasibility of introducing an air gap as an additional scatter reduction method. This was to be used in addition to the stationary grid used as the standard scatter reduction method. **METHOD:** The study group consisted of 18 female patients aged over 60 years who required lateral hip radiography. Nine patients were examined using the standard technique with a FFD of 100 cm and a stationary grid. The remaining nine patients were examined using a stationary grid but also using a 25 cm air gap with a 180 cm FFD. The thigh circumference of each patient was measured to evaluate any size differences between groups that would influence the amount of scatter produced. A visual image assessment tool was used by four observers to score various aspects of image quality. **RESULTS:** The image quality scores for horizontal beam lateral hip radiography with stationary grid and a 25 cm air gap at 180 cm FFD were significantly higher at the 0.05 confidence level than with no air gap at 100 cm FFD. Patient size variance between groups was not significant. **CONCLUSION:** This technique may provide marked improvements in plain film hip

radiography, but further work needs to be undertaken with a larger sample size and with more stringent controls for variables such as collimation. Dose implications need to be investigated.

#### POSTER 810

##### **MRI of peripheral nerve entrapment**

SHM Khan and FM Jewell

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**PURPOSE:** To draw attention to the MR features of peripheral nerve entrapment or mononeuritis and the usefulness of these features in unsuspected diagnosis. **METHODS:** Retrospective review of cases of peripheral nerve entrapment in multiple areas of the body. **RESULT:** Examples of nerve root entrapment are shown involving the foot, ankle, knee, shoulder and elbow. A common feature to each case is the presence of muscle oedema/atrophy in a well defined anatomical distribution related to the myotomes supplied by the involved peripheral nerve. In patients presenting with pain without overt neurological deficit, an underlying mass causing nerve entrapment may not be suspected. Awareness of muscle oedema as a sign of nerve compression should raise suspicion of the correct diagnosis. This would be particularly useful when the site of compression is distant to the area referred for imaging. **CONCLUSION:** Muscle oedema is a feature of nerve root entrapment. The presence of specific patterns of muscle oedema should raise a suspicion of nerve root involvement locally or distant to the site of imaging.

#### POSTER 811

##### **Imaging of pathology of the sacrum: a pictorial review**

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The sacrum or sacred bone, such is its derivation, was once regarded as the seat of the soul. Given such spiritual historical connotations, it is perhaps appropriately considered as the "graveyard of radiologists". The non-specific nature of the clinical presentation, poor visualization of sacral pathology on plain radiographs and failure to optimally utilize multimodality imaging are some of the factors contributing to the diagnostic dilemmas at the base of the spine. We present plain film, isotope bone scan, CT and MRI features of a comprehensive range of pathologies affecting the sacrum and emphasize the role of cross-sectional imaging in facilitating diagnosis.

#### POSTER 812

##### **Radiographic appearances of complications relating to total hip arthroplasty**

CJE Offiah and P Robinson

*St James University Hospital, Leeds, UK*

Total hip arthroplasty (THA) is one of the commonest surgical orthopaedic procedures and is predominantly performed in the elderly population. The sequelae of hip arthroplasty, both short- and long-term, are well documented, with the overall incidence quoted as between 5% and 20%. Although the incidence of severe complications is low, the large number of procedures performed means that such complications are a common clinical problem. Diagnosis of these complications still relies predominantly on clinical assessment and plain film imaging. CT, isotope scanning, ultrasound and MRI assessment are less frequently employed as these techniques are limited by availability, metal artefact and radiological expertise. It is therefore paramount to have a thorough understanding of the complications that may develop following THA as well as the natural history of plain film appearances, especially as similar complications occur after arthroplasty of other joints. This poster will present the commoner complications of THA, including loosening, fracture, infection, dislocation, heterotopic bone formation and granulomatous disease. Plain films appearances will be illustrated and the current concepts of pathogenesis for these various complications will be discussed, including incidence, temporal development post-operatively, natural history (clinical and radiological) as well as their management.

#### POSTER 813

##### **Denervation myopathy: a pictorial review of MRI of the shoulder**

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We present a pictorial review of the innervation of the muscles of the shoulder, the MRI patterns of denervation myopathy and a variety of

their causes. In its acute phase, denervation myopathy is characterized on MRI by increased signal within muscle on the  $T_2$  weighted sequences. Features of chronic denervation include reduction of muscle bulk and fatty replacement, which are more notable on  $T_1$  weighted and proton density sequences. These features need to be distinguished from myopathy secondary to rotator cuff tears. Patterns of involvement of the rotator cuff muscles and the shoulder girdle can indicate the site of neural involvement. Focal compression of the nerve to supraspinatus in either the suprascapular or spinoglenoid notch can be caused by glenoid labral cysts, varicose veins, fibrous bands and fractures of the glenoid rim. Denervation of the axillary nerve typically occurs in the quadrilateral space. Denervated muscles in multiple neural territories in the shoulder tend to be the result of more proximal processes such as viral brachial neuritis (Parsonage-Turner syndrome) or tumoral involvement.

#### POSTER 814

##### Ultrasound vs conventional radiography in sternum fractures

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**PURPOSE:** To estimate the accuracy of ultrasonography (US) in the diagnosis of sternal fractures compared with conventional radiography. **MATERIALS AND METHODS:** 25 patients (mean age 38.2 years) with thoracic trauma and clinical suspicion of sternal fracture were included in this study. The aetiology of the trauma included 20 motor vehicle accidents, 2 motorcycle accidents and 3 falls. Posteroanterior and lateral chest X-rays and sternal US were obtained and their findings were compared. Three patients with presternal subcutaneous emphysema were excluded from the study. Three patients also had axial helical CT scanning. **RESULTS:** In total, four fractured sternums were diagnosed by X-rays and nine fractures were determined by US with four local haematomas. In X-ray plain films sternal fracture was certain in 4/21 and suspected in 8/21 patients. There was only clinical suspicion for the remaining 9/21 patients. Both radiography and US demonstrated sternal fractures in four cases. Sternal fractures were detected only by US while the conventional films were negative in two patients with non-displaced fractures. Sternal US demonstrated no fracture signs in five subjects with suspicious radiographs and fracture line in three cases with uncertain fracture. The sensitivity and specificity of US examination was 100%. The sensitivity of plain radiographs was 77.7% and the specificity was 58.3%. Detection of local haematoma is better via US. However, X-rays remain the standard method of demonstrating the grade of displacement. **CONCLUSION:** In cases of sternal fracture involving clinical suspicion and uncertain radiographic diagnosis, the ultrasound examination is an accurate imaging method compared with plain radiographs.

#### POSTER 815

##### A pictorial review of soft tissue signs associated with bony and joint injury

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Plain film remains the mainstay for radiological assessment of acute bony and joint injuries. The injury itself may not always be apparent or appreciated on the initial film. Associated soft tissue signs can lower the threshold of suspicion of a bony or joint injury. We review diverse soft tissue signs including fat pad displacement, tissue plain obliteration, joint effusions and other soft tissue indicators of bony injury. These signs are useful for the general radiologist in everyday reporting.

#### POSTER 816

##### Imaging features of post-traumatic myositis ossificans: a pictorial review

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Post-traumatic myositis ossificans (MO) is a benign condition of heterotopic bone formation that can mimic soft tissue and bone malignancies. Despite advances in radiological and diagnostic techniques, it remains difficult to diagnose. Various imaging modalities

show a zonal pattern in MO that parallels the histological pattern of evolution. On plain radiographs, lesions show a zoning pattern of peripheral maturation with the core being more radiolucent than the periphery. Bone scintigraphy is very sensitive, but not specific, for detecting early MO lesions since similar uptake is seen in musculoskeletal tumours and osteomyelitis. Ultrasound commonly demonstrates a radiolucent line between the lesion and the cortex or periosteal reaction is important in differentiating the benign process of MO from malignancy. The zonal phenomenon is best demonstrated by CT. Lesions initially appear as a relatively low attenuation mass without central or peripheral rim calcification, and are later seen to develop a peripheral rim of calcification. MRI is limited by its relative inability to detect soft tissue calcification. The common finding on MRI is of a well defined, low intensity rim, but in the acute phase this may be absent and mimic soft tissue neoplasm. We present a series of cases that were sent to us for review regarding a possible diagnosis of malignancy, and which were later confirmed to be MO on biopsy. We hope that this will facilitate a broader understanding of this uncommon and infrequently considered condition for both the clinician and radiologist.

#### POSTER 817

##### Musculoskeletal presentations in AIDS: a pictorial review

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**AIM:** To familiarize radiologists with the more commonly encountered musculoskeletal (MSK) manifestations in AIDS and their imaging characteristics. **SUMMARY:** Human immunodeficiency virus (HIV) has brought about a global epidemic. The World Health Organisation estimated that the number of people living with HIV or AIDS at the end of year 2000 stood at 36 million. The prevalence of MSK complications, whilst relatively uncommon, is likely to rise with the increased life span of AIDS patients. MSK complications constitute an unusual clinical expression in patients with HIV infection. A high index of suspicion is required when patients present with various MSK symptoms. Plain radiography is most useful in the initial workup, with cross-sectional imaging techniques being increasingly used to provide an accurate diagnosis and evaluation of disease extent. When a specific diagnosis cannot be made from imaging alone, histology can be obtained from image-guided biopsy of muscle, bone and synovium or aspiration of synovial fluid. We present a pictorial essay of various MSK neoplasms, infections and other miscellaneous conditions that may present in AIDS patients.

#### POSTER 818

##### Imaging, classification and staging of osteosarcoma: a pictorial review

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Osteosarcoma is second in frequency only to myeloma as the most common primary malignant neoplasm of bone. The majority of osteosarcomas are of the conventional type, but a large number of variants exist with differing imaging features and behaviour patterns. Appropriate diagnosis and management of these tumours relies on a multi-disciplinary team approach and diagnostic imaging has a crucial role. In addition to suggesting the diagnosis, the radiologist must identify the precise extent of the tumour within and outside the bone, the presence of "skip lesions" and distant disease. We present a pictorial review of the radiological features of the different subtypes of osteosarcoma, including plain film, CT and MRI appearances, and discuss features to aid accurate diagnosis and staging.

#### POSTER 819

##### Regional migratory bone marrow oedema: a pictorial review of the spectrum of radiological appearances

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We present three cases of regional migratory bone marrow oedema. The plain radiographic, radio-isotope and magnetic resonance images of these three cases illustrate the patterns of presentation of this uncommon condition. The three male patients, aged between 39 years and 58 years, presented with acute lower limb arthralgia that migrated



from joint to joint in a variety of patterns of distribution. These patterns include sequential proximal to distal joint involvement, intra-articular migration and metachronous bilateral hip involvement. The arthralgia resolved without consequence in all except one joint where subchondral collapse ensued. The imaging findings include regional demineralization on plain radiographs, increased radio-isotope uptake on bone scintigraphy and bone marrow oedema on MRI. The features of collapse secondary to subchondral insufficiency fractures are also presented. We discuss the pathophysiology of this condition and the relationship to regional migratory osteoporosis, transient osteoporosis of the hip and transient bone marrow oedema.

**POSTER 820**

**Imaging spectrum of lipomatous tumours**

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AIM: To describe the imaging features of musculoskeletal lipomatous tumours and to elucidate characteristics allowing differentiation between benign and malignant lesions as well as between lipomatous variant tumours. METHOD: The surgical and radiology database at Aberdeen Royal Infirmary was reviewed from 1997–2002 for lipomatous tumours. Imaging for review was available in 69 patients with a histologically proven diagnosis. RESULT: The lipomatous tumours comprised superficial and deep lipomas; heterotopic lipomas—intramuscular, intermuscular, discrete lipoma of tendon sheath; infiltrating lipomas—diffuse lipomatosis, shoulder girdle lipomatosis; parosteal lipoma; fibrolipoma; angiolipoma; pleomorphic lipoma; hibernoma; and liposarcoma. There were 65 MRI studies, 13 CT examinations, 5 ultrasound studies and 5 angiographic studies. CONCLUSION: MR and CT images of lipomatous masses are usually characteristic to suggest the diagnosis. Ultrasound is usually non-specific. Angiography results depends upon the relative vascularity of the lesion rather than tumour type. Whilst the histological variants cannot be convincingly predicted, correlation between various radiological modalities may provide sufficient indication in certain lesions such as angiolipomas. Although of limited value in characterizing liposarcomas, MRI is the best modality to demonstrate the pathological anatomy, essential for pre-operative planning and post-operative follow-up.

**POSTER 821**

**Imaging features of angiolipoma and infiltrating angiolipoma with histological correlation**

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PURPOSE: MRI, ultrasound and angiographic features of angiolipomas and the rare variant, infiltrating angiolipomas (cellular angiolipoma/intramuscular haemangioma), are described, along with certain characteristics that could lead to a correct diagnosis when evaluating a soft tissue mass. MATERIALS: On review of the surgical and radiology database at Aberdeen Royal Infirmary from 1997–2002, imaging was available for three patients with angiolipoma and two patients with infiltrating angiolipoma. RESULTS: On ultrasound, angiolipomas are subcutaneous nodules, partially compressible, predominantly hyperechoic in relation to the subcutaneous fat, with interspersed low echoes and posterior acoustic shadowing. On MR this lesion is well defined, capsulated with signal characteristics nearly following fat on T1W and T2W sequences, but with incomplete suppression on STIR sequence. Serpiginous signal voids in keeping with small vessels are noted. Infiltrating angiolipomas, however, are much larger tumours, deeply sited, with infiltration into adjacent muscles and compartments. While MR signal characteristics are similar to that of angiolipoma, the lesion is infiltrative, poorly circumscribed, with large vascular channels. On angiography, appearances range from neovascularity to normal. CONCLUSION: Angiolipomas are common subcutaneous lesions, where imaging is rare and diagnosis is usually established clinically. Infiltrating angiolipomas, although non-metastasizing, are locally aggressive, requiring resection with a wide margin to prevent recurrence. MRI is the best modality for demonstrating the pathological anatomy, aiding treatment. In the differential analysis of an aggressive soft tissue mass, the presence of fat should distinguish it from an angiomatous abnormality, and the large vascular channels from that of a liposarcoma.

**POSTER 822**

**Imaging of soft tissue tumours**

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AIM: To provide a pictorial review of the varied appearances of soft tissue tumours on cross-sectional imaging. MATERIALS AND METHODS: Imaging of “lumps and bumps” is an everyday task to the general radiologist. Sometimes this can be challenging to even the specialists. We provide a pictorial review of the imaging appearance of various soft tissue tumours in the body on ultrasound, CT and MRI. A brief introduction is given on the technical aspects, followed by good quality examples of soft tissue tumours. The group includes lipomas, haemangiomas, low and high grade liposarcomas, intramuscular fatty tumours, neurofibromas, stump neuromas, desmoid tumours, sacro-coccygeal tumours etc. Metastasis can cause diagnostic confusion and its imaging appearances are discussed. Mimics of tumours are haematomas, muscle rupture, myositis ossificans and abscesses, and their differentiating features are highlighted. The limitations of cross-sectional imaging are discussed, followed by a brief description of interventional radiological techniques in making the final diagnosis, of course not without pitfalls. CONCLUSION: This pictorial review aims to provide an overview of the value of cross-sectional imaging and features of soft tissue tumours, mainly directed towards general radiologists, trainee radiologists and radiographers.

**POSTER 823**

**MRI of soft tissue haemangioma: a pictorial review**

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Haemangiomas are common congenital soft tissue lesions, the majority being capillary or cavernous that can be easily diagnosed clinically. Less than 1% of all haemangiomas occur in muscle or deep soft tissue, presenting typically as an enlarging, tender soft tissue mass with no cutaneous changes, pulsation or bruit to suggest a vascular aetiology. Diagnosis can be delayed for 1–2 years; the majority of patients undergo surgery without definitive evaluation of the extent of the lesion or pre-operative tissue diagnosis. A recurrence rate of approximately 20% has been attributed to inadequate resection at initial surgery. We present 21 patients with soft tissue haemangioma to illustrate the ability of MRI to define clearly and non-invasively the extent and anatomical relationship of haemangioma. The major advantage of MRI over CT or angiography is the exquisite difference in contrast between haemangioma and the surrounding structures on T2 weighted image, in which haemangiomas have a relatively intense signal. The presence of lobulation, septation, rim of fat and intense enhancement with contrast strongly suggests haemangioma. The information obtained with MRI may be valuable in planning treatment and in defining recurrence.

**POSTER 824**

**London NW10—“the gun capital of London”: violent crime presenting at an inner city London hospital**

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AIM: To present a pictorial review of the varying types of violent crime presenting to our department over the last 12 months. ABSTRACT: The British Crime Survey (BCS) 2001/2002 estimated that there were 2,891,000 violent incidents experienced by adults in England and Wales, and that this had increased by 2% compared with 2000. Common assault (62%), wounding (23%) and robbery (13%) accounted for 98% of all types of violent crime, with a significant number at risk of injury. BCS crime reporting indicated that 39% of victims of wounding and 19% of robbery victims attended a hospital A&E department; with 5% of victims requiring a hospital stay. Considerable geographic variation in the regional rates for violence exists, with London and the South East having the highest crime rates (800–900 per 10,000 adults) compared with the North East of England (386). In addition, violent crime rates vary widely within each region, with the Metropolitan Police area having 305 violent crimes per 10,000 population compared with the East of England Region (91). This is particularly relevant in London NW10, which has been dubbed the “gun capital of London” owing to the high rate of gun-related crime. It is with this in mind that we would like to present a pictorial review of the varying types of violent injuries that have presented themselves to our radiology department over the last 12 months.

## Neuroradiology and Head &amp; Neck

## POSTER 901

**Improved diagnosis of vessel dissections by ultrasound B-flow imaging**<sup>1</sup>D Clevert, <sup>1</sup>E Jung, <sup>2</sup>D Clevert and <sup>1</sup>N Rupp<sup>1</sup>Klinikum Passau, Passau, Germany and <sup>2</sup>TU-Berlin, Berlin, Germany

**STUDY:** A study was completed to evaluate the efficiency of different ultrasound techniques (color-coded duplex sonography, power mode imaging and B-flow imaging) in vessel dissection diagnosis. **METHODOLOGY:** The study compared flow representation by color-coded duplex sonography, power mode imaging and the recently developed B-flow imaging method in the case of dissections of the carotid artery (11 cases), vertebral artery (9 cases), abdominal artery (13 cases), iliac artery (12 cases) and femoral artery (23 cases). Reference standards were provided by contrast-enhanced MRA in 22 cases, CTA in 9 cases and intra-arterial DSA in the remaining cases. **RESULTS:** Boosted reflector signals provided by B-flow imaging facilitated identification of the dissection membrane. Unlike intra-arterial DSA, CTA and MRA, B-flow imaging detected all 68 dissections. The comparative detection rates for color-coded duplex sonography, power mode imaging and B-flow imaging were, respectively, 9, 10 and 11 for eleven carotid artery dissections, 6, 7 and 9 for nine vertebral artery dissections, 11, 11 and 13 for thirteen abdominal artery dissections, 8, 9 and 12 for twelve iliac artery dissections and 19, 20 and 23 for twenty-three femoral artery dissections. The absence of overwriting in B-flow imaging produces more exact residual flow records, in particular for the false lumen. The reduced effect of angles facilitates the representation of fissures and membranes, and enhanced near-wall flow recording improves the identification of low-reflection wall deposits. **CONCLUSION:** B-flow imaging allows the primary diagnosis of dissection membranes, shows haemodynamic effects and facilitates the representation of membranes and any windowing.

## POSTER 902

**Novel use of ultrasound-guided surface marking of deep tumours involving facial skin**<sup>1</sup>SY Ng, <sup>2</sup>A Songra and <sup>3</sup>I Hutchison<sup>1</sup>Guy's King's & St Thomas' Dental Institute, London, UK,<sup>2</sup>Royal Victoria Hospital, Belfast, UK and <sup>3</sup>Barts and The London NHS Trust, London, UK

Special diagnostic and treatment problems occur with malignant tumours that arise from deep structures but which then implicate skin. Often the tumour causes oedema, erythema and induration beyond the tumour margin, making clinical assessment difficult. Conventional imaging cannot reliably differentiate oedema from tumour involvement of skin. Good surgical practice dictates removing the tumour with a wide margin at primary resection. However, when facial skin is involved, it is desirable to avoid an unnecessarily wide margin in order to reduce morbidity and to facilitate surgical reconstruction. **AIM:** To use high resolution diagnostic ultrasound to delineate tumour margins and to transfer the information to the overlying skin using water-insoluble ink. **METHOD:** In two cases where deep malignant tumours involved the facial skin, ultrasound imaging was used to demonstrate the periphery of the tumour and to distinguish areas of oedema from tumour. The maximum contour of the tumour was marked on the skin surface with ink under ultrasound guidance. The ink marking helped the surgeons to plan a safe surgical margin and also to plan the type and site of reconstruction skin flap. **RESULTS:** Histological examination showed the surgical margins were clear of tumour. **CONCLUSION:** High resolution ultrasound imaging is effective at defining tumour margins. Ultrasound-guided surface marking of skin is a relatively simple and efficient means of conveying critical information to the surgeons.

## POSTER 903

**CT angiography vs digital subtraction angiography in the depiction of cerebral aneurysms**

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C Artinopoulos and GM Zavras

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**PURPOSE:** To estimate the accuracy of spiral CT angiography (CTA) in the demonstration of cerebral aneurysms compared with digital

subtraction angiography (DSA). **MATERIALS AND METHODS:** 90 patients underwent spiral CTA as well as intra-arterial DSA (IA-DSA). 70 patients were suffering from subarachnoid haemorrhage (SAH), and in 20 patients there was suspicion of an aneurysm (clinical or CT suspicion, family or past history of aneurysm). 150 ml of intravenous contrast medium was injected at 4 ml s<sup>-1</sup>, with CTA commencing after a delay of 20 s. Slice thickness was 1 mm and a reconstruction index of 0.5 with a pitch was used. Axial slices as well MPR, MIP and SSD reconstructions were reviewed. IA-DSA was also performed for all these patients. The CTA images were reviewed separately, blinded to the DSA findings. **RESULTS:** IA-DSA depicted 86 aneurysms (2–30 mm in size) in 68 patients. There were eight patients with more than 1 aneurysm (2–5). Spiral CTA detected 85 aneurysms. One was a false positive. There were two aneurysms demonstrated only by IA-DSA, both smaller than 3 mm in diameter. The sensitivity of CTA was 97.6% and its specificity was 95.2%. Characterization of the aneurysms (size, shape, orientation, neck of the aneurysm and its relationship with adjacent vessels, calcification, thrombosis) was possible in most cases. **CONCLUSIONS:** Spiral CTA is a very helpful method and a reliable alternative to IA-DSA in the depiction and evaluation of cerebral aneurysms. DSA is still needed for the detection of aneurysms smaller than 3 mm.

## POSTER 904

**Meniere's disease: high resolution 3D T<sub>2</sub> weighted MRI findings of the inner ear**<sup>1</sup>SK Stathopoulou, <sup>1</sup>A Gouliamos, <sup>2</sup>J Xenelis,<sup>2</sup>A Papakrivopoulos and <sup>1</sup>L Vlahos<sup>1</sup>Areteion Hospital, Medical School, Athens, Greece and<sup>2</sup>Hippokraton Hospital, Medical School, Athens, Greece

**PURPOSE:** To evaluate the diagnostic accuracy of high resolution 3D T<sub>2</sub> weighted (T2W) MRI of the inner ear in Meniere's disease. **MATERIALS AND METHODS:** 21 patients with unilateral Meniere's disease, 3 patients with bilateral disease and 25 healthy ears were examined at 1.5 T using a Philips Gyroscan ACS MR unit (The Netherlands) with routine MRI and high resolution 3D volume T2W images in the axial plane with surface coil (TR/TE = 2000/300; thk 1.2/–0.6; FOV 13; ScTime 8 min). We evaluated the visibility of the intraosseous portion of the endolymphatic duct and sac complex and the width from the vertical part of the posterior semicircular canal and the posterior surface of the vestibule to the subarachnoid space. **RESULTS:** Visualization of the endolymphatic duct/sac was found in 7/27 Meniere's diseased ears and in 20/25 control ears, which represents a significant difference ( $p=0.0001$ ). Patients with Meniere's disease had a statistically smaller width than controls between the vestibule and the posterior fossa ( $p=0.036$ ) and between the posterior semicircular canal and the subarachnoid space ( $p=0.002$ ). There were no significant differences for the three previously mentioned parameters between affected vs non-affected ears ( $p=0.27$ ,  $p=0.29$ ,  $p=0.25$ , respectively). The majority of subjects with Meniere's disease had non-visualized endolymphatic ducts/sacs and smaller temporal bone dimensions bilaterally, regardless of which ear was symptomatic. This may partially explain a predisposition to the development of bilateral Meniere's disease. **CONCLUSION:** 3D T2W FSE MRI of the temporal bones supports the diagnosis of Meniere's disease and the hypothesis that there is a congenital predisposition for the development of endolymphatic hydrops.

## POSTER 905

**Imaging appearances of abnormal salivary glands: a pictorial review**

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**AIM:** To understand the various imaging appearances of salivary gland pathology as seen by ultrasound, CT and MRI. To understand and evaluate the strength and limitation of each modality with respect to the disease process. **METHODS:** From November 2001 to October 2002 a total of 189 neck MRI, 199 neck CT and 299 neck ultrasound examinations were performed in our department. On ultrasound, 83 studies were performed to exclude salivary gland abnormality; 30 of them showed abnormal features related to the parotid gland and 23 of them showed abnormality related to the submandibular gland. 25 MRI scans were performed specifically to exclude parotid abnormality and 10 of them were found to be abnormal. **DISCUSSION:** Salivary gland

diseases are common. Radiologists are increasingly being asked to evaluate the salivary glands so that appropriate referral and management can be sought. Salivary gland pathology includes calculus disease as well as inflammatory and neoplastic disease processes. Ultrasound is the best first test and helps guide FNA. We present a comprehensive pictorial review of salivary gland imaging, including all modalities (ultrasound, CT, conventional sialography, and MRI) as well as recent advances such as MR sialography.

**POSTER 906****Can MRI replace radiography in the evaluation of dental disease?**

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<sup>2</sup>Department of Oral and Maxillofacial Surgery, Oxford, UK

**PURPOSE:** To compare the use of MRI with conventional radiography and computed tomography in the evaluation of dental disease without the burden of radiation exposure to the patient. **MATERIALS AND METHODS:** The study group consisted of patients with a range of dental diseases, especially those presenting with idiopathic dental root pain. Appropriate conventional imaging was undertaken with relevance to the diagnostic question being posed. The study group was then referred for a dental MRI examination on a General Electric 1.5 T MR scanner. An initial pilot study had provided data for a robust imaging protocol in terms of sequences and receiver coil chosen.  $T_1$ ,  $T_2$  and fat suppression imaging was undertaken with relevance to the suspected pathology. **RESULTS:** MRI was compared with conventional X-ray based techniques: intraoral radiography, panoramic tomography or computerized axial tomography. The presence or absence of pathology was identified for each technique and was compared with the MRI data. Pathology was confirmed by further histological examination after aspiration, extraction or biopsy, where possible. Sensitivity and specificity were calculated from receiver operating characteristic curves for each imaging modality. **CONCLUSION:** MRI was found to have high sensitivity and specificity compared with the alternative techniques. MR also demonstrated pathology not seen on the other modalities, especially lesions of the bone marrow. MRI shows promise in the field of dental imaging, in the earlier or exclusive detection of dental pathology. Furthermore, this technique does not expose the patient to ionizing radiation.

**POSTER 907****Imaging of the pterygopalatine fossa**

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The pterygopalatine fossa is a small anatomically complex space at the base of the skull that acts as a major pathway for transmission of important neural and vascular structures between the brain and extracranial compartment. Owing to its strategic location it can act as a potential pathway for spread of tumours and infection from orbits, maxillary sinus, nasal passage and nasopharynx to the intracranial compartment. We present normal magnetic resonance (MR) and computed tomography (CT) anatomy along with varying pathologies encountered in the pterygopalatine fossa. MR was performed in all patients. Gadolinium enhancement was used for better definition of lesion and extent including perineural spread. In addition to routine sequences, pre-contrast T1 weighted (T1W) and post-contrast T1W sequences with fat saturation were also obtained. Axial thin (2 mm) high resolution CT slices were obtained through the skull base in a few patients with sagittal and coronal reformations. Tumours were the most common pathology seen, which included nasopharyngeal angiofibroma, metastasis, nasopharyngeal carcinoma and lymphoma. Extension of infections from orbit and adjacent sinuses, traumatic fractures and bullet injury were some of the other pathologies seen. MR and CT play a pivotal role in assessing this complex anatomical region difficult to assess clinically.

**POSTER 908****"Not all are infected branchial cysts!" Cystic neck masses: imaging appearances and a space-based approach**

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**AIM:** (1) To show with the imaging appearances of various cystic lesions of the neck. (2) To understand the radiological approach based on location to reach an accurate diagnosis. Cystic lesions of the neck are infrequently encountered. There are several differential diagnoses that need to be considered. However, an accurate diagnosis can be reached in many cases based on the anatomical site and imaging appearances alone. The lesions can be congenital, inflammatory, vascular, and benign or malignant tumours. These lesions can occur in the parotid/periparotid space, carotid space, submandibular/sublingual spaces, pharyngeal/retropharyngeal space and along the midline of the neck. The importance of recognizing a cystic necrotic node due to metastatic focus is stressed, as this could be the first manifestation of a primary malignancy in the head/neck or from elsewhere.

**POSTER 909****Intraoperative ultrasound assessment of surgical margin at excision of primary oral squamous cell carcinoma**

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Various studies advocate surgical margin clearance of 10–20 mm for oral squamous cell carcinomas. The depth of surgical resection is estimated by clinical judgement rather than by objective measurements, because a reliable non-invasive technique has not been available until now. Recent studies have shown that high resolution ultrasound imaging is a promising technique for measuring tumour depth. **PURPOSE:** To assess the deep margin of oral cancers with the use of intraoperative, intraoral ultrasound to provide real-time guidance to the surgeon during the actual definitive resection. **METHOD:** Ultrasound imaging (linear 5–10 MHz; HDI 5000, ATL (UK) Ltd) was performed at the beginning and half-way through tumour resection. To demonstrate the cut margin on ultrasound, an echogenic surface was placed in the surgical cut. Furthermore, the resected tumour specimen was also examined with ultrasound before and after fixation in formalin. **RESULTS:** In all cases where ultrasound showed clearance at the deep margin at the time of surgery, there was actual clearance at histological assessment. In cases where tumour was shown by ultrasound to be close to, or at, the resection margin, histology showed tumour cells close to or at the surgical margin. **CONCLUSION:** This original paper shows that high resolution ultrasound imaging is a promising and reliable tool in assessing deep margin clearance at the time of operation.

**POSTER 910****Imaging of oculomotor nerve palsy**

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The oculomotor nerve provides motor innervation to the majority of orbital muscles and a palsy can be debilitating as well as being an early manifestation of a morbid pathology. The fibres of the oculomotor nerve arise from a group of nuclei in the floor of the cerebral aqueduct. The fibres pass through the tegmentum, red nucleus and medial part of the substantia nigra, and emerge on the medial side of the cerebral peduncle. The nerve passes between the superior cerebellar and posterior cerebral arteries, and then pierces the dura mater near the posterior clinoid processes. It runs along the lateral wall of the cavernous sinus, above the other orbital nerves and divides into branches, which enter the orbit through the superior orbital fissure. We studied 35 patients with oculomotor nerve palsy. 27 patients had a magnetic resonance (MR) scan and 8 patients initially had a computed tomogram followed by an MR scan. Gadolinium enhancement was performed in 13 cases. An MR angiogram (time of flight) was performed in seven cases. A compressive aetiology was identified in 23 patients. The commonest cause was a posterior communicating artery aneurysm (7) followed by parasellar tumours (6). Rarer causes such as brain stem tumours, schwannomas and inflammatory and infiltrative conditions were also seen. Pupil-sparing third nerve palsy was most often due to ischaemic microvascular disease, but the commonest cause of a third nerve palsy with pupillary involvement was a posterior communicating artery aneurysm. We believe an MR scan should be the first imaging modality in these patients.

**POSTER 911****Out of many, one: the ophthalmic artery in development and disease**

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The ophthalmic artery is commonly described and dismissed as the first branch of the internal carotid artery. Whilst acknowledging its importance in supplying the eye and therefore in maintaining vision, little further attention is typically accorded to this intriguing artery. Advances in interventional neuroradiology have made this vessel amenable to safe micro-catheterization, and a more detailed understanding of its radiological anatomy is therefore important. Embolisation in the external carotid territory is also widely performed and the potential, often occult, communications between branches of the maxillary and ophthalmic arteries must be familiar to the radiologist to avoid severe complications. The extraordinary embryological development of the ophthalmic artery deriving from three different precursor vessels (the ventral ophthalmic arising from the anterior cerebral artery, the dorsal ophthalmic arising from the intracavernous internal carotid artery and the stapodial artery) explains the anatomy and dangerous anastomoses we should expect. Here we illustrate this development by reference to a series of recent angiograms and CT studies on patients with a variety of lesions and variations. These are compared with a new series of anatomical and embryological illustrations and aim to provide a deeper understanding of the anatomy of the ophthalmic artery as well as an appreciation of the beauty of its embryogenesis.

**POSTER 912****Unravelling the brachial plexus: MRI features of normal anatomy and pathology**

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**PURPOSE:** The brachial plexus is a complex structure that arises from the lower cervical and upper thoracic spinal nerve roots coursing through the scalene muscles and terminates dividing into peripheral nerves in the axilla. This review discusses the imaging techniques and illustrates the normal anatomy and various pathologies involving the brachial plexus. **RESULTS:** Generally it is difficult to pinpoint the site and cause of a brachial plexopathy by clinical or neurophysiological examination. MRI is an ideal technique to study the brachial plexus because of its high contrast resolution and multiplanar capabilities. A clear understanding of the anatomy of the thoracic inlet is necessary in the interpretation of these studies. The pathologies encountered include primary and secondary tumours, trauma, radiation damage and thoracic outlet syndrome. **CONCLUSION:** MRI is the imaging modality of choice for evaluating the anatomy and pathology causing brachial plexopathy.

**POSTER 913****Facial nerve revisited: review of anatomy and pathology**

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**PURPOSE:** Radiological examination of the facial nerve requires detailed knowledge of its anatomy and the clinical history, which will help to decide the appropriate imaging modality. We aim to trace the course of the nerve and to illustrate common pathology affecting the different segments. **METHODS AND MATERIAL:** Cases from the image bank collected over many years in a tertiary neuro referral centre are presented in this study. The facial nerve can be divided into four segments for understanding the anatomy: the nucleus and tracts; the cisternal segment that traverses the internal auditory canal; the intratemporal segment through the bony canal; and the extracranial segment. Each segment of the facial nerve may be involved by different pathology. CT and MRI are well established imaging modalities to examine the course and the facial nerve itself. **RESULTS:** Spiral CT with the high spatial resolution facilitates delineation of the facial canal with the use of reformatted multiplanar images in oblique planes, avoiding additional examination in the coronal plane. This is beneficial in patients with temporal bone trauma, malformation or osseous changes. On the other hand, MRI has a superior soft tissue contrast to CT, which enables imaging of the facial nerve itself. Therefore the normal facial nerve as well as pathological changes of the facial nerve

are readily visualized from pons to the parotid gland. **CONCLUSION:** In this pictorial review we break down the facial nerve into easily understood divisions and cover the common pathology affecting each of these segments.

**POSTER 914****Cerebellar volumes in symphony orchestra musicians: a structural MRI study**

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The most visible skill of orchestral musicians is motor control, particularly co-ordinated upper limb movements. It has been proposed that fast and co-ordinated arm movements cannot be executed under the control of pure feedback loops, as these biological systems are too slow and have small gains. The cerebellum, which has long been known to be involved in motor control, has been implicated as the site of internal models of upper limb dynamics for learned movements. Animal studies have provided evidence of microstructural cerebellar changes after prolonged and intense motor activity. We hypothesized that the considerable amount of time devoted by musicians to refining and maintaining very specific upper limb motor skills would be reflected in cerebellar volume and would be associated with maintenance of these motor skills throughout childhood and adulthood. Male symphony orchestra musicians ( $n=26$ ) and right-handed, male non-musicians ( $n=26$ ) were recruited. High resolution  $T_1$  weighted brain images were acquired on a 1.5 T SIGNA MR system (GE, Milwaukee, USA) using a 3D-SPGR sequence. Cerebellar volumes were estimated using the Cavalieri method in combination with point counting. ANOVA showed that musicians possessed significantly larger cerebellar volumes than non-musicians, both absolute ( $F_{1,50}=8.6$ ,  $p=0.005$ ) and corrected for (a) total hemispheric volume ( $F_{1,49}=4.8$ ,  $p=0.03$ ) and (b) intracranial volume ( $F_{1,49}=8.9$ ,  $p=0.005$ ). Cerebellar volume was negatively correlated with age when starting instrument lessons ( $r=-0.41$ ,  $p=0.05$ ). We interpret these findings to reflect use-dependent adaptation of the cerebellum associated with age of commencement of instrumental practice and continued musical performance throughout adulthood.

**POSTER 915****Grey matter and IQ: a voxel-based morphometry study**

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Early last century, Spearman proposed a general factor (g) for defining success in diverse forms of cognitive activity. "g factor" measured by intelligence tests is interpreted as average efficiency of the total set of cognitive functions. Association between IQ and frontal lobes has been reported, whilst a PET study of neural substrates of intelligence reported a significant role for the prefrontal cortex (PFC), specifically lateral PFC bilaterally, in performing tasks that correlate highly with g. Voxel-based morphometry was applied to high resolution MR brain images ( $n=65$ ) to investigate the relationship between grey matter (GM) density and/or volume and Cattell's Culture Fair (CF) measure of g. CF scores correlated positively with GM concentration bilaterally in the medial PFC (dorsomedial, BA8/9,  $p<0.05$  corrected for multiple comparisons). Controlling for age, these relationships remained in the medial PFC ( $p<0.001$ , uncorrected) although the centre of interest shifted from BA8/9 to 24/32 (mainly anterior cingulate) and 11/10 (mainly medial-orbital PFC). CF scores correlated positively with GM volume in the medial PFC (mainly dorsomedial PFC, BA8/9) and insula bilaterally ( $p<0.05$  corrected for multiple comparisons), and in the left dorsolateral PFC and inferior temporal gyrus. Controlling for age, these relationships remained in the medial PFC and insula bilaterally and left inferior temporal gyrus ( $p<0.001$ , uncorrected). A significant positive relationship was also observed in the right dorsolateral PFC ( $p<0.001$ , uncorrected). These findings provide support for involvement of the PFC in measures of cognitive ability and for enhanced performance on cognitive tasks being associated with larger volumes of relevant brain structures.

**POSTER 916****Is increased relaxivity beneficial for contrast-enhanced MRI of brain tumours: blinded intraindividual comparison of Gd-BOPTA and Gd-DOTA**

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**PURPOSE:** To compare intraindividually gadobenate dimeglumine (Gd-BOPTA; MultiHance) and gadoterate meglumine (Gd-DOTA; Dotarem) for contrast-enhanced MRI of the CNS. **METHOD AND MATERIALS:** 21 patients with suspected glioma or metastases received Gd-BOPTA and Gd-DOTA in blinded cross-over fashion, each at 0.1 mmol kg<sup>-1</sup> bw. Both agents were administered at 2 ml s<sup>-1</sup> with an interval of ≥60 h between exams. Images were acquired pre dose (T1wSE, T2wFSE sequences) and post dose (sequential T1wSE sequences at 2, 4, 6, 8, 10 and 15 min with a T1wSE-MT sequence at 12 min) at 1.5 T using a head coil. Each exam was standardized to ensure reproducibility. Assessment of subjective and objective enhancement parameters was performed by two experienced fully blinded off-site readers. **RESULTS:** 19/21 patients were evaluated for efficacy. For the global assessment of contrast enhancement (primary criterion), reader 1 rated Gd-BOPTA superior in 18/19 cases ( $p < 0.0001$ ; Wilcoxon signed rank test) and the agents equal in 1/19 cases. Reader 2 rated Gd-BOPTA superior in 15/19 cases ( $p < 0.001$ ) and the agents equal in 4/19 cases. Consensus determined superiority for Gd-BOPTA in 18/19 cases and equality in 1 case ( $p < 0.0001$ ). Significant ( $p < 0.0001$ ) superiority for Gd-BOPTA was noted by both readers for all secondary criteria (CNS-to-lesion contrast, lesion delineation, global preference). **CONCLUSION:** The two-fold greater relaxivity of Gd-BOPTA permits improved contrast enhancement compared with Gd-DOTA.

**POSTER 917****A pictorial review of emergency on-call head CT**

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A large percentage of emergency on-call work, both in the DGH and in teaching hospitals, involves head CT. This is a vital and often diagnostically crucial investigation that can demonstrate a wide variety of pathologies. The pathology can often be obvious, but in some circumstances the more subtle pathology can have just as important consequences. The head CT needs to be effectively interpreted, as important management decisions rely on the result. This pictorial review of head CT in emergency radiology will demonstrate trauma and non-trauma cases, and will act as an "aide memoire" to consultants, registrars and radiographers.

**POSTER 918****A review of out-of-hours CT head scans and their clinical impact**

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**PURPOSE:** To review out-of-hours CT head scans with respect to the referring team, indication for referral, scan result and impact on immediate patient management. **MATERIALS AND METHODS:** A retrospective review using a standardized questionnaire of the case notes of 72 patients who had an out-of-hours CT head scan in a 4-month period at a teaching hospital. **RESULTS:** The majority (67%) of scans were referred by neurology teams. Suspected subarachnoid haemorrhage and haemorrhagic stroke were the most common indications (26% and 19%, respectively). 42% of scans were abnormal. The CT scan report appeared to alter out-of-hours management in 58% of cases, although this assumes reliable documentation. **CONCLUSIONS:** Most out-of-hours CT head scans were appropriately requested. However, in over 40% of cases they did not appear to impact immediate patient management. Following this review, guidelines have been formulated by the neuroradiology team to streamline out-of-hours CT head scan referral. A second review is in progress.

**POSTER 919****The usefulness of axial helical HRCT of the temporal bones in acute craniocerebral trauma**

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**PURPOSE:** To evaluate the role of axial helical high resolution CT (HRCT) imaging of the temporal bones in the setting of acute head trauma after emergency clinical (otorrhea) or CT brain findings (mastoid opacification, temporal lobe injury). **MATERIALS AND METHODS:** HRCT of the temporal bones was carried out on 87 selected patients with acute head trauma (direct trauma or severe craniocerebral injury) following conventional CT brain examination. The causes of trauma were car accident (44), motorcycle accident (37), pedestrian injuries (2), fall (3) and bicycle accident (1). The protocol included unenhanced axial thin sections (2/2/1 mm), reformatted in multiple projections in selected cases. **RESULTS:** 57 temporal bone fractures were depicted (45 unilateral and 6 bilateral); 48 longitudinal fractures (84%), 5 transverse fractures (9%) and 4 mixed fractures (7%). There was no fracture line in two patients, but only ossicular chain dislocation. The total results as well as the original and MPR images will be discussed. **CONCLUSION:** Axial helical HRCT imaging of the temporal bones in the acute phase of craniocerebral trauma is an easy and reliable imaging method for the early detection and further management of petrous bone trauma.

**POSTER 920****Intracranial and intraspinal manifestations of tuberculosis: a pictorial review**

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**PURPOSE:** The purpose of this poster is to emphasize the fact that although brain tuberculomas are rare in developed countries, diagnosis should be kept in mind when confronted with space-occupying lesion(s) in the brain. This is of particular importance in immigrants from endemic countries and also the Caucasian population with the rise of multiresistant strains of *Mycobacterium tuberculosis*. The other major group that should be considered in the same way is the ever-increasing population of HIV/AIDS patients. **MATERIALS AND METHODS:** We looked at MRI examinations over the last 3 years at our institution and found cases of intracranial tuberculomas and intraspinal manifestations with illustrative MRI findings and corresponding histological appearances. **RESULTS:** Intracranial TB can affect most parts of the brain and we focused on the typical MR findings of the same, especially the rare occurrence of intracranial and intraspinal tuberculosis in the same patient. **CONCLUSION:** The aim of our poster presentation is to increase the awareness towards the rising number of cases of intracranial and intraspinal tuberculosis in the West, along with its complications.

**POSTER 921****MRI of tuberculosis: a pictorial review**

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Tuberculosis (TB) has re-emerged as a major health concern in recent years with the onset of the AIDS epidemic. This poster will review the varied MRI features of TB with an emphasis on the central nervous system (CNS) and the musculoskeletal system. CNS infection with *Mycobacterium tuberculosis* causes a granulomatous inflammatory reaction that involves the meninges and/or the CNS parenchyma. MRI features of tuberculous meningitis include abnormal basal meningeal enhancement, hydrocephalus and ischaemic infarcts. Involvement of the spinal meninges may be manifest as matted nerve roots with nodular thick intradural enhancement. Spinal cord infarction and syringomyelia are recognized features. CNS parenchymal TB commonly manifests as tuberculomas, however TB abscesses can occur particularly in AIDS patients and drug abusers. The MRI features of individual tuberculomas depend on whether they are non-caseating, caseating with a solid centre or caseating with a liquid centre. Skeletal involvement occurs in approximately 1–3% of patients with mycobacterium TB, with approximately 25–60% of cases involving the spine. MRI features of spinal TB include reduced vertebral body marrow and disc signal on T<sub>1</sub> weighted images and increased signal on T<sub>2</sub> weighted images. Epidural abscess, paraspinal abscesses and potential cord compression

are best shown by MRI. Tuberculous arthritis caused by *Mycobacterium tuberculosis* is usually monoarticular and commonly affects the hip or the knee. MR is more sensitive than plain radiography in the detection of joint change, however the changes are non-specific. In addition to signal changes in the synovium, MRI may show subchondral bone destruction and marrow abnormalities.

#### POSTER 922

##### **CNS manifestations of Langerhans' cell histiocytosis: a pictorial review**

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**INTRODUCTION:** Langerhans' cell histiocytosis (LCH) is a rare disease of unknown aetiology characterized by proliferation of Langerhans' histiocytes. It usually presents in children and has a wide clinical spectrum. In older children and adults, LCH is usually confined to a single organ, typically bone, and has a good prognosis. In younger children, however, multisystem involvement is more typical. Organ failure can occur, which is often resistant to treatment. This review illustrates the CNS manifestations of LCH. Four case histories will be discussed. **SKULL:** Osteolytic lesions in the skull vault are the most common manifestation of LCH. Radiographic appearance depends on the phase of disease. Early lesions appear aggressive with poorly defined margins. Later lesions appear well defined and may show sclerotic margins. Typical features include a bevelled border and residual bone fragment. A soft tissue mass and epidural haematoma can occur. CT accurately depicts the extent of bone destruction and any associated abnormality. LCH has also been described in the skull base, orbit, maxilla and mandible. **INTRACRANIAL DISEASE:** Intracranial involvement most commonly affects the pituitary and/or hypothalamus, usually manifesting as diabetes insipidus. The infundibulum is thickened and irregular and the posterior pituitary bright spot is absent. An enhancing suprasellar mass can occur. LCH may rarely involve the cerebral hemispheres, cerebellum and dura. **SPINE:** Spinal involvement may be isolated or accompany systemic disease. Lytic foci and compression fractures are common. Near complete collapse of a vertebral body (vertebra plana) is classical.

#### POSTER 923

##### **Radiological manifestations of AIDS-related disorders: a pictorial review**

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**PURPOSE:** To highlight the key role of imaging in diagnosing and monitoring the progression of AIDS. **MATERIALS AND METHODS:** We retrospectively reviewed AIDS cases over the last 5 years to gather information about the various imaging modalities used to assess disease progression in AIDS patients and their influence on the overall management of the patient. **RESULTS:** Neuroradiological manifestations play a crucial role in diagnosis and monitoring of brain and spinal cord disease. The pattern of neuroradiological findings range from HIV encephalopathy, to opportunistic infections including tuberculosis and toxoplasmosis, and tumours such as lymphomas. This spectrum of CNS disease is highlighted in our presentation. Children with AIDS most commonly present with chest infections, from opportunistic infections such as CMV, *Pneumocystis carinii* or atypical mycobacteria and tuberculosis in endemic areas. AIDS-related lymphomas are the principal form of intestinal involvement in this group of patients and again the role of imaging is vital in disease evaluation and progression monitoring. **CONCLUSION:** We have highlighted the radiological manifestations of various conditions associated with AIDS as well as the characteristic findings in certain cases, particularly spinal and intracranial abnormalities, that can help avoid invasive and potentially hazardous biopsies and can significantly improve the morbidity in this group of patients.

#### POSTER 924

##### **Congenital anomalies in the central nervous system**

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Some conditions, such as hydrocephalus, may be diagnosed on ultrasound in infancy, and underlying conditions such as aqueduct

stenosis may also be detected. The majority of congenital lesions in the CNS, however, are well demonstrated on CT and MRI. Chiari malformations are well described and graded (Types 1 to 4) according to severity of deformity. In more than half of cases there is associated syringomyelia. Dandy-Walker syndrome, with hypoplasia of the cerebellum, expansion of the posterior fossa and dilatation of the fourth ventricle, may be seen in isolation or in association with other anomalies including meningoceles. This is distinguished from the Dandy-Walker variant where the posterior fossa is not enlarged and from mega cisterna magna where the posterior fossa may be enlarged but the fourth ventricle and cerebellum are normal. Arachnoid cysts, often an incidental finding in adulthood, can occasionally cause mass effect depending on their size and location. These simple fluid collections are most common in the posterior or middle cranial fossa. Anomalies of the corpus callosum include agenesis and lipoma. Cleavage and neuronal migration anomalies may be detected in infants investigated for epilepsy or mental retardation. We illustrate a spectrum of congenital disorders, including the above anomalies, and highlight the salient imaging features on CT and MR.

#### POSTER 925

##### **An audit of the performance of lumbar puncture following a negative CT scan for suspected subarachnoid haemorrhage**

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We performed an audit at Northampton Hospital of the performance of lumbar puncture (LP) for suspected subarachnoid haemorrhage (SAH) following a negative CT. CT has a significant false negative rate in SAH, while CSF xanthochromia is always present 6 h after SAH. The Society of British Neurological Surgeons recommends LP for all cases of suspected SAH following negative CT. **METHODS:** All patients who had CT requests for suspected SAH were recorded. If the scan was negative, the hospital clinical investigations database was searched to see whether they had CSF samples taken. If not, the clinical notes were examined to determine whether LP was attempted and, if not, whether there was a valid contraindication. **RESULTS:** Audit carried out over 3 months (Aug–Oct 2001). Number of CT requests for suspected SAH 23, of which 15 were negative. Of these 15 patients, 5 had LP, all of which were negative for xanthochromia. Of the remaining 10, 2 sets of clinical notes were not available. LP had not been attempted in the other 8, and no valid contraindication to LP was mentioned in the notes. **RECOMMENDATIONS:** (1) Reiterate to clinicians that a negative CT does not exclude SAH, and that LP must be performed in all suspected cases. (2) Insert an addendum to this effect in both the provisional report in the clinical notes and the final report. (3) Re-audit following the implementation of these recommendations. A re-audit is currently in progress and will be completed by February 2003.

#### POSTER 926

##### **Proton MR spectroscopy in Lhermitte-Duclos disease**

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**PURPOSE:** Lhermitte-Duclos disease is a rare abnormality occurring in the cerebellum, with only 80 cases reported in the literature. There is debate as to whether this abnormality is a hamartoma, a malformation or a tumour. This work aims to describe the MR proton spectroscopic appearances of this pathology in this context. **METHODS:** Proton spectra were obtained from cerebellar abnormalities in two patients (40-year-old female and 28-year-old male) and compared with spectra from eight normal controls. Spectroscopy was performed at 1.5 T (Eclipse, Philips Medical Systems) using a single voxel PRESS technique (TE 135 ms, TR 1600 ms). Results are expressed as ratios under the three prominent resonances representing choline (Cho), creatine (Cr) and N-acetyl (NA) groups. **RESULTS:** The cases demonstrated lower NA/Cho and NA/Cr ratios for the two subjects compared with controls (1.2 and 1.2 vs 1.7 ± 0.3, and 1.1 and 1.0 vs 1.4 ± 0.3). There was no marked difference in Cho/Cr ratio between patients and controls (0.95 and 0.84 vs 0.84 ± 0.7). Inverted doublets representing lactate were present in patient spectra only. **CONCLUSIONS:** The low NA/Cr and NA/Cho ratios could be due to

a lack of neuronal architecture and/or the presence of embryonic neural tissue, which does not express NA. The near normal values of Cho/Cr are not suggestive of tumour. The lactate peaks suggest altered anaerobic metabolism. These anecdotal results favour "benign" hamartoma rather than tumour.

**POSTER 927**

**Extracranial manifestations of Neurofibromatosis Type 1**

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AIM: To describe the range of imaging features of Neurofibromatosis Type 1 (NF-1). MATERIALS AND METHODS: A retrospective review of all the imaging of 15 patients with known NF-1. RESULTS: Neurofibromas were universally seen, occurring in the thorax, abdomen, pelvis and extremities. Neurofibromas were most common in the retroperitoneum and paravertebral areas, particularly associated with enlargement of the intervertebral exit foraminae. Lesions were also seen in subcutaneous fat, muscle and within the peritoneal cavity. Lesions were of low density and showed little contrast enhancement on CT and were of low T1, high T2 signal on MRI. Plexiform neurofibromas were also demonstrated, particularly in the distribution of the sciatic nerve. Malignant peripheral nerve sheath tumours, by contrast, were larger lesions often associated with bone destruction and showing contrast enhancement on CT. Skeletal abnormalities, including "ribbon ribs", kyphoscoliosis and enlargement of intervertebral exit foraminae, were also demonstrated. CONCLUSION: NF-1 is the most common of the neurocutaneous syndromes. There is a wide range of imaging findings of NF-1 owing to the ubiquity of peripheral nerves. Neurofibromas may be misinterpreted as lymph nodes and familiarity with the various manifestation of NF-1 is important in making the diagnosis.

**Paediatrics**

**POSTER 1001**

**Congenital lung lesions in children: a pictorial review**

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Congenital lung lesions are a spectrum of interrelated uncommon developmental anomalies that share a similar pathogenesis. The exact aetiology, however, is not well defined. The most common of these lesions are congenital cystic adenomatoid malformation, pulmonary sequestration, congenital lobar emphysema and bronchogenic cysts. They vary widely in their presentation and severity from hydrops and fetal demise to apparent complete resolution before birth. After birth they may remain asymptomatic or may present with dramatic symptoms that require prompt diagnosis and treatment. The majority of these conditions are diagnosed antenatally, largely as a result of advances in prenatal ultrasound and sometimes with fetal MRI. A minority of cases may not be identified by prenatal imaging techniques and go unnoticed after birth, presenting in infancy or later childhood with respiratory symptoms and even life-threatening infections. CT is an extremely useful imaging modality in the evaluation and differential diagnosis of suspected lung abnormalities in the extrauterine life and should be routine in all antenatal cases, even those thought to have resolved antenatally. Recognition of these relatively rare lesions is therefore important and would usually lead to proper surgical intervention dictated by the presence of symptoms, recurrent infection and the potential risk of malignant transformation. We present in pictorial form the imaging and histopathology findings of some relatively common forms of congenital lung lesions in children.

**POSTER 1002**

**Imaging the child with a limp: a pictorial essay**

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PURPOSE: To present a comprehensive pictorial essay and diagnostic approach in the child with a limp. MATERIALS AND METHODS: Limping is a common problem in children caused by a variety of congenital and acquired disorders. Although narrowing the differential diagnosis depends on clinical history and clinical examination, most of the time the assessment is difficult in children. Radiology plays an

important role in assessment of a child with a limp. Conventional radiography is still the primary imaging modality, with sonography, scintigraphy, CT and MRI an adjuvant in difficult cases or when radiography is equivocal. CONCLUSION: Imaging plays an important role in the assessment and early management of a child who presents with a limp.

**POSTER 1003**

**CT findings in children with unilateral hearing loss**

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The prevalence of unilateral hearing loss in children is approximately 0.1%. The role of imaging is unclear in this group of patients. The aim of our study, which was undertaken in conjunction with the Department of Audiology, was to evaluate the usefulness of imaging in these patients. All patients willing to participate were scanned with an isometric axial helical scan technique. 10 of 33 (31%) patients had abnormal scans. We present the results with a pictorial review of the main findings. We conclude that CT provided useful information on the aetiology and aided the provision of a diagnosis and prognosis to these children.

**POSTER 1004**

**Radiological investigation of children with precocious pubertal changes**

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PURPOSE: To illustrate the radiological features of children presenting with precocious pubertal changes. MATERIALS AND METHODS: Over a period of 15 years, 67 children have been investigated for precocious pubertal changes. We have reviewed the radiological investigations of 10 patients in whom a pathological cause for precocious pubertal changes was found. The mean age at presentation was 6 years. RESULTS: Neuroimaging revealed a central nervous system cause of precocious puberty in six children, including hypothalamic hamartomas in four patients and a suprasellar teratoma in one. One boy had cerebral atrophy following neonatal meningitis. One patient had both neurofibromatosis and polyostotic fibrous dysplasia, indicating a diagnosis of McCune-Albright syndrome. Other peripheral causes included adrenal carcinoma in a 3-year-old girl, a granulosa cell tumour of the ovary in an 8 year old and an ovarian cyst in a 5-year-old girl. CONCLUSION: Radiological investigations play a central role in the investigation of precocious puberty in children. Our poster illustrates typical appearances of the underlying pathologies with a range of imaging modalities.

**POSTER 1005**

**Mediastinal masses in children: a pictorial review**

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Detection of mediastinal masses in children can be challenging, as there is frequently diagnostic uncertainty. We illustrate the plain film, CT, MRI and ultrasound features and we discuss the various methods of facilitating an accurate diagnosis in the majority of cases, by determining the position of the mass within the mediastinum and correlation with the relevant clinical and imaging features. We extensively illustrate the radiological features of mediastinal masses seen in childhood.

**POSTER 1006**

**Necrotising enterocolitis: the plain film revisited and extending the role of ultrasound**

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PURPOSE: Necrotising enterocolitis (NEC) is a mostly idiopathic and often severe enterocolitis that occurs in premature infants. The most clearly defined risk factor is prematurity. Overall mortality is 20-40%, which increases with decreasing birth weight. The clinical signs of NEC are varied and non specific. The most clearly recognized radiological signs of NEC are pneumatosis intestinalis, in the most severe cases accompanied by portal venous gas. Unfortunately these usually indicate the presence of more severe disease. As with the clinical

findings, early radiological signs are non specific and may not progress. In progressive cases there are characteristic radiological signs of NEC seen prior to the development of the severe features described above. Ultrasound has been increasingly used in our institution to aid the early diagnosis and follow-up of NEC. This presentation reviews the radiological and ultrasound features of NEC with particular emphasis on early diagnosis and monitoring of the disease. **PATIENTS AND METHODS:** A retrospective review of the radiological and ultrasound features of NEC in infants treated in the unit over a 15-month period. Ultrasound scans were performed by two radiologists and one neonatologist. **RESULTS:** Radiological signs of NEC reflecting disease progression are demonstrated. With ultrasound, pneumatosis intestinalis and portal venous gas have been demonstrated in cases where these signs have not been radiologically apparent. Bowel wall thickening, and incipient and actual perforation have been diagnosed and inflammatory masses have been monitored. **CONCLUSION:** Early NEC may be demonstrated radiologically as well as with ultrasound, which may also demonstrate features generally associated with a poorer outcome before these become radiologically apparent.

**POSTER 1007****Radiology of paediatric liver tumours: pictorial review**

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Primary liver tumours are relatively uncommon within the paediatric population. The third most common site of primary abdominal neoplasia, they represent only 3% of tumours within this age group, although unfortunately the majority of these are malignant. The clinical presentation, histological classification and radiological appearances of these tumours are diverse. We present and discuss the radiological appearances of the commoner types of benign and malignant tumours at ultrasound, computed tomography and magnetic resonance imaging, with a brief discussion on the further management.

**POSTER 1008****Pictorial review: surgically correctable causes of vomiting in children**

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We present a pictorial review of various surgical conditions that present or are associated with vomiting in a child. Many children are referred to the Radiology Department for imaging to help the clinicians in reaching the diagnosis. Age of the child at presentation often helps in narrowing the differential diagnosis. Pyloric stenosis is the commonest surgically correctable cause of non-bilious vomiting in infants. Intestinal atresia, gastro-oesophageal reflux, malrotation, meconium ileus etc. are other common causes and are dealt in this review.

**POSTER 1009****VACTERL syndrome: a pictorial review**

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A non-random association of vertebral defects, rectal anomalies and oesophageal atresia with tracheo-oesophageal fistula has been recognized for a long time. When these abnormalities occur in an association they form the VACTERL syndrome. The term VACTERL is an acronym for Vertebral, Anal, Cardiac, Tracheal, Esophageal, Renal and Limb abnormalities. VACTERL syndrome is a rare disorder seen in 1:10,000 live births, but its identification can lead to proper early management of the child in appropriate centres. A pictorial review with the aid of radiographs, MRI scans, ultrasound images, contrast studies and line diagrams, the history, the various methods of diagnosis by imaging and also surgical management of these conditions, are illustrated. The differential diagnosis of the various presentations is also discussed. Antenatal imaging is also presented. An in-depth discussion of our management of a VACTERL baby is also elucidated.

**POSTER 1010****Development of a digital paediatric image archive: highs, lows and pitfalls**

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**PURPOSE:** To digitize our film library for use in training and the production of lectures. The poster will explain the problems and solutions encountered during development. **METHODS AND MATERIALS:** We created our own database program using MS Visual Basic 6 and LeadTools Raster Pro ActiveX v12.1. Image digitization is performed using a Umax Mirage 11 film scanner, or digital camera, and existing digital images can be imported directly from disc. **RESULTS:** The digital archive allows films to be filed under multiple diagnostic "keygroups" and user-definable database fields ("categories"). Images from a particular case can be related to each other and also allocated to useful teaching collections. Radiographic images can be scanned directly into the database preventing the extra expense of hard copying film. The program allows image manipulation, editing and direct export into MS PowerPoint for easy creation of lectures. The archive system is more compact than any conventional film library. It needs no librarian to maintain the filing system, and the problems that occur during re-filing are completely diminished. Initial problems included the cost of hardware, time and expense developing the software, and the time spent teaching staff to use the new archive effectively. **CONCLUSION:** The digital image archive database system appears to offer many advantages over the conventional hard-copy filing system. It has proved an asset in the production of lectures and presentations and for teaching purposes.

**Science and Technology****POSTER 1101****Effect of sampling bandwidth on signal-to-noise ratio in MRI**

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**PURPOSE:** Quality control guarantees that MR systems perform according to the expected specifications. It ensures the consistency of the MR system's performance and the reproducibility of clinical results in long-term studies. Signal-to-noise ratio (SNR) is the parameter most commonly used in quality control programmes. However, the SNR is dependent on the sampling bandwidth (BW) of the quality control protocol. The aim of this work was to experimentally study the effect of the sampling BW on the SNR in MRI and compare it against the theoretically expected behaviour. **MATERIALS AND METHODS:** Three high-field (1.5 T) scanners from different manufacturers were tested. A cylindrical test object filled with aqueous solution of NiCl<sub>2</sub> (1.66 g l<sup>-1</sup>) was placed centrally in the head coil of each system. The test object was imaged at the isocentre of the system with a conventional spin echo sequence. All sequence parameters were kept constant (TR = 1000 ms, TE = 30 ms, matrix = 256 × 256, slice width = 5 mm, FOV = 250 × 250 mm, NEX = 1) apart from the sampling BW, which was changed within the available range of each system. **RESULTS:** Results show that the SNR follows the expected 1/√BW behaviour. However, on some scanners the measured signal was 12% lower than the theoretical value at low BWs. This might be due to the increased susceptibility artefacts occurring at smaller sampling BW. **CONCLUSION:** This work indicated that the performance of most MR systems did not deviate much from the expected theoretical behaviour. Future work will examine other MR systems over a wider range of scanning sequences.

**POSTER 1102****Proton magnetic resonance spectroscopy of abdominal fluids**

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**AIM:** To determine whether different abdominal fluids can be distinguished using *in vitro* proton magnetic resonance spectroscopy (MRS). **METHODS:** Specimens were collected from patients undergoing percutaneous drainage of abdominal fluids. MRS was performed with a 1.5 T scanner and head coil. Water-suppressed single voxel spectra were acquired using a point resolved spin echo sequence with the



parameters: TE 35 ms, TR 2000 ms, 64 and 256 acquisitions, voxel size 1 cm<sup>3</sup>. For each spectrum, the signal-to-noise ratio (SNR) was defined as the ratio of highest peak/background signal at <0 ppm. RESULTS: 35 samples were examined: 8 pus, 8 serosanguinous collections, 12 bile and 7 ascites (3 malignant, 1 chylous, 3 other benign). Pus had the highest SNR (mean 19, range 8.9–28); non-pus mean 4.5, range 2.6–8.8. A bifid peak at 1.3 ppm was found in 5/8 pus samples and 9/27 non-pus samples. A broad base (1–2 ppm width) to the peak pattern located between 0.3–2.5 ppm, with either few or multiple peaks, was seen in all pus specimens and 1/27 non-pus samples. Peaks at 0.9 ppm were found in 3/8 pus samples. Four bile samples were contaminated with iodinated contrast media and these all returned a characteristic three peak spectra. The single sample of chylous ascites exhibited a prominent peak at 1.2 ppm. Six non-pus samples had no identifiable peaks. CONCLUSION: (1) Pus can be distinguished from other common abdominal fluids by high SNR and a broad based peak pattern from 0.3–2.5 ppm. (2) Fluid contaminated with iodinated contrast media has unique peaks identified with MRS.

#### POSTER 1103

##### Implementation of MRI for radiotherapy treatment planning of brain tumours

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PURPOSE: Definition of the gross tumour, a fundamental stage of radiotherapy treatment planning, is commonly performed using CT data. However, it has been demonstrated that for brain tumours, MRI offers improved tumour visualization in >50% of patients. This work describes a feasibility study that assesses the use of MR images, registered with CT, for treatment planning of brain tumours. METHODS: Commissioning included: (i) investigation of MR image distortion and MRI–CT registration accuracy using a purpose-built phantom; (ii) patient immobilization; (iii) selection of an MR scanning protocol; and (iv) assessment of scanner time requirements. Several patients were then planned using MRI–CT data as a pilot study. RESULTS: Image distortion/registration error was typically <1 mm (1.8 mm max.). Immobilization was achieved using a purpose-built MR couch top and thermoplastic mask. An MR scanning protocol involving T1 SE and T2 FSE axial scans was found to combine minimum distortion, optimum tumour visualization and ease of image registration. Finally, it was calculated that a weekly 30 minute MRI scanner slot would be required for this to become a routine procedure. Tumour visualization was improved, in some cases dramatically, for each of the patients. CONCLUSION: It is possible to commission MRI for brain tumour radiotherapy planning within a busy radiology department. Once commissioned, the impact of this procedure on the routine MRI workload is not large. MRI has enabled the gross tumour volume to be defined with greater confidence in all of the patients scanned so far, and therefore their radiotherapy treatment to be improved.

#### POSTER 1104

##### Monte Carlo simulation of X-ray mammography using a realistic voxel phantom

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PURPOSE: A computer model of X-ray mammography has been developed that uses a realistic high resolution model of the breast. It allows for the first time dosimetry for individual breast tissues as well as studies of the dependence of image properties on breast structure. METHOD: The Monte Carlo model was developed from earlier simulations using homogeneous phantoms. The realistic breast phantoms, developed by Bakic et al, have a voxel size of 400 micron and simulate in three dimensions adipose and fibroglandular tissues, Cooper's ligaments, ducts and skin. The program calculates the dose to each tissue as well as image properties such as energy imparted and noise per pixel and scatter-to-primary ratios (S/P). RESULTS: The application of the program is illustrated with calculations of absorbed dose and S/P for breast voxel phantoms of varying glandularity and thickness (range 20–80 mm). In a preliminary study, doses to each tissue have been calculated for a phantom 50 mm thick and a Mo/Mo spectrum at 28 kV. Doses (normalized to 100 for adipose tissue) are: fibroglandular tissue 92; ducts 87; skin 284; Cooper's ligaments 147.

Calculations of S/P (no grid case) show that this is 0.28 at the chest wall with a maximum of 0.71. Variations due to tissue inhomogeneity are 25%. More detailed studies are in progress. CONCLUSIONS: A computer model of mammography incorporating a realistic breast simulation has been developed that has significant advantages over models using homogeneous phantoms. Calculations have demonstrated the power of the model for dosimetry and the study of image properties.

#### POSTER 1105

##### Phantoms in radiology

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With a brief reference to the history and evolution of phantoms, the aim of this poster was to provide an overview of different phantoms used in a radiology department. Using phantoms in our own department, we highlight the necessity for regular equipment evaluation and quality assurance and we finish with what the future may hold. This poster serves to familiarize the radiology trainee with the diverse nature of quality control tests, to provide a quick reference for radiographers at work and to refresh the knowledge of a trained radiologist. MATERIAL AND METHODS: Photographs were made of various phantom test tools, such as TOR Leeds test tool, CRS mammography phantom, CT phantom, and nuclear medicine, ultrasound and MRI test phantoms, used in our radiology department. Images are also downloaded from the Internet of phantoms used at the turn of the century as well as futuristic phantoms. RESULTS: This poster demonstrates quality control tests used in a radiology department to provide efficient patient care in keeping with the EU safety standards in a radiology practice. CONCLUSIONS: Phantom test objects were first used at the turn of the century and are now essential equipment in a radiology department. This is reflected in the fact that quality control tests are part and parcel in running a radiology department. This poster serves to provide an overview of phantoms and stimulate its viewers to further reading.

#### POSTER 1106

##### Quantification of total tumour uptake in PET scans: evaluation of a method

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AIM: To develop and evaluate an accurate and reproducible method of quantifying abnormal uptake in PET scans, to be applied to quantification of tumour burden from <sup>18</sup>F-FDG-PET in recurrent thyroid cancer. METHOD: Concentric circular ROIs were drawn around a lesion to identify the optimal ROI size relative to the lesion. Total tumour uptake was calculated from the product of average radiotracer concentration (kBq ml<sup>-1</sup>) within a ROI and the ROI volume, summed over all slices and expressed as a percentage of administered activity. A circular background region around the perimeter of the lesion ROI was used to assess the effect of background subtraction on accuracy. Accuracy was assessed using a standard chest phantom containing five spherical lesions of different sizes (13–38 mm internal diameter), all with a lesion-to-background ratio of 4.7. Reproducibility was tested by three operators separately analysing two different patient scans twice each. RESULTS: The optimal size of the lesion ROI was 2 pixels (4.3 mm) larger than the lesion when the grey-scale was set to half the maximum activity for that lesion. Analysis of the phantom showed that, with no background subtraction, the method was accurate to within 10%. Interoperator variability of total tumour uptake was found to be 10% or less, and intraoperator variability was less than 6%. Background subtraction was found to be inappropriate, reducing the total tumour uptake to approximately 50% of its true value. CONCLUSION: This was an accurate and reproducible method for quantifying total abnormal uptake in PET scans.

#### POSTER 1107

##### Survey of radiation doses in CT angiograms performed in a teaching hospital for the period 2001–2002

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Computed tomography (CT) angiograms are routinely performed in

the assessment of patients both in acute and elective conditions. CT angiograms are performed in our hospital in a multislice CT scanner (GE Light speed Plus). We would like to present a survey of radiation doses in all CT angiograms performed from the period December 2001 to December 2002. A total of 77 CT angiograms were performed, of which 39 were aortic angiograms, 11 were mesenteric angiograms, 5 were neck angiograms, 2 were pancreatic angiograms, 12 were renal angiograms and 3 were aorto-iliac vessel angiograms. The average age of aortic angiograms was 66 years, with an average dose of 833 cGycm<sup>2</sup>; the average age of mesenteric angiograms was 59, with an average dose of 915 cGycm<sup>2</sup>; neck angiograms had an average age of 60, with an average dose of 613 cGycm<sup>2</sup>; pancreatic angiograms had an average age of 65 with an average dose of 983 cGycm<sup>2</sup>; renal angiograms had an average age of 56, with an average dose of 829 cGycm<sup>2</sup>; and iliac vessel angiograms had an average age of 70, with an average dose of 765 cGycm<sup>2</sup>. The various parameters influencing radiation dose in CT angiograms are also discussed. Various indications for CT angiograms are also discussed. This is part of a work in progress in which we aim to compare doses from CT angiograms in relation to conventional digital subtraction angiograms in age-, sex- and body-weight-matched controls.

**POSTER 1108**  
**PACS workstation software**

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Through advances in technology and developments in the application of Information Technology to radiographic imaging, Picture Archive and Communication Systems (PACS) are becoming increasingly attractive as the image management solution for radiology departments. User interaction with a PACS takes place at a workstation, which is commonly a PC connected to the PACS network, running PACS software. As the performance of the software can influence the efficiency of the complete PACS, this poster aims to highlight the important

aspects of PACS software, the importance of good user interface design and the increasing versatility of PACS as a result of enhancements and clinical tools. This has been achieved by examining PACS vendor's software functionality datasheets and a number of workstation software packages. Discussion on what users would like from PACS workstation software also took place between myself and a number of radiologists and radiographers. No direct comparisons are made between particular vendor's products, rather the particular advantages and disadvantages of the products are used to highlight what good PACS workstation software should be able to achieve and the best way to achieve it.

**POSTER 1109**  
**Clustering explained: why use clustering in PACS?**

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The need to have core systems, especially PACS, running all the time means that high availability is imperative. Since a computer system consists of many parts, planning for high availability centers around back-up and fail-over processing, and data storage and access. It is no longer possible for a single computer to solve all of an enterprise's processing needs. Owing to the nature of the different applications in a PACS environment, they each require server resources in different ways, for example data transaction servers (manage core processes, e.g. image distribution), Web application servers and appliance servers (manage specific network functions) all require different server dynamics, yet the applications that run within these different groups, and which in many PACS environments are probably implemented on separate servers, must access, share and update each others data in real-time. This is where clustering is an ideal solution because it provides transparent integration and reliability of these mission-critical applications whilst delivering redundancy of systems and increasing performance.

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