

# Scientific Programme Abstracts

## Monday 22 May

0830-0915

### Quality Management Hall 8

0830

#### Achieving recognition of the title and role of the radiographer in Irish legislation

L Murray and M Coffey

*Irish Institute of Radiography, 28 Milbrook Court, Dublin 8, Ireland*

**PURPOSE:** To achieve acknowledgment of the role played by radiographers in Ireland by formal inclusion of the title and role within the statutory instrument which gives legal status to 97/43/Euratom on Radiation Protection in Ireland. **MATERIALS AND METHODS:** Over an 18 month period we chaired a working party of the Irish Institute of Radiography (IIR) which reviewed all relevant documentation on radiation protection that formed the basis of 97/43/Euratom. Representatives attended seminars and workshops and participated in multidisciplinary committees reviewing the directive. Following extensive research, a submission was made to the Irish Department of Health and Children and to the Department of the Environment with recommendations for inclusion into the subsequent Irish legislation. In the context of the increased emphasis on justification within the Directive, we also contacted the Irish College of General Practitioners (ICGP) and the Faculty of Radiologists with a view to increasing the level of awareness amongst general practitioners in their role as prescribers. Three meetings were arranged between the three professional bodies and the IIR working party convened in the interim periods to make recommendations as to how awareness could be raised. **RESULTS:** At the recent annual conference of the IIR, the focus of one session was 97/43/Euratom. Speakers included representatives of the IIR, the Faculty of Radiologists and the Vice President of the ICGP. A legal perspective was given by the IIR legal advisor and the Minister for Health and Children attended and endorsed the initiative taken by committing funding to progress the project. A draft Statutory Instrument has since been circulated which has reflected some of our recommendations. **CONCLUSIONS:** The proactive approach taken by the IIR has to date proved successful. As a new professional body we have succeeded in raising awareness of the important role played by the radiographer in the delivery of a quality service to patients.

0840

#### Quality management in diagnostic imaging and radiotherapy

K R Batty

*Centre for Radiography Education, University of Portsmouth, Portsmouth PO1 2HY, UK*

The College of Radiographers (1992) and Audit Commission (1995) advocated the use of quality management (QM) practices, such as BS 5750.(BS.EN.ISO 9000), to improve radiography services. Projects, funded by the Department of Health in the late 1980s/early 1990s and based on application of QM Systems, indicated that the principles can be successfully adapted to radiography. A questionnaire was developed to assess the adoption of quality practices and principles. Randomized distribution, to radiotherapy (RT) and diagnostic imaging (DI) managers throughout the UK was used for both pilot and main questionnaires. Quantitative data analysis indicates that RT managers and staff are more proactive, with respect to quality, than their DI colleagues. Consideration of aspects of QM and continuous quality improvement (CQI) produced negative opinion, from both specialisms. There was unexpected sceptical opinion by DI respondents with regard to a number of issues. Analysis of qualitative data demonstrates a minimally proactive approach to quality and indicates serious concern over poor resourcing of quality initiatives, communication barriers, monitoring of quality and training issues. Initial conclusions are that managers appear not to understand or believe that better leadership; communication, motivation, performance monitoring and training will help prepare themselves, their departments and staff for the future. Suggestions for effective and beneficial QM practices are made.

0850

#### Effect of a "rolling audit" on radiographic standards of plain radiograph examinations

E A O'Grady, S McKay, P Lloyd and S Weston

*Radiology Department, University Hospital Aintree, Liverpool L9 7AL, UK*

**PURPOSE:** To assess the effect of regular audit of radiographic standards on the standard of commonly performed plain radiographs in a university hospital department. **METHOD:** Since 1997, retrospective audits of plain radiographs submitted for reporting have been performed. For each examination, 100 films pulled from 1 particular month have been reviewed by a panel of radiographers and a radiologist. Non-compliance with a series of pre-determined radiographic criteria has been recorded and all films have been additionally assessed by the radiologist as to suitability for reporting. **RESULTS:** An initial audit of chest radiographs (CXRs) showed several areas where improvement was indicated (incomplete patient demographics, patient rotation, inappropriate film orientation and clipping of lung bases). Overall, 14% of CXRs were suboptimal on radiographic criteria, 25% were suboptimal on radiological criteria, with 5% felt to be poor. A re-audit 12 months later showed marked improvement in all areas with only 3% of films suboptimal and no poor films. Subsequent audits of other examinations have shown continued maintenance of this improvement. The results of these follow-on audits will be presented. **CONCLUSION:** Following the improvement indicated by these initial studies, a rolling radiographic audit is now performed on a regular 4 monthly basis in our department. Involvement of all levels of radiographer has enabled commonly encountered problems to be reviewed and protocols to be clarified. Radiological input has improved radiographer awareness of the effect of radiographic factors on radiologists' interpretation of radiographs.

0900

#### How do you check yours?

D Anderson

*Centre for Radiography Education, St Georges Building, University of Portsmouth, Portsmouth PO1 2HY, UK*

**PURPOSE:** The author has become increasingly aware of the problems experienced by newly qualified radiographers when checking radiographs. The criteria for optimal radiographs are usually well defined, but less clear is how far below this standard a radiograph can fall, and still not justify re-irradiating the patient. Clinical restraints mean that departmental radiographers have less time to guide the student through the checking process and give them the feedback that is so essential. One answer to the problem may be a computer-assisted learning package which could not only provide feedback at all stages, but if correctly designed would also encourage good checking technique. **METHOD:** Several colleagues of the author were invited to attend semi-structured interviews, at which they were all asked to assess the same radiograph using the pattern they would normally use when checking a radiograph in the department. The results of these interviews were then used to design a questionnaire that was distributed to radiographers in both clinical and academic fields and to students. **RESULTS:** A variety of checking patterns was demonstrated and an overall pattern determined by ranking the order of preference. **CONCLUSION:** At present there is no set pattern for checking radiographs, which may lead to confusion amongst students. Particularly worrying is the fact that most students were unaware of any pattern being used, and realized especially that suboptimal radiographs did not always justify repeats, but were unclear where the distinction between suboptimal and unacceptable lay.

0910

#### Discussion

0900-1030

### Techniques in the Chest Hall 5

0900

#### Invited Review

##### Thoracic intervention (non-vascular)

S P G Padley

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

Percutaneous techniques for the diagnosis and management of mediastinal, pleural and pulmonary pathology will be discussed.

MONDAY

with the main emphasis being on percutaneous needle biopsy. Points covered will include:

- Indications and contraindications.
- Needle choice and biopsy technique.
- Range and frequency of complications.
- Practical management of complications.
- Manoeuvres designed to minimize complication occurrence.
- Recent developments in biopsy technique.
- Day-case biopsy selection criteria.
- Management of pleural fluid collections.

0925

**Invited Review****Thoracic ultrasound**

F Gleeson

*Department of Radiology, The Churchill Hospital, Old Road, Headington, Oxford OX3 7LJ, UK*

Thoracic ultrasound (US) is predominately used to identify pleural fluid collections and the appropriate site for drain placement. However, it has been shown to be of use in the following:

- Identification of pneumothoraces.
- Characterization of pleural fluid into transudates and exudates.
- Detection of pleural invasion by bronchial carcinoma.
- Biopsy of pleural lesions, pulmonary masses abutting the pleura, mediastinal masses and rib lesions.
- Analysis of diaphragmatic movement and thickness.
- Identification of rib fractures and metastases.

The accompanying talk will expand and illustrate these aspects of thoracic US.

0950

**Invited Review****The radiology of pleural malignancy**

S R Desai

*Department of Radiology, King's College Hospital, Denmark Hill, London SE5 9RS, UK*

- Malignant pleural mesothelioma (MPM) accounts for only 1% of all thoracic neoplasms and is almost universally associated with a poor prognosis.
- Microscopically the tumours are epithelial, sarcomatous or of mixed histopathological pattern; the microscopic subtypes have a bearing on prognosis.
- On chest radiography and CT the appearances of MPM are non-specific: metastatic adenocarcinoma may have identical radiological features.
- Advances in the treatment of patients with MPM have been hampered by clinical nihilism. However, the recently proposed TNM staging system recognizes some of the encouraging results of multimodality therapy and the variable influences of "T" and "N" status in patients with MPM.
- Plain chest radiography is of limited value in staging.
- The accuracy of CT in predicting unresectability remains unresolved.

1015

**Discussion**

## 0915-1100 Radiological History in Motion Hall 11b

0915

**Invited Review****Radiology in developing countries**

U Busch

*German Roentgen-Museum, Schwelmer Strasse 41, 42897 Remscheid, Germany*

In developed countries, between one-third and one-half of all crucial medical decisions depend on radiological information, but only one-third of the population of the world has access to diagnostic facilities. The 1993 statistics from the World Health Organisation (WHO) turn sickness, sadness and death into frightening figures. In economical developing countries, 192.5 million or one in three children under the age of 5 years were malnourished. In 1993, 16.3 million people of all ages died of infections or parasites, compared with 135 000 people living in the developed world. From the epidemiological point of view, the majority of radiographic examinations in hospitals in the developing world are simple examinations,

namely of the chest, abdomen and skeleton. These hospitals are usually in the larger towns or cities and it has been observed that 30-60% of the radiographic equipment is out of order. The result is that these simple examinations have to be carried out in the university or referral-level hospitals. Also, in rural and marginal urban areas, most people do not have access to diagnostic imaging services. Furthermore, there is a large deficiency in properly trained staff to operate and maintain the radiological services. Until a few decades ago, owing to the difficulties of travel and transportation, tropical diseases were contained geographically. Now, in our age of intercontinental travel, the world is becoming smaller and these diseases are becoming more prevalent in the developed countries, e.g. AIDS. Neither the role that tropical radiology has played in identifying these diseases nor its contribution to epidemiology should be underestimated. However, complacency must not be allowed to set in: there is still a need for visionaries to provide the solutions bringing basic health to every citizen of the world.

0945

**Invited Review****The work of Professor Sir Howard Middlemiss, CMG, MD, FRCP, FRCR**

H Baddeley

*Paul Strickland Scanner Centre, Mount Vernon Hospital, Northwood, Middlesex HA6 2RN, UK*

Howard Middlemiss was one of the outstanding radiologists of his generation with enormous enthusiasm for promoting all aspects of radiology. He was appointed Director of Radiology in Bristol in 1949 where he insisted on high standards in radiodiagnosis and radiography. He was an enthusiastic teacher of registrars and undergraduates. He was also one of the first to devise regular collaborative meetings with clinicians that are now accepted practice in radiology. He was a founder member of the Bristol Bone Tumour Registry. In 1953 he first visited Africa as an adviser and saw the urgent need to develop basic radiographic and radiology facilities in underprivileged communities. Over the next 30 years as adviser to the Department of Overseas Development/Aid, Inter-University Council and WHO he promoted radiological facilities and education in the West Indies, East and West Africa, India and SE Asia. He initiated schools of radiography, university departments of radiology and hospital radiography departments and arranged visits and exchanges between them and his own department in Bristol where over 100 radiologists trained during his time as director and professor. Until the early 1970s the DMRD and DMRT courses and examinations were sufficient for consultant appointment. Howard Middlemiss felt strongly that radiology and radiotherapy would develop if training was improved and if the fellowship examination became the standard for consultants. As Warden of the Faculty of Radiologists (1966-1971) he reviewed registrar training and devised an effective fellowship examination of a high standard which formed the basis of the present FRCR. With like-minded colleagues, he felt the Faculty should become the Royal College of Radiologists and this was achieved in 1975 when he became its first president. It has proved to be the basis for the successful development of clinical radiology and clinical oncology in the UK. In 1983 the College established the Sir Howard Middlemiss Memorial Trust which continues his work to support radiological education in developing countries. The trust supports visits and exchanges, particularly to the West Indies, East and West Africa and Malaysia.

1015

**Invited Review****The influence of UK radiology on developing Greek and military radiology**

G Ph Livadas

*A & L Medical Supplies Ltd, 6 Parmenidou Street, Athens 116 36, Greece*

It is documented that the first use of military radiology was during the Greco-Turkish War, about 100 years ago. However, very little is known on the matter. In our work we illuminate some of the details with the aim of paying tribute and honouring the British pioneers who voluntarily, in the name of humanity and the Cross, traveled to Greece and established the advanced base military hospital that was to house the cradle of military radiology. Of the general support of the British newspapers for the Greek cause, that of the Daily Chronicle proved to be of paramount assistance for the Greek wounded and decisive for military radiology. Our research was based on British and Greek newspapers from the time and on unpublished archival material, found both in libraries and museums, as well as private archives in Greece, England and Turkey. We also present our research concerning the actual building used to house the hospital and details on the British expedition, not previously published. Unpublished material on Greek radiology is also presented.

1045

**Status, space and safety: challenges for the British radiologist**

J M Guy

*Radiology Department, West Suffolk Hospital, Bury St Edmunds CO10 9PR, UK*

This paper examines the factors promoting and retarding the development of radiology as a clinical speciality in Britain up to 1930. Articles in medical journals and the unpublished records of hospital committees reveal the considerable problems of those wishing to practice radiology in a hospital setting. Private radiology is less well documented but faced similar difficulties; financial, technical and interprofessional. Voluntary hospital management was slow to accept radiologists on the regulatory board. Fellow doctors were reluctant to accept specialists of any kind. Rather than being given status as "honorary" physicians or surgeons, the radiologists were paid a meagre salary for their services. Accommodation was generally in cramped, dark basements, equipment grudgingly supplied, electrical power unreliable, radiation protection inadequate. Radiologists themselves claimed that their knowledge of the nature and dangers of radiation gave them the qualification for specialist status. Though aware of its dangers, they were not for the first several years able to measure the radiation to which they, the patients and their assistants were exposed, and so failed to prevent damage.

1055

**Discussion**

0930–1030

**Web Publishing How To—  
Beginner  
Olympian Suite**

0930

**Web Publishing How To Course**

M Tatlow

*Division of Professions Allied to Medicine, South Bank University, 103 Borough Road, London SE1 0AA, UK*

- This is the first of three 1-h practical sessions intended for all levels of Web site builder.
- The sessions are split into Beginner, Intermediate and Experienced.
- Each session follows on from the previous one, building on the knowledge and experience gained, although it is not essential that delegates attend all 3 sessions; they can be attended singularly.
- Attending all 3 sessions will take the novice World Wide Web (3W) builder through basic 3W site design and concepts, considerations necessary when using images, and the use of more complex page design including forms and active content such as dynamic HTML and Flash Movies.
- Each session will use examples of Internet sites to illustrate the concepts, which will then be tried out in practice. The emphasis is very much "hands on". (Note there are limited places in the "hands on" sessions.)

0945–1130

**The NHS Breast Screening  
Programme—Planning for the  
Future  
Hall 8**

0945

**Invited Review**

**Clinical and service considerations**

C Rogers

*Breast Test Wales, 18 Cathedral Road, Cardiff, South Glamorgan CF1 9LJ, UK*

- What are the main issues for future planning?
- What effect will they have on workload?
- What manpower implications are there?
- Possible approaches to meeting the need.

1010

**Invited Review**

**Radiation protection and technological development**

C P Lawinski

*Kings College Hospital, London, UK*

The presentation will cover the following areas:

**DEVELOPMENTS IN MAMMOGRAPHY X-RAY EQUIPMENT:**

- Multiple added filtration.
- Dual target track X-ray tubes.
- Advanced automatic exposure control.
- Developments in compression devices.
- Effect on breast dose.

**DEVELOPMENTS IN FILM-SCREEN TECHNOLOGY:**

- High contrast film-screen combinations.
- Faster processing cycles.
- Image quality and dose considerations.

**DEVELOPMENTS IN DIGITAL IMAGING:**

- Small field digital imaging system: use in stereotactic localization, spot imaging and magnification techniques; CCD technology.
- Full field digital imaging: CCD-based detectors; scanning beam systems; amorphous silicon flat plate detectors.
- Image quality and dose considerations.
- Prone breast biopsy tables.
- Telemammography.
- Computer-aided diagnosis.
- 3D imaging.
- Change from film to electronic reporting.

1050

**Invited Review**

**An educational perspective**

L K Lee

*Breast Directorate, City Hospital, Nottingham NG5 2DP, UK*

The following areas will be discussed:

- The transition of the radiography education from DCR to MSc.
- Post diplomat to postgraduate mammography.
- The specialist role of the radiographer in breast screening.
- Meeting the future needs of the NHSBSP.
- Linking education to service requirements and the future of the radiography profession.

1115

**Discussion**

1045–1230

**The Issue of Colon Cancer  
Screening  
Hall 5**

1045

**Invited Review**

**Genetics and colorectal cancer screening**

V A Murday

*St George's Hospital, Medical Genetics, Cranmer Terrace, London SW17 0RE, UK*

- 5–15% of colorectal cancer occurs in genetically susceptible individuals.
- These individuals can be identified through their personal or family history or through genetic testing.
- Screening in these individuals should have a significant impact on the mortality and incidence of premature disease.
- Susceptibility can be due to dominant genes with high penetrance (FAP and HNPCC) that cause early onset disease or lower penetrance genes with an age of onset not dissimilar to the general population.
- Genetic testing is available for the high risk families, FAP and HNPCC.
- Screening should be considered for moderate risk as well as these high risk families. However, the age over which these individuals will be screened and the frequency will be different from screening those individuals with or at risk of FAP and HNPCC.

1115

**Invited Review****Colorectal cancer screening**

D G Morton

*University Department of Surgery, Queen Elizabeth Hospital, Birmingham B15 2TH, UK*

- Colorectal cancer is the second most common cause of death from cancer in the western world, and asymptomatic diagnosis can reduce mortality by at least 20%.
- Asymptomatic diagnosis can be performed on a population screening basis and/or by targeting high risk groups.
- Genetic pre-disposition to colorectal cancer accounts for up to 20% of all cases. A symptomatic diagnosis in this population has been proven to prevent death from colorectal cancer.
- Population screening by faecal occult blood testing of individuals between 55 and 65 years of age has been shown to reduce mortality by 18%. However, sensitivity for colorectal cancer is low with this technique.
- Endoscopic screening provides the opportunity to prevent colorectal cancer by polypectomy. Cohort studies indicate that up to 80% of cases can be prevented. Randomized study results are awaited.
- Stool DNA analysis for tumour mutations may provide the optimal screening method in the future.

1145

**Invited Review****Overview of the UK pilot centres**

C Bartram

*Department of Radiology, St Mark's Hospital, Northwick Park, Harrow HA1 3UJ, UK*

The following points will be discussed:

- How the pilot sites will be used to assess the feasibility of CRC screening using haemoccult testing in the 50–69-year-old population.
- An outline of the centres involved, with a review of the organization for haemoccult testing and the investigation of positive tests.
- The role of the DCBE and how this is being performed in the pilot sites.
- Data collection, audit and communication.
- How the pilot sites may act as a model to assess the implications of CRC screening for radiology departments.
- Alternative models for CRC screening — should there be more pilot sites?

1215

**Discussion**

## 1045–1215 Studies in Paediatric Imaging Hall 6

1045

**Invited Review****Imaging in neonatal intensive therapy units**

F C Rodger

*Department of Radiology, Great Ormond Street Hospital for Children, London WC1N 3JH, UK*

The following points will be discussed:

- Radiographic technique: basic good practice for radiographers including the advantages of computed radiography.
- Common requests: mobiles and other radiographic investigations with reference to justification of the requested examination.
- Anatomy and physiology: including examples of the different radiographic findings in neonates.

1115

**MRI in the management of growth plate abnormalities in children**

M Balogun and K Johnson

*Department of Radiology, Birmingham Children's Hospital, Birmingham B4 6NH, UK*

**PURPOSE:** In children, growth plate disturbances and bony bar formation have significant long-term implications due to growth arrest. MRI with volume acquisition and 3D post-processing has enabled improved demonstration and therefore assessment and surgical planning for abnormalities present. **METHODS:** 14 children (aged 7–16) presenting for MRI at the Birmingham Children's

Hospital with possible growth plate abnormalities secondary to trauma, infection or developmental anomaly were assessed. All children had MRI of the appropriate growth plate and adjacent joint with 3D volume double echo steady state (DESS) or spoiled gradient echo (SPGR) acquisitions. The effect of the images on surgical management was reviewed. **RESULTS:** In all 14 cases the MRI sequences well demonstrated the growth plate enabling the extent of abnormality and the presence of bony spurs to be evaluated. Detailed planar and 3D anatomical representations of the region of interest and of the growth plate in isolation were obtained and used for surgical assessment. The growth plates evaluated included proximal humerus, distal radius, proximal tibia and distal femur. **CONCLUSION:** 3D volume acquisition of the growth plate is useful for assessing the extent and severity of growth plate disturbance. It gives detailed representation of any abnormality and allows area measurements to be made. Surgical planning is improved. The different image sequences are comparable.

1125

**National survey of the use of steroid prophylaxis for intravenous paediatric contrast procedures**

A Evans and S J Morris

*Radiology Department, University Hospital of Wales, Cardiff CF4 4XW, UK*

**PURPOSE:** The aim of the study was to assess the use of steroid prophylaxis for intravenous paediatric contrast procedures in those at increased risk of contrast reaction or with severe asthma/allergy. **METHOD:** Postal questionnaires were distributed to paediatric radiology departments at 83 hospitals nationally. Questions included those regarding local policy and the preferred method and administration of prophylaxis when given. **RESULTS:** Replies were received from 52 departments (62.6% response rate). 19.2% of departments currently have a standard policy relating to steroid prophylaxis in children at increased risk of contrast reaction or with severe asthma/allergy undergoing iv contrast procedure. 80.8% of departments have no such policy. Despite this, 58.8% of responders do consider steroid prophylaxis to be indicated in certain paediatric groups. **CONCLUSION:** There are currently no set guidelines relating to steroid prophylaxis for intravenous contrast procedures in the paediatric population. In view of the national discrepancy in steroid prophylaxis usage, particularly in the paediatric setting, we suggest a review of the current evidence to allow a standard policy to be adopted nationally.

1135

**Should asymptomatic neonates with heart murmurs be irradiated?**

R S Oeppen and J Fairhurst

*Paediatric Radiology, Southampton General Hospital, Southampton SO16 6YD, UK*

**PURPOSE:** Although there are published data addressing the value of chest radiography in the assessment of children with asymptomatic heart murmurs, there are no studies evaluating its use in neonates. **METHODS:** The chest radiographs of 70 neonates referred with an asymptomatic murmur were classified as normal or showing possible evidence of heart disease. The case notes were reviewed for the results of echocardiography and clinical outcome. **RESULTS:** Of 54 neonates with normal chest radiographs (CXRs), 17 had a structural heart defect confirmed by echocardiography (sensitivity 29%). 9 of 16 neonates with an abnormal CXR were not subsequently found to have a structural cardiac defect. (specificity 80%). There was no correlation between CXR and echocardiography findings in this study ( $p=0.15$ ). **CONCLUSION:** Chest radiography cannot be recommended in the initial investigation of heart murmurs discovered in asymptomatic neonates.

1145

**Unenhanced CT scans of the paediatric abdomen: radiation exposure vs diagnostic benefit**

C G Taylor, S Bose, A K P Lim and K McHugh

*Department of Imaging, Great Ormond Street Hospital for Sick Children, London WC1N 3JH, UK*

**PURPOSE:** It is a commonly held belief that non-contrast scans of the paediatric abdomen are useful in the initial assessment of abdominal lesions to detect calcification. This study aims to investigate whether this practice provides significant diagnostic benefit. **MATERIALS AND METHOD:** 70 consecutive cases were reviewed by a consultant paediatric radiologist and a radiology fellow. Pre- and post-iv contrast scans of the abdomen and/or pelvis were analysed separately at least a week apart. No clinical history was given. Results were recorded on data sheets. Each anatomical area was recorded as normal/abnormal/not sure. Presence or absence of calcification within an abnormality was noted. A diagnosis



was made including a degree of certainty of 95%/75%/50%. RESULTS: A correct diagnosis was made from 67% of non-contrast scans vs 79% of enhanced scans. Diagnostic certainty of 95% was recorded in 36% of non-contrast studies vs 56% of enhanced scans. The number of "not sures" recorded per anatomical area was 40% less in contrast enhanced scans. 20 out of 70 cases had a calcified abnormality. The calcification was missed in 28% of the contrast-enhanced scans, however this did not significantly affect the diagnosis given. CONCLUSION: Unenhanced CT scans of the paediatric abdomen increase the radiation burden considerably and do not provide significant diagnostic benefit.

1155

**The role of the nephrostogram following pelvi-ureteric junction surgery in children**

S Ramachandran, N B Wright, J Bruce and D S C Gough  
Departments of Radiology and Surgery, Royal Manchester Children's Hospital, Manchester M27 4HA, UK

The purpose of this study was to assess the role of the nephrostogram following pelvi-ureteric junction (PUJ) surgery in children. A retrospective case history analysis of 50 children undergoing surgery was undertaken. The time interval following the surgery, the position of the nephrostomy tube and the presence of peritubal and perinephric leakage and ureteric drainage were recorded and graded. Only 25 children had congenital PUJ obstruction and were eligible for inclusion (age 1-132 months, average 17.7 months). Pre-operative pelvic diameter varied from 10-41 mm, average 17 mm. Nephrostograms were performed 4-7 days after surgery, immediately following removal of a transanastomotic tube. Nephrostomy tube position was satisfactory in 22. 1 tube was displaced, 1 fell out just prior to the procedure, and in 1 no data was recorded. Peritubal leakage was absent in 14 (63%), minimal in 6 (27%) and moderate and severe in 1 each (4.5%). No perinephric leakage from the anastomosis site was identified. Ureteric drainage was seen in only 8 children (36%), mild in 5, and moderate in 3. All children had the nephrostomy tube removed shortly after the nephrostogram, regardless of the presence of ureteric drainage. All children had a good outcome assessed by clinical parameters and isotope renography. This series suggests routine nephrostograms following surgery for PUJ obstruction are not necessary. Although 64% of nephrostograms failed to demonstrate ureteric drainage, this did not appear to affect outcome.

1205

**Routine Doppler ultrasound in the immediate post-operative period following liver transplantation**

L Pearson, L Macpherson, K Bradshaw and K Johnson  
Department of Radiology, Birmingham Children's Hospital, Birmingham B4 6NH, UK

INTRODUCTION: The number of paediatric orthotopic liver transplants (OLT) being performed in the UK is increasing. These children need regular post-operative ultrasound scans, but the number and frequency of these scans is variable. The frequency of complications detected by ultrasound needs to be assessed, so that a safe and manageable post-operative ultrasound surveillance regime can be established. METHODS: At Birmingham Children's Hospital, 37 children underwent 38 OLTs. The post-operative ultrasound scans and the medical records for these patients were retrospectively reviewed. The scan reports were analysed for the nature and timing of post-operative complications and the medical records were assessed for the patients' corresponding clinical state. RESULTS: 154 Doppler ultrasound scans were performed on 37 patients (38 transplants) in the first 5 days post-transplant. 23 patients had daily ultrasound surveillance on days 1-5, 16 had daily scans on days 1-3. No patient had an ultrasound detectable complication identified on either day 4 or day 5, without accompanying clinical deterioration and/or previously documented abnormal ultrasound findings on days 1-3. CONCLUSION: In the immediate post-operative period following OLT, the risk of a serious vascular complication is high, particularly in children. Routine post-operative ultrasound scans are therefore essential. We propose that routine surveillance should consist of daily scans on days 1-3 post surgery, with further scans being reserved for those patients in whom there are serious clinical concerns or in whom there were previous abnormal ultrasound findings.

## 1045-1245 Image Analysis Olympian Suite

1045

**Invited Review  
Medical image registration**

D Hawkes  
Division of Radiological Sciences and Medical Engineering,  
Guy's Hospital, London SE1 9RT, UK  
No abstract.

1115

**Invited Review  
Quantification of medical images**

A Todd-Pokropek  
Department of Medical Physics & Bioengineering, University  
College London, Gower Street, London, UK  
No abstract.

1145

**Invited Review  
Breast imaging: a principled approach to image processing**

M Brady  
Oxford University, Parks Road, Oxford OX1 3PJ, UK  
No abstract.

1215

**Invited Review  
Virtual reality and surgery**

A Linney  
University College London, London, UK  
No abstract.

## 1100-1145 Royal Society of Medicine Finzi Lecture Hall 11b

1100

**Eponymous Lecture  
A century of radiology in the US and the UK**

J D Howell  
University of Michigan, 6312 Medical Science Building 1,  
Campus Box 0604, Ann Arbor, MI 48109-0604, USA  
Invented in 1895, the X-ray machine was applied to human health and disease on both sides of the Atlantic with astonishing speed, at least as reflected in the published medical literature. Actual clinical application for day-to-day use was much slower to become a matter of routine. When the X-ray machine was finally incorporated in standard clinical care, this transition reflected structural as well as scientific influences. Moreover, the machine was located and applied to clinical activity in very different ways in the US and the UK. This presentation will focus on the early use of the X-ray machine. In both the US and the UK, negotiations took place over almost every aspect of the machine. Who was to take charge of its use — medically or non-medically trained people? Where was it to be placed within the hospital structure? What was the relationship between diagnostic and therapeutic use of radiology? I shall explore these various choices for the early years of the century. I shall then trace the use of the X-ray machine during the 20th century, in both the US and the UK, and will show how answers to these same sorts of questions have continued to be negotiated and renegotiated. I shall also explore how differences in the cultures of the US and the UK shaped and will continue to shape the status of how X-rays and other imaging technologies are applied to patient care.

1145–1315  
**Society of Radiographers  
 Annual General Meeting**  
 Hall 8

1200–1400  
**Studies in Management and  
 Audit**  
 Hall 11b

## 1200

**Clinical commissioning of diagnostic X-ray equipment?**

N S A Wells, D P Emerton and C P Lawinski

*Kings Centre for the Assessment of Radiological Equipment (KCARE), Kings College Hospital, East Dulwich Grove, London SE22 8PT, UK*

Commissioning forms an important part of the purchasing and installation cycle of new diagnostic X-ray equipment. This part of the process follows the critical examination and acceptance stages and is designed to ensure that equipment is ready for clinical use. Guidance given in IPEM Report Number 77 suggests the range of tests which should be carried out by the "purchasers representative", normally the local medical physics department and not the user. These are primarily technical tests designed to check the performance of the system and to establish baseline values for future routine performance tests, but do not consider how the unit will be used in the clinical environment. Thus, a system which appears to function correctly and safely might not be ergonomically fully suitable or ready to carry out the required range of clinical examinations. Currently, there are no guidelines or protocols for the clinical commissioning of equipment to assist the user in determining whether the unit is usable and suitable for the clinical workload. This presentation will focus on the importance of clinical commissioning and will put forward suggestions for those parameters and features that should be considered. These could form the basis of a standard protocol in order to formalize this stage in the purchasing process.

## 1210

**Factors influencing access to MRI services**W Hollingworth, R Mackenzie, A K Dixon and C J Todd  
*Health Services Research Group and the Department of Radiology, Addenbrooke's Hospital and the University of Cambridge, Cambridge CB2 2QQ, UK*

**PURPOSE:** To assess variations in quality of life and access to MRI services. **PATIENTS AND METHODS:** A prospect of multicentre study recording health status (SF-36) and waiting time for MRI in 1798 patients seen in 4 MRI units in East Anglia. **RESULTS:** There was wide variation in health status amongst patients referred for MRI. Patients referred with lumbar spine problems had the worst health, while patients referred with possible cerebellopontine lesions had only marginally worse health than the general population. The study also demonstrated wide variation in waiting times between different centres and between NHS and privately funded patients. Patients with worse physical health tended to be imaged more promptly than those who reported a better quality of life. **CONCLUSION:** Process factors such as the individual imaging centre and private insurance cover seem to be very important in determining how quickly a patient will get an imaging appointment. Clinical factors, such as the pre-imaging suspected diagnosis and patient quality of life were more weakly linked to waiting time.

## 1220

**An audit of medical emergency admission chest radiographs**<sup>1</sup>R Bagree, <sup>2</sup>S Lo, <sup>2</sup>V Acharya, <sup>2</sup>J Beynon and <sup>2</sup>J R Harding<sup>1</sup>*University Hospital of Wales, Heath Park, Cardiff CF14 4XW and*  
<sup>2</sup>*St Woolos & Royal Gwent Hospitals, Newport NP20 4SZ, UK*

Chest radiographs (CXRs) are commonly performed on patients admitted as medical emergencies. An audit was undertaken to determine the reasons for requesting a CXR, documentation of CXR findings in notes and whether CXR reporting (either by a radiologist or a chest physician) alters management. Over a 5 day period all CXR requests on patients admitted as acute medical emergencies were reviewed. The following data were collected on each patient: basic demographic data, reason for CXR, working diagnosis on admission, documentation of CXR findings in notes. All available CXRs performed were also reviewed by an independent expert. 176 (88%) of 199 patients admitted underwent CXR examination, of which 164 (93.2%) CXRs were available on the ward and 157 were available for independent reporting. Of the 176 CXRs performed, a reason for performing the CXR was documented in 175 cases. Of 164 CXRs available on the ward, findings were documented in the notes in 73 (44.5%). 157 of the CXRs performed were available for independent review. In 27 (17.2%) cases it was felt that the independent reviewers report would alter management/influence treatment plan. From this initial audit the following conclusions and recommendations were made. Consider carefully whether CXR is required, ensure findings are documented in the notes, ensure if possible that CXR is available on the post-intake ward round for a senior member of the team to review. Obtain a radiology opinion if there are any concerns. These findings were disseminated to members of the medical and radiology directorates and a repeat audit is currently being performed.

## 1230

**Emergency cranial CT: discrepancies of radiology trainee reports and final interpretations, and management relevance**

R Bhatt, N Messios and A Liddicoat

*Department of Radiology, Leicester Royal Infirmary NHS Trust, Leicester LE1 5WW, UK*

**PURPOSE:** To determine the rate and clinical outcome of discrepancies in interpretation by radiology trainees and final reports by consultants of out-of-hours emergency cranial CT scans. **MATERIALS AND METHODS:** A prospective evaluation was performed for 246 out-of-hours emergency cranial CT scans reported by radiology trainees over a 10 month period. Discrepancies between final reports and trainee reports were recorded. Discrepancies were divided into false positive (interpreting normal as abnormal) or false negative (failure to report an abnormality). A discrepancy was considered major when it affected patient care in the emergency setting and minor when it did not affect the immediate care of the patient. **RESULTS:** There was agreement between preliminary reports (trainee reports) and final reports in 206 (83.7%) scans. Overall, 40 (16.2%) discrepancies were recorded of which 34 (13.8%) were minor discrepancies and 6 (2.4%) were major discrepancies. 3 (1.2%) false positive and 37 (15%) false negative errors were observed. **CONCLUSION:** This study showed low interpretation discrepancy rate for emergency cranial scans between radiology trainees and consultants. Most discrepancies were minor. No adverse clinical outcome due to interpretation error was seen.

## 1240

**Reduction in inappropriate use of radiographic investigations amongst GPs by an education initiative**<sup>1</sup>B Eyes, <sup>2</sup>C Garvey, <sup>3</sup>K Abba, <sup>1</sup>J Makowska-Webb and <sup>1</sup>J Whalley<sup>1</sup>*Department of Radiology, Aintree Hospital NHS Trust, Liverpool,* <sup>2</sup>*Department of Radiology, Royal Liverpool University Hospital, Liverpool and* <sup>3</sup>*Audit Department, Liverpool PCAG, Liverpool, UK*

**PURPOSE:** An interface audit project was undertaken to reduce inappropriate use of radiographic investigations (especially those involving high dose radiation) amongst general practitioners (GPs). **METHODS:** Data regarding referral rate by GPs for 5 commonly requested radiological investigations (lumbar spine, hip, pelvis, knee and chest radiographs) were collected prior to the audit. Subsequently, all GP practices within the Liverpool region received a copy of the Royal College of Radiologists guidelines "Making the Best Use of a Department of Clinical Radiology". This was followed by a number of educational exercises aimed at both GPs and patients. Requests from GPs received by the 3 provider units were

then collected on a 6 monthly basis, beginning with the period of January-June 1997 and ending July-August 1998. Referral rate for the above-mentioned radiographic investigations was then calculated for each practice. The resultant data, comparing referral rates of practices with each other and the city as a whole, were regularly fed back to the GPs involved. RESULTS: Over the time period of this audit, significant decreases in referral rates ( $p < 0.01$ ) were observed in 4 of the 5 investigations under review: lumbar spine radiograph, 48%; knee radiograph, 38%; hip radiograph, 30%; pelvic radiograph, 24%. The referral rate for chest radiograph did not show any significant change during the studied time period. CONCLUSIONS: The use of written feedback to GPs on their practice referral rates for commonly requested, frequently inappropriate and high dose radiation investigations, together with written guidelines, were highly effective in the reduction of patients' radiation exposure.

#### 1250

##### Repeat plain film requests by general practitioners—are they indicated?

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PURPOSE: To find out if repeat general practitioner (GP) requests for plain films are indicated according to the RCR guidelines. MATERIALS AND METHODS: Prospective review of all repeat GP requests for plain films over 1 month in the Leicester Royal Infirmary. The current and previous films and reports were compared. The indications were compared with the RCR guidelines (4th edition, 1998). If the indications were not addressed in the guidelines, a decision regarding their appropriateness was made in consensus by 3 radiologists. RESULTS: In the 1 month period, 1615 plain film investigations were requested by GPs, of which 134 (8.3%) were found to have had identical investigations before. According to the RCR guidelines, 33 (25%) were indicated and 55 (41%) were not indicated. The guidelines failed to address 46 (34%) of cases. Of these 46 cases, we decided that 32 were appropriate and 14 were inappropriate in view of the clinical information provided. New positive findings were found in 16 cases of those investigations with appropriate indications (33 + 32). Only 7 new positive findings were found in those investigations with inappropriate indications (55 + 14). However, 6 of these 7 positive reports would not have changed patient management. CONCLUSION: About half of the repeat GP requests were not indicated. There were significantly more positive findings in those investigations with appropriate indications than those without. Of the few positive findings in the inappropriate investigations, the vast majority have no clinical implication. The RCR guidelines failed to give advice in a third of cases.

#### 1300

##### Audit of in-patient ultrasound requests

E A Dick and J Young

Department of Radiology, Whittington Hospital, London, UK

PURPOSE: To assess whether the target of performing in-patient ultrasound scans within 36 h of receiving the request form was being achieved. METHODS: 69 consecutive in-patient ultrasounds were assessed over a 2-week period. The following information was noted: (i) the number of days between the date of the request on the form and date of receipt in the department; (ii) the number of days between the request form arriving in the department and the date the scan was performed (excluding weekends and bank holidays); and (iii) the number of requests that were irrelevant or gave inadequate information (as assessed by the radiologist who performed the scan). RESULTS: 83% (57) of request forms arrived in the department on the same day; 17% arrived at least 1 day late. 95.6% (66) of scans were performed within 36 h of the request form arriving in the department. There were 2 irrelevant/inadequate request forms. CONCLUSIONS: The standard of performing scans within 36 h of request forms arriving in the department was being met in 95.6% of cases. 97% of forms had adequate and relevant clinical information. These figures disproved a perception held by both clinicians and radiologists that many request forms were inappropriate and that there was a significant delay in performing scans.

#### 1310

##### NHS Estates (DoH) new contribution to the design and planning of diagnostic imaging facilities

N E Tomlinson, J Britton and S Taylor

NHS Estates, Department of Health, Frant House, Coach & Horses Passage, The Pantiles, Tunbridge Wells, Kent TN2 5NP, UK

PURPOSE: NHS Estates has identified a need for updated national guidance in the form of a modernized Health Building Note to support the design of diagnostic imaging and interventional

radiology facilities. This will replace the existing HBN6. The intention is to combine the expertise of many organizations, including those representing imaging professionals, to generate comprehensive advice aimed at ensuring high quality design and estates provision. METHOD: Imaging is identified as a particularly rapidly developing area. Recent technological advances of particular influence on service delivery and the built environment include digital image data acquisition, storage, communication and the rise of non-ionizing radiation based modalities. The design influence of these new elements is taken into account and the document is structured to give advice that is sensitive to operational, ergonomic and technological factors. Modern radiation protection standards published in NRPB advice and the new 2000 Ionising Radiations Regulations are significant factors within the design guidance. The new work will cover the provision of diagnostic facilities from primary care to the tertiary level. The potential impact of telemedicine is considered. The recommendations made by the Egan Report are interpreted in terms of imaging projects, as are the requirements of the Capital Investment Manual, private finance initiative and public-private partnerships. The document will be of electronic modular construction, on DVD, to allow for frequent updates reflecting the high pace of change in modern imaging and intervention.

#### 1320

##### Determination of the potential for the development of occupational standards in imaging and oncology

N J Prime, F Mellor, R Fernando, J High, K Cooke and A R T Higgs

Department of Radiography, University of Hertfordshire, College Lane, Hatfield AL10 9AB, UK

This paper describes on-going research sponsored by the NHSE Eastern Region Education Innovation Fund. Following the production of occupational standards in diagnostic ultrasound, and the current debates about skill mix issues in the work place and curriculum design, funding was sought to determine whether occupational standards might be designed in the broad areas of imaging and oncology. Initial results of the first stages of the research are presented. A variety of qualitative methods have been used in the project and a report on the output from the initial questionnaires is given. The questionnaire was sent to a wide variety of workers (including support workers, radiologists, oncologists and radiographers) within imaging and oncology departments ( $n = 1500$ ) throughout the UK (excluding Northern Ireland) and university departments of radiography education ( $n = 20$ ). All respondents were asked to comment on whether they recognized their roles and responsibilities in the derived key purpose for imaging and oncology: "To promote optimal patient care and management through the best use of available resources by acquiring, interpreting and communicating diagnostic imaging information, and treating patients where appropriate while maintaining the ALARA principle". Respondents were also asked to comment on a number of key roles and indicate how they thought occupational standards might inform practice and curriculum design. Initial results seem to indicate broad acceptance of the key purpose and key roles but more detailed results will be presented together with implications for further research.

#### 1330

##### Minerva revisited

E A Dick, K El Haddad and B Holloway

Department of Radiology, Royal Free Hospital, Pond Street, London NW3 2QG, UK

PURPOSE: To review the weekly pictorial case reports in "Minerva" (British Medical Journal) to establish the number of cases in which the diagnosis was made by a radiologist and, of these, when a radiologist was included as an author or acknowledged. MATERIALS AND METHODS: 52 issues of the BMJ from January 1999 to January 2000 were reviewed. Illustrations were classified into: (i) clinical pictures; (ii) non-radiological investigation (e.g. histology); and (iii) radiological imaging, divided into plain films, axial imaging (CT and MRI) and interventional imaging (angiography and barium studies). All cases were grouped according to whether the diagnosis was radiological (primarily made from imaging) or non-radiological. Authors were divided into clinicians, radiologists and histopathologists. RESULTS: Out of 52 case reports, there were 18 cases of radiological imaging, in all of which the diagnosis was primarily radiological. 7 cases were plain films (and therefore it was reasonable to assume that the clinical team had made the diagnosis). In 3 of these cases, further imaging (CT, angiography) confirmed the diagnosis. In 11 cases, the diagnosis was made by interventional or cross-sectional imaging. CONCLUSION: In 14 out of 52 cases the diagnosis was made or confirmed by interventional or cross-sectional imaging and therefore

was likely to have been made by a radiologist. In all of these cases the authors included clinicians, but no radiologist. The BMJ guidelines state authorship should include all those who have made a "substantial contribution to the...analysis and interpretation of data". In reports where this is the case, the radiologist involved should be included.

**1340**  
**Discussion**

**1230–1330**  
**Studies in Gastrointestinal MRI**  
**Hall 6**

**1230**

**MR colography with carbon dioxide**

<sup>1</sup>D J Lomas, <sup>1</sup>R R Sood, <sup>1</sup>M J Graves, <sup>1</sup>J Joubert, <sup>1</sup>C Sims, <sup>1</sup>H J Franklin, <sup>2</sup>N R Hall and <sup>2</sup>R Miller

*Departments of <sup>1</sup>Radiology and <sup>2</sup>Surgery, University of Cambridge and Addenbrookes Hospital, Cambridge CB2 2QQ, UK*

**PURPOSE:** To demonstrate the technical feasibility *in vivo* of a carbon dioxide-based MR colography technique. **MATERIALS AND METHODS:** A new technique for imaging the colon using gas (carbon dioxide) as a contrast medium and subsecond single shot half-Fourier rapid acquisition with relaxation enhancement (RARE) imaging resistant to motion and susceptibility artefacts was developed. 6 patients (4 male, 2 female, age 41–85 years) with known colon carcinoma were recruited for an initial assessment of the technique. All patients were studied during the 24 h prior to excision of their tumours. Imaging was performed with a 1.5 T whole body MR system (Signa LX, GEMS) and a torso multicoil array. Initial thick slab imaging was used to observe filling of the colon with CO<sub>2</sub>. Subsequently, multiple blocks of contiguous thin (3–5 mm) slice images were obtained in the coronal and axial planes through the colon. Comparison of the surgical and MR findings was made using the original and reformatted images. **RESULTS:** In all 6 patients the technique demonstrated clearly the known carcinomas of the colon. There was good agreement between the surgical and MR demonstration of the lesions regarding extent and location. No additional lesions were found at MRI or at surgery. **CONCLUSION:** Gas-based colography of the colon with single-shot RARE sequences is feasible and can demonstrate known colon carcinoma lesions. This technique may offer a robust method of non-invasive imaging of the colon for use in staging and potentially in the future for screening high risk patients.

**1240**

**Review of MR cholangiopancreatography techniques**

H Wilson and D J Lomas

*Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge CB2 2QQ, UK*

**PURPOSE:** To provide a descriptive review of imaging methods used in MR cholangiopancreatography (MRCP). **MATERIALS AND METHODS:** A variety of MR techniques have been described for imaging the pancreatic and biliary duct which are now challenging diagnostic ERCP. We reviewed the literature and our own experience (over 350 MRCP examinations over the past 5 years) to identify the available methods in order to summarize the techniques and their respective advantages and disadvantages. Each technique has to provide visualization of the duct system, manage artefacts related to motion (respiratory, bowel and vascular) and susceptibility at air-tissue interfaces. **RESULTS:** Examples of the various techniques in actual clinical practice will be presented and discussed along with our current technique which utilizes a long effective TE with a single-shot half-Fourier rapid acquisition with relaxation enhancement (RARE) sequence (SSFSE). Both thick slab or projection images and multiple thin slice images are acquired during breath-holding over a half-hour examination. **CONCLUSION:** A range of MRCP techniques are available which permit good visualization of the biliary and pancreatic ducts. Control of respiration, motion and susceptibility artefacts are of particular importance for good results.

**1250**

**Detection of choledocholithiasis: diagnostic accuracy of ultrasonography, CT, magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography**

D Pickuth, S H Heywang-Köbrunner and R P Spielmann  
*Department of Diagnostic Radiology, Martin-Luther-University, Halle-Wittenberg 06112, Germany*

**PURPOSE:** To compare ultrasonography (US), unenhanced spiral CT, magnetic resonance cholangiopancreatography (MRCP) and endoscopic retrograde cholangiopancreatography (ERCP) in the diagnosis of choledocholithiasis. **MATERIALS AND METHODS:** Over a period of 2 years, 82 patients with clinically suspected choledocholithiasis underwent US, CT and MRCP immediately before undergoing ERCP. US/CT/MRCP scans and ERCP images were evaluated for the presence of bile duct stones, ampullary stones and extrahepatic biliary dilatation. **RESULTS:** US/CT/MRCP depicted common bile duct stones in 23/24/27 of 28 patients, respectively, found to have stones at ERCP. Five patients had stones impacted at the ampulla, two/all/all of which were detected with US/CT/MRCP. US/CT/MRCP had a sensitivity of 82%/86%/96% and a specificity of 98%/98%/100% in the diagnosis of choledocholithiasis. **CONCLUSION:** MRCP is an accurate, non-invasive alternative to ERCP in the detection of common bile duct stones and may reduce the number of unnecessary diagnostic ERCPs. MRCP can be performed rapidly without instrumentation and avoids the complications of ERCP, which include pancreatitis, sepsis, perforation and haemorrhage. US and CT are less useful for evaluating suspected bile duct stones and are only recommended when MRCP is not available.

**1300**

**Prospective comparison of breath-hold MRCP and ERCP**

<sup>1</sup>D J Lomas, <sup>1</sup>P W P Bearcroft and <sup>2</sup>A E Gimson

*Departments of <sup>1</sup>Radiology and <sup>2</sup>Gastroenterology, University of Cambridge and Addenbrooke's Hospital, Cambridge CB2 2QQ, UK*

**PURPOSE:** To compare prospectively a breath-hold projection MRCP technique with ERCP. **MATERIALS AND METHODS:** 76 patients with suspected biliary strictures or choledocholithiasis referred for ERCP underwent MRCP on the morning of their ERCP examination. A breath-hold fat suppressed long effective TE-based technique was employed using either single or multishot RARE sequences with a 1.5 T whole body MR system and a torso multicoil. Images were obtained in the axial, coronal and oblique coronal planes and interpreted directly with no post-processing. The 2 examinations were reported prospectively and independently and the results compared using ERCP as the gold standard. **RESULTS:** MRCP failed in 2 and ERCP in 5 patients. In the remaining 69 referrals MRCP correctly diagnosed 22 of 23 normals, 19 strictures with 1 false positive, 9 common duct calculi with 2 false positives, 12 of 14 non-specific dilatation and only 1 of 4 cases of chronic pancreatitis. **CONCLUSION:** Breath-hold projection MRCP can provide diagnostic results comparable to ERCP and in the future may allow a reduction in the requirement for diagnostic ERCP examinations. The current MRCP technique has limited ability to detect the early changes of chronic pancreatitis as demonstrated by ERCP.

**1310**

**MR small bowel follow through—choice of bowel contrast agent using HASTE sequence**

A K P Lim, S Redla, C Todd, A W M Mitchell and M E Roddie  
*Department of Imaging, Charing Cross Hospital, London W6 8RF, UK*

**PURPOSE:** To evaluate the effectiveness of various water-based oral contrast preparations in delineating small bowel using the half-Fourier single shot turbo spin echo (HASTE) sequence. **METHOD:** 4 subjects were starved overnight on 5 different occasions, 1 week apart. On each occasion, a different contrast agent consisting either of: (a) control (nothing), (b) water (1 l), (c) gastrografin (15 ml made up to 1 l with water), (d) sorbitol (70 ml 70% w.v. made up to 1 l with water), or (e) mannitol (25g of powder dissolved in 1 l of water) was administered orally 1 h prior to MRI. Coronal and paracoronar 6 mm HASTE sequences were performed through the abdomen and pelvis using a Magnetom (Siemens) 1.5 T MR scanner. The films were randomized and 2 independent readers each reviewed the images and scored each preparation (1–5) for the assessment of small and large bowel anatomy, distension and mucosal delineation. Subjects also evaluated the side-effects and taste of the various agents. **RESULTS:** The most severe side-effect was diarrhoea experienced with the mannitol preparation and the most unpleasant tasting preparation was that containing

gastrografin. There was a significant difference between the various preparations of contrast agents in delineation of the small and large bowel. These will be discussed. **CONCLUSION:** Water can be used as a simple and effective way of delineating the small and large bowel using HASTE sequences but addition of other agents can significantly improve image quality.

**1320**  
**MR small bowel enteroclysis with a combined half-Fourier RARE technique**

D J Lomas, R R Sood, M J Graves, A H Freeman and J Joubert  
*Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge CB2 2QQ, UK*

**PURPOSE:** To investigate the technical feasibility of a combination of jejunal intubation and half-Fourier rapid acquisition with relaxation enhancement (RARE) for imaging small bowel strictures. **MATERIALS AND METHODS:** A technique for imaging the strictured small bowel using methylcellulose solution (MC) as a contrast medium and subsecond half-Fourier RARE imaging resistant to bowel peristalsis and susceptibility artefacts was developed. 6 patients (age 41–85 years) with a small bowel enema evidence of Crohn's disease were recruited. MRI was performed after the patients (fasting 8 h) were intubated with a small bowel balloon enteroclysis catheter (TEC-100, Cook) under X-ray fluoroscopy. Imaging was performed with a 1.5 T whole body MR system (Signa LX, GEMS) and a torso multicore array. 1.5/2.0 l of MC was infused at 1.2 ml min<sup>-1</sup> using a manual peristaltic pump. Small bowel filling at 3–5 s intervals was observed using fat suppressed thick slab imaging. An antiperistaltic agent was given and infusion stopped after the terminal ileum was visualized. Subsequently, multiple blocks of contiguous thin (3 and 10 mm) slice images were obtained in the coronal and axial planes through the colon. **RESULTS:** In all 6 patients, uniform distension and good visualization of the small bowel was achieved. There was good agreement between the 2 examinations regarding distribution and extent of stricturing and in 1 patient MR demonstrated an unsuspected fistula track. **CONCLUSION:** MR small bowel enteroclysis using a combination of half-Fourier RARE and MC as contrast medium can provide diagnostic quality images and additional information regarding wall thickening and soft tissue abnormalities.

**1230–1315**  
**Chernobyl Update for the 21st Century**  
**Hall 11a**

**1230**  
**Invited Review**  
**Chernobyl accident update for the 21st century**  
R F Mould

*41 Ewhurst Avenue, South Croydon, Surrey CR2 0DH, UK*  
The nuclear accident at Chernobyl on 26 April 1986 had a heavy impact on life, health and the environment. It caused agony to people in the Ukraine, Belarus and Russia and anxiety far away from these countries. The economic losses and social dislocation were severe in a region already under strain. At the end of the 20th century it is now possible to make more accurate assessments of these effects than it was in the first few years following the catastrophe. This presentation will, after a brief description of why the accident occurred and of eyewitness accounts, consider aspects of the following topics:

- Early medical response and follow-up of patients with acute radiation syndrome: power plant workers and liquidators.
- Evacuation and resettlement.
- The sarcophagus: current and future status.
- Dose measurement and estimation methods.
- Population doses.
- Environmental contamination.
- Psychological illness in adults and thyroid cancer in children.
- Predicted cancer incidence in the 21st century; leukaemia and solid cancers.

The presentation will be well illustrated and include photographs of early and late effects on the skin of firemen who fought the blaze and of one of the control room operators who has survived. The speaker was a member of the UK Government Delegation to the first post-accident conference attended by the experts from the USSR (August 1986 at the IAEA, Vienna), and has visited the

Chernobyl Nuclear Power Station in December 1987 and June 1998. Photographs from these two dates will be shown. Also included are colour photographs of the damage inside the sarcophagus and of the remaining radioactive fuel massed within the sarcophagus, such as the so-called "Elephant's Foot" mass from which samples are chipped off using Kalashnikov rifles.

**1245–1330**  
**Luminary Lecture 1**  
**Hall 5**

**1245**  
**Invited Review**  
**High resolution CT in the immunocompromised host: differential diagnosis at high resolution CT**

N L Müller  
*Department of Radiology, Vancouver General Hospital and University of British Columbia, Vancouver, BC, Canada*

**INTRODUCTION:** The aim of this presentation is to review the high resolution CT (HRCT) findings of pulmonary complications seen in acquired immunodeficiency syndrome (AIDS) and in non-AIDS immunocompromised patients. The prevalence of the various pulmonary complications in AIDS patients differs considerably from that seen in other immunocompromised patients. Therefore these 2 groups of patients will be considered separately.

**PATIENTS WITH AIDS:**

- Ground glass attenuation: *Pneumocystis carinii* pneumonia—by far the most common cause; rarely—cytomegalovirus pneumonia, lymphoid interstitial pneumonia (LIP).
- Consolidation: infection—bacterial pneumonia, tuberculosis, *Mycobacterium avium intracellulare*, fungi; malignancy: AIDS-related lymphoma.
- Nodules: peribronchovascular distribution—Kaposi's sarcoma; other distribution; infection—septic emboli, tuberculosis, *Mycobacterium avium intracellulare*, fungi, nocardia; malignancy—AIDS-related lymphoma.

**IMMUNOCOMPROMISED NON-AIDS PATIENTS:**

- Ground glass attenuation: non-specific finding. Infection—*Pneumocystis carinii*, cytomegalovirus; drug-induced lung disease, haemorrhage, oedema.
- Consolidation: bacterial pneumonia; lymphoma; drug-induced disease; pulmonary oedema.
- Nodules: nodules with halo of ground glass attenuation—*invasive aspergillosis*. Nodules without halo: infection—septic emboli, *aspergillosis*, nocardia; malignancy—metastases, lymphoma, post-transplant lymphoproliferative disorder.

**1330–1530**  
**The Barium Enema Revisited**  
**Hall 8**

**1330**  
**Invited Review**  
**The role of barium enema in cancer detection**  
H A McRitchie

*Department of Radiology, Borders General Hospital, Huntleyburn, Melrose, Roxburghshire TD6 9BS, UK*  
The following areas will be discussed regarding the role of barium enema with respect to cancer and screening:

- The natural history of colorectal cancer.
- How good is barium enema at detecting colorectal cancer?
- How does barium enema compare with other means of colorectal cancer detection?
- Barium enema in the detection of symptomatic colorectal cancers.
- Barium enema as a screening tool for colorectal cancer.

MONDAY

1400

**Invited Review****Bowel preparation for double contrast barium enemas**

A M Booth

*Department of Radiology, York District Hospital, Wigginton Road, York YO31 8HE, UK*

The following areas will be discussed:

- The need for bowel preparation.
- A brief résumé of bowel physiology.
- The history of bowel preparation.
- A review of preparations on the market.
- A review of the literature.

1430

**Invited Review****Diagnostic fluoroscopy—will it become the province of the radiographer?**

R L Law, H M Carter and N Slack

*Department of Radiology, Frenchay Hospital, Bristol BS16 1LE, UK*

- Radiographers at Frenchay Hospital started performing gastrointestinal fluoroscopy 17 years ago.
- Involvement of radiographers has evolved to the extent that now all gastrointestinal related fluoroscopy and peripheral phlebography is the province of a small team of radiographers.
- There is no reason why, with experience, radiographers should not perform the more complex and time-consuming diagnostic fluoroscopic procedures.
- Radiographers with the support of radiologists, physicians and surgeons at this hospital, control, organize and run their own fluoroscopy workflow. In many hospitals, interested radiographers are only undertaking 3, 2 or just 1 fluoroscopy list per week.
- As radiographers gain competence and experience they should be encouraged to increase their number of fluoroscopy lists, freeing the radiologists to focus on those aspects of their role that cannot be devolved.

1500

**Quality assurance—radiographer-performed barium enema examinations**

F A Hawke

*Department of Radiology, Borders General Hospital, Melrose TD6 9BS, Roxburghshire, UK*

**PURPOSE:** To introduce a quality assurance programme using the correlation of radiological, endoscopic and pathological findings. **METHOD:** Standardized reporting proformas were completed by the radiologists. Copies of colonoscopy report sheets were obtained from the gastroenterologists. Colo-rectal surgical procedures operation notes and pathology results were obtained from the surgical directorate. All results were coded into American College of Radiology (ACR) coding. These codes were entered into separate tables in an Access Database. **RESULTS:** Barium enema was the preliminary investigation. Surgery and/or theatre colonoscopy confirmed 100% of the radiologically suspected tumours. 1 additional tumour was detected in an area of sigmoid diverticular disease. 80% of radiologically suspected polyps were confirmed. 2% of small polyps (<4 mm) were missed at barium enema. 10% of the radiologically suspected polyps not confirmed by theatre colonoscopy were caecal lesions. The colonoscope was not thought to have reached the caecum in these cases. 20% of the radiologically suspected polypoid lesions confirmed by theatre procedure were found to have malignant changes. Colonoscopy, performed in the outpatient endoscopy suite by gastroenterologists, confirmed 71% of polyps suspected radiologically. These included some caecal lesions. The remaining 29% of radiologically suspected lesions were not confirmed. These were all caecal lesions. The colonoscope did not reach the caecum in these cases. 2 cases indicated further polyps (<4 mm), 1 in the ascending colon, 1 in an area of sigmoid diverticular disease which were not noted radiologically. **CONCLUSION:** Review of the radiographer-performed enema examinations indicates that the results compare favourably with therapeutic investigations of the colon.

1510

**Comparison of radiographers' and radiologists' reports on radiographer-conducted barium enemas**

M Murphy, C F Loughran, H Birchenough, J Savage and C Sutcliffe

*Department of Radiology, Macclesfield District General Hospital, Macclesfield, Cheshire SK10 3BL, UK*

**PURPOSE:** To compare radiographer and radiologist reports on radiographer-conducted barium enemas. **METHOD:** 2 specially trained, experienced radiographers performed barium enemas and

prepared provisional reports without consulting radiologists. Later, formal radiologist reports were issued. Both reports were compared and correlated with clinical findings derived from case note review. **RESULTS:** 669 patients had barium enemas; 248 (37%) were males and 421 (63%) females. Patients were from 17 to 95 years (mean 62). The radiologist reported 206 as normal, 397 as diverticular disease (alone or together with other pathologies) 60 with polyps, 21 carcinomas and 11 as colitis. The radiographer reports were concordant in 637 (95%) and discordant in 32 (5%). Of the discordant reports, there were 17 false positive diagnoses by radiographers of polyps and 5 of diverticular disease. The radiologist diagnosed polyps in 7 cases; of these only 1 was later found to have a polyp. The radiologist diagnosed colitis once but this was not substantiated on later review. There were 2 radiologist reports of diverticular disease that the radiographers regarded as normal. There were no false negative diagnoses of carcinoma by either radiographer or radiologist. There was 1 concordant false positive diagnosis of carcinoma. **CONCLUSION:** Specialized radiographers can report barium enemas to a high standard. This study did not reveal any significant difference between the reports issued provisionally by radiographers and those made later by radiologists.

1520

**Discussion**

1330–1530

**How to Cope with IR(ME)R 2000**

Hall 11a

1330

**Invited Review****IR(ME) Regulations 2000—a view from the department**

S Ebdon-Jackson

*Imaging Policy Team, Health Services Directorate, Department of Health, London SE1 8UG, UK*

The following areas will be discussed:

- Procedures.
- Protocols.
- DRLs.
- What is expected, by when and from whom?

1355

**Invited Review****The 4 roles and who does what in imaging departments**

A J Scally

*Division of Radiography, University of Bradford, 25 Trinity Road, Bradford BD5 0BB, UK*

This talk will address the following issues:

- The definition of the roles of: employer, practitioner, operator and referrer.
- How these roles differ from the roles defined in IR88 (the POPUMET regulations).
- Differentiation between people, professions and roles.
- The development of departmental protocols to identify who undertakes each of the roles.
- The scope for variation between departments.
- The additional training/CPD requirements engendered by the new regulations.

1420

**Invited Review****IRMER—the medical directorates role**

P Cavanagh

*Department of Diagnostic Imaging, Taunton and Somerset NHS Trust, Musgrove Park Site, Taunton, Somerset TA1 5DA, UK*

The following points will be covered:

- The implications of IRMER to the Trusts activity.
- How should the Trust instigate the changes?
- How should the Trust monitor compliance?
- IRMER and the clinical governance agenda.

1445

**Invited Review**

**Issues from a radiographic manager's perspective**

A S Whitley

*Blackpool Victoria Hospital NHS Trust, Blackpool, Lancashire, UK*

- Outline of the duties of the employer to ensure effective management of medical exposures.
- Introducing the new regulations across the Trust.
- What are the implications of justification?
- What are the implications of optimization?
- Examples of good clinical audit.
- Aspects of equipment and training requirements.

1510

**Discussion**

1345–1430

**British Institute of Radiology  
Kodak Mayneord Memorial  
Lecture  
Hall 5**

1345

**Eponymous Lecture**

**Is there any science in radiology?**

W R Lees

*Department of Radiology, The Middlesex Hospital, Mortimer Street, London W1N 8AA, UK*

Although using tools developed from fundamental scientific discoveries, radiology as a discipline has been criticized for being purely technological. Radiological diagnosis follows the classic scientific method: observation of anatomy and alteration to anatomical models, comparison with pathological databases and with disease models, prediction of the effect of diagnosis on management, prognosis and outcome. Subjectivity in this process is controlled by blinded reading by multiple observers with interobserver and intraobserver comparisons. There are many problems with this approach. Much work is underway to reduce the need for a subjective observer using statistical pattern recognition, shape analysis and construction of image databases. Although making strong progress in some areas such as mammography it will take many years to render human skills redundant. The main weakness in the radiological method is our lack of interest in disease processes and outcome measures even where our scientific methodology is strong.

1400–1530

**Studies in Chest Imaging  
Hall 6**

1400

**Clinical validity of normal angiography in suspected pulmonary embolism—a meta-analysis**

E J R van Beek, E M J Brouwers-Kuyper and M Oudkerk

*Department of Radiology, Royal Hallamshire Hospital, Sheffield S10 2JF, UK and Daniel den Hoed Clinic, Rotterdam, The Netherlands*

**PURPOSE:** To assess the clinical validity of withholding anticoagulant therapy in patients with clinically suspected pulmonary embolism (PE) and normal findings at pulmonary angiography. **MATERIALS AND METHODS:** A literature search was performed using Medline and Current Contents databases. The search comprised English, German and French articles that described patients with suspected PE, who were followed for a minimum of 3 months after a normal pulmonary angiogram. Articles were evaluated using pre-defined criteria for strength of design. Articles of good or excellent design were included. **RESULTS:** A total of 8 studies met the criteria, describing 1050 patients. Follow-up was incomplete in 51 patients. Recurrent thromboembolism was described in 18 patients (1.8%; 95% CI: 1.0–2.7%), and this was fatal in 3 patients (0.3%; 95% CI: 0.02–0.7%). In a worst case scenario, where all patients lost to follow-up had died from recurrent PE, these rates would have been 6.3% and 5.1%, respectively.

**CONCLUSION:** It is safe to withhold anticoagulant therapy in patients with suspected PE and a normal pulmonary angiogram. Pulmonary angiography should still be considered as the reference method for excluding PE.

1410

**A comparative analysis of gadolinium enhanced magnetic resonance angiography with pulmonary angiography for diagnosis of pulmonary embolism**

E J R van Beek, E M J Brouwers-Kuyper, A Berghout, A H H Bongaerts and M Oudkerk

*Department of Radiology, Royal Hallamshire Hospital, Sheffield S10 2JF, UK and Daniel den Hoed Clinic, Rotterdam, The Netherlands*

**PURPOSE:** To assess the diagnostic accuracy of gadolinium (Gd) enhanced magnetic resonance angiography (MRA) for diagnosis of pulmonary embolism (PE). **MATERIALS AND METHODS:** An ongoing randomized trial enrolled 141 patients for pulmonary angiography. Gd enhanced MRA was performed prior to angiography. Management took place on the basis of angiography. Informed consent was obtained from all patients. High resolution 3D Gd enhanced MRA (512 matrix; TR/TE/a = 3.65 ms/1.6 ms/25; minimum field of view 200 × 320 cm). Each lung was covered sagittally using 1.25 mm slices. A double dose of contrast was administered for each lung (2 ml s<sup>-1</sup>, 10 s). Catheter angiography was performed using digital subtraction angiography, 6 frames s<sup>-1</sup>, two projections. Independent, blinded reading was performed by two radiologists. **RESULTS:** MRA and pulmonary angiography were available in 122 patients (19 patients had contraindications for MR). PE was demonstrated in 37 patients (30%). MRA demonstrated 25/37 PE (sensitivity 67%), while false positive results were obtained in 6 patients (specificity 93%). MRA was better in central arteries than in subsegmental vessels. **CONCLUSIONS:** MRA is comparable with helical CT for diagnosis of PE. Further studies should be aimed at improving the resolution of MRA.

1420

**Ultrafine needle aspiration in suspected thoracic malignancy**

<sup>1</sup>A M Beale and <sup>2</sup>V Masani

*Departments of <sup>1</sup>Radiology and <sup>2</sup>Respiratory Medicine, Princess Margaret Hospital, Swindon SN1 4JU, UK*

Biopsy of intrathoracic malignant lesions has a relatively high complication rate in comparison with biopsy of other organs. This is primarily due to the relatively high incidence of pneumothorax. The predominant method of obtaining tissue from lung lesions has been using 18–22G fine needle aspiration (FNA) rather than a core biopsy. We describe a previously unreported technique using an ultrafine 25G needle (UFNA) with immediate bedside cytology provided by the radiologist. **METHOD:** 61 outpatients with suspected thoracic malignancy underwent a single pass 25G UFNA using CT guidance. All aspirates were immediately assessed in the radiology department for adequate cellularity by the radiologist using Diff-Quick stain. Only those with inadequate cellularity on the first pass needed further aspiration. A post-procedural limited CT and a 4 h chest radiograph were done to assess complications prior to discharge. **RESULTS:** Adequate cellularity was obtained in 56/61 (92%) patients. 52 patients had histologically proven malignancy; UFNA was positive in 48/52 (92%), 4/52 (8%) required subsequent core or open lung biopsy. There were 9 (15%) small pneumothoraces, none of which required intervention or admission. **DISCUSSION:** In patients with suspected thoracic malignancy, 25G UFNA with immediate evaluation of cellularity is both safe and accurate in an outpatient setting.

1430

**Success of image-guided pleural cutting needle biopsy in the presence of a suspected malignant effusion**

R F Adams and F V Gleeson

*Radiology Department, Churchill Hospital, Oxford Radcliffe Hospitals, Oxford OX3 7LJ, UK*

**PURPOSE:** Both pleural fluid cytology and non-image-guided Abrams or Cope biopsies have sensitivities of approximately 60% for detecting malignant disease in the presence of a pleural effusion. Thoracoscopic biopsy has approximately 90% sensitivity for detecting malignant pleural disease and mesothelioma. The aim of this study was to evaluate the diagnostic accuracy of percutaneous image-guided cutting needle biopsy (CNB) of pleural thickening in the presence of a pleural effusion. **PATIENTS AND METHODS:** 33 patients, with diffuse or focal pleural thickening (median 1.0 cm, range 0.2–6.0 cm) and a pleural effusion (median depth 3 cm, range 0.5–10 cm), had a percutaneous image-guided CNB. The clinical outcome, radiological findings, and histology results were recorded.

**RESULTS:** Biopsy guidance was by CT in 24 patients, and by ultrasound (US) in 9 patients. Of the 24 patients with malignant pleural disease, a correct histologic diagnosis of malignant disease was made in 21 patients, 87.5% sensitivity, 100% specificity. A correct histologic diagnosis was made in 13/14 cases of mesothelioma, 93% sensitivity. A correct diagnosis of benign pleural disease was made in 9 patients. Positive and negative predictive values for malignant disease were 1.0 and 0.75. Complications comprised one chest wall haematoma. **CONCLUSION:** Image-guided percutaneous CNB of pleural thickening in the presence of a pleural effusion is a safe procedure, with an overall accuracy of 88%, with a sensitivity for detecting malignant mesothelioma of 93%. Pleural thickening of 5 mm or less may be successfully and safely biopsied.

1440

**Lung volume reduction surgery for pulmonary emphysema: imaging assessment and clinical outcome**  
A Rajesh, M Aslam, I Oey, D Waller, N Taub, N Hudson and K Jayapalan

Department of Radiology, Glenfield Hospital NHS Trust, Groby Road, Leicester LE3 9QP, UK

**PURPOSE:** To evaluate the value of chest radiography (CXR), CT and ventilation perfusion (V/Q) scans in the preoperative assessment for lung volume reduction surgery (LVRS). To determine whether pre-operative imaging findings can reliably predict clinical outcome. **MATERIALS AND METHODS:** 43 patients underwent LVRS at our centre from 1996 to 1999. We retrospectively reviewed 21 patients in whom we could obtain all imaging data. These patients had CXR, CT and V/Q scans. Post-operative chest radiographs were reviewed. The CXR and CT scans were scored for severity of emphysema (0–3), heterogeneity, compression and incidental lung abnormalities. The V/Q scans were scored for perfusion and heterogeneity. The pre-operative and post-operative (3–6 months) FEV1 (forced expiratory volume in 1 s) were obtained for these patients (16 patients). **RESULTS:** We compared the heterogeneity scores from different imaging modalities using kappa. The value of kappa for CXR vs CT and CT vs V/Q scans was 0.57 with 95% CI: 0.12 to 1.00 (moderate strength of agreement) and 0.52 with 95% CI: 0.05 to 1.00 (moderate strength of agreement), respectively. 13 patients showed a reduction in transthoracic diameter (TTD) ranging from 0.5 to 3 cm. There was an improvement in FEV1 ranging from 12 to 200%. **CONCLUSION:** There was moderate strength of correlation between CXR vs CT and CT vs V/Q scans. All patients showed an improvement in FEV1 irrespective of the type of emphysema. CXR is used in the preliminary investigation and CT scans are helpful in further evaluating the extent of emphysema and to detect other abnormalities. The V/Q scan helps the surgeon to have a road map of perfused vs non-perfused lung. We will discuss the imaging features and results in this paper.

1450

**The relationships between the extents of CT abnormalities and pulmonary function impairment in asbestos-exposed subjects**

S J Copley, A U Wells, M B Rubens, W Musk and D M Hansell  
Department of Imaging, Royal Brompton Hospital, London SW3 6NP, UK

**PURPOSE:** Asbestos-exposed individuals may have a combination of interstitial fibrosis, emphysema and diffuse pleural thickening, all of which contribute to a pulmonary functional deficit. The purpose of the study was to determine which index of pulmonary function correlates most strongly with the individual disease processes. Our study compared correlations between the extent of fibrosis, emphysema and pleural disease and pulmonary function indices using a high resolution CT (HRCT) scoring system. **MATERIALS AND METHODS:** Two observers independently scored the HRCT scans of 81 individuals with asbestosis for the extent of fibrosis ( $n=81$ ), emphysema ( $n=38$ ), and diffuse pleural thickening ( $n=79$ ), scored to the nearest 5% at 5 levels. Correlations between lung function indices and the extents of individual CT features were evaluated. **RESULTS:** There were strong relationships between the extent of fibrosis and both total lung capacity (TLC) and DLCO ( $r=-0.51$ ;  $p<0.00005$  and  $r=-0.50$ ;  $p<0.00005$ , respectively); the circumference of diffuse pleural thickening and forced vital capacity and TLC ( $r=-0.57$ ;  $p<0.00005$  and  $r=-0.57$ ;  $p<0.00005$ , respectively) and extent of emphysema and KCO ( $r=-0.42$ ;  $p<0.0001$ ). **CONCLUSION:** Despite the highly variable mixture of pathological processes encountered in patients with asbestosis, good correlations were found between the extents of individual CT features and the degree of functional impairment. CT may have a role in quantifying the degree of functional impairment individually ascribable to asbestos exposure or cigarette smoking.

1500

**The discriminatory value of high resolution CT in obstructive lung disease**

S J Copley, A U Wells, N L Müller, M B Rubens, J Cleverley, N J Hollings and D M Hansell

Department of Imaging, Royal Brompton Hospital, London SW3 6NP, UK

**PURPOSE:** Establishing the cause of significant airflow obstruction on clinical grounds and on pulmonary function testing can be difficult. The aim of the study was to evaluate the accuracy of high resolution CT (HRCT) in differentiating between causes of obstructive lung disease. **MATERIALS AND METHODS:** The CT scans of 138 patients (35 asthma, 31 centrilobular emphysema, 20  $\alpha_1$ -antitrypsin deficiency, 19 obliterative bronchiolitis and 33 normal) were assessed independently by two observers. The most likely diagnosis and confidence rating (confident vs uncertain) were recorded. A second-choice diagnosis was stated when the first-choice diagnosis was uncertain. **RESULTS:** In 240/276 (87%) of observations the correct diagnosis was either first or second choice, and in 199/276 (72%) of observations the first-choice diagnosis was correct. A confident diagnosis was made in 161/276 (58%); diagnostic accuracy was higher with a confident diagnosis (127/161, 79%) than with a non-confident diagnosis (71/115, 62%),  $p<0.005$ . For first-choice CT observations, the negative predictive value was 71% and positive predictive value was 73%. Interobserver agreement in first-choice diagnosis was good overall ( $K=0.68$ ). Observer agreement was highest in distinguishing between obliterative bronchiolitis and centrilobular emphysema ( $K=0.74$ ) and lowest in distinguishing between centrilobular emphysema and  $\alpha_1$ -antitrypsin deficiency ( $K=0.45$ ) and between asthmatics and normal controls ( $K=0.50$ ). **CONCLUSION:** HRCT is accurate in distinguishing between diseases causing airflow obstruction, particularly in separating small airways from emphysematous disease.

1510

**CT appearances in acute respiratory distress syndrome: comparison of direct and indirect pulmonary injury**

<sup>1</sup>S R Desai, <sup>2</sup>A U Wells, <sup>2</sup>G Suntharalingam, <sup>2</sup>M B Rubens, <sup>2</sup>T W Evans and <sup>2</sup>D M Hansell

<sup>1</sup>Department of Radiology, King's College Hospital, Denmark Hill, London SE5 9RS and <sup>2</sup>The Royal Brompton Hospital, London SW3 6NP, UK

**PURPOSE:** To evaluate the differences in CT appearance in patients with acute respiratory distress syndrome (ARDS) due to direct and indirect pulmonary injury. **MATERIALS AND METHODS:** CT scans in 41 patients (males=27; mean age=42.1±17.1 years) with ARDS (direct,  $n=16$ ; indirect,  $n=25$ ) were scored by 2 radiologists at 5 levels. The extents of ground-glass opacification (GGO), dense parenchymal opacification (dependent [DPOD] or non-dependent [DPOND]), cysts and septal lines were quantified. Overall CT appearances were categorized as "typical" (*i.e.* dependent areas of DPO and non-dependent areas of GGO) or atypical of ARDS. **RESULTS:** In patients with direct ARDS, DPOND was more extensive than in indirect ARDS ( $p=0.05$ ). Areas of DPOND were more extensive in the anterior ( $p=0.01$ ), posterior ( $p=0.05$ ), and in the lower ( $p<0.01$ ) but not the upper zones in direct ARDS. There was no significant difference between direct and indirect ARDS for the extents of GGO, DPOD, cysts or septal lines. A "typical" distribution of CT changes was more frequent in indirect than in direct ARDS (18/25 [72%] vs 6/16 [31%];  $p<0.01$ ). In patients with an atypical distribution on CT, DPOND ( $p=0.03$ ) and cysts ( $p=0.05$ ) were more extensive; conversely, in patients with a typical distribution DPOD ( $p=0.01$ ) was more extensive. **CONCLUSIONS:** The distinction direct and indirect ARDS is of relevance in management. In many cases, the morphological changes on CT may allow differentiation between direct and indirect pulmonary injury.

1520

**Non-specific interstitial pneumonitis vs usual interstitial pneumonitis: structural-functional relationships**

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<sup>1</sup>Department of Radiology, King's College Hospital, Denmark Hill, London SE5 9RS and <sup>2</sup>The Interstitial Lung Disease Unit, Royal Brompton Hospital, London SW3 6NP, UK

**PURPOSE:** To compare CT functional relationships in patients with usual interstitial pneumonitis (UIP) and non-specific interstitial pneumonitis (NSIP). **MATERIALS AND METHODS:** Thin-section CT scans in 24 patients (males=18; mean age=54.6±9.1 years) with UIP and 29 patients (males=9; mean age=47.6±12.2 years) with NSIP were independently reviewed by 2 radiologists; the extent and severity of CT patterns were quantified. Functional indices were correlated with CT features. **RESULTS:** Patients with UIP had more extensive disease on CT ( $p<0.0005$ ) but a lower ratio of ground-glass opacification (GGO) to a reticular



pattern ( $p=0.02$ ); predominant GGO was recorded in 10/29 NSIP patients and 2/24 UIP patients ( $p=0.04$ ). In the combined group of UIP and NSIP patients the per cent predicted DLCO correlated most strongly with disease extent on CT ( $r=-0.78$ ;  $p<0.0005$ ) closely followed by TLC ( $r=-0.63$ ) and FVC ( $r=-0.62$ ). There were no independent functional differences between UIP and NSIP for a given CT disease extent. **CONCLUSION:** In patients with NSIP there is a greater prevalence of GGO on CT, but there is an overlap in appearance with UIP. Despite reported differences in prognosis, there were no independent functional differences between UIP and NSIP.

## 1400-1515

### Studies in Image Analysis Olympian Suite

#### 1400

##### Improved osteoporotic fracture risk analysis from plain radiographic films

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The use of plain radiographs to assess skeletal status regarding osteoporosis has a long and intriguing history. It has been known for a century that the radiolucency of an X-rayed bone reflects the amount of bone present. However, owing to variations in capture conditions bone loss must be 20–40% to be visible to the naked eye. The availability of advanced computerized image analysis has enabled a system to be developed based on the established principles of radiogrammetry and radiogrammetric measurements. In traditional radiogrammetry, the structure of the bone is not included in bone mineral density (BMD) calculations. To improve the accuracy of BMD estimations, the Pronosco X-posure System<sup>®</sup> uses image texture analysis to provide information on the microstructure of bone that is not included in traditional radiogrammetry. 2 bone quality parameters, "porosity" and "striation", are evaluated and used as factors in the BMD calculation. In addition, these parameters are presented as additional information that assist in the accurate prediction of fracture risk. This paper will present a summary of the technique and indicate its performance compared with other available techniques in the assessment of osteoporosis and fracture risk.

#### 1410

##### An evaluation of two methods of true 3D display in surface-rendered 3D CT

<sup>1</sup>C van Tulleken, <sup>1</sup>T Bowles, <sup>1</sup>G Ashdown, <sup>1</sup>D Dobson,  
<sup>2</sup>S R Watt-Smith and <sup>1</sup>S J Golding

<sup>1</sup>Department of Radiology, University of Oxford and  
<sup>2</sup>Department of Maxillofacial Surgery, John Radcliffe Hospital, Oxford OX3 9DU, UK

**PURPOSE:** To compare the clinical utility of 2 methods of true 3D display: flicker-interleaved liquid crystal shutter spectacles (SS) and a virtual reality head-set (VR). **MATERIALS AND METHODS:** Data were taken from 10 patients undergoing CT of facial lesions; data from high resolution images were transferred to a stand-alone workstation and surface rendered for 3D display using in-house software. Further software was written to reduce flicker and optimize resolution. A standard viewing file for each method was created and 18 volunteers viewed the results under standardized conditions. A standardized questionnaire was used to elicit information concerning resolution, depth perception and ease of use. **RESULTS:** Clinically adequate display was obtained with both methods but SS performed better, especially in diagnostic effectiveness. Differences exist between the two techniques relating to ease of use, depth perception and cost. The significance of these is discussed. **CONCLUSION:** SS appear to offer an effective and inexpensive method of true 3D display, although VR has significantly greater development potential.

#### 1420

##### 3D CT volumetric assessment of lung volume and emphysema in silicosis

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Departments of <sup>1</sup>Diagnostic Radiology, <sup>2</sup>Medicine and  
<sup>3</sup>Paediatrics, The University of Hong Kong and <sup>4</sup>Department of Radiology, Queen Mary Hospital, Pokfulam Road, Hong Kong  
**PURPOSE:** To evaluate the relationship between CT-derived 3D lung volumes and physiological indices, and to examine if the 3D

CT-derived emphysema volume was related to lung function impairment in silicosis. **METHODS:** 60 adult men in a steady clinical state for silicosis and without significant concomitant illness were recruited. Non-enhanced volumetric 7 mm collimated sections with 3.5 mm interslice interval from lung apex to base in full inspiration and expiration was performed (Hi-Speed Advantage; GE Medical Systems). Volumetric data were transferred to a graphics workstation (Advantage Windows; GE Medical Systems) and 3D models were reconstructed. Threshold limits of -1024 to -400 HU were applied to inspiratory and expiratory data sets to obtain 3D total lung capacity (TLC) and 3D residual volume (RV), respectively. 3D emphysema volume (EV) was obtained by applying limits of -1024 and -910 HU to the inspiratory data set. Lung function tests included forced vital capacity (FVC), TLC, forced expiratory volume in 1 s (FEV1), FEV1/FVC, RV and carbon monoxide diffusion coefficient (DLCO/VA). **RESULTS:** 8 men were excluded due to inability to perform either lung function tests or CT examination satisfactorily. Data from the remaining 52 men [mean age  $\pm$  SD (65  $\pm$  8.9 years)] were analysed. There was a close agreement between CT-derived and physiological measurements for TLC ( $r=0.61$ ,  $p<0.0001$ ) but not for RV. CT-derived emphysema volume was found to correlate significantly with FEV1 ( $r=0.45$ ,  $p=0.001$ ), FEV1/FVC ratio ( $r=-0.58$ ,  $p=0.0001$ ), RV ( $r=0.49$ ,  $p=0.0003$ ), RV/TLC ratio ( $r=0.46$ ,  $p=0.0008$ ), weakly with TLC ( $r=0.31$ ,  $p=0.03$ ) and DLCO/VA ( $r=-0.37$ ,  $p=0.01$ ), but not with FVC. **CONCLUSION:** 3D CT volumetric assessment of emphysema and lung volumes is useful as an indirect method of functional and lung volume evaluation in silicosis.

#### 1430

##### CT virtual cystoscopy

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**PURPOSE:** To compare the findings at CT virtual cystoscopy with conventional flexible cystoscopy in patients with bladder tumours. **MATERIALS AND METHODS:** 10 patients (9 male, 1 female; mean age 75 years, range 65–83) with haematuria found to have bladder tumour at flexible cystoscopy were included in this study. CT was performed on an IGE Hispeed Advantage scanner. Helical CT of the bladder was obtained immediately and 30 min after the injection of 100 ml of intravenous iohexol 300. Axial 3 mm sections were obtained at a pitch of 1.3 and the images reconstructed at 1 mm. Virtual cystoscopy images were generated using Advantage Windows version 1.2 software on an IGE/Sun Microsystems computer workstation. The radiologist was unaware of the flexible cystoscopy finding. The imaging findings were correlated with those of cystoscopy and histology. **RESULTS:** 19 bladder tumours (all transitional cell carcinoma at histology), 1 carcinoma *in situ* (CIS) and 5 diverticulae were seen at flexible cystoscopy. Virtual cystoscopy identified 18 tumours (sensitivity 95%), 5 diverticulae (sensitivity 100%). A 3 mm tumour seen at flexible cystoscopy was not seen by virtual cystoscopy and the CIS was not identified. There were no false positive findings (specificity 100%). The tumours were correctly located but the relationship to the ureteric orifices could not be assessed at virtual cystoscopy. **CONCLUSION:** CT virtual cystoscopy has high specificity and sensitivity in the detection of bladder tumours but is not able identify CIS or the relationship of the tumours to the ureteric orifices. Further study is required to assess its clinical role.

#### 1440

##### Correlative imaging of renal neoplasms using ultrasound including colour Doppler flow imaging and CT

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**PURPOSE:** To evaluate the imaging features of renal neoplasms by ultrasound (US) and CT and correlate them with operative/histopathological findings. **MATERIAL AND METHODS:** 34 adult patients with renal neoplasm were evaluated by both US and CT. Color Doppler flow imaging (CDFI) was also done in 16 patients. The imaging findings were correlated with histopathological/operative findings in 29 cases. In 5 patients, diagnosis was based on imaging/clinical features alone. **RESULTS:** 34 patients with renal neoplasm were evaluated. These included 26 with renal cell carcinoma (RCC), 5 with angiomyolipoma (AML), 2 with metastases and 1 with Adults Wilms Tumour. Most RCC (26/27) were large in size (> 3 cm) and showed a heterogenous morphology (26/27) with areas of necrosis (all), calcification (12/27), inhomogenous enhancement and presence of collaterals and AV shunting. Additional features included presence of renal vein and inferior vena cava (IVC)

thrombosis (2), retroperitoneal lymphadenopathy (13) and distant metastases (7). Most AML were well defined, <3 cm in size, homogeneously hyperechoic on US and showed a low attenuation area (fat density) on CT. Metastases (from primary lung and nerve sheath tumor) were seen as small discrete masses <3 cm (2/3), hypoechoic and hypodense, non-enhancing on CT. CONCLUSION: It is possible to characterize most renal neoplasms based on image morphology. Addition of CDFI is helpful in evaluation of lesion vasculature, renal vein and IVC. CT is a good modality for overall staging of renal neoplasm.

**1450****An automated method for measuring the volume of extraocular muscles from MR images**

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*University Department of Radiology, Royal Victoria Infirmary, Newcastle upon Tyne NE1 4LP, UK*

**PURPOSE:** Extraocular muscle volume may be a useful indicator of treatment progress in thyroid associated ophthalmopathy. Calculating muscle volume by estimating muscle cross-sectional area on multiple images is time consuming and imprecise, particularly if muscles are outlined manually. This study describes an algorithm for the automated outlining of extraocular muscles from a 3D MRI dataset and assesses its accuracy and reproducibility. **MATERIALS AND METHODS:** The algorithm utilizes dynamic contours: an initial contour placed by the operator is deformed to outline a region. The algorithm automatically propagates the contours throughout the orbit. The algorithm was tested on 2 sets of data. (1) Orbital 3-dimensional magnetization-prepared rapid-acquisition gradient echo (3DMP-RAGE) datasets (TR 15 ms; TE 7 ms; TI 500 ms; TD 100 ms; 1 mm<sup>3</sup> voxels). (2) Computer simulated "orbital" images of similar volumes to extraocular muscles and similar pixel intensities and noise levels to patient images. **RESULTS:** For simulated images, measured volumes averaged 3% smaller than true volume. For images from 1 patient, automated muscle volume estimation was 3% greater than for the manual technique. The coefficient of variation over 5 replicate measurements was 1.5% for the automated and 4% for the manual technique. The automated method produced qualitatively acceptable results on 3 other patients. User-guided automated segmentation took <5 min, compared with 15–20 min for manual segmentation. **CONCLUSION:** The automated algorithm provides a rapid and accurate method for estimating extraocular muscle volumes. The method is of particular value when multiple thin slices are reconstructed from 3D datasets.

**1500****Rapid estimation of intracranial CSF volume with single shot half-Fourier RARE**

R R Sood, M J Graves and D J Lomas  
*Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge CB2 2QQ, UK*

**PURPOSE:** To develop a method for rapid intracranial cerebrospinal fluid (CSF) volume estimation. **MATERIALS AND METHODS:** Rapid estimation of fluid volume can be obtained using heavily  $T_2$  weighted thick slice projection imaging in which the signal form predominantly is retained. The unknown volume can be estimated by including a known volume of fluid (with similar relaxation characteristics to the fluid under investigation). 6 volunteers (age 25–65 years) were studied using the quadrature transmit/receive head coil of a 1.5 T whole body MR system (Signa LX, GEMS). Sagittal images encompassing the entire brain were acquired with a gated (peripherally) single shot half-Fourier RARE (rapid acquisition with relaxation enhancement) with effective TE 892.0 ms and bandwidth 31.2 kHz, modified to obtain a slice thickness of 500 mm. CSF volumes ( $V_{\text{CSF}}$ ) were estimated from the projection images by manually tracing around the intracranial CSF and saline regions and using the ratio of the brightness area product for CSF ( $S_{\text{CSF}}$ ) and the reference volume ( $V_s$ ) of 50 cm<sup>3</sup> saline ( $S_s$ ), where  $V_{\text{CSF}} = (S_{\text{CSF}}/S_s) \times V_s$ . Multiple measurements were performed on each volunteer. **RESULTS:** The mean measured CSF volume over the 7 subjects was 191.2 ± 53.24 ml, in good agreement with other published values. The standard deviation of volumes for all the volunteers was less than 1 ml. **CONCLUSION:** This work indicates that it is possible to estimate intracranial CSF volume in less than 1 s.

**1510****Discussion****1430–1600****MR Angiography—Is It Worth It?****Hall 11b****1430****Invited Review****MR angiography of the peripheral arteries: is it worth it?**

J F M Meaney

*CT Unit, The General Infirmary at Leeds, Leeds LS1 3EX, UK*

- MR angiography (MRA) of the peripheral arteries is well established in clinical practice.
- "Time-of-flight" or "inflow" techniques have long been the cornerstone of MR techniques for evaluation of the peripheral arteries, and are available at all field strengths.
- "Phase contrast" techniques show promise for the rapid evaluation of the peripheries although data in support of this approach are scant.
- Over the last few years, there has been an enormous amount of interest in contrast-enhanced techniques which offer unrivalled advantages in terms of speed of acquisition, freedom from artefacts and signal-to-noise. However, there are some disadvantages including the requirement for a contrast injection rendering the technique minimally invasive; the approach requires the availability of "fast gradients" and has thus only been widely implemented at 1.5 T, and more recently at 1.0 T.
- Moving-bed contrast-enhanced MRA is a rapidly evolving technique that allows comprehensive evaluation of the entire peripheral vasculature. This is achieved by successive imaging over the abdomen, thighs and legs, with rapid table movement between imaging locations during a single bolus of contrast material.
- Developments in coil design, pulse sequence and the availability of improved contrast agents will offer substantial advantages in the future.

**1500****Invited Review****MR angiography of the abdomen**

G M Bongartz and M Boos

*Institute of Diagnostic Radiology, University Basel, Basel CH-4031, Basel, Switzerland*

- Abdominal MR angiography (MRA) requires recent MR techniques with advanced hardware and optimized software to enable ultrafast imaging.
- Contrast-enhanced MRA is far superior to native MRA techniques.
- Application of contrast media must be tailored individually to the patient's requirements.
- Aortic disease, renal artery disease and proximal mesenteric disease are the most important indications for abdominal MRA.
- Portal venous disease requires delayed imaging, optimally in multiple steps acquired consecutively.

**1530****Invited Review****MR angiography in the chest**

M J Lipton

*Department of Radiology, University of Chicago, 5841 South Maryland Avenue, Chicago, IL 60637, USA*

The presentation details the following points concerning MR angiography (MRA) in the chest:

- Arterial lesions: trauma, e.g. aortic dissection; congenital—co-arcuation, right arch, pulmonary hypoplasia; subclavian syndromes; pulmonary embolism.
- Venous lesions: AV malformation of lung; pulmonary venous anomalies; vena caval obstruction.
- Cardiac disease: coronary artery imaging; coronary by-pass patency; role of contrast agents in MRA; future expectations, e.g. interventional angiography, competing modalities and diagnostic trade-offs.

## 1445–1645 Paediatric Radiology—Clinical Practice Tips Hall 5

1445

### Invited Review Imaging of childhood epilepsy

W K Chong

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

The following points will be discussed:

- Identification of potential cause of seizures.
- Exclusion of treatable pathologies.
- Documenting the extent of related brain injury.
- Providing imaging guidance for surgery.
- Monitoring of disease and surgical results.

1510

### Invited Review

#### Postnatal management of antenatal hydronephrosis

J J Fairhurst

Children's X-ray Department, Southampton University Hospitals  
Trust, Tremona Road, Southampton SO16 6YD, UK

Key issues to be discussed will include:

- What constitutes significant fetal pyelectasis and at what gestational age?
- When should postnatal ultrasound be performed?
- Should infants receive prophylactic antibiotics?
- Which children require further imaging and what should it be?
- Potential diagnosis and long-term management options.
- Suggestion of an integrated management pathway.

1535

### Invited Review

#### Ultrasound in diagnosis and management of developmental dysplasia of the infant hip (DDH, formerly CDH)

S T Scott

X-Ray Department, Dorset County Hospital, Dorchester  
DT1 2JY, UK

- Ultrasound is now the established imaging method for detection and staging of developmental dysplasia of the hip (DDH) in the newborn.
- Treatment of DDH is becoming ultrasound based.
- Responsibility for treatment decisions is shifting from clinicians to imaging departments.
- There are 3 stages of treatment of DDH, namely: reduction of displacement; retention of unstable hips; maturation of dysplastic hips.
- The ultrasound method used for diagnosis must be accurate and reproducible so that the appropriate treatment can be given.
- The role of ultrasound in population screening in the UK is still uncertain.

1600

### Invited Review

#### Secrets of a paediatric radiologist—tips on how to make a difficult examination easy!

A Sprigg

Sheffield Children's Hospital, Sheffield S10 2TH, UK

- Work as a team—parents, radiographers, aides/nurses.
- Children are NOT small adults! Adults are big children.
- Prior preparation of both parents and child is vital.
- Understand the specific reason for doing the test.
- Environment is also important.
- Vary your technique with the age and mood of the child.
- Minimize radiation dose by careful (or alternative) technique.

1625

### Discussion

## 1545–1800 Studies in Musculoskeletal Imaging Hall 6

1545

### Diagnostic contribution of the frontal lumbar view in community referred low back pain—1000 patients

L A L Khoo, C Thomas, U Patel, K K Khaw, A Grundy,

R Given-Wilson, C Heron and D D Dundas

St Georges Hospital NHS Trust, London SW17 0QT, UK

The acquisition of 2 lumbar spine views in the investigation of patients with low back pain is routine practice. This prospective study evaluated the diagnostic contribution of the anteroposterior (AP) radiograph. MATERIALS AND METHODS: AP and lateral radiographs were obtained in 1000 patients. Analysis of the radiographs was shared between 6 consultants who recorded the findings on the lateral radiographs first. The AP radiographs were subsequently examined and categorized as "strengthened diagnosis", "no change" and "altered final diagnosis". The per capita financial and radiation costs of the AP radiograph were calculated. RESULTS: To date, 800 patients have been analysed. Clinical indications were: low back pain (85%), neurological symptoms (4%), ?malignancy (1.8%) plus hip, leg or sacroiliac pain or trauma. The AP radiograph was non-contributory in 89% but strengthened diagnosis in 4.8%. In 6% (46) the diagnosis changed: scoliosis (24), facet joint degeneration (4), sacroiliitis (4), transitional vertebrae (4); with single cases of spina bifida occulta and bladder calcification. With neurological symptoms the diagnosis was altered only once (scoliosis). In 14 referrals for ?malignancy the only AP finding was scoliosis in 3. Single cases of a haemangioma, malignancy and infection were seen on both views. CONCLUSION: The AP radiograph altered the diagnosis in 6% and strengthened it in 4.8%. The alteration was considered significant in 4/800 (all sacroiliitis). When relevant clinical information concerning conditions such as ankylosing spondylitis is provided the AP radiograph may be omitted with significant financial and radiation savings without compromising patient care.

1555

### Lumbosacral MRI signs in low back pain: a review of asymptomatic subjects

J H L Henson

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NHS Trust, Princess Margaret Hospital, Swindon SN1 4JU, UK

PURPOSE: The relationship between lumbar spine MR findings and low back pain remains controversial. The purpose of the study is to determine the incidence of abnormalities in the lumbosacral MR of asymptomatic subjects. 50 subjects had sagittal T<sub>2</sub> MR scans of their lumbar spine performed and the images were reported independently by 3 radiologists. The specific signs recorded were disc degeneration, annular tears, disc herniation and end plate changes. RESULTS: Disc protrusion, common, 40%; disc extrusion, uncommon, 6%; disc sequestration, 0%; disc degeneration, common, 50%; posterior annular tear, uncommon, 12%; end plate changes, uncommon, 5%. CONCLUSIONS: All signs are age-related but in the younger (less than 50 years) age group, end plate changes are uncommon in the asymptomatic subject and may be predictive of low back pain.

1605

### The discrepancy between MRI and CT myelography in the investigation of cervical degenerative disease

R J V Bartlett, C Rowland-Hill and C Soh

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UK

PURPOSE: When modern quality MRI is used to investigate cervical radiculopathy there are known to be approximately 10% combined false positive (FP) and false negative (FN) results when compared with an appropriate gold standard. We thus advocate a policy of undertaking CT myelography (CTM) if MRI is inconclusive or inconsistent with clinical features. METHODS: The imaging of 45 such patients was reviewed blindly, randomly and independently by 2 consultant neuroradiologists. Foramina and cord compression were assessed against established criteria. A "best diagnosis" was determined by the 2 observers reviewing all the imaging studies together and reaching a consensus "gold standard". RESULTS: Full results will include statistical analysis of inter and intraobserver variance. For a preliminary analysis of the first 35 cases (140 foramina) CTM was considered the gold standard. In

this analysis, MR manifest a 13% FP and 10% FN rate in comparison with CTM, giving the test a sensitivity of 63% and specificity of 83%. Surprisingly, MRI demonstrated a 12% FN rate for "cord compression" (sensitivity 35%) when compared to CTM. Over 70% of these discrepancies occurred in patients with a congenitally narrow canal. CONCLUSION: Many of these findings relate to the position in which patients are investigated and the marked hyperextension obtained during myelography, however they have important implications for the way in which patients with radiculopathy and even myelopathy are investigated.

**1615****The importance of 24 h follow-up in discography**

P S Rajan, D T Rajan, A Warner and A S Wojcik

Departments of <sup>1</sup>Radiology and <sup>2</sup>Orthopaedics, Hinchingbrooke Health Care NHS Trust, Huntingdon PE18 8NT, Cambridgeshire, UK

**PURPOSE:** In the absence of disc herniation, MRI is unhelpful in locating the level of discogenic pain. Discography allows the detection of gross disc degeneration and is currently the only available reliable test capable of reproducing the patient's symptoms. This prospective study underlines the role of discography and its correlation with disc degeneration on MRI and a 24 h post-discography follow-up to establish the reproduction of pain as a critical part of the result. **METHODS:** 51 discs in 43 patients with chronic low back pain, who had failed conservative treatment, were prospectively evaluated with MRI, discography and CT discography. Those with disc herniations were excluded. Pain at discography was categorized into no pain, discordant pain and immediate/delayed concordant pain. 24 h follow-up was done after discography to detect onset of delayed pain. **RESULTS:** 51 disc levels imaged, 45 were abnormal on MRI and 42 on discography. There was reproduction of concordant pain in 28 (67%) discs, 26 of which showed abnormal MRI signal patterns. Of the 42 degenerate discs on discography, concordant pain was produced at 28 levels (67%). In 14 (50%) of these it was a delayed pain and in 27 (96%) the staging of disc degeneration (Adams) 3 to 5. Surgical outcome comparison of those with immediate and delayed concordant pain showed similar good results. **CONCLUSION:** 24 h post-discography follow-up to detect delayed concordant pain may be significant in the surgical management of patients with discogenic pain. Various theories of discogenic pain production are also discussed.

**1625****Incidence of degenerative hip disease in patients referred with "chronic groin strain"**

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**PURPOSE:** To determine the prevalence of degenerative hip disease in patients referred to a sports medicine clinic with chronic groin strain. **MATERIALS AND METHODS:** In a prospective study of 100 patients referred with chronic groin strain, plain radiographs of the hips were evaluated by a musculoskeletal radiologist and standard hip examination involving physiological passive range of movement was carried out by a senior physiotherapist. **RESULTS:** 7 patients (all men) had significant radiological and clinical findings (mean age 35.2 ± 5.6 years, mean duration of symptoms 25.3 ± 15.7 months). All 7 had consistent passive restrictions in a capsular pattern (medial rotation > flexion > abduction; medial rotation, mean 6.7 ± 7.1°; flexion, mean 88 ± 2°; abduction, mean 37.8 ± 10°). Radiographs revealed 5 bilateral occult slipped upper femoral epiphyses. Of these 5, 3 had unilateral symptoms that correlated with the degenerative hip on the radiograph. Of the other 2, 1 had bilateral symptoms and degenerative changes and the other had a degenerative change on the symptomatic side. Of the remaining 2, 1 had a symptomatic hip which was due to old Perthe's disease. The other had a symptomatic hip associated with degenerative change. There was an occult slip of the contralateral hip. **CONCLUSION:** This study gives preliminary evidence on the prevalence of degenerative hip disease in the physically active adult population presenting with a chronic groin strain. Our study suggests that this group of patients presenting with a reduction in passive range of hip motion should have radiological evaluation for diagnostic and prognostic purposes.

**1635****In vivo quantification of response to therapy in active synovitis using dynamic MRI**

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**PURPOSE:** To correlate clinical remission of synovitis with laboratory parameters and MRI including dynamic augmentation.

**MATERIALS AND METHODS:** 6 patients with active synovitis were studied. All patients were HLA-B27 positive. Assessments included physical examination, measurement of erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), and MRI. 5 doses of pamidronate (60 mg) were given between Day 1 and Day 56, with assessment performed at Days 0 and 84. MRI sequences included T<sub>1</sub> spin echo, T<sub>2</sub> spin echo, STIR (short tau inversion recovery) and dynamic augmentation. The dynamic sequence was performed with simultaneous acquisition of 4 parallel slices at 23 s intervals for 4 min (4 × 12 slices). Gadolinium was administered during the second dynamic slice. MRI evaluation included: quantification of rate of increase (speed) and peak intensity of augmentation in synovium and bone marrow; and assessment of severity of bone marrow oedema, joint effusion, synovial thickness and bone erosion. **RESULTS:** Clinical results: 4 patients with knee symptoms demonstrated complete resolution of swelling, tenderness and effusion. The remaining 2 patients (hip and ankle) showed substantial symptomatic improvement. ESR and CRP decreased in all patients. MRI results: the speed and intensity of synovial augmentation improved significantly ( $p < 0.05$ ) in 4 knees: mean speed (signal intensity per pixel per s) pre treatment 7.89, post treatment 3.61; mean peak pre treatment 980, post treatment 566. Bone marrow augmentation improved significantly ( $p < 0.05$ ) in 2 knees and the hip. Bone marrow oedema improved in 5 cases. The degree of improvement in MRI findings corresponded to clinical and laboratory evidence of therapeutic response. **CONCLUSIONS:** Quantification of augmentation is possible with dynamic MRI, permitting objective *in vivo* assessment of response to therapy. This has implications for future rheumatology clinical trials.

**1645****Activity of ischaemic necrosis of hip, perfusion studies by dynamic enhanced MRI and bone scan**

C F Tan

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**PURPOSE:** To probe for pathophysiology and activity of ischaemic necrosis of hip by perfusion studies with dynamic enhanced (DE) MRI and radionuclide scintigraphy (RS). **METHODS AND MATERIALS:** Paired DE-MRI and SPECT scan (<sup>99m</sup>Tc<sup>m</sup> MDP) were correlated in the investigation of 52 hips in 47 patients with ischaemic necrosis of the hip. **RESULTS:** A perfusion disturbance heralds from early ischaemic necrosis in transient osteoporosis ( $n = 3$ ), minimal focal head lesion ( $n = 5$ ) to late avascular necrosis (AVN) of different stages ( $n = 26$ ). Subclinical ( $n = 7$ ) and inactive ( $n = 12$ ) AVNs demonstrate a negative DE-MRI and RS despite the presence of typical appearance of AVN on MRI (follow-up for 2 to 3 years). **CONCLUSION:** DE-MRI and RS provide tools in the investigation for the perfusion status of ischaemic necrosis of hips. The activity of ischaemic necrosis of hip can be illustrated by reversible conditions such as transient osteoporosis and early ischemia as well as in late AVN. Asymptomatic or quiescent cases are diagnosed which need proper management and surveillance.

**1655****MR arthrography in glenohumeral instability**

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**PURPOSE:** The aim of this study was to evaluate the use of MR arthrography in the assessment of glenohumeral instability following injury. **METHOD:** 56 patients (age range 14–60; mean 32 years) were referred for assessment of presumed traumatic glenohumeral instability, 9 following previous repair. Direct arthrography was performed with instillation of 15–20 ml of dilute gadolinium-chelate into the joint under screen control. The MR examination was performed on 1 of 2 1.5 T magnet systems using a T<sub>1</sub> weighted spin echo sequence with fat suppression in transverse, sagittal and coronal planes through the glenohumeral joint. The ABER (abduction with external rotation) view was performed in 16. **RESULTS:** 29 had a redundant anterior capsule with a Type III configuration, 27 had a Bankart or Bankart variant lesion, 20 had a Hill-Sachs deformity, 10 had rotator cuff tears, 8 had articular cartilage defects, 5 had SLAP tears, 2 had a reversed Bankart lesion and 1 had a ruptured inferior glenohumeral ligament. **CONCLUSION:** Direct MR arthrography is a useful imaging modality in the assessment of post-traumatic glenohumeral instability, particularly in those having undergone previous repair, with a high degree of accuracy.

1705

**MRI of knee in children with osteochondral lesions—stable or unstable?**

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**PURPOSE:** To compare the accuracy of MR and arthroscopic findings in children with osteochondral lesions and to evaluate the use of a standard grading system. **METHOD:** This was a retrospective study of 33 knees in 31 patients with osteochondritis dissecans who underwent MRI followed by arthroscopy. 5 consultant radiologists performed the initial studies. These were reviewed by a 6th radiologist with no knowledge of the previous MR reports or the arthroscopic findings. He applied a grading system and this was later compared with the arthroscopic findings. **RESULTS:** The initial MR findings correlated well with arthroscopic findings in 15 out of 33 knees (45.5% accuracy). Re-evaluation of the MR with grading correlated with arthroscopic findings in 28 out of 33 knees (84.5% accuracy). **CONCLUSION:** In children, plain radiographs are diagnostic and MRI is used to decide whether the lesion is stable or unstable. An unstable lesion warrants arthroscopy but if a lesion has been reported as stable it prevents unnecessary arthroscopy. It will be helpful if a standard system of reporting is adopted using a grading system. This requires regular liaison between the radiologists and the orthopaedic team.

1715

**CT scanning in spinal trauma—no need to remove patients from a scoop stretcher prior to imaging**

P Fielding, E Morris and D Lloyd  
 University Hospital of Wales, Cardiff

**PURPOSE:** Spiral CT scanning provides valuable information in the assessment of patients with suspected spinal injuries. Aluminium orthopaedic scoop stretchers are widely used in transferring patients with suspected injuries. The purpose of this study was first to assess whether the spine could be adequately imaged without removing the patient from the scoop. Second, we aimed to survey UK hospitals to assess their practice for transferring spinal trauma patients onto the CT table. **MATERIALS AND METHODS:** All imaging was performed on an IGE HiSpeed CTi scanner. A body phantom was scanned both on and off the scoop. A series of 10 patients was imaged on spinal scoops. Following this, UK hospitals seeing more than 75 000 new A&E referrals each year were contacted in a telephone survey. Details were recorded regarding how spinal injury patients are transferred onto the CT scanner table as well as whether or not the stretcher was removed prior to imaging. **RESULTS:** Satisfactory image quality was obtained when imaging the body phantom on the scoop stretcher. A series of 10 patients has been satisfactorily imaged on the scoop. In a telephone survey of 18 UK hospitals, 4 routinely used spinal scoop stretchers for transferring patients with suspected spinal injuries. Of these hospitals, 3 routinely remove the patient from the scoop prior to imaging. **CONCLUSIONS:** Patients with spinal trauma can be adequately scanned without removing them from an aluminium scoop stretcher. This is safer for the patient and saves time.

1725

**Scaphoid radiography for injury—is a routine second radiograph always necessary?**

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 Departments of <sup>1</sup>Emergency Medicine and <sup>2</sup>Radiology,  
 Kidderminster General Hospital, Kidderminster, UK

**PURPOSE:** To determine the frequency of scaphoid fractures on routine follow-up second radiographs where the initial radiograph showed no fracture. **METHOD:** All scaphoid radiographs taken during a 2 year period in our Accident & Emergency (A&E) Department were identified and their radiological reports reviewed. The second reports for all the negative first reports were reviewed to identify any positive reports. The A&E notes and radiographs of any such patients were reviewed to assess the clinical and radiographic features. **RESULTS:** 255 patients were identified who had scaphoid radiographs for injury. 249 had follow-up radiographs in 10–14 days. 6 patients had a single radiograph only. 9 initial reports were equivocal. 144 (57%) patients had no fracture on both radiographs. 83 (33%) had a fracture on initial radiograph confirmed on subsequent radiograph. 1 (0.4%) patient initially reported as negative and a fracture reported on second radiograph. However, review of the radiograph for this study with a previous radiograph suggested that no fracture had been present. The patient had no clinical signs of fracture on review and had not been treated in continued plaster. **CONCLUSION:** The second radiograph is unnecessary routine. We have now altered our policy, and only obtain a second radiograph if there is radiological uncertainty on initial radiograph

or if there are any continuing clinical signs or symptoms suggestive of fracture.

1735

**When is tenderness in the anatomical snuff box not a scaphoid fracture?**

A Page, F Haigh and K Johnson  
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 Birmingham B4 6NH, UK

**PURPOSE:** The classical sign of tenderness in the anatomical snuff box following a fall on the outstretched hand is not specific for scaphoid injury. In children, the history and accuracy of the clinical signs are less reliable. The routine use of MRI in the management of suspected scaphoid fractures has led to an increased detection of other injuries mimicking scaphoid injury. **METHOD:** 65 children with suspected scaphoid injury underwent wrist MRI. As well as fractured scaphoids and normal examinations, a group of children with other injuries was identified. **RESULTS:** Bony injuries demonstrated included fractured capitate (2), fractured lunate (1), bruised trapezium (1), bruised pisiform (1) and fractured distal radii (3). Diffuse soft tissue injuries with swelling and oedema were also seen and 4 children had ganglion cysts. **CONCLUSION:** Pain and swelling in the anatomical snuff box is a non-specific indicator of scaphoid fracture. Plain radiographs may confirm scaphoid or other bony injury but are not as sensitive as MRI. MRI is recommended as the gold standard in the management of suspected scaphoid injury in children.

1745

**MRI in the management of scaphoid injuries in skeletally immature patients**

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 Birmingham B4 6NH, UK

**PURPOSE:** The scaphoid is the most commonly fractured carpal bone, but excluding a scaphoid fracture with plain radiographs is difficult. The consequences of a missed fracture include non-union, avascular necrosis and early osteoarthritis, so many patients with suspected injury are treated even though no significant bony injury is present. MRI has been used in adults, but there have been few studies in children of the use of MRI to exclude scaphoid injury. **METHOD:** 65 children with clinically suspected scaphoid injury had an MRI scan performed within 10 days (mean 7 days) of initial trauma. The results of the MRI were used to determine clinical management. **RESULTS:** 37 of 66 (56%) MRI examinations (1 child had 2 examinations) were normal leading to early mobilization and discharge from care. In 29 examinations scaphoid fracture and/or other injury to the wrist joint was identified and appropriate treatment offered. **CONCLUSION:** MRI of suspected acute scaphoid injuries significantly alters management with those patients having a normal scan avoiding prolonged immobilization, further radiographs and clinic attendances. Children with abnormal scans have early confirmation of their injuries leading to appropriate management.

1755

**Discussion**

1545–1745  
**The Role of Imaging in Cancer Diagnosis**  
 Hall 8

1545

**Invited Review**  
**Role of imaging in cancer diagnosis**

J A Lawrance  
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 Manchester M20 2BX, UK

- Screening.
- Initial diagnosis.
- Staging.
- Assessment of response to treatment.
- Problem solving.
- Challenges and developments.

1630

**Invited Review****Imaging of bony metastases—nuclear medicine and other modalities**

P Facey

*University Hospital of Wales, Radiology Service Centre, Cardiff CF4 4XW, UK*

- Bone scintigraphy was first used in the early 1960s.
- Bone metastases are frequently detected in patients with breast or prostate primary cancers. More than 85% have multiple lesions.
- Bone radiography (plain films) has been recognized as relatively insensitive in detecting bony metastases.
- Skeletal blood flow influences local uptake of the radiopharmaceutical (diphosphonate).
- Uptake of diphosphonate is linked to osteoblastic activity. Lesions within the skeleton, in most cases, will excite a local osteoblastic response and an increase in vascularity. Examples of lesions that will give a photopenic appearance are myeloma and lymphoma primaries, and kidney and breast secondaries.
- The use of other imaging modalities such as plain film radiography, CT and MRI will aid bone scintigraphy in diagnosing bone metastases.

1655

**Invited Review****Imaging chest metastatic disease**

V A Fone

*Directorate of Imaging, Royal Brompton & Harefield NHS Trust, London SW3 6NP, UK*

- Manifestations of pulmonary metastases: haematogenous; lymphangitis carcinomatosa; endobronchial metastases; tumour embolization.
- Detection of pulmonary nodules: physical characteristics; method of imaging the observer.
- Current imaging: plain radiography; CT.
- Advantages of CT: causes of false positive and false negative CT scans.
- Imaging pulmonary nodules: current problems; possible solutions: MRI; radionuclide imaging.

1720

**Invited Review****Metastases in the abdominal organs**

P I Ignotus

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- Metastases within the abdominal organs are very common.
- A knowledge of the likely pathways and sites of spread helps for interpretation of images.
- A systematic approach is needed to ensure that all the organs are surveyed, including soft tissues and spine as well as lymph nodes, solid organs and lung bases.
- CT, ultrasound and MRI have complementary roles.
- (Adeno) carcinoma: although lymph node metastases are common, they are frequently underestimated on ultrasound and CT. Oesophagus, stomach, colorectal, pancreatic, bronchial and breast carcinomas frequently give rise to hepatic metastases. Carcinoma of the ovary often gives diffuse peritoneal disease with ascites. Renal carcinoma frequently involves the renal vein and IVC as well as regional lymph nodes.
- Lymphoma: there are slightly different patterns for Hodgkin's disease and non-Hodgkin's lymphoma. The spleen and lymph nodes need to be carefully evaluated as well as the other solid organs.

1545–1615

**Ultrasound Safety**

Hall 11a

1545

**Invited Review****Safety issues in diagnostic and therapeutic ultrasound**

G R ter Haar

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- There has always been a widespread belief among those using ultrasound that it is a safe technique that can be used without concern for safety.

• As ultrasonic imaging improves, and new techniques and applications emerge, it is important that its safety is reviewed. This is especially relevant in the light of the general trend for ultrasound scanners to use increasingly high pulse pressure amplitudes.

• There is now convincing evidence that ultrasound beams used clinically, especially for Doppler techniques, can induce biologically significant temperature rises in tissue, especially where bone is exposed. This must be taken into account when considering the risks associated with a given exposure.

• A number of non-thermal mechanisms are known to cause biological effects in laboratory systems. It seems unlikely that acoustic cavitation will be induced by diagnostic exposures *in vivo* in humans, but effects due to the interaction of ultrasound with existing gas pockets, *e.g.* the alveoli in the lung, have been observed in a number of experimental animal models.

• Epidemiological studies of human exposure to ultrasound have largely been unable to demonstrate an association between ultrasound exposure and the endpoints studied. Questions remain, however, about the apparent increase in incidence of left-handedness in boys exposed to ultrasound *in utero*.

• Safety related information is now available in real time to the user during an ultrasound examination. Many modern instruments are now required to display indices related to the probability of producing either thermally or mechanically induced biological effects. This display can be used to make judgements about the risk of a given ultrasound exposure.

1630–1745

**Radiation Protection**

Hall 11a

1630

**Experimental simulation of A-bomb electron/gamma spectra in the hospital laboratory for radiobiological benchmarking**

<sup>1</sup>J E Pattison, <sup>2</sup>R P Hugtenburg, <sup>3</sup>M W Charles and <sup>2,3</sup>A H Beddoe  
*<sup>1</sup>University of South Australia, Adelaide, Australia, <sup>2</sup>Queen Elizabeth Hospital and <sup>3</sup>University of Birmingham, Birmingham, UK*

Improved radiation protection of humans requires a better understanding of the mechanisms of radiation action and accurate estimates of radiation risk for both internal and external radiations. The Japanese atomic bomb survivors represent the most important source of human data on the late carcinogenic effects of ionizing radiation. Current risk estimates for low linear energy transfer (LET) radiations used for the protection of radiation workers and the public, and for patient exposures from medical X-rays, are based mainly on the epidemiological analyses of these survivors. A fundamental assumption implicit in the use of radiation risk estimates derived from the atomic bomb survivor data is that the atomic bomb  $\gamma$ -rays are of equal radiobiological effectiveness (RBE) to the lower energy low LET radiations commonly encountered in the workplace. However, evidence is mounting from cell radiobiology studies that there is an inverse relationship between energy and biological effectiveness. A collaborative European series of radiobiology experiments is planned to produce a consistent data set of RBE values for various end-points, over a wide range of photon energies. These should help to clarify the magnitude of the variation of RBE with LET for low LET radiations and provide basic input for the formulation of revised international recommendations. The present study was undertaken to investigate whether it would be possible to use hospital radiotherapy/radiobiology equipment to mimic the spectra encountered in Hiroshima and Nagasaki. The estimated total  $\gamma$ -ray fluence spectra (including both prompt and delayed photons) at both Hiroshima and Nagasaki, for distances of 500, 1000, 1500 and 2000 m have been evaluated using DS86 data and previously unpublished information for delayed gamma radiations which constitute the major contribution to survivor doses. Monte Carlo (EGS4) simulations were performed to transport these photons through the body in order to investigate the variation in photon spectra for various body organs. The electron spectra obtained for these fluences at, for example, the colon, have been matched with combinations of electron spectra produced by linear accelerators to within 5% SD. These will, for the first time, enable a direct link to be made between radiobiological studies (for example, on mammography spectra) and the epidemiological data from Japan which currently underpin radiation risk estimates.

1640

**Scatter fraction and quality in diagnostic radiology: variation with angle**<sup>1</sup>D G Sutton, <sup>2</sup>J R Williams and <sup>1</sup>A J Reilly<sup>1</sup>Department of Medical Physics, Ninewells Hospital & Medical School, Dundee DD1 9SY and <sup>2</sup>Department of Medical Physics, Western General Hospital, Edinburgh, UK

**PURPOSE:** An implicit requirement for a cost effective approach to the design of radiation shielding for diagnostic radiography rooms is adequate knowledge of the characteristics of the primary, secondary and leakage radiations. Recent work [1] has challenged the assumptions on scattered radiation made in the revision to the publication NCRP 49 [2]. This work addresses the contradiction between the 2 very different sets of results. **METHOD:** Measurements of scatter fraction and quality were made using a RANDO phantom. Scatter fraction was evaluated at accelerating potentials of 50, 80 and 110 kVp at scattering angles of 30, 60, 90, 120 and 150°. Quality was measured using HVL in aluminium. Monte Carlo simulations using MCNP code and parallel virtual machine technology were used to validate and extend the experimental work. The spectra used in the Monte Carlo simulations were generated using IPEM Report 78 and the patient was modelled as an ellipse. Scatter spectra, fraction and quality were simulated. **RESULTS AND DISCUSSION:** The results obtained here are compared with those obtained from Refs [1] and [2] and with other published data on the quality of scattered radiation [3]. The assumptions made in the revision of NCRP 49 are questioned. Some of the implications for the design of shielding in radiography rooms are discussed. **REFERENCES:** [1] Williams JR. Scatter dose estimation based on dose-area product and the specification of radiation barriers. *Br J Radiol* 1996;69:1032-7. [2] Simpkin DJ, Dixon RL. Secondary shielding barriers for diagnostic X-ray facilities: scatter and leakage revisited. *Health Physics* 1998;74:350-65. [3] Marshall NW, Faulkner K, Warren H. Measured scattered X-ray energy spectra for simulated irradiation geometries in diagnostic radiology. *Med Phys* 1996;23:1271-6.

1650

**The impact of local reference dose levels at Nottingham City Hospital**

A T Rogers, J Poveda and M E Holloway

Department of Medical Physics, Nottingham City Hospital NHS Trust, Nottingham NG5 1PB, UK

The concept of local reference dose levels (LRDLs) currently being debated within the UK stems from the Consultation Paper issued by the Department of Health regarding implementation of the EU Medical Exposures Directive. In the Consultation Paper, the Department of Health proposes that Trusts develop their own LRDLs to reflect local practice in the context of developing national reference dose levels. Although there seems to be a consensus that LRDLs cannot be applied to individual patients *per se*, there is as yet no consensus about how to use the concept of LRDLs in a positive way. The National Radiological Protection Board (NRPB) have proposed the idea of an "Achievable Dose". The authors, however, have taken a "Target Dose" approach to LRDLs. This presentation will outline the historical development of the "Target Dose" concept at Nottingham City Hospital. This has been enabled by the development of a unique patient dose logging network which utilizes a dose-area product meter network with barcode readers. The relative merits and drawbacks of the data collection and analysis, and also of the concept itself, will be discussed. Our system of "Target Dose" requires a monthly comparison of median dose-area product with the "Target" value for all common examinations. Depending upon locally set trigger mechanisms, an audit of radiographic processes is initiated, taking into account radiographic technique, dose and image quality. Early experiences of various trigger mechanisms will be presented along with results from audits pertaining to film-screen and computed radiography. Finally, a suggested role for LRDLs will be given.

1700

**Dose improvements by optimization and automatic exposure control harmonization in computed radiography and film/screen radiography**<sup>1</sup>J J Poveda, <sup>1</sup>A T Rogers and <sup>2</sup>W LeeDepartments of <sup>1</sup>Medical Physics and <sup>2</sup>Radiology, Nottingham City Hospital, Nottingham NG5 1PB, UK

Under new legislation, optimization of radiological procedures is an explicit requirement. In departments with a range of radiographic

imaging media, e.g. film/screen and computed radiography (CR), it is important to ensure that the exposure from each X-ray machine is optimized to its imaging medium. Exposures will then be harmonized between machines to maintain the required standard of image quality and keep patient doses low. It was the purpose of this study to quantify the difference between patient doses using CR and film/screen receptors, investigate causes and use the results to optimize and harmonize the exposures. Patient dose data were collected for 1 month from the networked dose-area product (DAP) meters attached to every X-ray unit in the Radiology department. Patient exposures used a fast film/screen cassette or a Fuji CR phosphor imaging plate. There was no significant difference (at 95% confidence) in the mean DAP doses between chest examinations using CR and film/screen in the same room. Also, chest DAP doses in one CR room were comparable with those received in film/screen rooms. However, there was a significant difference in mean CR and film/screen DAP doses recorded for abdominal and lumbar spine examinations. This suggests that differences in doses between CR and film/screen rooms may be dependent on the automatic exposure control (AEC) device, which has been optimized for the film/screen rooms but not for the CR rooms, and not dependent on the imaging modality. The results of comparison of doses will be presented together with methods of optimization, harmonization of AEC exposures and subsequent dose reduction.

1710

**The use of ionizing radiation in paediatric intensive care and neonatal units**

C Proctor, A L Platt, J Pilcher, J Kyriou, M Fitzgerald and E J Adam

The Radiological Protection Centre and Diagnostic Radiology, St George's Hospital, Blackshaw Road, London SW17 0QT, UK

**PURPOSE:** The children admitted to the paediatric intensive care and neonatal units are very ill and often have several radiographs within the first few months of their lives. This project aimed to assess the total effective dose to these patients during their stay in hospital. Radiographic practice was assessed along with the requesting procedure and clinical usefulness of each radiograph. **MATERIALS AND METHODS:** Patient doses were calculated using in-house software based on NRPB-R279 data; thermoluminescent dosimeter (TLD) measurements were also made using phantoms. A request form was designed to enable the audit of request procedures and resultant clinical information. Radiographic technique and image criteria given in the "Guidelines on Best Practice in the X-ray Imaging of Children" were used to assess the films. **RESULTS:** 153 patients ageing from 0 to 1 years were involved in the study, amassing 690 radiographic examinations, the vast majority of which were plain chest radiographs. A small number of patients also underwent fluoroscopic and CT examinations. The maximum cumulative effective dose for plain film examinations was in the order of 0.3 mSv. For patients undergoing fluoroscopy as well as plain film radiography, the maximum cumulative effective dose was approximately 2 mSv and for those having head CT scans it was as high as 14 mSv. **CONCLUSION:** Reassurance can be given that low patient doses and staff exposure can be achieved with good radiographic practice; however, the use of radiation on these units must be constantly justified in order to ensure that the ALARP (as low as reasonably practicable) principle is followed.

1720

**Patient dose optimization in CT scanography**<sup>1</sup>A R Lecomber, <sup>2</sup>K O'Neil, <sup>3</sup>T Harman and <sup>2</sup>D Tennant<sup>1</sup>Regional Medical Physics Department, Newcastle General Hospital, Newcastle upon Tyne NE4 6BE, <sup>2</sup>X-Ray Department, North Tyneside General Hospital, North Tyneside NE29 8NH and <sup>3</sup>Philips Medical Systems, (Service) Newcastle, c/o Philips Components Durham, Durham DH1 1TG, UK

**PURPOSE:** CT scanograms are routinely performed at the start of CT procedures for the purposes of selecting cross-sectional imaging planes. Their use as a low-dose alternative to film/screen radiography has also been demonstrated for measurement of leg lengths and angles prior to prosthetic surgery, although patient dose is limited by machine selectable factors. We set out to determine whether further dose reductions are possible without compromising the necessary information content of the image, simply by placing additional filtration between the X-ray source and the patient. **MATERIALS AND METHODS:** An ionization chamber was used to measure CT scanner output as the X-ray beam of a Philips

Tomoscan operating at its minimum available parameters (100 kVp and 50 mA) was filtered using various thicknesses of aluminium and copper. A Rando anthropomorphic phantom was then scanned under the same set of conditions. The quality of the image was assessed in terms of suitability for its clinical purpose. Patient risk was quantified by loading the phantom with thermoluminescent dosimeters and scanning it at the filtration that gave the lowest exposure consistent with acceptable image quality. This model enabled us to calculate effective dose. **RESULTS AND CONCLUSIONS:** Images of the phantom acquired under various beam qualities are presented, together with the associated estimates of effective dose. The images obtained demonstrate that heavy filtration of the X-ray beam allows for substantial dose reduction in CT scanography, while still permitting satisfactory visualization of bony landmarks.

**1730****Extremity doses in nuclear medicine: demonstrating compliance with the skin dose limit?**

C J Martin and M Whitby

*Department of Clinical Physics and Bio-Engineering, North Glasgow Hospitals University NHS Trust, Glasgow G12 8SQ, UK*

**PURPOSE:** The Ionising Radiation Regulations 2000 require the dose limit for the skin to be applied to an area of 1 cm<sup>2</sup>. If this requirement is to be fulfilled, parts of workers' hands that are likely to receive the highest doses must be identified for regular assessment and a method of monitoring established to demonstrate compliance. **METHOD:** An Advanced Extremity Gamma Instrumentation System (AEGIS) employing a small semiconductor probe has been used, together with thermoluminescent dosimeters (TLDs) to study finger doses of technical staff working in a radionuclide dispensary and in nuclear medicine departments. Relative doses to different parts of the hand have been evaluated during a variety of manipulations from monitoring, observation and simulation. **RESULTS:** Doses to the tip of the index finger were highest in most circumstances. Dosimeters worn at the finger tip may impede manipulations and ring dosimeters worn at the base of the finger often provide a more convenient tool. If ratios between doses to the tip and base of the finger could be established, these would allow ring dosimeters to be used for evaluating the dose to the tip. Preliminary measurements show that ratios between doses to the tip and the base of the index finger are typically 2.0–2.5 for dispensing with an unshielded syringe and 1.2–1.6 when a syringe shield is used. **CONCLUSION:** Correction factors could be applied to extremity dose measurements made using ring dosimeters to assess doses to the finger tip, but the factors may need to be tailored to the technique adopted.

**1740****Discussion****1700–1745****Luminary Lecture 2****Hall 5****1700****Invited Review****Acute pulmonary embolism: state-of-the-art imaging**

N L Müller

*Department of Radiology, Vancouver General Hospital and University of British Columbia, Vancouver, BC, Canada*

The aim of this presentation is to discuss the indications and limitations of the various imaging techniques used in the diagnosis of acute pulmonary embolism (PE) and to recommend a diagnostic imaging algorithm. The emphasis of the lecture will be on spiral (helical) CT. For many years, ventilation-perfusion (V/Q) scintigraphy has been the main imaging modality used in the evaluation of patients with suspected PE. A high probability V/Q scan provides sufficient certainty to confirm the diagnosis of PE while a normal or near normal scan reliably excludes the diagnosis. However, in the PIOPED (Prospective Investigation of Pulmonary Embolism Diagnosis) study, indeterminate scans present in 39% (364 of 931) of patients showed a 30% incidence of PE, and low probability scans seen in 34% (312 of 931) of patients showed a 14% incidence. Based on these data the authors concluded that indeterminate and low probability lung scans (*i.e.* two-thirds of V/Q scans in the PIOPED study) were not useful in establishing or excluding PE. Currently, pulmonary angiography is considered to be the gold standard for diagnosing PE. Pulmonary angiography allows direct visualization of the pulmonary arterial tree and detection of filling defects, typical for PE. However, it is an invasive test with associated morbidity (6%) and mortality (0.5%) and is underutilized. It has been estimated that even in academic centers only 12–14% of patients with non-diagnostic V/Q scan undergo pulmonary angiography. The introduction of spiral CT technology has made it possible to image the entire chest in a short period of time and analysis of the pulmonary arteries during the peak of contrast enhancement. Several studies have shown a high sensitivity and specificity for spiral CT in the diagnosis of PE. Characteristic findings of acute PE on spiral CT are: (1) partial central or marginal filling defect surrounded by a thin rim of contrast material or (2) complete filling defect with obstruction of an entire vessel section. Optimal assessment of the pulmonary vessels on spiral CT requires careful attention to several parameters including scan collimation, imaging volume and contrast enhancement. A number of technical, anatomical and patient-related pitfalls may lead to misinterpretation of the CT images. Technical failures occur in 1–5% of scans, and are usually due to motion artefacts in dyspneic patients or insufficient vascular enhancement.



Tuesday 23 May

0830-1030

## Advanced Imaging of the Lumbar Spine Hall 5

0830

### Invited Review Spinal stenosis

I McCall

*Department of Radiology, RJA Orthopaedic Hospital, Oswestry, Shropshire SY10 1AG, UK*

- The canal dimension may be reduced as a developmental feature or due to degenerative changes in the motion segment. Spondylolisthesis may increase this effect.
- The effect of degeneration changes may be exacerbated by a trefoil canal shape.
- Spinal stenosis may be central, subarticular or foraminal.
- Chronic nerve root pain with claudication symptoms result from lumbar stenosis.
- Long tract signs may be caused by cervical or thoracic myelopathy.
- MRI is the investigation of choice but CT myelography with dynamic studies in flexion and extension may be helpful in problematic cases.
- Long-standing stenosis may result in chronic nerve root fibrosis or persistent myelomalacia.

0855

### Invited Review Disc disease

J P R Jenkins

*Department of Clinical Radiology, Manchester Royal Infirmary, Oxford Road, Manchester M13 9WL, UK*

The following points will be discussed:

- The importance of the correct classification of disc herniations and their MR appearance: annular bulge/tear; protrusion/prolapse; extrusion; sequestered fragment.
- Correct determination of the position of disc herniations: centrolateral; posterolateral; lateral (intraforaminal); far lateral; anterolateral; central (Schmorl's node).
- Disc degeneration begins at the second/third decade of life, being earlier in males than females.
- Discogenic unit with associated vertebral marrow signal change.
- Post-operative scar/epidural fibrosis vs recurrent disc herniation—so called "failed back syndrome".
- Acute inflammatory degenerative discogenic disease vs infective discitis.

0920

### Invited Review

#### Spondylolysis and spondylolisthesis

B J Preston

*Department of Radiology, University Hospital, Queen's Medical Centre, Nottingham NG7 2UH, UK*

- Spondylolisthesis 5 types: dysplastic; isthmic; degenerative; traumatic; pathological.
- Isthmic spondylolisthesis: the lesion is in the pars interarticularis and is a spondylolysis due to a stress fracture. Elongated but intact pars and acute fractures are less common. Spondylolyses are bilateral/unilateral, complete/incomplete, acute/chronic.
- Symptoms of spondylolyses: back pain, worse with activity and better with rest; leg/root pain is not usually a major feature. If symptomatic, we need to know whether the spondylolysis is causing all the symptoms or some of the symptoms. It may be asymptomatic.
- Investigate on a need to know basis.
- Plain films can be useful for diagnosing spondylolyses. However, they may not appear on plain films because the films are in the wrong plane, they may be incomplete, or they may have a small gap or overlying structures. Oblique views are used less and less.
- Planar bone scanning (PBS) and single photon emission tomography (SPET) scanning—SPET is better with a greatly increased sensitivity for detecting spondylolyses but it will not show every defect.
- CT: superior to plain film and SPET scanning. Employ a reverse angle on the gantry, use thin sections and obtain reconstructions. A spondylolysis is recognized by an incomplete ring at the level of pedicles, a defect in the approximate coronal plane that is

straight with irregular margins and may have associated bone fragmentation.

- MRI: not so good for detecting spondylolyses as CT but improvements are being made. MRI is very useful for detecting associated disc degeneration and root entrapment.
- Assessment of a painful spondylolysis: SPET, lysis infiltration and MRI.

0945

### Invited Review Spinal dysraphism

N Evans

*Imaging Department, The Royal Orthopaedic Hospital, Bristol Road, South Northfield, Birmingham B31 2AP, UK*

- A brief description of spinal embryology and its role in the creation of spinal dysraphic change.
- The historic role of imaging in demonstration of spinal dysraphic change, including plain films and myelography.
- The role of MRI in the demonstration of spinal dysraphic change.
- Various examples of spinal dysraphic change demonstrated primarily by MRI.

1010

### Discussion

0830-0945

## Studies in Interventional Techniques Hall 6

0830

### Survey of the use of sedation and analgesia during percutaneous nephrostomy insertion

L M Freeman, A J Bradley and S M Reaney

*Department of Diagnostic Radiology, South Manchester University Hospital, Manchester M20 2LR, UK*

**PURPOSE:** An opportunity recently arose in our department to alter practice during percutaneous nephrostomy insertion (PCN). It was felt that using sedation and systemic analgesia would be beneficial to patients, as previously sedation was rarely used. General guidelines regarding the use of sedation during radiological procedures were produced by a Joint Working Party of the Royal Colleges of Radiologists and Anaesthetists in 1992, but there is relatively little literature regarding its use specifically during PCN. **METHOD:** Before changing departmental practice, we undertook a postal survey of a wide spectrum of UK radiologists regarding their current practice and opinions. **RESULTS:** 152 replies were received. Sedation was used in the majority of cases by 52% of radiologists, analgesia by 51%. 10% never use sedation, 16% never use analgesia. Only 28% of departments had an agreed drug regimen for sedation. Sedation was felt to be both safe and effective by 86%, but only 56% felt it was preferable to not using sedation. 60% starve the patient prior to PCN. 56% consider the presence of a trained nurse essential, 73% routinely administer oxygen and 89% monitor with pulse oximetry. 12% reported complications related to the use of sedation. **CONCLUSION:** Compared to previous literature fewer radiologists routinely use sedation, but the use of supplemental oxygen and pulse oximetry has increased. The risk of complication from sedation may be higher than the risk of the procedure itself and this should be considered when obtaining consent.

0840

### Percutaneous fluoroscopic gastrojejunostomy with single puncture and single anchor gastropexy

K Choji and A Odurny

*Department of Radiology, Southampton General Hospital, Southampton SO16 6YD, UK*

**PURPOSE:** To evaluate the safety and efficacy of percutaneous fluoroscopically directed gastrojejunostomy catheter placement with single puncture and single anchor gastropexy (SSPFG) for enteral feeding. **METHODS:** A retrospective review of SSPFG in 101 consecutive cases of 98 patients was undertaken. In all patients, placement was attempted with gastropexy with a single anchor fixing the anterior gastric wall against the abdominal wall delivered via a single puncture. Placement of a 10.2 French or 12 French catheter was then accomplished with the Seldinger technique. The frequency of major and minor complications was assessed. **RESULTS:** The success rate for catheter placement was 94% for gastrojejunostomy tubes and 98% for both gastrojejunostomy and gastrostomy tubes. In 2 patients (2.0%), colonic and hepatic interposition precluded

TUESDAY

safe gastric puncture and the procedure was abandoned; in another 4, due to colonic interposition giving limited gastric access, a gastrostomy tube only was inserted. In 3 patients, two separate procedures were performed. Non-routine catheter replacement was necessary in 43 instances in 23%. 51% of these were attributed to tube displacement. There were 3 major and 51 minor complications. The 30 day mortality rate was 11% with a 30 day procedure-related mortality of 1%; peritonitis being contributory to death in 1 patient. 5 patients required modification of the standard feeding regime. 2 patients were unable to tolerate enteral feeding. **CONCLUSION:** SSPFG is a safe procedure and the results are favourably comparable to those with gastrostomy and gastrojejunostomy with gastropepy with multiple puncture.

#### 0850

##### **Tumour seeding—an inevitable or avoidable legacy of biopsy of colorectal liver metastases?**

G R Plant, T G John and M Rees

*Hepatobiliary Unit, The North Hampshire Hospital, Basingstoke, Hampshire, UK*

**PURPOSE:** To evaluate the incidence and pattern of malignant seeding following liver biopsy in a consecutive series of patients with colorectal liver metastases deemed suitable for potentially curative hepatic resection. **MATERIALS AND METHODS:** Between November 1986 and November 1998, 308 consecutive patients deemed suitable for potentially curative hepatic resections for colorectal liver metastases (including 27 patients having repeat resections (8.8%)) were evaluated for the presence of additional deposits at the time of surgery. Evidence of track seeding was sought on the pre-operative computed aortoportogram, at laparotomy and in selected patients at laparoscopy prior to laparotomy. Only lesions along a known percutaneous track or in adherent omentum adjacent to a surgical biopsy site were accepted as true seeding. The policy in our unit is to avoid biopsy where possible, as we believe that the presence of seeding may change the operation from being potentially curative to being palliative. The majority of these patients were referred to this unit after their biopsy. **RESULTS:** Out of the total of 308 patients, 54 (18%) had had biopsy or needling of the tumour. Of these, evidence of tumour spread was seen in 11 (20%). 5 out of 20 patients who had percutaneous biopsy had deposits (25%). 5 of 34 patients who had intraoperative biopsy had deposits (15%) and 1 who had received 4 percutaneous laser treatments was affected. Of these 11 patients, 9 had hepatic resection together with locoregional resection and 2 had delayed resection of their additional deposits. 5 patients died from carcinomatosis between 2 and 51 months. Overall for the whole series of patients, those deemed potentially curative had a 5 year survival of 33%, for those deemed palliative it was 0%. **CONCLUSIONS:** Malignant seeding due to violation of colorectal liver metastases occurs more often than is recognized. Biopsy of suspected and potentially resectable colorectal liver metastases rarely assists in patient management and should be discouraged.

#### 0900

##### **Radiology day case ultrasound-guided liver biopsy unit—an initial experience**

R T Dhawan

*Department of Radiology, King's College Hospital, 43D Belsize Square, London, UK*

**PURPOSE:** A prospective study to determine the clinical utility, safety and feasibility of a radiology day case unit (RDCU) for ultrasound (US)-guided liver biopsy. **MATERIALS AND METHODS:** Patients assessed by the Liver Unit, as suitable for day case biopsy, were seen by a radiology specialist nurse (RSN). The RSNs were responsible for patient care during and after the procedure and for follow-up at 24 h. All biopsies were performed by a radiologist, using a 16G needle, following site selection under US guidance. The incidence of complications and US findings at 5–7 h after the biopsy were recorded. Patient acceptability of the RDCU was assessed by a random survey using a questionnaire of patient satisfaction at the time of discharge. **RESULTS:** 125 patients underwent US-guided liver biopsies over a 7 month period. All specimens obtained were satisfactory for histological analysis. 30 patients complained of local pain/soreness controlled by oral analgesia and 2 required parenteral analgesia. 124 patients remained stable and were discharged at 6–7 h post-procedure. 1 patient had a vaso-vagal episode and a subcapsular haematoma on US, and needed overnight admission. Follow-up US in 117 patients demonstrated no procedure-related complications. Of the 50 patients surveyed at discharge, 45 were satisfied with the day care concept, 5 expressed a preference for an inpatient procedure. **CONCLUSION:** The performance of day case liver biopsies translates into substantial cost savings and reduction of waiting lists. Our experience demonstrates that the RDCU achieves a level of safety comparable to inpatient care, with a high level of patient satisfaction. We believe

that imaging guidance is contributory in obtaining an adequate core using a single pass in the majority of patients.

#### 0910

##### **Improving glandular coverage in prostate biopsy—results of a 33 mm core length needle**

G N Ubhayakar, W Y Li, C Corbishley and U Patel

*Department of Radiology, St George's Hospital NHS Trust, Blackshaw Road, London SW17 0QT, UK*

**PURPOSE:** A large minority of prostate cancers are isoechoic and in large glands coverage with standard 18 mm core length needles is inadequate. Longer throw needles should improve coverage and should increase pick-up of these sonographically silent cancers. This study compared a 33 mm core length with a standard 18 mm core length needle. **MATERIALS AND METHODS:** A 33 mm core length BioPince VSL disposable and a Standard 18 mm core length needle were used to perform sextant biopsies on 2 separate groups of 15 patients (Group B and Group S, respectively). The following were assessed of each needle: (a) mean core length; (b) biopsy quality—? fragmented; (c) capsular coverage—1 or both capsules in each biopsy specimen; (d) side effects assessed using patient returned questionnaires from BioPince group and compared with historical data from a larger group biopsied with the standard needle. Finally, a global comparison of needle performance was made. **RESULTS:** For Groups B and S, respectively: (a) mean core length 19.4 mm (SD 8.9 mm) and 14.9 mm (SD 5.1 mm); (b) fragmented samples: 15/90 (16.7%) and 38/90 (42%); (c) both capsules present: 6/90 (6.7%) and 4/90 (4.4%); (d) haematuria: median duration of 2 days and 1 day. However, many of the biopsies in Group B had to be repeated because no sample was retrieved (compared with none in Group S) and 4 needles had to be exchanged (none in Group S). **CONCLUSION:** Although a longer throw needle does improve glandular coverage per biopsy (by 30%), the currently available needle has significant technical shortcomings, and these will be discussed.

#### 0920

##### **Ultrasound-guided cutting needle biopsy in thyroid nodules: complementary to fine needle aspiration cytology**

N J Screaton, L H Berman, P W P Bearcroft and J W Grant

*University Department of Radiology and Department of Pathology, Addenbrooke's Hospital, Cambridge CB2 2QQ, UK*

**PURPOSE:** To evaluate the safety, yield, and diagnostic accuracy of ultrasound (US)-guided thyroid cutting needle biopsy (CNB). **MATERIALS AND METHODS:** A prospective study of 210 consecutive thyroid CNBs performed over a 5 year period. Biopsies were performed as outpatient procedures under local anaesthesia using non-advancing 16–18 gauge biopsy needles. Indications for biopsy included previous failed fine needle aspiration (FNA) of thyroid nodules (80%) and small impalpable thyroid nodules (20%). The site, size and echo pattern of the thyroid lesions, number of biopsy samples and complications were recorded. Final diagnosis and delayed complications were determined 6–60 months post-biopsy. Resection histology when available or concordance of the CNB histological diagnosis and clinical follow-up were used as the diagnostic reference standards. **RESULTS:** Ages ranged from 15 to 80 years (median 48 years). There was a 4:1 female preponderance. 95% (200/210) of biopsies provided adequate histological material. Sensitivity, specificity and accuracy of CNB in differentiating neoplastic from non-neoplastic thyroid nodules were 99%, 89% and 94%, respectively. Diagnostic surgical biopsies were required in only 7% (14/210) of cases. There were no major complications. Minor complications comprised 3 small haematomas and 1 minor haemoptysis, none requiring admission or intervention. **CONCLUSION:** CNB of the thyroid is a safe outpatient procedure with a high diagnostic yield and accuracy. Although FNA is sensitive in the detection of thyroid malignancy inadequate and non-diagnostic samples are common. US-guided CNB may complement FNA, enabling non-invasive diagnosis in patients with recurrently non-diagnostic FNA.

#### 0930

##### **Direct puncture ethanol embolization in the management of superficial vascular malformations**

J J Bhattacharya and E Teasdale

*Institute of Neurological Sciences, Southern General Hospital, Glasgow G51 4TF, UK*

**PURPOSE:** Superficial haemangiomas and vascular malformations often present difficult therapeutic challenges. Mullikens classification divides these lesions into vascular tumours, such as haemangiomas, and vascular malformations, comprising arterial lesions + fistula, capillary, venous, lymphatic and mixed lesions. Vascular lesions are usefully further divided into high flow (AVMs and AVFs) and low-flow (capillary, venous and mixed) lesions.

Absolute alcohol has become an indispensable embolic agent for many of these conditions. We discuss the technique and present our experience of 18 patients with limb and craniofacial vascular malformations treated by direct puncture alcohol injection. **MATERIALS AND METHODS:** 44 patients with superficial vascular lesions have received endovascular treatment in our centre since 1985. Technique has evolved from mainly transcatheter to principally direct puncture methods. Embolic agents have included polyvinyl alcohol (PVA), coils, cyanoacrylate glue and increasingly ethanol. In 18 patients (12 high-flow and 6 low-flow lesions, 16 scalp and craniofacial and 2 limb) treated from 1990 to 1999, direct injection of ethanol was the main treatment. Procedures were performed under general anaesthesia. Technique will be discussed in detail. **RESULTS:** In the 6 patients with low-flow lesions shrinkage of the lesion was observed in all cases with cosmetic and symptomatic improvement. No complete cures were achieved by embolization alone in this group. In the 12 high-flow lesions complete obliteration was achieved in 2/7 maxillofacial AVFs, 3/4 acquired scalp AVFs and 1/1 leg AVF. There were no major complications. **CONCLUSION:** With experience ethanol is a safe and effective embolic agent especially with high-flow AVFs where venous outflow is controllable.

0940

Discussion

0830–1000

## Calman Hine in Cancer Care— How Far Have We Got? Hall 8

0830

Invited Review

**The good, the bad and the ugly: an oncology manager's view**  
M Jackson

*Department of Radiotherapy, Christie Hospital, Wilmslow Road,  
Withington, Manchester M20 4BX, UK*

- Equality of access for all—but access to what?
- Finance—where has it all gone?
- Education and training.
- Recruitment concerns to fulfil plans.
- Standards of care—not so NICE after all?
- The future—managed clinical networks.

0850

Invited Review

**Oncologist to address the issues**

G Ross

*Royal Marsden Hospital, London, UK*

No abstract.

0910

Invited Review

**Expert lay person's view**

J A Brodie

*CancerBacup, 3 Bath Place, Rivington Street, London EC2A 3JR, UK*

- The Calman Hine perspective on patient-centred services and patient information.
- Progress since Calman Hine.
- What we know about the need for information and support for people affected by cancer.
- Information and support in a fast-changing environment—new health service, new technology.
- Improving the patient experience now.

0930

Discussion

0830–0930

## How to Shield an X-ray Room Hall 11a

0830

Invited Review

**Concepts and methods for shielding design**

D G Sutton

*Tayside University Hospitals NHS Trust, Dundee DD1 9SY, UK*

- Introduction to the session: why we need the information.

Concepts:

- Definition of dose: what do we mean by dose?
- Design criteria: adoption of constraints.

- Sources of radiation: primary and secondary—magnitude, energy and angular variation.
- Occupancy factors: the return of realistic assessment.
- Workload: how does one determine workload.

Methods for dealing with primary and secondary radiation:

- Primary radiation: methods and geometries.
- Secondary radiation: leakage and scatter kerma.
- Calculations involving primary and secondary radiation: how to do it.
- Summary of recommended method.

0845

Invited Review

**How to shield an X-ray room: materials, transmission and assessment**

C J Martin

*Department of Clinical Physics and Bio-Engineering, North Glasgow Hospitals University NHS Trust, Glasgow G12 8SQ, UK*

- What materials are available?
- What should I choose?
- How do I work out the transmission?
- Are there potential pitfalls that I need to bear in mind?
- How do I make sure the contractor puts in what I want?
- Can I check that shielding is in place after a room has been completed?
- What source should I use? Americium-241—advantages and disadvantages; <sup>99</sup>Tc<sup>m</sup>—advantages and disadvantages; X-rays—advantages and disadvantages.
- Checking for gaps in shielding.
- Assessing the level of protection.

0900

Invited Review

**X-ray shielding—putting methods into practice**

J R Williams

*Medical Physics, Western General Hospital, Edinburgh EH4 2XU, UK*

For each type of installation the following points will be covered:

- Sources of radiation.
- Workload.
- Sample calculation.
- Special points to note.

Shielding design for the following types of installation will be described:

- Radiographic room.
- R&F installation.
- C-arm.
- Mobile equipment.
- Dental radiology.
- Mammography.
- CT scanning.

0915

Discussion

0900–1100

## New Approaches to Imaging in GI Malignancy: Staging Hall 11b

0900

Invited Review

**The role of MRI in the local staging of rectal cancer**

G Brown

*Department of Radiology, The Royal Marsden Hospital NHS Trust London and Surrey, Downs Road, Sutton, Surrey SM2 5PT, UK*

The following points will be discussed:

- The value of meticulous pathological radiological correlation in developing image interpretation criteria.
- The high resolution MR depiction of pelvic surgical and its relevance in image interpretation.
- The relevance of pre-operative identification of important prognostic factors and its potential impact on treatment strategies.

- The accuracy of MRI in local staging of rectal cancer compared with other techniques.
- The clinical effectiveness and cost effectiveness of high resolution MRI compared with other methods of staging rectal cancer.

0920

**Invited Review**

**The role of oesophagogastric endoscopic ultrasound**

A M McLean

*Department of Diagnostic Imaging, St Bartholomew's Hospital, West Smithfield, London EC1A 7BE, UK*

- Endoscopic ultrasound (EUS) is valuable in the pre-operative staging and assessment of patients with oesophagogastric cancer who are deemed operable on spiral CT.
- The need for accurate staging has been driven by advances in non-surgical treatment options for advanced disease and techniques of endoscopic resection for small tumours.
- EUS is superior to CT for local T-staging and is more accurate at predicting resectability.
- EUS is more accurate than CT in the prediction of nodal involvement using criteria of size, shape, margins and echotexture.
- Staging of tumours at the cardia is less accurate than for tumours arising within the oesophagus or stomach.
- EUS is of limited value in re-staging disease post chemo/radiotherapy.

0940

**Invited Review**

**The assessment of liver metastases**

J B Karani

*Department of Radiology, King's College Hospital, London SE5 9RS, UK*

- Identification of hepatic metastases is an accurate predictor of survival.
- No imaging technique is pre-eminent with an increased diagnostic yield from a multimodality approach.
- All techniques identify lesions of > 4 cm. Therefore, key developments are directed at the identification of lesions of 2 cm or less.
- Metastases can be stratified according to their pattern of vascularity and an appropriate technique can be used.
- Hepatic resection improves survival in selected patients with colorectal metastases. Accurate lesion detection, their segmental anatomy, vascular relationships and exclusion of extrahepatic metastatic disease are critical elements in the management pathway.
- Benign incidental hepatic lesions will be detected in patients with primary malignancy during the staging of radiological investigations. An imaging strategy should reliably diagnose these lesions which do not effect prognosis.

1000

**Invited Review**

**Pancreatic cancer: imaging—surgical correlation**

Z Amin

*Imaging Department, Chelsea & Westminster Hospital, 369 Fulham Road, London SW10 9NH, UK*

Despite considerable improvements in abdominal imaging (in particular multislice spiral CT and liver-specific MR contrast agents), small liver and peritoneal metastases and neurovascular invasion are frequently found at surgery in patients thought to have resectable pancreatic cancer on pre-operative imaging.

- About one-third of patients proceeding to laparotomy are found to have unresectable tumour.
- Spiral CT and MRI both provide good quality images of local tumour extension, vascular involvement and liver metastases.
- Imaging of pancreatic cancer is highly dependent on good technique.
- Comparative studies tend to be biased in favour of one modality. The most appropriate imaging modality for staging pancreatic cancer is determined by local availability and expertise, but will usually be CT.

A review will be given on the reliability of imaging criteria for predicting surgical resectability of pancreatic cancer.

1020

**Invited Review**

**PET in gastrointestinal malignancy**

G J R Cook

*Department of Nuclear Medicine, Guy's & St Thomas' Hospital Trust, St Thomas Street, London SE1 9RT, UK*

- Colorectal cancer: recurrence (hepatic and extrahepatic)—accuracy; impact on management; cost effectiveness.

- Oesophageal and gastric cancer: pre-operative staging.
- Pancreatic cancer: assessment of pancreatic mass; impact on surgical management.
- Liver tumours: metastases; primary tumours—hepatocellular carcinoma.
- Therapy evaluation: chemotherapy; post-surgical surveillance.
- Pitfalls: tumours with low 18-FDG accumulation; benign "false positives".

1040

**Discussion**

0900–1000

**Web Publishing How To—Intermediate Olympian Suite**

0900

**Web Publishing How To Course**

M Tatlow

*Division of Professions Allied to Medicine, South Bank University, 103 Borough Road, London SE1 0AA, UK*

- This is the second of three 1-h practical sessions intended for all levels of Web site builder.
- The sessions are split into Beginner, Intermediate and Experienced.
- Each session follows on from the previous one, building on the knowledge and experience gained, although it is not essential that delegates attend all 3 sessions; they can be attended singularly.
- Attending all 3 sessions will take the novice World Wide Web (3W) builder through basic 3W site design and concepts, considerations necessary when using images, and the use of more complex page design including forms and active content such as dynamic HTML and Flash Movies.
- Each session will use examples of Internet sites to illustrate the concepts, which will then be tried out in practice. The emphasis is very much "hands on" (Note there are limited places in the "hands on" sessions.)

0945–1145

**The Challenge of Communicating Radiation Risk to the Patient**  
Hall 11a

0945

**Invited Review**

**Communicating radiation risk: a radiologist's perspective**

R F Bury

*Department of Clinical Radiology, Leeds General Infirmary, Leeds LS1 3EX, UK*

- How much information can/should patients be given?
- Do we have any accurate information to give them?
- Who should give it?
- How dangerous is radiation relative to the other risks of radiological investigation?
- What is the likely effect of risk communication on referral practice?
- Are informed patients a good thing?

1010

**Invited Review**

**Communicating radiation risk: a radiographer's perspective**

J A Shrimpton

*Department of Neuroradiology, The Radcliffe Infirmary, Woodstock Road, Oxford OX2 6HE, UK*

The following questions are discussed:

- Do patients need reassurance re radiation risk?
- Do patients underestimate or overestimate the risk?
- Do we have accurate information to give them?
- Who should give it?

TUESDAY

1030

**Invited Review**

**Communicating risk: a view from the social sciences**

A Irwin

*Department of Human Sciences, Brunel University, Uxbridge, Middlesex UB8 3PH, UK*

- Introduction and background.
- What do we know about the public understanding of science?
- Beyond the deficit theory.
- Communicating risk—3 case histories.
- Key lessons and conclusions.
- Ways forward for policy and practice.

1055

**Invited Review**

**A leaflet for patients on diagnostic X-rays**

B F Wall

*National Radiological Protection Board, Chilton, Didcot OX11 0RQ, UK*

- Background.
- Objectives.
- Method of distribution.
- How we have attempted to communicate the risks.

1120

**Discussion**

## 1000–1200

### Studies in Vascular Radiology Hall 6

1000

**Translumbar aortography—a 10 year review**

G J Robinson, J A Clark, N Macklin, F M Ameli, A G Lossing and R A Pugash

*Department of Medical Imaging, Wellesley Central Site, St Michael's Hospital, University of Toronto, 160 Wellesley St East, Toronto M4Y 1J3, Canada*

**PURPOSE:** All cases of translumbar aortography (TLA) performed at our hospital in the last 10 years are reviewed. **METHODS:** Between January 1990 and January 1999, 321 TLAs were performed in 305 patients (215 males and 90 females, median age 62 years, range 30–92). Their films, radiology reports and case notes were assessed retrospectively. **RESULTS:** Indications for TLA were usually previous surgery but included 9 cases of failed femoral access and 1 case of failed brachial access. All procedures were successful. 162 were performed by staff, 150 by fellows and 9 by residents. There was 1 procedure-related death (0.3%). This occurred in an 82 year old man with severe widespread atheromatous disease who became hypotensive several hours after TLA. Extravasation from a lumbar artery was noted on retrospective review of the TLA films and would have been treatable by percutaneous embolization but the family would not consent to any further invasive procedures. No other major complications requiring treatment occurred. There was 1 potentially serious complication with a subintimal contrast injection leading to a common iliac artery dissection, which was not clinically significant and required no therapy. There were 17 minor complications (5.3%). 12 of which were minor extravasation from an initial puncture with uneventful repeat punctures. **CONCLUSION:** Our results support the view that TLA is a safe procedure. In view of the published complication rates of upper limb arterial punctures, we believe TLA should be considered as the second choice access for diagnostic arteriography when a femoral artery approach is not possible.

1010

**Transradial arteriography—a case for its routine use**

R A Carver, P Sinha and K D G Williams

*Department of Diagnostic Imaging, Bromley Hospital, Cromwell Avenue, Bromley BR2 9AJ, UK*

**PURPOSE:** Transradial arteriography has been the preferred method of investigating the peripheral arterial tree in our hospital for the past 4 years. The purpose of this study is to assess the efficacy and safety of the procedure. **PATIENTS AND METHODS:** A retrospective review was carried out on 248 consecutive patients in which the examination had been attempted. The Allen test was performed on all patients to confirm the integrity of the palmar

arch. The technique will be briefly described together with "technical tips". **RESULTS:** 11 patients failed the Allen test. Of the remaining 237 patients, radial artery puncture was unsuccessful in 2 patients, and the catheter/guidewire could not be directed into the descending aorta in a further 6. The procedure was therefore successful in 229 patients (92.3%). There were 8 minor complications including a haematoma (1 patient), arm pain (1 patient), vasovagal symptoms (2 patients), transient paraesthesia of the hand (2 patients) and short-term amnesia (2 patients). There were no major complications. **CONCLUSION:** Transradial arteriography is a safe procedure. It is also inexpensive since no bed is required. Patients need not be cancelled due to bed shortages. Angioplasties can be planned for future dates. More units should consider adopting transradial arteriography as a routine procedure.

1020

**Toxic erythema following administration of iodixanol (Visipaque) for arteriography**

A A McCafferty, S E G Goudie and A C Downie

*Department of Radiology, Victoria Infirmary, Glasgow G42 9TY, UK*

**PURPOSE:** To assess the incidence of delayed contrast reactions following administration of iodixanol (Visipaque) for arteriography. **METHODS:** All patients undergoing day-case arteriography with iodixanol over a 10 month period were followed up by postal questionnaire to assess the incidence of delayed contrast reactions. Patients reporting severe reactions were further assessed by telephone or in clinic. **RESULTS:** Between January and October 1999, 118 day-case arteriograms were performed, all using iodixanol. 83 (70%) responded to the questionnaire. 9 patients (11%) reported a red rash which developed 12–48 h after the procedure. 3 of these (4%) reported a more severe skin reaction involving a scaly eruption, especially of the hands and feet, which took up to 6 weeks to resolve. 1 required referral to a dermatologist. These reactions were more typical of a toxic erythema than an allergic reaction. **CONCLUSION:** Delayed reactions to iodixanol may be more frequent than previously reported. In particular, toxic erythema is a severe reaction not normally associated with contrast media, and which may be peculiar to iodixanol administration.

1030

**Treatment of iatrogenic pseudoaneurysm with percutaneous ultrasound-guided thrombin injection**

T Sabharwal, M Earley, M Lynch, A Mitchell and J Jackson

*Department of Radiology, Hammersmith Hospital Trusts, London, UK*

**PURPOSE:** Iatrogenic pseudoaneurysms are managed by conservative, ultrasound-guided compression, endovascular techniques and surgical repair. These methods bear some limitations: among them are prolonged procedure time, discomfort for patients, increased cost and length of hospital stay. We currently use thrombin to treat pseudoaneurysms and present our initial results and technique of thrombin injection. **MATERIALS AND METHODS:** Between 11/98–11/99, 14 consecutive patients with pseudoaneurysms (1 brachial, 13 femoral) were treated. Colour flow duplex ultrasound of the pseudoaneurysm and the underlying native artery was performed. Under ultrasound guidance, a 23G needle, attached to a 1 ml syringe, preloaded with topical thrombin (1000 U) was advanced into the pseudoaneurysm. 0.2–1.0 ml of thrombin was slowly injected into the pseudoaneurysm. Within seconds, thrombus formed within the pseudoaneurysm, and the colour flow signal faded out. If thrombosis was incomplete, the needle was redirected into the remaining flow cavity and more thrombin injected. Distal pulses were measured before and after the procedure. After successful thrombosis, patients were kept on bedrest overnight and then followed up clinically and by ultrasound. **RESULTS:** In 12 cases the pseudoaneurysms were successfully treated. 2 patients who developed recurrence required surgery. There were no procedure-related complications. **CONCLUSIONS:** Thrombin injection is painless, fast and effective in the treatment of pseudoaneurysms even in the face of anticoagulation. It is cost effective and appears to be safe.

1040

**Endovascular stent-graft management of complex thoracic aortic disease**

T Sabharwal, D Farsaris, C Engelke, P Taylor and J Reidy

*Department of Radiology and Surgery, Guy's Hospital, Bromley BR20 0XF, UK*

**PURPOSE:** To review the early experience of the use of endovascular stent-grafting in the treatment of high risk patients with complex thoracic aortic disease (CTAD). **MATERIALS AND METHODS:** 14 patients (10 male, 4 female), mean age 68.1 years (range 20–90),

referred with CTAD (7 atherosclerotic, 2 aortic dissections, 2 traumatic transections, 2 pseudoaneurysms and 1 aorto-oesophageal fistula) underwent endovascular stent-grafting. 21 stents (11 GoreTagexcluder, 8 AncuRx, 1 Stenford and 1 Vanguard) were deployed. 9 patients had 1 stent, 3 patients had 2 and 2 patients had 3 stents. The procedures were performed under general anaesthesia in the radiological suite. Patients were followed clinically and by CT angiography. RESULTS: In all patients, successful deployment of stents and exclusion of aneurysms were achieved. 2 patients died, 1 from a myocardial infarction Day 3. The other (aged 85) was recovering from procedure-related cerebrovascular accident (CVA) and at 8/52 died from pneumonia. No other neurological complication was observed. Follow-up CT in 9 patients to date show exclusion of the aneurysm in all except 1 patient with dissection who still had filling of the false lumen. 1 patient had an access site complication. There was 1 case of proximal leak, and this patient eventually underwent surgery. CONCLUSION: Our early experience would suggest that endovascular stent grafting in CTAD is technically feasible, safe and appears to be very promising. The results need to be compared with the high morbidity and mortality of surgery.

## 1050

**"Push and park": an alternative strategy for management of arterial embolism**

A P Higginson, F Ataeddin, A Bolia and G Fishwick  
Department of Radiology, Leicester Royal Infirmary, Leicester LE1 5WW, UK

Percutaneous transluminal angioplasty (PTA) is an established technique in the management of arterial disease. One of the complications of PTA in some cases is distal embolism. The conventional treatments for this include percutaneous catheter aspiration, thrombolysis and surgical removal. In the event of failure to aspirate an embolus during a procedure we have successfully used a further approach in patients with more than 1 run-off vessel. This involves pushing the embolus into 1 run-off vessel and leaving at least 1 remaining vessel with free flow. 3 cases will be presented to demonstrate the use of this technique, which will be described in more detail.

## 1100

**Experience and follow-up of aortic side branch embolization in abdominal aortic aneurysm endovascular repair**

<sup>1</sup>A Anbarasu, <sup>1</sup>D A Gould, <sup>1</sup>R G McWilliams, <sup>1</sup>P C Rowlands, <sup>1</sup>R D Edwards, <sup>2</sup>J Martin, <sup>1</sup>D White, <sup>2</sup>A Bakran, <sup>2</sup>J Brennan, <sup>2</sup>G L Gilling-Smith and <sup>2</sup>P L Harris  
Departments of <sup>1</sup>Vascular Radiology and <sup>2</sup>Vascular Surgery, Royal Liverpool Hospitals, Prescot Street, Liverpool L7 8XP, UK

PURPOSE: To assess the feasibility of embolization of aortic side branches and its impact on the incidence of Type II endoleak following endovascular aneurysm repair (EVAR) of abdominal aortic aneurysms. MATERIALS AND METHODS: EVAR was performed in 62 patients. Aortic side branch vessels were evaluated on pre-operative angiograms and, where indicated, were embolized prior to the stentgraft procedure. Intraoperative angiography and follow-up CT were used to assess the presence of Type II endoleak. RESULTS: 59 patients were followed past 1 month: 16 of these patients had received pre-operative embolization and 1 (6.2%) had a demonstrable Type II endoleak on follow-up past 1 month. Of 43 patients without prior embolization, 9 (20.9%) showed Type II endoleak on follow-up. CONCLUSION: Although the cohort size is below a level which would confer significance, the trend of these findings is such as to suggest an association between aortic side branch embolization and a reduction in the incidence of Type II endoleak during the follow-up period.

## 1110

**The role of chest radiography following subclavian vein catheter insertion for ambulatory chemotherapy**

P R Burn, D Skewes and D M King  
Radiology Department, Chelsea and Westminster Hospital, London SW10 9NH, UK

PURPOSE: The purpose of this study was to establish the importance of routine chest radiography following subclavian venous catheter insertion for ambulatory chemotherapy administration. METHODS: Retrospective analysis of 3844 patients who had undergone line insertion was performed. Of those patients with a complication detected on the routine post-procedure chest radiograph, evidence was sought of problems at insertion or the presence of subsequent symptoms by examination of the clinical notes. RESULTS: In 52 cases, a complication was demonstrated on the post-insertion radiograph, of which 46 were pneumothoraces. Of

the 18 pneumothoraces that required active intervention, 14 could be predicted on the basis of risk factors at insertion and/or subsequent symptoms. Thus, in the 4 remaining cases, a chest radiograph provided the sole means of pneumothorax identification. Of the 6 patients with a non-pneumothorax complication, the chest radiograph report resulted in a change of clinical management in 3 cases. CONCLUSION: (1) A post-procedure complication was detected in 1.4% of cases. (2) Routine chest radiography provided the sole means of complication detection in 0.2% of cases overall.

## 1120

**Tunnelled central venous catheters: correlation between line tip position and complications**

A E Mills and J A L Lawrance  
Department of Diagnostic Radiology, The Christie Hospital, Manchester M20 9BX, UK

PURPOSE: To prove that the ideal central venous catheter tip position is the lower third of the superior vena cava or right atrium. MATERIALS AND METHODS: Permanent central venous catheters inserted non-radiologically in our hospital (Cancer Centre) were audited over a 2 month period. The clinical notes were reviewed at least 6 months following line insertion, and details of the operator, patient line days, reason for removal, complications (e.g. thrombus, infection etc.) and interventions recorded. The post-insertion chest radiographs were reviewed for pneumothoraces, line position and course. The notes and radiographs of 58 permanent catheters in 55 patients were included in the study. RESULTS: Venous thrombosis occurred in 5 patients (5/58=8.6%) and was extensive in 4 of these. The thromboses occurred at an average of 66.8 days post-insertion (range 20-104 days). No significant gender or operator predominance was seen. We postulated that the ideal catheter position is in the lower SVC or right atrium: 48/58 lines were in this "ideal" position and none of these developed thrombosis. 10 catheters were in a "non-ideal" position, and of these, 5 (50%) developed proven venous occlusion due to thrombosis. Alternatively, 100% of the lines that caused a thrombosis were in a "non-ideal" position. Furthermore, no complications from right atrial tip position were seen. CONCLUSION: We have shown that a central venous catheter tip should be placed in the lower SVC or right atrium for the lowest risk of venous thrombosis.

## 1130

**An audit of the D-Dimer test in the investigation of deep venous thrombosis**

<sup>1</sup>W A Munro, <sup>2</sup>D C Howlett, <sup>2</sup>D F Sallomi, <sup>3</sup>A Goddard, <sup>2</sup>E Ruffell and <sup>1</sup>R Grace

Departments of <sup>1</sup>Haematology, <sup>2</sup>Radiology and <sup>3</sup>Audit, Eastbourne District General Hospital, Eastbourne BN21 2UD, UK

PURPOSE: D-Dimer in a neo-antigen produced by the action of plasmin on cross-linked fibrin and elevated levels may be found in venous thrombo-embolic disorders. This study investigates whether D-Dimer assay is useful in the investigation of patients with suspected lower limb deep venous thrombosis (DVT). MATERIALS AND METHODS: Over a 6 month period, 128 patients with suspected DVT underwent D-Dimer assay and ultrasound examination. D-Dimers were measured in human citrated plasma (ng ml<sup>-1</sup>) by a turbidmetric immunoassay. Venous ultrasound was performed using grey scale with compression and colour Doppler techniques within 48 h of the D-Dimer assay. Patients were categorized using an established protocol for risk stratification as low, moderate or high risk according to the presence of risk factors including known cancer, recent surgery or immobilization, venous tenderness or collaterals and leg swelling. RESULTS: The D-Dimer range followed by the mean D-Dimer level is given in brackets. Low probability (12 patients)—ultrasound positive in 1 (4883) and negative in 11 (252-6300, mean 1103). Moderate probability (42 patients)—ultrasound positive in 10 (314-2830, mean 1299) and negative in 32 (100-3400, mean 828). High probability (74 patients)—ultrasound positive in 21 (209-14320, mean 3472) and negative in 53 (13-6210, mean 930). CONCLUSION: A wide spectrum in D-Dimer levels was encountered unrelated to the probability of DVT or ultrasound results. In this study, D-Dimer assay did not provide useful additional diagnostic information when combined with risk stratification protocol and ultrasound in the assessment of DVT.

## 1140

**Single-scan instant access DVT imaging with ultrasound**

T Hall, W-Y Li and K-T Khaw  
Department of Radiology, St George's Hospital, London SW17 0QT, UK

Since January 1998 we have used a policy of rapid access DVT imaging with limited 3 point compression colour-duplex ultrasound. In the first year a negative scan was followed by a repeat scan at

1 week. Audit at 6 months and a year showed this technique to be safe, simple, quick and effective in identifying the acutely symptomatic patient with clinically relevant DVT. Imaging practice was subsequently modified and a second scan was no longer routinely booked. From January–July 1999, 539 DVT imaging requests (200 in-patient, 89 out-patient, 250 A/E) were received. 80/539 (14%) first scans were positive. Only 7/186 (3.7%) second scans were positive. In 4–11 months, only 4/351 patients (1.1%) with negative imaging have re-presented with documented DVT/PE, comparable to or better than venography. These findings will be discussed. 18 month follow-up confirms the effectiveness of this limited technique. Second scans are not routinely required unless there is high clinical suspicion, previous history of DVT/PE, significant risk factors, positive D-dimer or persisting symptoms. Instant access DVT imaging has significantly improved management for clinicians and patients as treatment can be commenced immediately with low-molecular-weight heparin without the need for admission. However, the impact on workload in the imaging department is considerable. Imaging requests have doubled in the first year and will triple this year even before the inclusion of second scans. Positive scan rates have dropped from 25% to 29% yearly to 15%. The clinical threshold for requesting imaging has decreased significantly and audit of clinician practice is now required.

**1150**  
**Discussion**

## 1015–1215

### Moving to the 24 hour Department Hall 8

**1015**  
**Invited Review**  
**The Torbay experience**  
R Seymour  
*Department of Radiology, Torbay Hospital, Torquay TQ2 7AA, UK*

- In an attempt to deal with ever increasing numbers of medical admissions that were disrupting routine booked work, several changes have been made at Torbay Hospital and to working practices.
- The main changes have been the opening of an emergency admissions unit and an institution of 7 day radiology.
- Emergency radiological cover only is provided in the evenings and overnight.
- From 9.00 am to 5.00 pm on Saturday and Sunday there is a consultant radiologist in the department covering both emergency and booked routine work.
- To compensate for these 4 fixed working sessions, double time is received in lieu. This is taken as a fixed period of leave from Tuesday to Friday of the week following the weekend on call.
- The advantages and disadvantages of this system will be discussed.

**1030**  
**Invited Review**  
**Review of out of hours systems in relation to the working time directive**  
J Collingwood  
*X-Ray, Stoke Mandeville Hospital, Aylesbury, Buckinghamshire HP21 8AL, UK*  
The presentation aims to review a study of the out of hours work undertaken at Stoke Mandeville Hospital, Aylesbury.

- The study analysed whether the out of hours system complied with the working time directive, provided adequate staffing levels and was affordable.
- The presentation will review the general implication of the working time directive for radiography departments.
- The effect of long working hours on workers will be discussed.
- The results of a questionnaire about out of hours systems sent to other X-ray departments will be outlined.
- Conclusions reached and changes to the out of hours system at Stoke Mandeville will be discussed.

**1045**  
**Invited Review**  
**Moving to the 24 h department: the business manager's perspective**  
P A Williams  
*Department of Radiology, Kent and Canterbury Hospital, Canterbury CT1 3NG, UK*

- Establish a demand and case of need.
- Identify resource requirements: financial; consumables; human.
- Get staff on board: communicate and inform.
- Actively involve staff in formulating new system of work.
- Be open to ideas: listen to fears.
- Set timetable for implementation: review the process.
- Participation is the key to success.

**1100**  
**Invited Review**  
**Delivering the opinion of the Medical Director**  
M Rimmer  
*The Queen Elizabeth Hospital, Kings Lynn, UK*  
No abstract.

**1115**  
**Invited Review**  
**Moving to the 24 h department—US opinion**  
M J Lipton  
*Department of Radiology, University of Chicago, 5841 South Maryland Avenue, Chicago, IL 60637, USA*  
The following points will be discussed:

- Evolution of US health care: government and private involvement.
- Present forces driving US health care reform.
- Perceptions and expectations of US radiology departments.
- Challenges driving change in radiology.
- Benefits and concerns of business driven medical and radiology practices.
- Where are we now and where are we going?
- The relevance of case-based medicine, patient outcomes and training issues.

**1130**  
**Discussion**

## 1030–1230

### 3D Imaging 1 Olympian Suite

**1030**  
**Invited Review**  
**New ideas in 3D ultrasound**  
WR Lees  
*Department of Imaging, The Middlesex Hospital, Mortimer Street, London W1N 8AA, UK*

- New acquisition devices have been designed for obstetric, abdominal and small-parts imaging, particularly breast imaging.
- Spatial compounding reduces speckle and reveals underlying structural detail.
- Automatic gain compensation removes acoustic shadowing, producing a more isotropic data set.
- New methods of image analysis allow segmentation of structure with "solid" 3D data sets.

**1055**  
**Invited Review**  
**Critical issues facing post-processing in the era of high performance MRI and multislice CT**  
S J Golding  
*Department of Radiology, University of Oxford, Oxford OX3 9DU, UK*

- Software available on modern scanners has brought readily accessible 3D post-processing into potential routine clinical use.
- Clinical objectives and clinical justification need to be established for this work.
- The most appropriate means of communicating 3D information between radiologists and clinicians needs to be established.
- Quality assurance programmes are required to ensure standardization of this work.

- The incorporation of 3D guidance and virtual reality into surgical procedures has training implications.
- Modern concepts of radiation dose justification require that if acquiring the post-processing data requires an increase in dose to the patient (as is usually the case), the added dose must be justified by increased clinical benefit.

**1120****Discussion****1130****Virtual endoscopy of aortic stenting: a pictorial review**

<sup>1</sup>Z H Sun, <sup>2</sup>R J Winder, <sup>3</sup>B Kelly, <sup>3</sup>P K Ellis and <sup>1</sup>D Hirst

<sup>1</sup>School of Biomedical Sciences, University of Ulster, <sup>2</sup>NI Medical Physics Agency, Belfast and <sup>3</sup>Department of Radiology, Royal Victoria Hospital, Belfast, UK

**PURPOSE:** To review the clinical application of virtual intravascular endoscopy (VIE) in the assessment of abdominal aortic aneurysm (AAA) pre- and post-stent graft placement and to present a pictorial review of VIE applied to AAA. VIE may be useful in the assessment of the stent relationship to other aorta branches. **MATERIALS AND METHODS:** A critical review of the literature from 1994 to 1999 was performed by a search of Medline and Pubmed. 10 papers were found and reviewed. VIE images of aortic stenting will be shown to illustrate the current extent of research work. Images of patients scanned at our institution will be used to illustrate the potential applications of VIE in this area. **RESULTS:** The results of the literature review were as follows. A wide range of CT scanning parameters and software packages was used in different centres with no consensus as to the optimum scanning parameters. The limitations of current research work include small numbers of cases, a subjective assessment of the technology and no confirmation of the clinical application of VIE. **CONCLUSION:** We conclude that VIE of AAA undergoing stenting is a promising new technology. Due to the limited current research we intend to carry out an objective assessment of the efficacy of this technique.

**1140****The evaluation of a prototype MR compatible flexible bronchoscope for diagnostic and therapeutic use**

M A Ederies, M R Hetzel, R Davies, M Keen, R Hartley-Davies and P R Goddard

*Bristol Royal Infirmary Open Scanner, Bristol Oncology Centre, Bristol BS2 8HW, UK*

**INTRODUCTION:** MRI-based therapy has evolved due to the development of open magnets, the availability of fast imaging sequences and dedicated MR compatible guidewires, catheters and percutaneous biopsy instruments. We describe our preliminary experiences with a prototype MR compatible flexible bronchoscope. **MATERIALS AND METHODS:** The flexible bronchoscope (Olympus, Tokyo) was designed and manufactured with components that allowed it to be used within the MR environment. In order to visualize the bronchoscope tip in a relatively low proton environment, the tracheo-bronchial tree, we used a passive tracking system. It consisted of a balloon-tipped catheter filled with gadolinium (Gd) DTPA-BMA (1.5 ml of 0.5 ml Gd DTPA-BMA in 1000 ml of water). Images [Turbo Spin Echo (TSE), FLASH 2D, Fisp 2D, Tru Fisp] were acquired on a 0.2 T (Siemens Magnetom) scanner with the tip in varying orientations to the static, or external, magnetic field (Bo). **RESULTS:** The results provided information regarding the quantitative physics of MR bronchoscopy and also safety and compatibility data. In general, the distortions due to the magnetic impurities in the bronchoscope were small but could be seen. The TSE overestimated the true diameter by 10%, whereas the other sequences estimated the artifact size at 1.5 times the true diameter. The TruFisp sequence produced the best signal averages (2.71 s). The passive tracer was identified as a bright signal (flow refocusing sequence). No torque or subjective heating of the bronchoscope was noted. **CONCLUSION:** We have demonstrated that the prototype flexible bronchoscope is both safe and compatible for clinical MR diagnostic and therapeutic bronchoscopy.

**1150****MR-guided laser thermoablation of inoperable renal tumours in an interventional MR scanner**

R Joarder, M de Jode, J Vale and W M W Gedroyc

*Interventional MR Unit, St Mary's Hospital, Paddington, London W2 1NY, UK*

**PURPOSE:** To develop a minimally invasive technique for performing MR-guided laser interstitial thermoablation (LITT) for inoperable renal tumours. **MATERIALS AND METHODS:** 3 patients with inoperable renal tumours were treated using a percutaneous technique with real-time MR guidance in an open access interventional MR scanner. Renal tumours were punctured after

the administration of intravenous gadolinium using real-time MR image guidance under local or general anaesthesia and treated using a water-cooled interstitial fibre and a neodymium-yttrium-aluminium-garnet source. Therapy was monitored using a real-time MR coloration sequence. Thermoablation was followed by a colour change in a region of interest. **RESULTS:** Burn sizes of 30–45 mm in maximum diameter were achieved. All procedures were performed without complication and the patients discharged the next day. Follow-up with gadolinium-enhanced MRI in a conventional high field system confirmed necrosis in targeted tissue. In 2 of the 3 patients there had been complete replacement of tumour with non-enhancing tissue; in the third, good palliation with regard to pain relief was achieved. **CONCLUSION:** We conclude that LITT could be useful in treating inoperable renal malignancy and merits further evaluation.

**1200****A performance intercomparison of 5 surgical gamma probe systems**

A Maxwell and M A Avison

*Bradford Hospitals NHS Trust, Bradford BD9 6RJ, UK*

The purpose of this study was to evaluate each of the surgical gamma probe systems that were available in March 1999. The evaluation was performed to determine which system was most suitable for use in lymph node biopsy procedures. Each system was tested according to a predefined protocol. The measured parameters were directional response, sensitivity, energy resolution and signal noise. The measurements were conducted using <sup>99</sup>Tc<sup>m</sup> sources. The directional response varied by 60°, the sensitivity by 650%, the full width half maximum of the energy resolution by 40 keV and the noise response by 260% compared to the best performing system. These results show that hospitals planning to purchase a surgical gamma probe should investigate all the systems on the market to obtain the best deal.

**1210****Application of parallel processing in three-dimensional reconstruction of CT images**

C K S Tong and K K Chan

*Department of Medical Physics, Pamela Youde Nethersole Eastern Hospital, Chai Wan, Hong Kong, PR China*

Parallel processing is a technique that makes use of multiple processors to speed up the computing process. In diagnostic radiology, some computationally demanding techniques, such as three-dimensional (3D) reconstruction, currently require the use of expensive mini-workstations. In this paper, a method to apply parallel processing in 3D reconstruction of CT images using dual Intel Celeron processors in a relatively low cost personal computer (PC) is presented. The hardware configuration of the PC consists of an Intel BX compatible motherboard, 2 × 128 Mbytes 100 MHz RAM, 2 × 450 MHz over-clocked Celeron 300A processors and 2 portable 6.4 Gbyte hard disks installed with two versions of the Windows NT operating system. Single and dual processor versions of the operating system were installed in the 2 portable hard disks. Hence, it is possible to switch the computer from single to dual processor by changing the portable hard disk. The installation of dual Celeron processors is as described by Kikumaru's Technical Laboratory. 2 3D reconstruction softwares were developed using direct volume rendering (DVR) algorithm. In DVR algorithm, each screen pixel is the average of all voxel values in the direction of projection. Since each screen pixel is independent of the others, DVR algorithm allows the application of parallel processing during the computation. In a study, 64 slices of CT angiographic brain images were acquired after contrast agent enhancement using a Siemens Somatom Plus CT scanner. The 3D reconstruction software was applied to the acquired data in single and dual processors states. The times measured for rendering a scene of 400 × 400 pixels using DVR algorithm were 4 s and 2.5 s in single and dual processors states, respectively. The gain due to parallel processing is about 1.6 s. In conclusion, the application of parallel processing in diagnostic radiology using an Intel-based PC is found to be feasible and provides a low cost solution for 3D reconstruction applications.

**1220****Discussion**



## 1045–1200

### Understanding and Recognizing Artefacts in MR Imaging

#### Hall 5

1045

#### Invited Review

##### Why do we get them and where do they come from?

A P Jones

North Western Medical Physics, Manchester M20 4BX, UK

The following points will be discussed:

- The importance of recognizing artefacts.
- The nature of k-space (a non-mathematical treatment): treatment of errors in Fourier space.
- Aliasing.
- Rectangular FOV/reduced phase encoding.
- The nature of imaging pulse sequences: events within TE period; events within TR period; the meaning of bandwidth, sampling rate etc.
- Explanation of technical artefacts: chemical shift; truncation; ghosts; radiofrequency effects; susceptibility; phase encoding errors; magic angle effect.
- Artefacts resulting from bodily functions: flow phenomena; perfusion and diffusion effects.

1120

#### Invited Review

##### Artefact or pathology: clinical pitfalls of MR image artefacts

J P R Jenkins

Department of Clinical Radiology, Manchester Royal Infirmary, Manchester, UK

- An artefact is defined as any signal intensity, including a signal void, that does not have an anatomical basis in the image. A good understanding of normal anatomy is required to recognize an artefact.
- It is important to recognize artefacts and to understand their source in order to eliminate, or help to minimize, their effect on the resultant image.
- The incorrect interpretation of an artefact on a MR image can lead to misdiagnosis.
- Examples of the different types of artefacts in the various organ systems, given in the first part of this session, will be presented and explained.

1155

#### Discussion

## 1200–1245

### Institute of Physics & Engineering in Medicine

#### Douglas Lea Lecture

#### Hall 11a

1200

#### Eponymous Lecture

##### On the track to DNA damage and effects of low level ionizing radiation

D T Goodhead

Medical Research Council Radiation and Genome Stability Unit, Harwell OX11 0RD, UK

Ionizing radiation remains in wide use in diagnostic and therapeutic medical practice. Its enormous benefits are tempered by concomitant risks of detrimental effects, as early radiologists found to their cost. Douglas Lea himself recognized the special features of radiation in producing microscopic clustered patterns of ionizations. Modern techniques allow detailed analysis of radiation track structures at the most microscopic levels and assessment of the consequent damage in DNA and cells. These indicate that permanent damage can result even from a single electron track—the lowest possible cellular dose. If this includes a very rare initiating event in

the multistage carcinogenesis process, then a linear no-threshold extrapolation of risk down to zero dose should be expected. There is also an alternative paradigm based on the observed high efficiency of radiation to induce, by untargeted mechanisms, genetic instability in cells. It has been hypothesized that this could enhance the entire carcinogenic process. There is, to date, no evidence that a single electron can induce instability. It would not be unreasonable to suggest that a threshold dose is required for this and hence for any consequent cancer induction. This is a speculative, but intriguing, possibility. In many common radiological procedures, cells typically receive only a single electron. However, in others the absorbed doses and numbers of electrons are much higher and they overlap dose regions where statistically significant increases in cancer have been observed under some circumstances. Hence, expectations of risk depend greatly on the choice paradigm.

## 1200–1230

### British Institute of Radiology

#### Presidential Address

#### Hall 11b

1200

#### The growing impact of nuclear medicine on clinical oncology

P A Griffiths

Medical Physics Department, County Hospital, Greetwell Road, Lincoln LN2 5QY, UK

Nuclear medicine is assuming an increasing role in the management of patients with cancer. New pharmaceuticals and imaging techniques are providing information which affects the staging of disease, planning of treatments and follow-up of patients. These developments are not restricted to those centres with specialist facilities and will rapidly impact on most nuclear medicine and clinical oncology departments. This presentation aims to review the current status of positron emission tomography (PET), particularly the contribution of F-18 FDG to the diagnosis and staging of cancer and the use of gamma camera technology for positron imaging. In addition, it has been shown that functional changes in tumours precede changes in size, and the nuclear medicine techniques to predict and measure the response of tumours to treatment will be described and discussed.

## 1215–1300

### Luminary Lecture 3

#### Hall 5

1215

#### Invited Review

##### High resolution CT in the differential diagnosis of chronic infiltrative lung disease

N L Müller

Department of Radiology, Vancouver General Hospital and University of British Columbia, Vancouver, BC, Canada

The aim of this lecture is to present an approach to the differential diagnosis of chronic infiltrative lung diseases based on the pattern and distribution of abnormalities on high resolution CT (HRCT).

The parenchymal abnormalities on HRCT may be divided into 6 main patterns:

- Septal pattern (interlobular septal thickening): thickening of the interlobular septa may be due to edema, tumor or fibrosis. Hydrostatic pulmonary edema causes smooth thickening of the septa while lymphatic spread of tumor may cause smooth, nodular or beaded thickening. In patients with fibrosis, the thickening of the interlobular septa is irregular and is associated with distortion of the architecture of the secondary lobule.
- Reticular pattern (intra-lobular linear opacities): irregular intra-lobular lines of attenuation (reticular pattern) usually indicate the presence of pulmonary fibrosis. Fibrosis also leads to distortion of the pulmonary architecture, traction bronchiectasis and bronchiolectasis. Characteristic patterns of fibrosis have been described in idiopathic pulmonary fibrosis, fibrosing alveolitis associated with collagen vascular disease, sarcoidosis, extrinsic allergic alveolitis and asbestosis.

TUESDAY

- Cystic pattern: cystic airspaces are most commonly seen in end-stage pulmonary fibrosis, lymphangioleiomyomatosis and Langerhan's pulmonary histiocytosis.
- Nodular pattern: nodules 1–10 mm in diameter are seen most commonly in patients with sarcoidosis, silicosis, coal worker's pneumoconiosis and hypersensitivity pneumonitis. In sarcoidosis, the nodules tend to have irregular margins and are located predominantly in the interstitium along the bronchovascular bundles and, to a lesser extent, along the interlobular septa and subpleural lung regions. The nodules in hypersensitivity pneumonitis have ill-defined margins, a centrilobular distribution and are seen throughout both lungs.
- Ground-glass pattern: ground-glass attenuation is defined as the presence of hazy increased opacity without obscuration of underlying vascular markings. The most common chronic diseases causing ground-glass opacities are hypersensitivity pneumonitis and the various idiopathic interstitial pneumonias.
- Airspace consolidation: the most common chronic diseases associated with airspace consolidation are cryptogenic organizing pneumonia (COP) and chronic eosinophilic pneumonia.

## 1215–1345 Studies in Gastrointestinal Imaging Hall 6

### 1215

#### Optimization of scanning parameters for spiral CT pneumocolon

N Power, M Pryor, A Martin, J Horrocks, A McLean and R H Reznik

*Department of Diagnostic Imaging, St Bartholomew's Hospital, West Smithfield, London EC1A 7BE, UK*

**PURPOSE:** To determine the optimal scanning parameters (collimation, pitch, reconstruction interval and dose) for spiral CT pneumocolon by subjectively and objectively assessing the effects of a range of such parameters on the conspicuity of phantom polyps of varying sizes. **MATERIALS AND METHODS:** 10 spherical polyps between 1 and 10 mm in diameter were made using tissue equivalent material (CT number of 40) and placed in the colon of an anthropomorphic phantom—a 5.5 cm thick cross-section of the abdomen. The phantom was scanned at collimations of 3, 5 and 7 mm and pitches of 1.0, 1.3, 1.5, 1.7 and 2.0 on an IGE advantage system, using SmartScan to optimize the mA per scan. Images were reconstructed at the minimum intervals allowed along the z-axis. The optimum scanning protocol was assessed by measuring contrast between the polyp and air, z-axis sensitivity and relative radiation dose. The images were reviewed separately by 2 radiologists who graded polyp conspicuity as 0—polyp not seen, 1—faintly seen, 2—well seen. **RESULTS:** Polyps 7 mm in diameter and above were well seen on all protocols while those 3 mm in diameter and less were not well seen in any circumstances. The 4 mm polyp was well seen only up to 3 mm collimation, pitch 1.7; the range of contrasts from best to worst case was from 600 HU to 180 HU with relative dose of 2:1. **CONCLUSION:** Scanning parameters can be varied to optimize contrast, radiation dose and subjective conspicuity in spiral CT pneumocolon. The optimal parameters will be presented.

### 1225

#### The therapeutic impact of abdominal ultrasound in patients with acute abdominal symptoms

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*Department of Clinical Radiology, Northwick Park and St Marks Hospitals, Harrow HA1 3UJ, UK*

**PURPOSE:** Although the diagnostic capabilities of abdominal ultrasound (AUS) are well described, its direct influence on patient management remains poorly understood. We aimed to determine the therapeutic impact of AUS in patients with acute abdominal symptoms by using a prospective pre- and post-intervention study design and established indices to measure the effects of imaging. **MATERIALS AND METHODS:** 91 consecutive patients with acute abdominal symptoms in whom AUS was being requested were recruited prospectively. Prior to AUS, referring physicians completed a questionnaire detailing reasons for the request, primary and secondary working diagnoses, their level of confidence in these and intended management plans. In the light of AUS findings, physicians completed a second questionnaire that similarly detailed working diagnosis, diagnostic confidence and intended management. Physicians also quantified the direct benefit or otherwise of AUS in each

individual case. Pre- and post-AUS questionnaires were compared and therapeutic impact determined. **RESULTS:** Mean diagnostic confidence scores rose significantly following AUS (pre- vs post-AUS, 6.4 vs 7.8,  $p < 0.0001$ ). Following AUS, working diagnoses were confirmed in 27 (30%), rejected in 37 (40%), provided where previously lacking in 10 (11%) and obscure in 17 (19%). Intended management changed following AUS in 21 subjects (23%); medical treatment became surgical in 6 subjects and surgical treatment became medical in 15. AUS was felt to be of major or moderate benefit in 81 subjects (89%). **CONCLUSION:** This study confirms the anecdotal belief that AUS has major therapeutic impact in patients with acute abdominal symptoms, demonstrating significant effects on both diagnostic confidence and intended management plans.

### 1235

#### Small intestine blood flow in man: the effects of age and caloric loading

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<sup>3</sup>J Pryce, <sup>2</sup>P J A Williams and <sup>2</sup>K D Bardhan

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**INTRODUCTION AND AIM:** Small intestinal ischaemia is uncommon, suggesting the superior mesenteric artery (SMA), its principal blood supply, may be specially protected against age-related changes. However, little is known of gut blood flow in health and in disease. We therefore examined the effect of age on SMA flow, fasting and when stressed with a caloric load. **METHOD:** 10 healthy young volunteers (all men; mean age 27 years) and 10 healthy older volunteers (6 male, 4 female; mean age 72 years) were examined. The SMA flow pattern determined by Doppler studies was assessed fasting, immediately after a 600 Kcal milkshake (757 mOsm l<sup>-1</sup>) and then every 15 min for 1 h, and repeated under identical conditions on a second day. We measured: (1) peak-systolic (PSV) and end-diastolic (EDV) velocity; these reflect SMA flow; (2) the magnitude of peak response after the caloric load and its timing; (3) reproducibility (comparison of Day 1 and Day 2); (4) qualitatively assessed spectral width, reflecting turbulence, which increases with luminal narrowing. **RESULTS:** (1) SMA flow, reflected by PSV and EDV, is similar in the healthy young and old, when fasting and after caloric loading. Median PSV (m s<sup>-1</sup>) (and interquartile range (IQR)) values in young and old, respectively: baseline (fasting) 1.21 (1.06, 1.32), 1.35 (1.07, 1.51); maximum (post-drink) 1.82 (1.61, 2.00), 2.00 (1.64, 2.42); magnitude of peak 0.62 (0.49, 0.83), 0.70 (0.50, 0.91); intraclass coefficient (ICC) of area under curve (AUC), a measure of reproducibility (maximum is 1) (and lower bound of 95% CI), 0.92 (0.77), 0.87 (0.65). Median EDV (m s<sup>-1</sup>) (and IQR) values in young and old, respectively: baseline 0.20 (0.18, 0.21), 0.14 (0.06, 0.25); maximum (post-drink) 0.43 (0.41, 0.52), 0.46 (0.38, 0.54); magnitude of peak 0.23 (0.18, 0.31), 0.32 (0.27, 0.42); ICC of AUC 0.91 (0.75), 0.83 (0.57). (2) Peak response: the magnitude is similar and time-to-peak consistently at 30 min (in 17/20 subjects) and reproducibly so. (3) The day-to-day reproducibility is high. (4) Spectral width is similar in both age groups. **DISCUSSION AND CONCLUSION:** Our method allows for the investigation of SMA blood flow in health and in disease. The early results suggest SMA flow is precisely regulated and apparently "protected" against age-related changes, which may partly explain the rarity of small gut ischaemia.

### 1245

#### The therapeutic impact of CT in patients with acute abdominal symptoms

V J Goh, A Chambers, S Dhillon, A Hassan, S Halligan and D Katz

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**PURPOSE:** The diagnostic capabilities of CT in the acute abdomen are well described but the impact on subsequent clinical management, particularly in the UK, has not been addressed to date. We aimed to prospectively determine the therapeutic impact of CT in a consecutive group of patients with acute abdominal symptoms attending a large district general hospital. **MATERIALS AND METHODS:** Pre- and post-investigation questionnaires were filled in by the referring physicians detailing reasons for the request, primary and secondary working diagnoses, the level of confidence in these and the intended clinical management. The direct benefit or otherwise of CT was also quantified. The questionnaires were subsequently compared and the therapeutic impact determined. To date, 25 patients have been recruited. **RESULTS:** The mean diagnostic confidence score rose from 6.4 to 6.8. The mean difference in diagnostic confidence score rose by 0.76. Following CT, the working diagnosis was confirmed in 6 (24%), rejected in 14 (56%), provided where previously lacking in

4 (16%) and obscure in 1 (4%). Prior to CT, they had hoped to confirm the working diagnosis in 19 cases (76%). Intended management changed following CT in 12 cases (48%): surgical management changed to medical in 7 cases (28%). CT was felt to be of major or moderate benefit in 24 subjects (96%). CONCLUSIONS: This study to date indicates that CT has a positive therapeutic impact in patients with acute abdominal symptoms.

1255

**Ileoscopy marches on! Is it time the barium radiologist found something better to do?**

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**INTRODUCTION:** In patients with suspected or established Crohn's disease (CD), a small bowel barium study (SBBS) is the standard means of imaging the small intestine. However, the accuracy and quality of these studies is variable and the radiation exposure is not insignificant. Ileoscopy at colonoscopy provides an accurate assessment of a variable length of terminal ileum, the most frequent site of inflammation in such patients. **PURPOSE:** The aim of this retrospective study was to determine how often SBBS added additional diagnostic information in patients undergoing ileocolonoscopy for suspected or established CD. **METHODS:** 101 patients with suspected ( $n=77$ ) or established ( $n=24$ ) CD were identified who had undergone both ileocolonoscopy and SBBS within 3 months. In each patient, the findings at ileoscopy and SBBS were compared. **RESULTS:** In patients with suspected CD, ileoscopy revealed abnormalities (aphthoid ulcers and/or Crohn's ileitis) in 16 (20%) cases. Of these, only 2 had abnormalities detected at SBBS. All those with a normal ileoscopy had a normal SBBS. In patients with known Crohn's disease, 18 of 24 (75%) had an abnormal ileoscopy. In 13 of these, SBBS detected the same abnormality but in 5 cases the ileum was considered normal at SBBS. However, in 2 additional cases, SBBS detected structures sited more proximally in the ileum and not seen at ileoscopy. Both patients had obstructive symptoms. **CONCLUSION:** For the exclusion of small bowel CD, SBBS does not appear to add additional information to ileoscopy and can generally be avoided for this reason. In those with known CD, ileoscopy provides complete information in most cases but may fail to detect more proximal disease in those with obstructive symptoms. According to these results, SBBS can be used more selectively, thus avoiding unnecessary radiation exposure.

1305

**A new technique for diagnosing upper gastrointestinal anastomotic leaks**

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**PURPOSE:** At present no "gold standard" radiological technique exists for evaluating the integrity of the post-operative upper gastrointestinal anastomosis. The purpose of this study was to prospectively evaluate the diagnostic accuracy of a technique of 2 contrast swallows and 2 contrast agents in post-gastrectomy patients in comparison with a clinical impression of a post-operative anastomotic leak made by a consultant surgeon. **METHOD:** We have prospectively evaluated 25 patients who have undergone elective gastrectomy for malignancy with 50 contrast swallows at the 5th and 9th post-operative days, using both non-ionic iodinated water-soluble contrast media and barium. Additionally, 2 patients had a 3rd contrast swallow. **RESULTS:** 3 patients had evidence of an anastomotic leak clinically and radiologically. Use of the new technique has helped to reduce diagnostic errors: 1 false positive anastomotic leak was clarified as normal at a Day 9 swallow and a patient with negative Day 5 swallow had an anastomotic leak demonstrated on the Day 9 examination. Routine use of barium has also been helpful; 1 of the 3 anastomotic leaks could only be identified on barium swallow. There was disparity between the clinical and radiological assessment of the anastomosis of 1 patient in whom a leak was not demonstrated despite clinical concern and documented subphrenic sepsis. No asymptomatic leaks were detected. **CONCLUSION:** Therefore, although at the early stages, prospective comparison of clinical and radiological evaluation of post-gastrectomy anastomotic leaks has yielded a superior radiological diagnostic accuracy to most series reported in the literature. The sensitivity of the dual contrast agent swallow technique in our series of post-gastrectomy patients is 86% with a specificity of 98%.

1315

**How reliable are measurements taken during defaecating proctography?**

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**PURPOSE:** To investigate the interobserver and intraobserver variation in the quantitative assessment of various physical parameters measured during defaecating proctography (DPR). **MATERIALS AND METHODS:** 50 female patients with radiologically diagnosed rectoceles who had undergone DPR for a variety of defaecative disturbances were retrospectively reviewed. Blinded, independent assessment of the DPRs was carried out by 2 observers (SHL/IM) for interobserver variation, and follow-up measurements were taken by 1 observer (SHL) to assess intraobserver variation. Measurements taken were anorectal angle (ARA) and anorectal junction (ARJ), at rest and during straining, as well as anal canal width and length and rectocele width and length. **RESULTS:** For each parameter measured, the interobserver and intraobserver agreements were measured statistically and classified as good, fair or poor. In each case, the results for interobserver agreement and intraobserver agreement are presented, respectively. ARA at rest:  $r=0.69$ ,  $p<0.001$  (poor);  $r=0.77$ ,  $p<0.003$  (fair). ARA during straining:  $r=0.09$ ,  $p<0.001$  (poor);  $r=0.62$ ,  $p<0.03$  (poor). ARJ at rest:  $r=0.77$ ,  $p<0.003$  (fair);  $r=0.96$ ,  $p<0.0001$  (good). ARJ during straining:  $r=0.93$ ,  $p<0.001$  (good);  $r=0.96$ ,  $p<0.0001$  (good). Anal canal width:  $r=0.97$ ,  $p<0.0001$  (good);  $r=0.76$ ,  $p<0.0001$  (fair). Anal canal length:  $r=0.69$ ,  $p<0.001$  (poor);  $r=0.88$ ,  $p<0.0001$  (good). Rectocele length:  $r=0.87$ ,  $p<0.001$  (good);  $r=0.86$ ,  $p<0.0001$  (good). Rectocele width:  $r=0.84$ ,  $p<0.001$  (good);  $r=0.95$ ,  $p<0.0001$  (good). **CONCLUSION:** The most accurate and reproducible parameters on DPR measured in this study were those of rectocele length and width. The least accurate measurement was that of ARA. However, it is debatable whether these objective measurements relate in any way to patient symptomatology and/or outcome following treatment. Quantitative findings on DPR should be interpreted with caution and should act only as an adjunct to the patient's history, physical examination and other physiological parameters in determining management.

1325

**Contrast media for radiological evaluation of perforation from the gastrointestinal tract: an experimental and clinical study**

A Z Ginai  
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**PURPOSE:** Perforation or leakage outside the gastrointestinal tract is a very serious event and needs immediate diagnosis and relevant treatment. The contrast medium used to examine the patient should cause no untoward reactions on leakage to lungs, mediastinum, pleura or peritoneum. **METHODS AND RESULTS:** Experimental studies were carried out to determine reactions in the lung, mediastinum, pleura and peritoneum of rats using barium sulphate, oily contrast media, and water-soluble conventional and newer generation lower osmolality iodine-containing contrast media. The results of these studies showed the safety of lower osmolality contrast media in all tissues examined. Therefore, several years ago we began use of sodium and meglumine ioxaglate (Hexabrix) for evaluation of patients with suspected perforation or leakage. We have carried out more than 3000 examinations of the upper gastrointestinal tract, mainly the oesophagus, with Hexabrix and have found no untoward effects related to the use of this contrast medium. **CONCLUSION:** Lower osmolality ionic or non-ionic contrast media are safe for the radiological evaluation of upper gastrointestinal tract perforation or leakage.

1335

**Discussion**

1230-1430

**Radiographic Reporting  
Hall 8**

1230

**Invited Review  
Radiographic reporting—a radiologist's perspective**

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- With increasing levels of expertise and experience, radiographers could firstly undertake a red dot system, secondly issue descriptive

reports, thirdly interpret the findings in terms of pathology and lastly make specific comments regarding the significance of the findings in the individual patient.

- Radiographers can achieve all of these levels given appropriate ability, motivation and training.
- Assessment of the performance of reporting radiographers might be done by showing that a large sample of their reports was indistinguishable from the reports of radiologists viewing the same image data.
- The training of radiographers for reporting requires considerable financial investment, and although in theory savings should be realized introducing radiographer reporting, those departments which have done so have not yet been able to demonstrate realistic savings.
- Radiographers reporting within a written scheme of work agreed as policy by the imaging department and accepted by the employing NHS Trust or authority will qualify for professional indemnity by the employer. However, the GMC guidelines on delegation indicate that the reporting radiographer is responsible for his/her own performance.
- Radiographers undertaking new clinical roles should press for improved career structures to recognize their increased levels of responsibility.

## 1250

### Invited Review

#### Radiographic reporting—a radiographer's perspective

A M Paterson

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The Royal College of Radiologists maintains that a report comprises 2 components which may be summarized as, firstly, a description of the technical findings and secondly, a medical interpretation. However, this view was formulated prior to the implementation of systems of plain film reporting by radiographers (although, interestingly, in the light of many years of ultrasound reporting by sonographers). The focus of this contribution to the debate is that there should not be differences in the nature of reports according to the discipline of the reporter as this is unhelpful to those receiving and using reports. Nevertheless, it is postulated that the differences in the base disciplines of reporters are significant in relation to how the images and the background information are used in the promulgation of reports. Radiologists learn reporting skills after their general medical education while radiographers learn them after their radiographic education. In broad terms, it is likely that radiologists are driven by the clinical perspective with the images as secondary, while radiographers are influenced much more by the imaging process and the resultant images. In terms of providing a comprehensive reporting service, it is no longer appropriate to argue about who provides reports. Emerging evidence shows that radiographers are as capable as radiologists of producing accurate reports, at least in the field of plain film accident and emergency skeletal examinations. Rather, the debate should evolve to consider the nature and content of reports in some detail and to set standards for reports and reporting against which practice may be audited.

## 1310

### Discussion

## 1330

#### The accuracy of the red dot: will it improve training?

J S Hargreaves and S MacKay

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**PURPOSE:** This study aims to investigate whether the introduction of a training programme for radiographers, covering the basic principles of pattern recognition and fracture detection, can increase their accuracy of use of the red dot system. **METHOD:** The red dot system is used in trauma radiology to highlight clinically important abnormalities for the casualty officer. For a period of 8 weeks, 7 radiographers were monitored with respect to their sensitivity, specificity and accuracy of use of the red dot. These radiographers were then given a 10 week training programme in the basic principles of trauma radiology. Their sensitivity, specificity and accuracy were again monitored for a period of 8 weeks following the training. **RESULTS:** The accuracy of the radiographers as a group increased from 89.7% before the training to 92.3% after. Their sensitivity for fracture detection increased from 72.1% to 80.8%. Their specificity for fracture exclusion decreased slightly from 96% to 95.5%. **CONCLUSION:** Training can have an overall positive effect on the use of the red dot system within the radiology department.

## 1340

#### Has radiography outgrown the red dot?

B A Snaith

*Doncaster Royal Infirmary, Medical Imaging Department, Armthorpe Road, Doncaster DN2 5LT, South Yorkshire, UK*

**PURPOSE:** The concept of radiographers reporting trauma radiographs has become accepted practice, but has it actually impacted on immediate patient care in the A&E department? Or, is the red dot scheme still the best mechanism of alerting the referring clinician to abnormal appearances? This prospective study aimed to establish whether all radiographers within a district general hospital could be trained to provide immediate written opinions on skeletal trauma referrals, and whether this could successfully replace the red dot scheme in practice. Its eventual goal would be to ensure prompt, accurate diagnosis and correct treatment at the time of injury. **METHOD:** A 3 day in-house training course in trauma pattern recognition was implemented. Following its completion 32 radiographers took part in the study. For each skeletal trauma referral, a trained radiographer completed a written opinion on a pre-printed form indicating his/her assessment of radiographic appearances. The form was returned with the radiographs to the referring clinician for their information, but was separated from the radiographs prior to their eventual reporting in the imaging department. Over a 4 week period the forms were collated and analysed, comparing the opinion with the clinical report. **RESULTS:** 1370 forms were collated and, of these, 1021 received a clinical report. An accuracy level of 94.4%, sensitivity of 90% and specificity of 95.9% were achieved. The interobserver agreement demonstrated a kappa value of 0.85. **CONCLUSION:** Although the opinion could never replace the clinical report on content or accuracy, it does provide a very useful mechanism for the second reading of radiographs, both to A&E and the author of a final clinical report. The results prove the value of this initiative and its justification in replacing the red dot scheme.

## 1350

#### The role of preliminary interpretation of surgical chest radiographs by radiographers in a cardiothoracic centre

A D Tasker, E Sonnex and R A Coulden

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**PURPOSE:** A prospective study using the red dot system to assess the role of the radiographer in the preliminary interpretation of surgical chest radiographs (CXR) in a cardiothoracic centre. **MATERIALS AND METHODS:** Radiographers were asked to assess all pre- and post-operative surgical CXRs performed over a 6 month period. A protocol was developed and the radiographers given initial training in radiograph interpretation by a series of lectures which became a rolling programme for the benefit of new staff. A red dot was placed on films showing new, acute changes that may require urgent medical attention. Findings that were unchanged from the previous film and common post-operative changes were not included. The films were subsequently reported by a radiologist and using this as the "gold standard" an audit was performed of the radiographer's accuracy. Cases where a red dot should have been used and inappropriate use were also noted. **RESULTS:** Of 8614 CXRs taken, 464 (5%) were "red-dotted" as showing new and acute changes. Of these, 100 were considered to be incorrectly "red-dotted". The radiographers misinterpreted or missed potentially acute changes in 38 of the remaining 8150 films, giving a sensitivity and specificity of 90% and 99%, respectively. The most common cause for an incorrect red dot was a film showing no significant change. **CONCLUSION:** Interpretation of CXRs can be difficult. Experienced radiographers in our institution achieved a high sensitivity and specificity in film interpretation. The radiographers' opinion is valuable and has a role to play in contributing to the initial management of patients.

## 1400

#### Bone age estimation—another application for radiographer skill mix?

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*Department of Radiology, Princess Margaret Hospital, Swindon SN1 4JU, UK*

**INTRODUCTION:** Bone age estimations in busy district general hospitals are often shared by several non-specialist radiologists. The task is relatively infrequent and can be time consuming. Consequently, no single radiologist becomes fully adept. We explore the supervised delegation of this duty to a dedicated radiographer, trained in estimation using the Greulich and Pyle method, and compare the results with those of the consultant radiologists. **PURPOSE:** To determine how the radiographer-performed

estimations compare with those of the radiologists. **MATERIALS AND METHODS:** Over a 1 year period, 84 consecutive cases were estimated by a trained radiographer and independently by a consultant general radiologist. Where there was disagreement, blinded arbitration was sought from another radiologist. **RESULTS:** In 90% of cases, the radiographer was confident of the estimation and had a concordance rate with the radiologists of 96.4%. The remaining 10% of cases were recognized by both the radiologist and radiographer as difficult. This was due largely to asymmetrical development. In this group, agreement was only achieved following discussion between the radiologist and the radiographer. **CONCLUSION:** When confident of the estimation, the radiographer showed a high degree of concordance with the radiologist. In difficult cases, decisions based upon consensus are advised.

**1410**

**Evaluation of a technical reporting course for technologists**

K G Holmes and G Vivian  
*School of Radiography, University of the West of England, Bristol BS16 1DD, UK*

In 1999 the University of the West of England in Bristol began the first postgraduate technical reporting module for technologists employed in nuclear medicine. The module's aims include the development of the clinical skills of the practitioner enabling them to describe, discuss and evaluate radionuclide imaging procedures, within a framework of ethical, legal and management issues fostering effective, rational decision-making. It also aims to recognize the professional barriers that may cause inhibition of this process. Assessment was by logbook, objective structured clinical examination (OSCE) and an assignment "Discuss the extended role of the technologist in the light of clinical governance". This paper explores the results of the first cohort of students. All students successfully completed the OSCE with a range of marks from 80% to 95%. This compared favourably with a logbook that compared the students' reports with a supervising radiologist mentor. In all, the cohort of students undertook 2612 examinations on which they produced a technical report. Overall agreement with their mentor was 96% with a range from 88% to 99% agreement for lung, renal and bone scans. The results from this module demonstrate that appropriately trained technologists can undertake technical reporting to a high level of agreement with their medical colleagues. While most students will not report studies alone, all identified that the module enhanced their professional practice and procedures. Double reporting scans would result in more timely and accurate reports and improve patient management.

**1420**

**Plain radiograph reporting: is performance improved when radiologists are shown their errors?**

G R Tudor and D B Finlay  
*Department of Radiology, Leicester Royal Infirmary, Leicester LE1 5WW, UK*

**PURPOSE:** This study was designed to assess whether radiologists improve their performance when re-reporting a series of plain radiographs after being shown their errors. **METHOD:** 10 consultant radiologists reported 50 plain radiographs, where the diagnoses had been established. 32 of the radiographs showed an abnormality; 18 were normal. The radiologists were then shown their errors. After an interval of 4 to 5 months (to reduce recall bias) the radiologists then re-reported the series of radiographs. The same clinical information was available on both occasions. The accuracy of the reports to the established diagnoses was assessed.  $\chi^2$  test was used to calculate the difference between the viewings. **RESULTS:** Re-reporting the series of radiographs, after being shown their errors, 7 radiologists improved their accuracy score. 1 showed no change and 2 a lower score. Pre-education mean accuracy was 82.2% (range 78–92), post-education mean accuracy was 88% (range 76–96). Individually, 2 of the radiologists showed a statistically significant improvement post-education ( $p < 0.01$ ,  $p < 0.05$ ). Assessing the group as a whole, there was a trend for improvement in accuracy post-education, however this did not reach statistical significance. Assessing only the radiographs where errors were made on the initial viewing for the group as a whole there was a 63% improvement post-education. **CONCLUSION:** We suggest radiologists should be shown their errors, as there was a trend for improvement post-education, although this did not reach statistical significance for the group. This is partly explained by the fact that some radiologists gave incorrect responses post-education that had initially been correct.

**1300–1430**

**Multislice CT—On To The New Plateau?**

**Hall 11a**

**1300**

**Invited Review**

**Principles and applications of multislice CT**

<sup>1</sup>T Flohr, <sup>1</sup>B Ohnesorge, <sup>1</sup>S Schaller, <sup>1</sup>K Klingenberg-Regn, <sup>2</sup>C Becker, <sup>2</sup>U J Schöpf, <sup>2</sup>R Brüning and <sup>2</sup>M F Reiser  
*<sup>1</sup>Siemens Medizinische Technik, Forchheim and <sup>2</sup>Klinische Radiologie, Klinikum der Universität München, Großhadern, Germany*

**PURPOSE:** Technical principles and applications of multislice CT are presented. **METHODS:** Multislice CT systems allow simultaneous acquisition of up to 4 slices by using multirow detector systems. **RESULTS AND DISCUSSION:** Geometrical arguments are used to establish the limitation to a maximum of 4 slices to which all currently existing multislice CT systems comply. Two different detector principles are discussed, the "Fixed Array" detector and the "Adaptive Array" detector. Two different spiral interpolation techniques are compared: the extension of conventional 360LI and 180LI spiral interpolation techniques to multislice spiral CT, which leads to certain disadvantages, and a new generalized multislice spiral weighting concept, the so-called "Adaptive Axial Interpolation". Several techniques to improve multislice spiral image quality are discussed, with special emphasis on the "narrow collimation" technique. Finally, some examples for clinical applications are given, and the principle of ECG-triggered and ECG-gated cardiac examinations with optimized temporal resolution is presented. **CONCLUSION:** Multislice CT systems are a milestone with respect to increased volume coverage, shorter scan times, improved axial (longitudinal) resolution and better use of the X-ray tube output.

**1320**

**Invited Review**

**Multirow CT in the chest: is the hype justified?**

R A Coulsen  
*Department of Radiology, Papworth Hospital, Cambridge CB3 8RE, UK*

CT, by its very nature, is a transaxial imaging technique. Since the advent of MRI, which is truly multiplanar, CT has been at a significant disadvantage. Conventional spiral CT addressed this in part by allowing small volumes of tissue to be imaged as thin contiguous sections. These could be reconstructed in any plane with z-axis resolution limited only by slice thickness. For practical purposes, however, adequate z-axis coverage requires a disproportionately large slice thickness and voxels are far from isometric. The combination of multirow scanning with a faster gantry rotation speed has been a major step forward. Volume data for an entire chest can now be obtained in a 20 s breath-hold with z-axis resolution of 1 mm. As voxels become more isometric, the multiplanar and volume imaging techniques so widely used with MRI are equally applicable with CT. The technology is too new for there to be a significant body of literature detailing advantages and disadvantages but the areas of potential are clear.

- Greater accuracy in sizing mediastinal masses and defining their relationship to adjacent anatomical structures.
- Surgical planning, particularly for those less familiar with transaxial imaging.
- Imaging structures lying largely in the transaxial plane (*i.e.* diaphragm, lung apex and middle lobe/lingular bronchi and vessels).
- CT angiography of the pulmonary arteries, aorta and great vessels.
- Cardiac imaging.
- Cardiac anatomy and ? function.
- Proximal coronary arteries, grafts and coronary artery calcification.
- Increased patient throughput. ? improved utilization of intravenous contrast media.

As with all new technologies there are disadvantages. Huge numbers of images are generated, creating problems for reporting, filming and archive. Softcopy review is essential and workstations need to be faster to speed up data transfer, display and post-processing. Multiplanar format, MIP reconstruction and volume rendering are likely to be increasingly important and must be quick if they are to become a standard part of every examination.

TUESDAY

1340

**Invited Review****Abdominal multislice CT**

N R Moore

*Department of Radiology, University of Oxford, Oxford  
OX3 9DU, UK*

- Advantages of multislice CT: speed and flexibility of acquisitions; opportunities for improved lesion characterization; superb vascular studies using CT angiography; improved assessment of poly-trauma cases.
- Cautionary notes: radiation dosage with uncontrolled use ("Just another spiral").

1400

**Invited Review****Increasing repertoire? Pros and cons**

A K Dixon

*Department of Radiology, University of Cambridge and  
Addenbrookes's Hospital, Cambridge CB2 2QQ, UK*

- Increased data: particularly useful cardiovascular and abdominal applications.
- Detailed volume acquisition will replace subjective physical examination.
- Increasing use for abdominal emergencies (e.g. FACT).
- Increased demand and eventually increased throughput.
- Possible overall increased radiation dose to the public.
- Probable overall increased cost.

1415

**Discussion**

1315–1400

**British Institute of Radiology  
Silvanus Thompson Memorial  
Lecture**

Hall 5

1315

**Eponymous Lecture****Cancer treatment for a new century—non-invasive  
focused ultrasound ablation of tumours**

G R ter Haar

*Physics Department, Institute of Cancer Research and Royal  
Marsden Hospital, Sutton, Surrey SM2 5PT, UK*

The quest for cancer treatments into the new century will continue to be for those that are not only effective, but also non-invasive in application, with low toxicity to normal tissues. High intensity, focused ultrasound appears to fulfil these requirements. An ultrasound beam is brought to a tight focus in the target tumour volume. When sufficient energy is applied, all cells lying within the focal volume are killed while those outside survive. There is a sharp boundary between viable and non-viable cells (~10 cells wide). The mechanism for cell killing is primarily thermal, temperatures in excess of 60°C being achieved during the 1 s exposure. For the majority of applications, this technique is non-invasive, the source of ultrasound being outside the body. It can also be applied via an intracavitary probe and its potential for the treatment of benign prostate hyperplasia via a transrectal applicator has been explored. Focused ultrasound is currently under investigation for use in the treatment of cancer. A Phase I trial at the Royal Marsden Hospital is nearing completion. Treatment of soft tissue tumours of organs which include the prostate, liver and kidney has shown it to well tolerated, with no significant side-effects. The patients are not anaesthetized or sedated. A Phase II study for the treatment of liver metastases is now underway. Focused ultrasound surgery is an exciting technique that offers the promise of non-invasive outpatient treatments for deep-seated human tumours. There are also exciting potential non-cancer applications.

1400–1500

**Studies in MRI**

Hall 6

1400

**Calculating diagnostic performance from categorical  
data: observations from a systematic review of MR  
angiography**

<sup>1</sup>M E Westwood, <sup>1</sup>S Kelly, <sup>1</sup>E Berry, <sup>1</sup>J Cullingworth, <sup>1</sup>J Meaney, <sup>1</sup>J Bamford, <sup>1</sup>M J Gough, <sup>2</sup>M Airey, <sup>3</sup>A Jackson and <sup>1</sup>M A Smith  
<sup>1</sup>Centre of Medical Imaging Research and NHS Leeds Teaching  
Hospitals Trust, University of Leeds, Leeds, <sup>2</sup>Nuffield Institute for  
Health, Leeds and <sup>3</sup>Diagnostic Radiology, University of  
Manchester, Manchester, UK

**PURPOSE:** To assess the quality of articles on the diagnostic performance of MR angiography (MRA) in carotid artery stenosis. **METHODS:** As part of a systematic review, a search of MEDLINE (1990–present) was conducted for MRA and related terms. A search filter for diagnostic performance and carotid arteries was used. Pre-defined exclusion criteria were applied and validity assessed. **RESULTS:** Of 106 references, 63 were excluded. A further 15 articles were excluded as data needed to construct a 2 × 2 table were unavailable (10) or performance was not reported (5). The remaining 28 articles lacked consistency in grading stenoses, with over 50 different categories used. Sensitivity and specificity were calculated incorrectly in 5 articles, and 7 did not clearly define the calculation criteria. In the 16 remaining articles, the criteria used to define sensitivity and specificity fell into 3 groups: 11 used a dichotomy of the full range (0–100% stenosis), 3 assigned a positive diagnosis to a discrete mid-range, and 4 used a dichotomy of a truncated range. The 3 approaches were not comparable and applied to different clinical decisions. **CONCLUSION:** The meta-analysis of diagnostic performance is complex where results may be defined in multiple categories. 2 possible variations can occur; the choice of categories and the criteria used to calculate performance. Researchers should ensure that the clinical question is precisely defined at the outset of the study, to avoid misleading calculations and minimize heterogeneity in the literature. Standard categories, such as NASCET or ECST, should be used where applicable and clearly reported alongside diagnostic criteria.

1410

**A prospective study of CT angiography and MR  
angiography vs DSA in the detection of intracranial  
aneurysms**<sup>1,2</sup>P M White, <sup>1</sup>J M Wardlaw, <sup>2</sup>E Teasdale and <sup>1</sup>V Easton

<sup>1</sup>Department of Clinical Neurosciences, Western General  
Hospital, Edinburgh EH4 2XU, UK and <sup>2</sup>Department of  
Neuroradiology, Institute of Neurosciences, Southern General  
Hospital, Glasgow G51 4TF, UK

**PURPOSE:** To prospectively compare, in a cohort of patients, CT angiography (CTA) and MR angiography (MRA) in the detection of intracranial aneurysms against the reference standard (IADSA). **MATERIALS AND METHODS:** Patients aged 18–75 years undergoing IADSA for the detection of an aneurysm (post-SAH or people at risk of an aneurysm) were eligible for inclusion. Subjects underwent CTA and 3D TOF-MRA close to time of angiography. 147/183 patients underwent all 3 tests. Independent, blinded review of the angiogram by 2 neuroradiologists was used as the reference standard, with disagreements resolved by consensus review. 2 neuroradiologists, blinded to the IADSA, CT and clinical data, independently reviewed base and reconstructed MIP images of the CTA and MRA studies from hard copy. **RESULTS:** 5/147 patients did not complete MRA and were excluded. Accuracy per patient was 0.87 (95% CI 0.81–0.92) for CTA and 0.85 (0.78–0.91) for MRA. Overall accuracy per aneurysm (for all aneurysms) was 0.73 (0.66–0.79) for CTA and 0.67 (0.6–0.74) for MRA. Differences between readers were not statistically significant. Interobserver agreement was good (kappa 0.74 for CTA, 0.73 for MRA). Small aneurysms were poorly detected: size <3 mm, sensitivity=0.46 (0.26–0.67) for CTA and 0.29 (0.13–0.51) for MRA; 3–5 mm, sensitivity=0.67 (0.52–0.8) for CTA and 0.38 (0.28–0.53) for MRA; >5 mm, sensitivity=0.94 (0.81–0.99) for CTA and 0.89 (0.74–0.97) for MRA. **CONCLUSION:** CTA and MRA have limited sensitivity in the detection of small aneurysms. For other aneurysms, sensitivity is significantly greater. Interobserver agreement is good with no significant difference in diagnostic performance between the non-invasive modalities.

TUESDAY

1420

**High resolution *in vivo* MRI of carotid atheroma**

<sup>1</sup>M J Graves, <sup>2</sup>H J Flick, <sup>3</sup>A N Priest, <sup>1</sup>R A R Coulden and <sup>1</sup>D J Lomas

Departments of <sup>1</sup>Radiology, <sup>2</sup>GE Medical Systems and <sup>3</sup>Medical Physics, University of Cambridge and Addenbrooke's Hospital, Cambridge CB2 2QQ, UK

**PURPOSE:** The assessment of atherosclerotic plaque burden may be an important indicator of lesion vulnerability. MRI offers a number of advantages in studying atherosclerosis but the spatial resolution and image quality issues are very demanding. We have, therefore, developed a dedicated surface coil and optimized MR pulse sequences for high resolution *in vivo* imaging of the carotid bifurcation. **MATERIALS AND METHODS:** We have utilized a custom designed and constructed flexible, 4 element, phased array coil for bilateral imaging of the carotid bifurcation (GEMS, The Netherlands). Morphological images were acquired on a 1.5 T imaging system (Signa Horizon CV/i, GE) using an optimized, ECG-gated, fast spin echo (FSE) imaging sequence with blood suppressed preparation (BSP). Contiguous, thin (3 mm), axial slices were acquired with a field-of-view of 60 × 60 mm and an acquisition matrix of 256 × 256. (Voxel size: 234 μm × 234 μm × 3 mm.) With 2 signal averages, each image took approximately 1 min to acquire. Image quality was optimized by investigation of the effects of changes in echo train length (ETL), echo spacing (ESP) and effective TE. Fat suppression techniques were also studied. **RESULTS:** Results from normal volunteers and patients with atheroma clearly show that the combination of a dedicated coil and optimized FSE imaging sequences produce high quality images of the carotid lumen, vessel wall and atherosclerotic plaque. **CONCLUSION:** High resolution blood suppressed FSE imaging has potential application in the serial investigation of lesion growth and in studies that require accurate determination of lesion size.

1430

**Evaluation of the safety and efficacy of gadobenate dimeglumine in MRI of CNS metastatic disease**

<sup>1</sup>G Cherryman, <sup>2</sup>A La Noce, <sup>1</sup>I Salerio, <sup>2</sup>M Kirchin, <sup>2</sup>G Pirovano and <sup>2</sup>A Spinazzi

<sup>1</sup>Department of Radiology, University of Leicester Faculty of Medicine, Leicester Royal Infirmary, Leicester LE1 5WW, UK and <sup>2</sup>Medical & Regulatory Affairs, Bracco Spa, Via E. Folli 50, 20134 Milano, Italy

**PURPOSE:** To evaluate the safety and efficacy of incremental doses of gadobenate dimeglumine (Gd-BOPTA) (MultiHance) for the MR detection of CNS metastatic lesions. **MATERIALS AND METHODS:** A Phase II randomized, double-blind, parallel-group study of two incremental dose regimens of Gd-BOPTA (regimen 1: 0.05+0.05+0.1 mmol kg<sup>-1</sup> or regimen 2: 0.1+0.1+0.1 mmol kg<sup>-1</sup>) was performed in 150 patients with 1 to 8 proven intraaxial metastatic lesions to the CNS. Efficacy was assessed quantitatively by an unaffiliated neuroradiologist in terms of changes in lesion-to-brain (L-B/B) ratio and per cent enhancement of lesion signal intensity and qualitatively by 2 blinded off-site neuroradiologists in terms of number and size of lesions detected, diagnostic confidence and lesion conspicuity. Safety was assessed in terms of adverse events, vital signs, ECGs and laboratory parameters. **RESULTS:** Cumulative dosing in both regimens produced a significant dose-related increase in L-B/B ratio and per cent enhancement. The first doses of the 2 regimens led to the detection of additional lesions compared to pre-contrast in 22–29% (regimen 1) and 31–33% (regimen 2) of patients. Contemporaneously, diagnostic confidence was increased and lesion conspicuity improved over unenhanced MRI. Cumulative dosing in both regimens led to significant improvements in all qualitative parameters. No safety concerns were apparent up to a dose of 0.3 mmol kg<sup>-1</sup>. **CONCLUSIONS:** Gd-BOPTA-enhanced MRI is safe and of clear utility for the detection of brain metastases. Overall, an initial dose of 0.1 mmol kg<sup>-1</sup> followed, when necessary, by a second dose of 0.1 mmol kg<sup>-1</sup>, appears to provide better results in terms of lesion detection and diagnostic confidence.

1440

**Observations on the interaction between paramagnetic contrast media and the myometrium**

<sup>1</sup>A van Tulleken, <sup>1</sup>S Golding and <sup>2</sup>S Kennedy

Departments of <sup>1</sup>Radiology and <sup>2</sup>Obstetrics and Gynaecology, University of Oxford, Oxford OX3 9DU, UK

**PURPOSE:** To explore factors affecting myometrial uptake of paramagnetic contrast media, observed in previous studies, in pursuit of evaluating the role of MRI in the investigation of subfertility. **MATERIALS AND METHODS:** 10 uteri obtained following hysterectomy were examined *in vitro*. A simple and robust technique

was developed to expose sections of myometrium to Gd-DTPA (Magnevist, Schering) diluted to 1.25 mmol l<sup>-1</sup> under a range of pressures. Uptake of contrast medium into the myometrium was investigated by serial time base MRI scanning. **RESULTS:** The findings confirmed that contrast medium permeates the myometrium by a method not yet determined. The uptake seen in this study did not reflect that seen in previous experiments and suggests that several mechanisms may operate. The results suggest that uptake is not intracellular and suggests permeation via vessels. **CONCLUSION:** Further research on the relationship between the myometrium and paramagnetic contrast media is required before the technique can be used widely *in vivo*.

1450

**Breath-hold MRI diagnosis of arrhythmogenic right ventricular dysplasia**

I Joubert, M J Graves, R A R Coulden and D J Lomas

Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge CB2 2QQ, UK

**PURPOSE:** To demonstrate arrhythmogenic right ventricular dysplasia (ARVD) with breath-hold, fat and blood suppressed, fast spin echo (FSE) MRI. **MATERIALS AND METHODS:** Images were obtained in 8 patients with suspected ARVD using an ECG-gated FSE sequence with blood suppression preparation (BSP) on a 1.5 T imaging system (Signa CV/i, GE). A dedicated cardiac phased array coil was used to obtain images in the short axis view encompassing the right ventricle. Fat suppression was performed using both short tau inversion recovery (STIR) and chemical shift selective fat saturation. The sequence parameters were: ETL=32, acquisition matrix=256 × 192 with 1NEX. The effective TE was 44 ms and the TR was set to 2 × R-R, giving a total breath-hold acquisition time of 12 heartbeats per slice. A 62.5 kHz bandwidth was used to keep the interecho spacing (ESP) short. A field of view (FOV) of 34–38 cm and a slice thickness of 5 mm with an interslice gap of 5 mm was used. Slices at the same position with the same acquisition parameters were repeated with the 2 fat suppression methods. **RESULTS:** A conclusive diagnosis was made with all 8 patients scanned. There were 4 positives and 4 negatives. The images also allowed determination of whether the patients had partial or full adipose displacement of the myocardium. **CONCLUSION:** Breath-hold, fat suppressed BSP-FSE imaging is a rapid and highly effective method of diagnosing ARVD.

1400–1600

**New Approaches to Imaging in GI Malignancy: Tumour and Normal Tissue Effects**

Hall 11b

1400

**Invited Review**

**Imaging the pelvis and abdomen following treatment of cancer**

R J Johnson

X-Ray Diagnostic, Christie Hospital NHS Trust, Manchester M20 4BX, UK

- Imaging for cancer follow-up is of equal importance to imaging for diagnosis and staging of malignancy.
- Imaging permits evaluation of therapeutic response by measuring changes in tumour volume and tumour composition.
- Surgery, chemotherapy and radiation all induce changes in normal tissues.
- Significant radiation damage occurs in 5–10% of patients and is divided into acute, subacute and chronic reactions.
- Clinically significant damage most frequently occurs in the gastrointestinal and genitourinary tracts.
- Distinction of radiation damage from recurrent tumour relies on morphological appearances on CT, ultrasound and MRI. Signal intensity changes on MRI may be helpful but considerable overlap occurs.
- Positron emission tomography and monoclonal antibody imaging may have a role in the detection of recurrent tumour.
- Second malignant neoplasms are a consequence of the long-term survival now being seen in children and some adults who have been treated for cancer.

TUESDAY

1425

**Invited Review**

**Late effects of radiotherapy on bowel: clinical practice**

D M Tait

*Department of Radiology, The Royal Marsden NHS Trust, Downs Road, Sutton, Surrey SM2 5PT, UK*

The following points will be discussed:

- The extent of the problem: incidence and time scale.
- Dose-volume effects.
- Enhancing factors: patient, tumour, treatment.
- Diagnosis.
- Management: surgical, potential non-surgical approaches.
- Prevention.

1450

**Invited Review**

**The role of MR in functional studies of cancer**

A S K Dzik-Jurasz

*Clinical MR Research Group and Academic Department of Radiology, NMR Unit, The Royal Marsden Hospital, Downs Road, Sutton, Surrey SM2 5PT, UK*

- Conventional radiological tumour morphology does not always reflect the biological behaviour of a neoplasm.
- Functionally, a tumour presents a constantly changing micro-environment modulated significantly by anticancer treatment.
- Functional MR can either be image or spectroscopy based. As a result, functional MR is sensitive to biophysical, metabolic and angiogenic aspects of tumours and can be used to search for novel measures of treatment response, address questions of tumour biology and assess tumour and related drug metabolism.
- Integrating available functional MR modalities provides a new approach to the study and management of cancer.
- Some aspects of functional tumour imaging, particularly in relation to tumour vascularity, is of benefit as an adjunct to conventional MRI studies. Currently the majority of functional techniques available for use in humans remain experimental tools.

1515

**Invited Review**

**The role of CT in the acute complications of gastrointestinal malignancy**

J A Spencer

*Department of Clinical Radiology, St James's University Hospital, Leeds LS9 7TF, UK*

This lecture will cover the use of CT in the diagnosis of:

- Obstruction of the small and large bowel.
- Gastroduodenal obstruction.
- Localized (sealed) and free perforation of malignant GI tumours.
- Infectious complications of GI malignancy and its treatment.
- Problems of patient preparation for CT examination.

1540

**Discussion**

1400–1500

**3D Imaging 2  
Olympian Suite**

1400

**Invited Review**

**Clinical applications of 3D CT in relation to surgical support**

S R Watt-Smith

*Oxford Radcliffe NHS Trust, John Radcliffe, Headington, Oxford OX3 9DU, UK*

- 3D image presentation: static; rotating; screen surgery; archiving.
- Diagnosis: trauma; tumour extension.
- Teaching: surgical anatomy; surgical technique.
- Model making: customised prostheses; templates; bone plates.

1425

**Invited Review**

**Post-processing and 3D models in staging pancreatic carcinoma with CT and MRI. Presentation of research, clinical work and technology**

J T Geitung

*Department of Radiology, Ullevaal University Hospital, Oslo, Norway*

- It is important to achieve an absolute optimum regarding radiological staging. It is also important to avoid unnecessary operations, both for patient and for the hospital.
- To achieve this, we have performed CT and MRI, and undertaken a prospective investigation of the results, comparing the results with those of surgery. The results are encouraging.
- CT, MRI, MRCP and MR angiography of all patients provided an excellent basis for clinical evaluation, research and teaching of residents.
- The presentation will give an overview of scientific data and how to use the radiological tools clinically, and will show how we perform our conferences around a post-processing unit.
- Cases will be presented to demonstrate the teaching potential of the models. Direct comparison of 3D CT, 3D MRI, video from the operating theatre and histological samples may be used for teaching residents, students and colleagues. The presentation is intended as a "how to" demonstration for radiologists and, even more importantly, to demonstrate the usefulness for clinicians of receiving 3D and multiplanar reconstructions when performing surgery.

1450

**Discussion**

1430–1515

**Luminary Lecture 4  
Hall 5**

1430

**Invited Review**

**High resolution CT of obstructive lung disease**

N L Müller

*Department of Radiology, Vancouver Hospital and Health Sciences Centre, University of British Columbia, Vancouver, BC, Canada*

The aim of this lecture is to summarize the high resolution CT (HRCT) manifestations of some of the most common diseases associated with airway obstruction. These include various forms of bronchiolitis (small airway diseases), bronchiectasis, asthma and emphysema.

Inflammation of the bronchioles (bronchiolitis) results in 2 main types of abnormalities on HRCT: those resulting from thickening of the bronchiolar wall by inflammation and those resulting from obstruction of the bronchiolar lumen. Thickening of the bronchiolar wall, if severe, or when associated with intraluminal secretions, may be identified on HRCT as centrilobular linear or branching opacities when seen along the long axis or as centrilobular nodular opacities when seen in cross-section. Obstruction of the bronchiolar lumen by inflammation or fibrosis leads to reflex vasoconstriction, decreased attenuation and airtrapping. Blood flow redistribution to uninvolved lung leads to a pattern of mosaic attenuation and mosaic perfusion. The HRCT findings of bronchiectasis include bronchial wall thickening, bronchial dilatation, the so-called "signet ring" sign and the visualization of bronchi abutting the mediastinum or within 1 cm of the parietal pleura. Asthma is a disease characterized by hyperresponsiveness of the tracheobronchial tree to a multiplicity of stimuli. Findings on HRCT include bronchial wall thickening, mosaic attenuation, airtrapping and narrowing or dilatation of the bronchial lumen. Allergic bronchopulmonary aspergillosis, a condition seen almost exclusively in patients with asthma, is characterized by the presence of bronchiectasis which is characteristically central in distribution (involving segmental and subsegmental bronchi), and by the presence of mucoid impaction. Emphysema can be readily recognized on HRCT by the presence of areas of abnormally low attenuation without definable walls. The main indication for performing CT in emphysema is in the pre-operative assessment of patients being considered for lung volume reduction surgery. Patients who have severe emphysema with a predominantly upper lobe distribution and relative sparing of the lower lobes have a better outcome after lung volume reduction surgery than patients with diffuse emphysema or patients with predominantly lower lobe involvement.



## 1445–1515 College of Radiographers Presidential Address Hall 8

1445

### Interesting times

J Reid

*Ysbyty Gwynedd Hospital, Bangor, UK*

No abstract.

## 1445–1700 What You Should Be Doing About Clinical Governance Hall 11a

1445

### Invited Review

#### What is clinical governance?

R A Nakielny

*Department of Radiology, Central Sheffield University Hospitals,  
Royal Hallamshire Hospital, Sheffield S10 2JF, UK*

- Definition: corporate responsibility for improving quality.
- Operational framework: NICE (national standard setting); clinical governance (local accountability for quality); CHI (external monitor of compliance standards).
- Essential components of clinical governance: departmental organization; staff training; risk management; patient/user experience.

1505

### Invited Review

#### Clinical governance: the RCR view

P Armstrong

*Royal College of Radiologists, London W1N 4JQ, UK*

- The presentation will concentrate on national aspects of clinical governance.
- Major RCR publications of relevance to clinical radiology include: A Good Practice Guide; advice on manpower; various guidelines; "Audit Recipe Book" for local audits (in preparation).
- The RCR has set up a Clinical Radiology Service Review Committee to advise Trusts when clinical governance issues arise.
- The RCR has developed the CIRIS software program (Dr Peter Torrie).

1525

### Invited Review

#### Clinical governance

A Hackett

*NHS Executive, Department of Health, London SW1A 2NS, UK*

- Guidance on clinical governance— "Clinical Governance: Quality in the New NHS"—was issued on 16 March 1999.
- Clinical governance provides NHS organizations and health care professionals with a framework for quality improvement which, over the next 5 years, will develop into a single, coherent local programme for clinical quality improvement.
- Clinical governance is still in the early stages of development. The cultural change it requires will take at least 5 years to mature. However, there have been some early successes.
- It has been almost universally endorsed as the "right thing to do". Doctors and all other professions working in health have welcomed the focus on clinical quality.
- Given the developmental nature of the clinical governance agenda, it is more appropriate to prepare a synopsis of the issues to be covered at the conference closer to the event.

1545

### Invited Review

#### A medical director's perspective

B Ayers

*Department of Radiology, Guy's and St Thomas' Hospital Trust,  
St Thomas' Hospital, Lambeth Palace Road, London SE1 7EH,  
UK*

Commonly, the medical director is the nominated clinician leading clinical governance in acute trusts, sometimes in partnership or close liaison with the Director of Nursing/Quality.

The role can be summarized into 5 main aspects:

- To understand the government's intentions of clinical governance.
- To ensure that the Trust Board understands and meets the challenges of clinical governance.
- To ensure that local structures are in place to make it work.
- To stimulate, monitor and report on activity related to clinical governance.
- To assist in the management of the "expectations" arising out of clinical governance "within the resources available".

In our Trust each directorate is expected to produce a strategy for clinical governance. The elements expected relevant to imaging and oncology will be discussed.

1605

### Invited Review

#### Clinical governance: a clinical director's view

G J de Lacey

*Department of Clinical Radiology, Northwick Park, St Marks and Central Middlesex Hospitals, London, UK*

The discussion will include the following:

- The Clinical Director's Toolkit for Governance. This toolkit will assist with the presentation of the annual Governance report to the Trust Board.
- The importance of Clause 13 of the NHS Bill (1999): the duty of quality.
- The opportunity arising from this duty of quality.
- Evidence on quality from the clinical director— the crucial importance of providing a portfolio of relevant audits that address the duty of quality.
- The annual appraisal of the clinical director and of consultant colleagues: a painful step forwards.
- Governance means change—change for the better for those working in the Department of Clinical Radiology. The question is: will we have the wit to use it?

1625

### Invited Review

#### Clinical governance—the patients' perspective

D A Videlo

*RCR Clinical Radiology Patients Liaison Group, Farnham  
GU10 4AP, UK*

The following points will be discussed:

- Seen as further step to maintain high standards—patients support "it".
- What is "it"? Against which standards?
- See the benefits of recording and monitoring performance.
- What will governance really mean?
- Feedback to the public is essential—at least at department level.
- Will patients recognize a change?

1645

### Discussion

## 1515–1645 Studies in MR Technology Hall 6

1515

### Development of a combined functional MRI and optical imaging system

M N J Paley, J E Mayhew, J Matindale, P Coffey, P Redgrave, E Whitby, E van Beek, I D Wilkinson, P Greenwood and P Griffiths

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Sheffield S10 2JF, UK*

Many studies now use the BOLD effect and measurements of cerebral blood flow and volume to infer neuronal activation. However, the basic theory and experimental work underpinning these studies

is still not well understood. A combination of functional MRI (fMRI) and minimally invasive high temporal and spatial resolution optical imaging in a rodent preparation should help elucidate these questions. A dedicated low cost 3 T small-scale MRI system for fMRI and optical imaging has been developed to allow concurrent imaging for studies of the functional haemodynamic response to challenges such as visual or electrical stimulation. The radio-frequency system (RF) of a low field 0.2 T Niche MRI system has been adapted through frequency multiplication techniques to interface to a 3 T magnet with  $110 \text{ mT m}^{-1}$  self-shielded gradients. The RF system has shown good frequency stability based on multiplication of the low frequency direct digital synthesiser (DDS). A special handling system allows light guides, physiological support and various stimulators to be routed to the centre of the magnet and the very compact fringe field allows the associated electronic equipment including photomultiplier tubes to be located close to the magnet. The detailed design of the system will be presented.

## 1525

**An MR compatible endoscope with interchangeable inductively coupled receiver coil and tip tracking facility**

D J Gilderdale, D J Larkman, G A Coutts, A D Williams and N M de Souza

*Robert Steiner Magnetic Resonance Unit, Imperial College School of Medicine, Hammersmith Hospital, London W12 0HS, UK*

**PURPOSE:** To develop an MR compatible flexible endoscope capable of producing both high quality visual and MR image data. **MATERIALS AND METHODS:** A gastroscope was built, in which the proximal body steering control unit is MR safe (to eliminate projectile problems) with an extended service connection so that the light source and other services can be 3 m from the magnet. The flexible tube from the body to the tip is MR compatible as it is in the imaging volume. It was remade in plastic except for the outer helical windings of the 4 steering Bowden cables and the fibre optic bundle ferrule. All conventional services (biopsy channel, water, suction, illumination and fibre optic bundle) are incorporated. The MR receiver coil has no direct electrical connection with the tip. A small coil is inductively coupled to it during reception and inductively detuned from it during transmission. The signals from the small coil are fed out by cable which allows very simple replacement from 1 field level to another. A fiducial is incorporated in the small coil former to provide signals that locate the coil tip. These are used to provide navigator-like signals for motion artefact correction, which is otherwise a major problem in colonoscopy. **RESULTS:** Phantom experiments have demonstrated that both MR compatibility problems have been overcome, and early experiments indicate that the unit produces both high quality optical and MR information. **DISCUSSION:** The gastroscope is now being evaluated in clinical service. **ACKNOWLEDGMENT:** The device was developed under MedLINK Contract P37.

## 1535

**An array that exploits phase for SENSE imaging**

J V Hajnal, D J Larkman and D J Herlihy

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**INTRODUCTION:** SENSE (sensitivity encoding) and SMASH (simultaneous acquisition of spatial harmonics) both increase scan speed by utilizing spatial information from local receiver coils to reduce phase encoding. Although complex data are required, implementations have primarily relied on the amplitude sensitivity of the coils without emphasis on phase. Phase becomes critical in regions where magnitude does not provide a means of distinguishing between degenerate points in the reduced field of view (FOV) image data. **CONCEPT:** We consider a receiver array consisting of a loop and butterfly arranged as for a standard quadrature surface coil. Both coils have symmetric amplitude sensitivity distributions in the transverse direction. The loop coil has an approximately uniform phase structure, but the butterfly has a varying, antisymmetric pattern. Phase plays a critical role in reduced FOV imaging with these coils. **MATERIALS AND METHOD:** Experiments were performed on a Picker 0.5 T Apollo system using a loop  $12 \times 17 \text{ cm}$  combined with a butterfly  $20 \times 16 \text{ cm}$ . A gradient echo sequence (TR/TE 20/5 ms) with complex reconstruction was used to image phantoms with full FOV and FOV/2, which was converted to a full FOV using SENSE. **RESULTS AND CONCLUSION:** We have demonstrated a coil design in which phase structure plays a central role in SENSE. The array has spatially coincident coils that can be used as a quadrature receiver for maximum signal-to-noise ratio (SNR) or for reduced acquisition time using SENSE. Arrays of quadrature coil pairs may prove particularly flexible, with options

to maximize the speed-up factor, use an intermediate speed-up factor with local quadrature detection or standard imaging for maximum SNR.

## 1545

**Increasing temporal resolution in dynamic gadolinium enhanced breast imaging using SENSE**

D J Larkman, N M de Souza and J V Hajnal

*Robert Steiner Magnetic Resonance Unit, Imperial College School of Medicine, Hammersmith Hospital, London W12 0HS, UK*

**PURPOSE:** Dynamic magnetic resonance mammography (DMRM) can effectively screen for breast cancer provided adequate spatial coverage of both breasts can be achieved with sufficient time resolution to reveal the contrast uptake curve, which typically peaks at 2 min. The aim of this study is to use SENSE (sensitivity encoding) to double the acquisition rate of DMRM examinations. **METHOD:** SENSE requires an array coil with coil elements that have spatially distinct sensitivity profiles over the region of interest. We used a 4 channel coil. The dynamic examination consisted of volume scans with the phase encoded, left-right field of view (FOV) reduced by 2. The resulting degeneracy is unfolded using information about the sensitivity of the coils. Data were acquired on a 0.5 T Picker Apollo scanner using a 3D gradient echo sequence (TR/TE 10/3.75) to image a region  $30 \times 30 \times 18 \text{ cm}^3$  with half left-right FOV and a rectangular matrix of  $256 \times 128 \times 50$ . Dynamic data were acquired in 10 frames of 40 s each. The method was tested on 3 normal volunteers, including 1 examination with contrast; informed consent was obtained. Images were assessed for anatomical detail, artefacts and sensitivity to contrast uptake. **RESULTS:** Uptake curves obtained from a region of interest placed in glandular tissue showed degree of enhancement and time course that are consistent with published data. **CONCLUSION:** We have demonstrated an application of SENSE for increasing the temporal resolution of DMRM by a factor of 2. The method has been shown to be capable of detecting enhancement in normal tissue with a temporal resolution well-suited for pathological uptake.

## 1555

**A prototype open breast coil and intervention device for MRI**<sup>1</sup>G P Liney, <sup>1</sup>D J Tozer, <sup>1</sup>A J Knowles, <sup>1</sup>P Gibbs, <sup>1</sup>L W Turnbull, <sup>2</sup>H Brunsveld van Hulten and <sup>2</sup>E Beerens*<sup>1</sup>Centre for MRI, Hull Royal Infirmary, Hull, UK and <sup>2</sup>MACHNET, Utrecht, Holland*

**PURPOSE:** When breast MRI demonstrates lesions that are clinically occult, an MRI-based system is needed to guide needle biopsy or localization. This work describes a prototype open breast coil and intervention device. **MATERIALS AND METHODS:** Imaging was performed using a 1.5 T GE Signa. 2 coils were compared: a standard GE dual array closed coil and a prototype phased array open coil. Phantoms of 2 different  $T_1$  relaxation times were imaged in both coils for various fast-spoiled gradient sequences used in breast MRI. Measurements of signal-to-noise ratio (SNR) and percentage uniformity were made for each sequence. Patient examinations were also performed and fat suppression was assessed by a radiologist. The intervention device, which consisted of a perforated compression plate to guide the needle, was tested using either a grapefruit (using the seed as the target) or a breast phantom containing a gadolinium-doped capsule target. **RESULTS:** Values of SNR and uniformity were consistently higher in the open coil. Fat suppression in the coronal plane was comparable between coils, but superior in the sagittal plane with the open coil. In 13 tests of the intervention device, the deviation between the needle tip and the target was within 2 mm in 7 cases, approximately 5 mm in 4 cases and greater than 5 mm in 2 cases. **CONCLUSION:** Results demonstrate the superior imaging performance of the open coil. This coil has now been implemented for all routine breast MRI at the centre. Phantom tests with the intervention device suggest an accuracy of 2 mm for targets of 5 mm diameter.

## 1605

**Development of an RF model for evaluating hazards during interventional MRI**<sup>1</sup>J R Young, <sup>2</sup>W Qureshi, <sup>2</sup>R S Orton and <sup>1</sup>J V Hajnal*<sup>1</sup>Robert Steiner Magnetic Resonance Unit, Imperial College School of Medicine, Hammersmith Hospital, London W12 0HS and <sup>2</sup>Marconi Research Laboratories, Chelmsford, UK*

**PURPOSE:** Development of an RF model with which to investigate possible interactions and hazards during the performance of interventional MRI. **INTRODUCTION:** Interventional procedures in an MRI system introduce the possibility of metallic inserted devices causing burns if not adequately electrically isolated. Casual

repositioning of patients has already been found to be a source of RF burns. An RF model of a human subject situated in typical machine structures was developed to evaluate the hazards. **MATERIALS AND METHODS:** A prone volunteer was scanned in a 1.0 T scanner and 260 contiguous transaxial slices each 10 mm thick with an in-plane resolution of  $2.4 \times 2.4$  mm with a  $T_1$  weighted GRE sequence (TR 40 ms; TE 3 ms) were obtained. Permittivity and conductivity values from the literature were used for 8 significant tissues. The RF model system used was an in-house finite difference in the time domain (FDTD) suite. There is no extra significant information from using voxel dimensions smaller than  $0.1 \lambda$  (the wavelength at the modelling frequency) and the voxels used had an axial length of 50 mm and planar dimensions of  $20 \times 20$  mm. The contents of component voxels were averaged in each larger subvolume to obtain the electrical characteristics to be used for it. **RESULTS:** Electrical structures and devices can be included, and the model body removed relative to them and the rest of the machine. Body sections can be moved relative to each other. **CONCLUSION:** A sophisticated RF model for investigating the safety of interventional MRI procedures has been developed.

#### 1615

##### The use of echo planar imaging to obtain apparent diffusion coefficients for different tissues within the prostate

D J Tozer, P Gibbs and L W Turnbull

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**PURPOSE:** Recently, diffusion-weighted imaging (DWI) has been used for tissue classification in new areas such as the breast. The purpose of this work is to develop the technique within the prostate and obtain apparent diffusion coefficients (ADCs) in normal glandular tissue and benign and malignant prostatic pathology. **METHODS:** 31 patients were scanned using a 1.5 T GE Signa-Echospeed system and a pelvic phased-array coil. A series of DW single-shot echo planar (EP) images were obtained using the pulsed gradient sequence described by Stejskal and Tanner. Scans were performed with b-values ranging from 70 to  $780 \text{ mm}^2 \text{ s}^{-1}$ . Regions of interest were drawn in the peripheral zone (PZ) and, where applicable, in tumour and benign prostatic hyperplasia (BPH). ADCs were then obtained by fitting the data to the standard diffusion equation. The ADCs were compared using the Students paired *t*-test. **RESULTS:** 3 tissue types were found in 18 patients, 2 tissues in 10 patients and the remaining 3 patients only had 1 identifiable tissue type. The values obtained for the different tissue types were as follows: (ADC in  $1 \times 10^{-3} \text{ mm}^2 \text{ s}^{-1} \pm \text{SD}$ ) tumour =  $2.1 \pm 0.8$ , BPH =  $2.5 \pm 0.6$  and PZ =  $3.0 \pm 0.8$ . Despite relatively large SDs largely due to interpatient variability, significant differences were identified between PZ and both BPH and tumour and between tumour and BPH. **CONCLUSION:** It can be seen that images of diagnostic quality and, from them, ADCs can be obtained from the prostate using the method described above, and it is encouraging that highly significant differences are seen between tissue types. The large number of b-values means that the ADC calculated is precisely fitted with adequate signal to noise.

#### 1625

##### Inner volume 2D blood-suppressed cardiac MRI

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Cambridge CB2 2QQ, UK

**PURPOSE:** To implement inner volume imaging as a method of reducing scan times in breath-held, blood-suppressed, fast spin echo (FSE) cardiac MR. **MATERIALS AND METHODS:** Inner volume imaging was incorporated into a proprietary ECG-gated FSE sequence with blood-suppressed preparation (BSP) by moving the  $90^\circ$  slice selection gradient from the conventional slice select axis (Z) to the phase encoding axis (Y). Spin echoes are therefore only obtained from the region where the  $90^\circ$  excitation and the refocusing pulses intersect. The effective field of view (FOV) in the phase encoding direction is now controlled by the "slice thickness" of the  $90^\circ$  pulse and its gradient. The frequency offset of the  $90^\circ$  pulse was modified to account for any positional offset of the slice in the phase encoding direction. Asymmetric or rectangular field-of-view techniques can then be used to reduce the scan time without aliasing or compromising spatial resolution. The sequence was tested with normal volunteers and cardiac patients in a variety of planes using the following BSP-FSE protocol: TR =  $2 \times \text{RR}$ ,  $\text{eTE} = 40$  ms, echo train length (ETL): 32, receiver band width (RBW): 62.5 kHz, FOV: 15–30 cm. **RESULTS:** The reduction in scan time can be used to decrease the breath-hold period, acquire 2 slices per breath-hold, or acquire higher resolution images. The elimination

of chest wall fat from the FOV also helps to reduce residual ghosting artifacts. **CONCLUSION:** The inner volume imaging concept is a simple and effective modification to BSP-FSE imaging that improves the efficiency of the sequence in a variety of cardiac imaging applications.

#### 1635

##### Discussion

## 1515–1630

### CR/DR Digitization Olympian Suite

#### 1515

##### Invited Review

##### What benefits can we expect from a hospital-wide PACS?

G C Weatherburn

Health Economics Research Group, Brunel University, Uxbridge UB8 3PH, UK

Many hospitals are considering installing a picture archiving and communications system (PACS) with the long-term aim that the whole hospital will eventually be operating in a "filmless" environment. This paper will discuss the issues associated with some of the claimed advantages of a hospital-wide PACS:

- No lost images.
- Faster reporting times.
- Saves time for radiologists.
- Saves time for other clinicians.
- Faster turnaround of patients, images and reports.
- Reduced length of hospital stay.
- Lower patient doses.
- Fewer rejected images.
- Improves patient care.
- Is cost effective.

#### 1540

##### Invited Review

##### Digital imaging technology. Promises unfulfilled?

P Ryan

The Kent Cancer Centre, Maidstone Hospital, Hermitage Lane, Maidstone ME16 9QQ, UK

The following points will be discussed:

- Difficulties with DICOM implementations.
- Cost implications of digital technology.
- Social acceptance of new technology.
- Rapid technological change. The "leapfrog effect".
- Possible impact of internet technologies.
- Looking to the future.

#### 1605

##### Phantom-based clinical evaluation of multiple networked computed radiography systems

J Britton, N E Tomlinson and T Vaughan

NHS Estates, Qados, Frant House, Coach & Horses Passage, The Pantiles, Tunbridge Wells TN2 5NP, UK

**PURPOSE:** There is currently little in the published scientific literature on methods to clinically evaluate the performance of computed radiography (CR) systems. New methods have therefore been constructed using the Guys/Kings test object system. The test objects have been described in earlier work. The phantoms are calibrated for irradiation energies between 70 kV and 90 kV. It was therefore postulated that these test objects could clinically evaluate the performance of CR systems. The protocols were used to clinically evaluate the performance of three plate readers with associated identification terminals and image manipulation workstations, supplied by Philips Medical Systems. It was also postulated that the testing procedures could be used to check the cross-calibration between devices. **MATERIALS AND METHODS:** Images were acquired using the test objects to measure grey scale range (GSR), effective spatial resolution (ESR), noise (N) and dynamic range (DR). The tests to measure GSR, N and DR were carried out using standard general X-ray equipment and were processed with the general abdomen algorithm, to replicate clinical technique. The image of ESR test object was acquired using a mammographic unit and processed on a wrist algorithm to maximize the spatial characteristics. **RESULTS:** The images acquired were evaluated using the evaluation software available on the workstations. This allowed for comparison of devices, measurement of quantifiable parameters and

establishment of baseline values. **CONCLUSIONS:** Through necessity, new techniques for measuring the clinical imaging performance of CR systems have been constructed. The initial results appear promising, but have yet to be refined. The techniques will be further developed following commercialization of the Guys/Kings test object system by Qados in the near future.

**1615**  
**Discussion**

**1530–1730**  
**Update on the Head and Neck for the General Radiologist**  
**Hall 5**

**1530**  
**Invited Review**  
**Sinonasal tumours and their staging**  
J E Kabala

*Bristol Royal Infirmary, Marlborough Street, Bristol BS2 8HW, UK*

Sinonasal tumours may be malignant or benign, the latter group including some that exhibit aggressive local behaviour, notably the juvenile angiofibromas and, to a lesser extent, inverted papillomas.

- The malignancies include a number of histological possibilities, the commonest being squamous cell carcinoma.
- The biological behaviour of the different malignancies varies, for example adenocystic carcinoma showing a particular predilection for perineural spread.
- The potential directions for the extension of tumours, however, is still relatively predictable and relates to the anatomical relationship of the sinuses to adjacent structures.
- Posterior extension allows tumour to enter the pterygopalatine fossa. From here tumour may extend posterosuperiorly into the cranial cavity (via the foramen rotundum).
- Laterally, tumour can gain entry to the masticator space (infra-temporal fossa) via the pterigomaxillary fissure and beyond, via the foramen ovale, into the middle cranial fossa.
- Anterosuperiorly, tumor extends into the orbit via the inferior orbital fissure.
- Lymphatic spread is of critical importance. While many modalities may demonstrate subclinical metastases, imaging is often equivocal.

**1555**  
**Invited Review**  
**Inflammatory sinus disease**  
P L Anslow

*Department of Neuroradiology, Radcliffe Infirmary, Woodstock Road, Oxford OX2 6HE, UK*

- Inflammatory sinus disease is a frequent source of distress to patients but its treatment has been revolutionized by functional endoscopic sinus surgery.
- Anatomy and physiology of the sinus is pivotal to the understanding of pathology.
- This lecture will mainly discuss the role of CT but use of MRI in difficult cases will also be presented.

**1620**  
**Invited Review**  
**The larynx and the hypopharynx**  
J F C Ollif

*Department of Radiology, Queen Elizabeth Hospital, Edgbaston, Birmingham B15 2TH, UK*

The following points will be discussed:

- Imaging techniques to stage squamous cell carcinoma of the larynx and hypopharynx.
- What the clinicians want to know.
- Imaging assessment of areas where squamous cell carcinoma may spread and not be clinically evident.

**1645**  
**Invited Review**  
**A modern approach to salivary disease**

S J Golding  
*Department of Radiology, University of Oxford, Oxford OX3 9DU, UK*

- Modern imaging offers a non-invasive alternative to invasive sialography.
- Ultrasound, CT and MRI have all proved effective in the detection, localization and surgical staging of neoplasms.
- MRI also appears to have the ability to detect disease manifested by changes in the duct system, including calculi; the threshold for detection is not yet established.
- When the need for investigation is set in the context of clinical management, sectional MRI appears to be an effective first-line investigation in the majority of patients.
- The role of 3D MR sialography remains to be established.

**1710**  
**Discussion**

**1615–1745**  
**Studies in Radiotherapy Physics**  
**Hall 11b**

**1615**  
**The widths of error margins in radiotherapy treatment planning depend on beam configuration**

A L McKenzie  
*Bristol Oncology Centre, Horfield Road, Bristol BS2 8ED, UK*

**PURPOSE:** In order to allow for geometric uncertainty in the planning and delivery of radiotherapy treatment, an adequate margin must be drawn around the clinical target volume (ICRU50, ICRU62). It is now widely recognized that this margin must account separately for systematic (treatment planning) uncertainties and for random (treatment execution) errors. In general, the width of this margin should be different in different directions (because of organ motion characteristics, for instance, or the CT slice spacing in the craniocaudal direction). **METHODS:** A previously unconsidered effect contributing to the directional dependence of the margin width is that of the treatment plan beam configuration. In a coplanar-beam treatment plan, it is well known that the isodose separation at the edges of the treatment volume is generally larger in the craniocaudal direction than in the the treatment plane. It turns out that the physics underlying this observation is also responsible for a more general effect where larger margins are required in the craniocaudal direction than in the treatment plane to account for random (treatment execution) errors, including organ motion, set-up and linac-geometry errors. **CONCLUSION:** This lecture will quantify the differences in the margin widths that are needed to take into account the treatment plan beam configuration. This is particularly important where organ motion, such as lung, is relatively large.

**1625**  
**Radiotherapy for oesophageal cancer: a comparison of 3D conformal and intensity modulated techniques**

C M Nutting, J L Bedford, V Cosgrove, D Tait, D P Dearnaley and S Webb

*Royal Marsden NHS Trust and Joint Department of Physics, Institute of Cancer Research, Downs Road, Sutton, Surrey SM2 5PT, UK*

**PURPOSE:** The potential of intensity modulated radiotherapy (IMRT) to reduce the volume of lung irradiated in radical radiotherapy for oesophageal cancer was investigated. **METHODS:** A treatment planning study was carried out to compare three-dimensional conformal radiotherapy (3D-CRT) with IMRT in 5 patients with carcinoma of the oesophagus. 3D-CRT plans were created using a 2-phase technique (Phase I: AP-PA parallel opposed fields; Phase II: anterior and two postero-lateral oblique fields) to deliver a dose of 55 Gy in 30 daily fractions in accordance with ICRU50. Inverse-planned IMRT dose distributions were generated using the same beam directions (5-field), and using 9 equispaced beams (9-field). Treatment plans were compared using dose-volume histograms. **RESULTS:** The planning target volume was encompassed by the 90% isodose in all 3D-CRT and IMRT plans, and the spinal cord maximum dose was less than 45 Gy. The mean lung dose was  $20.33 \pm 5.0\%$  (1 SD) with 3D-CRT, compared with

17.2 ± 4.1% for the 5-field IMRT plans ( $p < 0.001$ ), and 21.3 ± 5.8% for the 9-field IMRT plans ( $p < 0.001$ ). The mean volume of lung treated above the threshold dose of 18 Gy were 19.4 ± 11.7% for 3D-CRT, 14.1 ± 10.1% for 5-field IMRT ( $p < 0.001$ ) and 22.1 ± 12.8% for 9-field IMRT ( $p = 0.002$ ). CONCLUSIONS: 5-field IMRT reduced the mean lung dose, and irradiated volume of lung. The doses to spinal cord and tumour were equivalent. The use of 9 equispaced IMRT beams, produced a higher mean lung dose ( $p < 0.001$ ) and a larger irradiated volume ( $p = 0.001$ ) than the 5-field IMRT technique, and is not recommended. Clinical implementation of IMRT in oesophageal cancer should reduce pneumonitis, or would allow tumour dose escalation within currently accepted lung toxicity.

**1635**

**Production of moulded cerrobend Ellis-type compensating filters for IMRT**

A W Beavis, C M Coldham, G M Langley and V J Whitton  
Department of Radiation Physics, Princess Royal Hospital, Hull HU8 9HE, UK

Intensity modulated radiotherapy (IMRT) offers the opportunity to conformally treat those tumours whose geometry renders beam shaping alone ineffective. Treatments are delivered by superposition of a number of beams whose profiles are uniquely modulated. It is common to design such beams to be defined on regular 1 cm resolution and using equal intensity increments in 10% steps. Hence, Ellis-type compensating filters are ideally suited for this purpose. Furthermore, their 40 year history in radiotherapy gives an element of "comfort" in their use in these novel techniques where high technology is normally deemed necessary. We have designed a low cost method for mass production of IMRT filters cast from molten cerrobend. A jig is used to form a representation of the filter, a negative is produced by moulding fast-setting dental impression "rubber" round it. The filter is formed from these moulds. We have produced intensity maps for IMRT beams using the NOMOS Peacock Inverse planning system and will present details of filters produced to deliver these fields. A critical analysis of this methodology will be given, identifying its benefits over other methods and its limitations. We will show comparisons (utilizing film dosimetry) between the delivered beams and the intensity maps they were intended to represent. In conclusion, we find that these Ellis-type compensating filters can be used to produce IMRT treatments. Such a method is intuitively simple and can be implemented without the need for expensive equipment.

**1645**

**Practical intensity modulated radiotherapy for improving dose homogeneity in tangent breast irradiation**

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Departments of <sup>1</sup>Medical Physics and <sup>2</sup>Oncology, Addenbrooke's NHS Trust, Cambridge CB2 2QQ, <sup>3</sup>Hebbard Ltd, Gallop House, Great Dunmow, Essex CM6 1XS and <sup>4</sup>Minolta UK Ltd, Milton Keynes MK13 8HF, UK

PURPOSE: The shape of the breast mound results in dose inhomogeneities both on- and off-axis. The "in-plane" inhomogeneity is conventionally compensated for by the use of wedge filters. As dose inhomogeneity is significantly correlated with late radiation effects in women with large breasts we set out to improve dose homogeneity in off-axis planes during tangent breast irradiation using techniques that would not significantly increase the time for simulation or treatment. MATERIALS AND METHODS: Breast shape from a volunteer was determined in 0.6 s using a non-contact 3D digitizer (Vivid 700, Minolta Ltd). The scan was converted into slice data using Metris (Hebbard Ltd) and transferred into our planning system. The treatment was planned conventionally and with an intensity modulated (IMRT) technique of 2 subfields per portal. Off-axis dose variations were calculated for both treatments. The planning process was repeated with a Rando phantom and thermoluminescent dosimeter measurements made during irradiation. The IMRT technique was also verified on another phantom and a CT data set. RESULTS: The off-axis dose variation was significantly reduced by the use of our IMRT technique in the cases studied. Calculated maximum dose for the volunteer was reduced from 113% to 106%, and for the Rando phantom 116% reduced to 106% (confirmed by measurement). CONCLUSION: The use of a 3D laser contouring system and a simple IMRT treatment technique can significantly improve dose homogeneity in tangential breast irradiation without increasing simulation or treatment times.

**1655**

**Limitations of intensity modulation for radiotherapy of the prostate**

<sup>1</sup>J Meyer, <sup>2</sup>A G Glendinning, <sup>3</sup>J A Mills, <sup>2</sup>D Bonnett, <sup>1</sup>O C L Haas and <sup>1</sup>K J Burnham

<sup>1</sup>Control Theory and Applications Centre, Coventry University, Coventry, <sup>2</sup>Leicester Royal Infirmary, Leicester and <sup>3</sup>Walsgrave Hospitals, Coventry, UK

PURPOSE: The use of IMRT may bring potential clinical gain in certain cases. The application of IMRT in the clinic is becoming a reality with technological advances in treatment delivery. However, for widespread implementation this will require robust and accurate delivery systems such as compensators and multiple-static or dynamic multileaf collimator (MLC) systems. MATERIALS AND METHODS: Generic shape studies applied to the prostate indicate the need for a high degree of modulation on some of the beams, which may not be possible with all IMRT delivery systems. These limitations have been demonstrated theoretically and experimentally for machined compensators and MLC techniques. RESULTS: The results identify the mechanical limitations that must be taken into account, either in the IMRT delivery technique or in the determination of the IMRT beam intensity profiles.

**1705**

**Reduction of pelvic small bowel irradiation using an optimized intensity modulated pelvic radiotherapy technique**

C M Nutting, D Convery, V Cosgrove, C Rowbottom, A Padhani, S Webb and D P Dearnaley

Royal Marsden NHS Trust and Institute of Cancer Research, Downs Road, Sutton, Surrey SM2 5PT, UK

PURPOSE: Small bowel toxicity is the dose limiting late side-effect of pelvic irradiation restricting the dose that can be safely delivered to pelvic lymph nodes to 45–50 Gy. Intensity modulated radiation therapy (IMRT) produces concave dose distributions sparing pelvic organs. METHODS: Pelvic nodes, small bowel, colon, rectum and bladder were outlined for 10 men with prostate cancer. Optimized 3-dimensional conformal radiotherapy (3D-CRT) plans were created using anterior and 2 lateral fields to deliver 50 Gy to the isocentre. IMRT plans were produced by an inverse treatment planning system (Corvus, NOMOS Corporation). Dose distributions and dose-volume histograms were compared. Optimization of beam number was undertaken for IMRT plans. RESULTS: For all plans, the target was encompassed by the 90% isodose. With 3D-CRT, the % volume of small bowel irradiated >45 Gy was 18.3 ± 7.7%, using 9 IMRT fields it was reduced to 5.3 ± 1.8% ( $p < 0.001$ ). For 7, 5 and 3 IMRT fields, the irradiated volumes were 6.4 ± 2.9%, 7.2 ± 2.8% and 8.4 ± 3.8%, respectively (all  $p < 0.001$ ). Compared with 3D-CRT, IMRT using 9 fields reduced the volume of rectum irradiated to >45 Gy from 50.5 ± 16.3% to 5.8 ± 2.1% ( $p < 0.001$ ) and bladder from 52.2 ± 12.8% to 7 ± 2.8% ( $p < 0.001$ ). Benefits were maintained for 7, 5 and 3 fields. CONCLUSION: IMRT using 9 fields significantly reduced small bowel, colon, rectum and bladder irradiation compared to 3D-CRT, and should reduce side-effects of irradiation. IMRT plans with only 3 fields maintained the clinical benefit, and promise less complex delivery techniques with shorter delivery times. The reduction of small bowel dose may allow modest dose escalation within currently acceptable complication rates.

**1715**

**Radiation therapy to inhibit coronary artery restenosis at the Cleveland Clinic**

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Department of Radiation Oncology, Cleveland Clinic Foundation, Cleveland, OH 44195, USA

Approximately 30–40% of coronary balloon angioplasty patients will exhibit restenosis. Endovascular radiation therapy has been shown to inhibit this process. At the Cleveland Clinic, we have participated in a national trial using <sup>192</sup>Ir (Gamma I & II, Cordis Company) and have also developed a beta source to use for endovascular radiation. The <sup>192</sup>Ir source trains come as 6, 10, and 14 seeds long (active lengths of 23–55 mm) for treatment of lesions no longer than 45 mm. Dosimetric checks and source quality assurance techniques will be discussed. Our in-house development centers around a <sup>188</sup>W/<sup>188</sup>Re source that irradiates the target vessel from a novel radiation-directed catheter. The useful rhenium source has an average beta-energy of 764 keV with a maximum range of 10 mm in tissue. It has been characterized dosimetrically using gafchromic film. Source activities of 50 mCi yield a dose to tissue at 2 mm of 18 Gy within 1.4 min. The dose perturbation caused by the presence of a Multilink Duet stent has also been studied and found not to be statistically different from the unstented dose delivery (–3.4% ± 5.2%). The unique features of the catheter include gold

shielding, torquability, and a built-in intravascular ultrasound (IVUS) device. We conclude that this source-catheter combination is suitable for use in coronary artery radiation.

1725

**Interdisciplinary collaboration to develop a multimodal verification system and its subsequent implications to clinical practice**

<sup>1</sup>B Thompson, <sup>1</sup>J Stratford, <sup>2</sup>P A Graham, <sup>2</sup>R J MacKay and <sup>2</sup>C J Moore

<sup>1</sup>Radiotherapy Department and <sup>2</sup>North West Medical Physics Department, Christie Hospital, Manchester M20 4BX, UK

Following the appointment of research radiographers at the Christie Hospital Radiotherapy Department to supervise the RT01 prostate conformal radiotherapy trial, it became pertinent to examine and evaluate the existing methods of set-up and portal image analysis of pelvic conformal treatments. In order to comply with the strict set-up and verification criteria demanded by the trial, existing departmental methods needed to be amended before patients could be recruited. Aware of the need to implement evidence-based practice, current set-up techniques were assessed against an alternative

method devised by the research radiographers in order to meet these criteria. A new, more sophisticated image analysis system was also required to examine lateral images. The Christie physics research department, as part of the European INFOCUS research project, had already produced a flexible image analysis tool—the “pantograph” computer program. This was a multimodal verification system featuring interactive image analysis via anatomical landmarks to calculate and display set-up displacement. However, although the concept and principles of the new system were sound, there had been minimal clinical input, and the system suffered from many practical drawbacks. This initiated a fruitful partnership between the 2 departments, leading to considerable development and customization of the verification software. The improved “pantograph” is now a quick and versatile user-friendly system, capable of routine clinical application. This paper describes the evolution of the system, which enabled the implementation of a set-up study, and the subsequent implications for departmental conformal radiotherapy practice.

1735

**Discussion**

TUESDAY

## Wednesday 24 May

0800-0900

### British Institute of Radiology Annual General Meeting Hall 11a

0830-0915

### Luminary Lecture 5 Hall 5

0830

#### Invited Review

#### CT and MRI in the diagnosis and staging of lung cancer

N L Müller

*Department of Radiology, Vancouver General Hospital and University of British Columbia, Vancouver, BC, Canada*

The aim of this presentation is to discuss the utility and indications for CT and MRI in the diagnosis and staging of pulmonary carcinoma. CT is commonly performed to confirm the presence of an abnormality and to determine whether a nodule is benign or malignant. The presence of central, laminated, popcorn or diffuse calcification in solitary lung nodules has been shown to be characteristic of a benign lesion. Focal collections of fat in a smoothly marginated pulmonary nodule have been shown to be diagnostic of a hamartoma. Nodule enhancement of less than 15 HU following intravenous administration of contrast has a 98% specificity in excluding the possibility of a bronchogenic carcinoma. Malignant nodules, on the other hand, almost always enhance following intravenous administration of contrast and typically have spiculated or lobulated margins. The staging of patients with lung cancer includes assessment of local extent of tumor and presence of metastases to mediastinal nodes, contralateral lung and extrathoracic organs. CT remains the major imaging modality used in the assessment of these patients. The low signal-to-noise ratio in the lungs, the lower spatial resolution and higher cost have limited the use of MRI in the thorax. However, MRI offers several potential advantages and in some instances the 2 techniques may be complementary. MRI has been shown to be superior to CT in the assessment of local vascular invasion, invasion of the mediastinum and chest wall, particularly in superior sulcus (Pancoast) tumors, and in the assessment of extrathoracic metastases.

0830-1015

### Studies in Oncological Imaging Hall 6

0830

#### Setting standards of oncological radiology in the North West of England

B M Carrington

*Department of Diagnostic Radiology, Christie Hospital NHS Trust, Manchester M20 4BX, UK*

**PURPOSES:** To set standards for oncological radiology in the North West of England. **METHODS:** (1) Initiation of North Western Regional Radiology Meeting to discuss oncoradiology standards with an invited representative from each North West hospital. (2) Review of regional cross-sectional examinations for technical quality and concordance with College Document "The use of computed tomography in the initial investigation of common malignancies". (3) Review of regional oncology reports for accuracy, completeness and TNM staging. (4) Audit of communication between oncologists and peripheral hospital radiologists. (5) Initiation of TNM staging seminars. **RESULTS:** (1) Agreed standardized protocols for staging. (2) Agreed standardized reporting of oncological patients. (3) All hospitals and oncologists responded to communication audit. (4) Agreed random re-audit of CT technical quality (by North West CT users' group). (5) High levels of attendance at TNM staging seminars. **CONCLUSION:** In the North West of England, there is interest in and willingness to participate in standardized oncological imaging

and reporting. Future work will focus on common follow-up protocols and standardized reporting pro formas. This is in accordance with requirements for clinical governance and is setting standards for regional oncological radiology.

0840

#### CT and oncology—a cause for concern?

L M Clarkson and J A Spencer

*CT Scanning, St James's University Hospital, Leeds LS9 7TF, UK*

**PURPOSE:** Working in a busy oncology centre, we recognize that CT imaging may produce anxieties specific to the oncology patient. This study assesses whether or not these anxieties correlate with the patient's perception of disease state. **MATERIALS AND METHODS:** 100 patients were randomized to enter a prospective questionnaire-based study investigating their experiences of anxieties relating to the CT examination. These patients were subdivided into 2 groups—A (those expecting good news) and B (those expecting bad news). Patients were further subdivided into the number of scans experienced: 1, 2-5 and 6+. **RESULTS:** 22% of patients felt more unwell after their CT examination. 22% of the patients were claustrophobic but 100% knew how to communicate with the staff during the examination. In terms of anxiety about undergoing the CT examination, patients were less anxious with repeated scans. (1 scan 71% anxious, 2-5 scans 56% anxious.) In terms of anxiety related to the results, this was most apparent in Group B with more than 6 scans (75%). **CONCLUSION:** In this pilot study, patient anxiety levels varied with individual perceptions of their disease state. There was significant physical and psychological morbidity related to CT. Effective communication is essential to minimize this. With recognition of specific anxieties, it may be possible to tailor the CT examination to the individual patient needs without compromising the technical and diagnostic quality of the CT.

0850

#### FDG PET in the evaluation of treatment response of oesophageal cancer

<sup>1</sup>W L Wong, <sup>1</sup>A Hassan, <sup>1</sup>J Lowe, <sup>2</sup>J Chambers, <sup>2</sup>E Townsend and <sup>1</sup>R Glynn-Jones

*<sup>1</sup>Paul Strickland Scanner Centre, Mount Vernon Cancer Treatment Centre, Northwood HA2 6RN and <sup>2</sup>Harefield Hospital, Uxbridge NA3 3PP, UK*

**PURPOSE:** To determine whether 2-[<sup>18</sup>F] fluoro-2 deoxy-D-glucose (FDG) with positron emission tomography (PET) could detect response to combination chemotherapy in oesophageal cancer patients. **METHODS:** 12 patients with distal oesophageal cancer were included. 5 patients had FDG PET prior to epirubicin, 5-fluorouracil and cis-platinum (ECF) and a repeat scan after completion of treatment—ECF 3-6 cycles. 2 patients had no pre-treatment scan but were scanned after completion of treatment—ECF 4 cycles. 1 patient had a pre-treatment scan and scanned during treatment, post 3 cycles ECF. 2 patients had no pre-treatment scan but were scanned during treatment, post 1-6 cycles ECF. 1 further patient had FDG prior to folinic acid, fluorouracil, epirubicin and cis-platinum (FFACE) and was scanned post-treatment—3 cycles. 1 other patient had FDG prior to combination chemo-radiotherapy (CF) and also scanned on treatment completion. Attenuation corrected PET scans (chest and upper abdomen) were obtained using a Siemens ECAT Exact 47. The FDG PET scans were evaluated qualitatively and also semi-quantitatively (standardized uptake value). Surgical correlation—6 patients (oesophago-gastrectomy, 5; laparotomy, 1). Clinical correlation—6 patients. **RESULTS:** Pre-therapy abnormal FDG uptake was seen in 7/7 primary lesions. On treatment completion, high FDG uptake at 6/9 primary sites and no increased FDG uptake in 3/9 scans. Surgical confirmation of active disease at 4/6 of these sites was obtained. In the other 2, clinical course confirmed active disease. In the 3 patients with no increased uptake, 1 subsequently had a negative endoscopy, 1 had no further dysphagia (1 year) and 1 remains well 3 years post-treatment. Of the 3 patients who had FDG scans during treatment, all had persistent disease (surgical confirmation, 2; clinical course, 1). FDG identified 3/5 pN+ patients and 1/1 pN0 patients. **CONCLUSION:** FDG PET is a promising method for assessing the therapeutic effects of combination chemotherapy on oesophageal cancer.

0900

#### Experience with laparoscopic ultrasound for defining resectability of pancreatic head and periampullary carcinoma

<sup>1</sup>A M Taylor, <sup>2</sup>J Manson and <sup>1</sup>S A Roberts

*Departments of <sup>1</sup>Clinical Radiology and <sup>2</sup>Surgery, Singleton Hospital, Swansea SA2 8QA, UK*

**INTRODUCTION:** Carcinoma of the pancreas has a poor prognosis. Surgical resection is possible, but accurate staging and patient selection are essential to avoid unnecessary operative morbidity. CT

is currently the most widely available staging investigation for pancreatic tumours. However, the accuracy of CT for defining tumour resectability can be poor, and laparoscopic ultrasound (LUS) is being assessed as a method for more accurate disease staging. **METHODS:** In this study, we present our experience with LUS for staging carcinoma of the pancreatic head and periampullary region. 33 patients with potentially resectable pancreatic tumours defined at CT underwent further investigation with LUS. 13 patients subsequently had an open laparotomy. The CT and LUS evaluations of tumour resectability were compared with the operative findings. **RESULTS:** At CT evaluation, 33 patients were deemed to have resectable pancreatic tumours. At LUS evaluation, 13 patients had resectable tumours, 13 non-resectable tumours and seven patients were shown to have no pancreatic tumour mass. 11 patients deemed to have resectable tumors by LUS evaluation underwent surgery. Nine patients were confirmed to have resectable disease; two patients had non-resectable disease. LUS prevented unnecessary extensive surgery in 33% of patients and altered clinical management in 48%. For the 11 patients who underwent surgery, the accuracy of LUS for defining tumour resectability was 82%. **CONCLUSION:** LUS is an accurate additional investigation for defining tumour resectability and directing management in patients with potentially resectable carcinoma of the pancreatic head or periampullary region.

#### 0910

##### Reduced dose SPIO for the detection of colorectal liver metastases

J Ward, D J Scott, J A Guthrie, D Wilson and P J Robinson  
Department of Clinical Radiology, St James's University Hospital, Leeds LS9 7TF, UK

**PURPOSE:** To compare the effects of high dose (HD) and low dose (LD) superparamagnetic iron oxide (SPIO) infusions on lesion-to-liver contrast-to-noise ratio (CNR) and to measure the accuracy of LD SPIO for the detection of surgically confirmed liver metastases. **MATERIALS AND METHODS:** 73 consecutive patients with known colorectal liver metastases underwent  $T_2$  weighted imaging before and after SPIO. SPIO was administered at a dose of  $15 \mu\text{mol kg}^{-1}$  (HD) and  $7.5 \mu\text{mol kg}^{-1}$  (LD) in 45 and 28 patients, respectively. The effects of HD and LD SPIO were measured by percentage signal intensity change (PSIC) lesion-to-liver CNR and change in lesion-to-liver ( $\Delta\text{CNR}$ ). Of 16 patients who underwent LD infusion and surgical resection, 4 blinded observers recorded the number and segmental location of lesions. Surgery with histopathology was used as a gold standard and alternative free-response receiver operating characteristic (AFROC) methodology used for analysis. **RESULTS:** In both HD and LD groups, all CNR values obtained after SPIO were significantly greater than those observed with unenhanced images. There was no significant difference in the mean CNRs obtained for either group for any sequence. Mean liver PSIC was significantly greater in the HD group but the mean  $\Delta\text{CNR}$  was not significantly different. 41 lesions were present in the 16 patients who underwent LD infusion and surgical resection. Only 4 lesions, all  $< 1 \text{ cm}$  were not detected, resulting in a mean AFROC area of 0.93. **CONCLUSION:** At a field strength of 1.0 T, SPIO may be administered at a dose of  $7.5 \mu\text{mol kg}^{-1}$  without loss of image quality or diagnostic accuracy.

#### 0920

##### The detection of small focal liver lesions using helical CT: the value of overlapping slices

P M Arnold and P J Robinson  
CT Scanning, St James's University Hospital, Leeds LS9 7TF, UK

**PURPOSE:** Partial volume averaging impairs CT detection of small focal liver lesions. This effect should be reduced if overlapping sections are reconstructed. **MATERIALS AND METHODS:** 26 patients aged 43–77 years with suspected liver disease underwent single phase contrast enhanced helical CT scans. Parameters included 10 mm collimation and a table increment of 15 mm per  $360^\circ$  tube rotation. Scanning commenced 65 s post IV injection of  $100 \text{ ml of } 300 \text{ mg ml}^{-1}$  contrast medium at  $3 \text{ ml s}^{-1}$ . 10 mm sections were reconstructed at 5 mm intervals, i.e. 50% overlap. Two separate sets of images, one contiguous and the other overlapping, were printed for review by two blinded independent observers. Contiguous sections were reviewed first and the overlapping images at a later session. Consensus review with a third observer was undertaken to establish a "gold standard" in the absence of histological correlation. **RESULTS:** Consensus identified 48 lesions in 19 patients. Mean observer sensitivity and accuracy were 79% and 86%, respectively, with contiguous sections, and 93% and 91% with overlapping sections. 6 lesions in 4 patients were only visible on overlapping sections but in all cases several other lesions were present and

the additional discovery did not influence diagnosis or treatment. **CONCLUSION:** Overlapping sections revealed more lesions but this finding did not influence patient management.

#### 0930

##### MRI in advanced cervical carcinoma: correlation of stage, tumour size and lymph node distribution

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Departments of <sup>1</sup>Diagnostic Radiology, <sup>2</sup>Clinical Oncology and <sup>3</sup>Medical Statistics, Christie Hospital NHS Trust, Manchester M20 9BX, UK

**PURPOSE:** To evaluate MRI in advanced cervical carcinoma treated with radiotherapy by correlation of MRI and clinical stage and to correlate tumour stage, size and volume with lymph node distribution. **METHOD:** 102 women (mean age 54.7, range 29–85) underwent MRI staging prior to radical radiotherapy for cervical carcinoma. The MRI protocol included  $T_1$  weighted abdominal and pelvic sequences plus 3–5 mm  $T_2$  weighted pelvic sequences using a phased-array coil. Tumour size, volume, MRI stage and nodal number, site and signal characteristics were assessed. These data were used to construct a frequency map for nodal stations to determine inclusion in standard treatment fields. Correlation was made between MRI and clinical stage and between patient age, MRI stage, tumour size and volume with nodal status. Multivariate analysis of outcome data is being assessed at 12 months follow-up. **RESULTS:** MRI stage was: 1A, 2 cases; 1B, 7 cases; 2B, 64 cases; 3A, 1 case; 3B, 18 cases; 4, 10 cases. There was good correlation between clinical and MRI stage (accuracy 49%,  $p < 0.0005$ ). Pelvic adenopathy (short axis diameter  $\geq 10 \text{ mm}$ ) correlated with tumour size and volume ( $p < 0.0005$ ), but not with MRI stage or patient age. Larger tumours were also more likely to have abdominal adenopathy. Most enlarged pelvic nodes were included within the radiotherapy field, but enlarged pre-sacral nodes occurred in 2 patients and were potential geographical misses. **CONCLUSION:** MRI stage correlates with clinical stage. Lymphadenopathy is a known poor prognostic indicator in cervical carcinoma and correlates with tumour size and volume. With advances in radiotherapy technique, MRI staging and nodal mapping are increasingly important in treatment planning.

#### 0940

##### The role of MRI in the follow-up of brachial plexopathy in patients with malignancy

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Department of Diagnostic Radiology, The Royal Marsden NHS Trust, Downs Road, Sutton, Surrey SM2 5PT, UK

**PURPOSE:** To assess the value of serial brachial plexus MRI in cancer patients with brachial plexopathy. **MATERIALS AND METHODS:** Retrospective review of sequential brachial plexus (BP) MRI examinations. 19 patients underwent 2 or more examinations between June 1995 and November 1998. Primary diagnoses: 16 breast carcinoma, 1 recurrent thymoma, 1 non-Hodgkins lymphoma and 1 non-small cell lung cancer. 1.5 T MRI was performed using body and surface coils with varied sequences. Studies were reviewed for BP thickening, mass, short tau inversion recovery (STIR) high signal and lymphadenopathy. **RESULTS:** 54 studies in 18 females and 1 male averaging 2.8 examinations per patient. Average scan interval 4.8 months (range 1–14 months). BP thickening remained stable in 9 of 10 cases (3 post-chemotherapy, 1 tamoxifen, 7 following radiotherapy) and progressed into tumour in 1 case (despite chemotherapy). Masses remained stable in 5 of 12 cases (1 after radiotherapy, 1 post-chemotherapy), regressed in 4 (3 post-chemotherapy, 1 post-radiotherapy) and progressed in 3 (despite chemotherapy in 1 case). High signal on STIR remained stable in 4 of 7 cases, regressed in 2 (post-chemotherapy) and progressed in 1 patient after radiotherapy. High signal developed in 1 patient *de novo* and 1 patient following BP biopsy. Lymphadenopathy remained stable in 6 of 7 cases (2 post-radiotherapy, 2 post-chemotherapy) and regressed in 1 following chemotherapy. Lymphadenopathy developed in 1 patient. **CONCLUSION:** Sequential MRI of the BP is useful for determining response to treatment in cases of tumour and for confirming stable appearances of thickening in cases of presumed fibrosis.

#### 0950

##### MRI of malignant mesothelioma: preliminary results

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Department of Radiology, Glenfield Hospital, Leicester LE3 9QP, UK

**OBJECTIVE:** Malignant mesothelioma (MM) is rare. However, its incidence is expected to triple over the next 3 years. We report our initial experience of the use of MRI in the accurate staging of MM



prior to radical surgery. **MATERIALS AND METHODS:** Patients with suspected MM underwent initial diagnostic/staging thoracoscopy and CT scan. Those without sarcomatoid MM and deemed operable for extrapleural pneumonectomy (EPP) were then evaluated by MRI. The MR protocol comprised of breath-hold  $T_1$  weighted flash (spoiled gradient echo) sequence in the axial, coronal and sagittal planes before and after gadolinium DTPA.  $T_2$  weighted axial scans were also obtained. In patients with involvement of the mediastinal pleura, cardiac gating was used. **RESULTS:** 9 patients with a median age of 60 years (55–68 years) were assessed by MRI. 2 patients were considered unresectable due to local invasion. MRI clarified uncertainty in the extent of diaphragmatic invasion in 7 patients and mediastinal invasion in 2 patients. 4 patients underwent EPP and 3 radical pleurectomy/decortication. The local extent of pleural involvement was correctly identified by MRI in all cases. 5 of whom had Stage I/II MM and 2 had pleural fibrosis. **CONCLUSION:** The use of contrast enhanced breath-hold  $T_1$  weighted MR in the 3 orthogonal planes is valuable in defining the extent of MM, particularly the involvement of the chest wall, apices, mediastinum and diaphragm. It is of value in planning for radical resection of MM.

#### 1000

##### Effect of osteosarcoma on systemic blood flow

<sup>1</sup>J F Griffith, <sup>2</sup>S M Kumta, <sup>1</sup>S Y Ho, <sup>3</sup>C K Li, <sup>4</sup>T Leung, <sup>4</sup>P Choi, <sup>5</sup>L T C Chow, <sup>2</sup>P C Leung and <sup>1</sup>C Metreweli

Departments of <sup>1</sup>Diagnostic Radiology and Organ Imaging, <sup>2</sup>Orthopaedics and Traumatology, <sup>3</sup>Paediatrics, <sup>4</sup>Clinical Oncology and <sup>5</sup>Anatomical and Cellular Pathology, Prince of Wales Hospital, Shatin, New Territories, Hong Kong

**PURPOSE:** To investigate the effect of osteosarcoma on systemic blood flow. **METHODS:** CVIQ flow estimation (7.5 MHz transducer, Philips Medical Systems) was compared to a phantom for simulated common carotid (CCA) and common femoral artery (CFA) flow. CCA flow and CFA flow was measured at presentation in (i) 6 patients with lower limb osteosarcomas (mean age 20.5 years), (ii) 6 patients with non-malignant lower limb primary bone tumours (21.3 years) and (iii) 6 patients with lower limb soft tissue tumours (27.4 years). Blood flow was measured serially during chemotherapy in 3 osteosarcoma patients. **RESULTS:** A near linear correlation was found between CVIQ and phantom flow measurements. CCA flow was significantly greater in patients with osteosarcoma ( $470 \text{ ml min}^{-1}$ , range  $423\text{--}533 \text{ ml min}^{-1}$ ) than in patients with non-malignant bone tumours ( $317 \text{ ml min}^{-1}$ ,  $204\text{--}444 \text{ ml min}^{-1}$ ) ( $p=0.03$ ) or soft tissue tumours ( $356 \text{ ml min}^{-1}$ ,  $274\text{--}465 \text{ ml min}^{-1}$ ) ( $p=0.01$ ). CFA flow to the affected lower limb was significantly greater in patients with osteosarcoma ( $457 \text{ ml min}^{-1}$ ,  $309\text{--}867 \text{ ml min}^{-1}$ ) than in patients with non-malignant bone tumours ( $97 \text{ ml min}^{-1}$ ,  $35\text{--}191 \text{ ml min}^{-1}$ ) ( $p=0.001$ ) or soft tissue tumours ( $252 \text{ ml min}^{-1}$ ,  $174\text{--}347 \text{ ml min}^{-1}$ ) ( $p=0.03$ ). CFA flow to the unaffected lower limb was greater, though not significantly, in patients with osteosarcoma ( $245 \text{ ml min}^{-1}$ ,  $91\text{--}535 \text{ ml min}^{-1}$ ) than in patients with non-malignant bone tumours ( $221 \text{ ml min}^{-1}$ ,  $35\text{--}305 \text{ ml min}^{-1}$ ) or soft tissue tumours ( $147 \text{ ml min}^{-1}$ ,  $65\text{--}215 \text{ ml min}^{-1}$ ). Systemic blood flow alteration tended to normalize during chemotherapy. **CONCLUSION:** Osteosarcoma leads to a systemic circulatory disturbance with both increased blood flow to the affected limb and increased CCA flow greater than that seen with non-malignant bone tumours or soft tissue tumours.

#### 1010

##### Discussion

## 0830–1030

### Role Developments in Radiotherapy Hall 11b

#### 0830

##### Invited Review

##### Radiographer-led treatment review clinics

L M Thorpe

Clinical Oncology, Truro Hospital, Truro TR1 3LJ, UK

The following points will be discussed:

- Are review clinics necessary and who should run them?
- Appropriate training and education.
- Written protocols and use of "Quart".
- Colleagues' reactions.
- Patients' response.
- Does it work?

#### 0855

##### Invited Review

##### Update on START breast trial

E A Winfield

START Trial Office, Marie Curie Research Wing, Mount Vernon Hospital, Rickmansworth Road, Northwood, Middlesex HA6 2RN, UK

The following points will be discussed:

- START trial overview and recruitment to date.
- Results from first visits to centres, incorporating breast technique, dosimetry and quality control data.
- Second visit aims and objectives.
- Tangential and nodal field junction matching.
- Current practice for breast radiotherapy in participating centres.

#### 0920

##### Invited Review

##### Information provision for radiotherapy patients

S Edwards

Macmillan Cancer Relief, 65 Montagu Crescent, Leeds LS8 2RD, UK

This presentation will explore:

- The factors behind the current drive to provide cancer patients with comprehensive, appropriate information.
- The difference between health professionals providing information to patients as part of their role and the provision of an effective information service.
- The process used to improve the quantity, range and consistency of information provision at a large regional radiotherapy centre and how this process was audited.

#### 0945

##### Invited Review

##### Extending the role of the radiographer

H McNair

Department of Radiotherapy, Royal Marsden Hospital, Fulham Road, London SW3 6JJ, UK

The following points will be presented:

- The simulator radiographer's role at Fulham Road.
- Tasks undertaken by radiographers in the simulator.
- Suggestion of areas to extend into and those to move away from using the planning process of brain patients as an example.

#### 1010

##### Discussion

## 0900–1000

### Web Publishing How To— Advanced Olympian Suite

#### 0900

##### Computer assisted learning in nuclear medicine technology

K G Holmes and J R Nixon

School of Radiography, Faculty of Health and Social Care, University of the West of England in Bristol, Glenside Campus, Stapleton, Bristol BS16 1DD, UK

The potential for learning with computers has several applications for students in the field of nuclear medicine. Computers allow the possibility of a distance learning course to become a reality. Students can learn at their own pace in the comfort of their workplace or home. The Internet allows worldwide access to modules written by "experts" in their field and these modules can be updated regularly to keep pace with changes in practice. Conferencing will allow live time communication with tutors and nuclear medicine experts. Once a "database" of the principles of practice and clinical cases has been established it can provide a powerful tool for reference and learning. Collaboration between nuclear medicine specialists, academic centres and the industry has begun the process of data collection and refinement. This paper will explore the potential uses and pitfalls of computer assisted learning for students on a nuclear medicine technology course. A database of clinical cases with the patient's information, protocols, images and outcomes is being evaluated as a learning tool. The applications in current and future education and continuous professional development will also be explored.

0915

**PRISM 21**

A Waldman and N Hollings  
*University College Hospital, London, UK*  
 No abstract.

0925

**Multimedia radiology school transplanted on site by Intranet: Intra-X**

S Ginocchio  
*Lycee J Monnet, Franconville, 38 Rue de la Liberation, 95350 Piscop, France*

**OBJECTIVE:** The objective of this study was to solve the lack of postgraduate education that radiographers receive; only 20% of French radiographers have regular access to postgraduate training courses. The main reasons for this are the amount of travelling to the postgraduate training centres, problems in getting study leave from the hospital, and family commitments outside work. **MATERIAL:** Using the Asymétrie Toolbox, accessed through a modem, and relevant software radiographers can learn via the Internet. The main study areas are radiographic anatomy, CT, MRI—pathology approaches to each of the topic areas—for the whole anatomical modules (over 5 years), technology RX, CT, MR, hygiene, radiation protection. **METHOD:** Installation of the software takes 1 day and gives 24 hours a day, 7 days a week access to the site and on-line resources. The programme tackles 1 topic per month and assesses the skills and knowledge gained with an educational pedagogy, which uses slides and computer-mediated communication. There is also an up-to-date hotline available for help and support. **RESULTS:** The multimedia support offers a solution for all levels of knowledge and increases personal progression with direct access to the site (4 hours a month on average: 1200 hours per year for 25 radiographers). Intranet access provides limited constraints, which allow for updating and explanations. The hotline gives support and human contact on any problems. Currently only 20% of clinical radiographers who have installed this system have registered less than 1 hour per month of training.

0935

**Web Publishing How To Course**

M Tatlow  
*Division of Professions Allied to Medicine, South Bank University, 103 Borough Road, London SE1 0AA, UK*

- This is the third of three 1-h practical sessions intended for all levels of Web site builder.
- The sessions are split into Beginner, Intermediate and Experienced.
- Each session follows on from the previous one, building on the knowledge and experience gained, although it is not essential that delegates attend all 3 sessions; they can be attended singularly.
- Attending all 3 sessions will take the novice World Wide Web (3W) builder through basic 3W site design and concepts, considerations necessary when using images, and the use of more complex page design including forms and active content such as dynamic HTML and Flash Movies.
- Each session will use examples of Internet sites to illustrate the concepts, which will then be tried out in practice. The emphasis is very much "hands on" (Note there are limited places in the "hands on" sessions.)

0915–1045

**Spiral CT**

Hall 11a

0915

**Invited Review****The use of spiral CT for major cardiovascular problems**

M J Lipton  
*Department of Radiology, University of Chicago, 5841 South Maryland Avenue, Chicago, IL 60637, USA*  
 The following points will be discussed:

- Requirements for cardiac imaging: competing modalities.
- Exposure speed, ECG gating and field of view.
- The need for quantitative data and validation studies.
- Diagnosis vs evaluation of disease severity and therapy cardiac reserve issues.

- Indications for CT procedures and longitudinal studies.
- Problems of patient referral and clinical service delivery.
- Issues of training radiologists, technologists and available machine time.
- Potential of newer development in CT technology for cardiac diagnosis.

0940

**Invited Review****Spiral CT: applications and techniques in the abdomen**

A K Dixon  
*Department of Radiology, Addenbrooke's Hospital and University of Cambridge, Cambridge CB2 2QQ, UK*

- Spiral CT should be regarded as the conventional CT method.
- Particular advantages in the juxtadiaphragmatic abdominal lesions.
- Allows multiphasic studies: liver, pancreas etc.
- Provides optimal vascular data and 3D rendering thereof.
- Allows faster management of traumatized patients.

1005

**Invited Review****Multiphasic helical CT for detection and characterization of hepatocellular carcinoma**

J H Lim  
*Department of Radiology, Samsung Medical Center, Seoul 135-710, Korea*

As the vascularity of hepatocellular carcinoma is increased and supplied only by the hepatic artery, the nodule of hepatocellular carcinoma can be selectively imaged by obtaining CT images of the arterial phase. By using multiphasic scanning with a helical scanner after injection of contrast material, diagnostic accuracy of CT imaging was improved. In a study based on explanted livers for transplantation in 41 patients, the sensitivity and specificity of hepatocellular carcinoma were 71% and 96%, respectively, whereas those of dysplastic nodules (pre-malignant lesions) were 39% and 97%, respectively. Multiphasic helical dynamic CT imaging is slightly better than conventional CT. The low sensitivity of hepatic arterial vascular supply in well-differentiated hepatocellular carcinomas and dysplastic nodules is not increased. To make matters worse, there may be false positive lesions in cirrhotic liver because of the presence of regenerative nodules, perinodular fibrosis and non-tumoral arterioportal shunts. CT arterial portography and CT hepatic arteriography have been known to be the most sensitive method in the detection of hepatic tumors. However, these studies proved to have many false positive results. In comparison, studies between multiphasic helical CT scan and combined CT arterial portography/CT hepatic arteriography, helical dynamic CT showed a comparable sensitivity and superior positive predictive value when compared with CT arterial portography and CT hepatic arteriography. Recently, MRI is increasingly used for the detection of hepatocellular carcinoma by using contrast material such as extracellular fluid space agents or reticuloendothelial agents. In comparison, studies of MRI and CT arterial portography and CT helical arteriography, MRI showed comparable sensitivity and a superior positive predictive value. In summary, multiphasic helical dynamic CT is the preferred method in the initial study of the detection of hepatocellular carcinoma in patients with liver cirrhosis and MRI with superparamagnetic iron oxide injection is suggested as a complementary study for staging.

1030

**Discussion**

0930–1100

**Embolotherapy**

Hall 5

0930

**Invited Review****Uterine artery embolization for fibroid disease**

J F Reidy  
*Department of Radiology, Guy's & St Thomas' Hospital Trust, St Thomas Street, London SE1 9RT, UK*

- This technique is still SER-NIP CI. It is essential that full informed patient consent is obtained and local ethics committee approval should be obtained.

- Close co-operation with a designated gynaecologist is essential, as are skill and experience with embolization procedures.
- Both uterine arteries are embolized with particulate emboli to the point of complete occlusion. PVA supplemented by Gelfoam is most commonly used.
- Ovaries are in the direct X-ray beam and radiation reduction measures are very important to prevent high dosage.
- Significant complications are rare, with infection being the most serious. This appears to be more common in large fibroid uteri.
- Short-term results are encouraging, but long-term results not yet available.

#### 1000

##### Invited Review

##### Varicocele embolization

C N Hacking

Department of Radiology, Southampton General Hospital, Tremona Road, Southampton SO9 4XY, UK

##### INDICATIONS:

- The symptomatic varicocele.
- Infertility.

##### TECHNIQUE:

- Left.
- Right.
- Embolic agents.
- Trouble shooting.

##### RESULTS:

- Symptomatic relief.
- Increased sperm count.

#### 1030

##### Invited Review

##### Treatment of gastrointestinal bleeding

A A Nicholson

Department of Radiology, Hull Royal Infirmary, Hull and East Yorkshire Hospitals NHS Trust, Kingston upon Hull HU3 2JZ, UK

- Selective and highly selective angiography are vital.
- Acute patients must be haemodynamically unstable.
- Femorovisceral catheters, Waltman loop technique, hydrophilic wires and co-axial systems are useful.
- Varices can be missed by endoscopy.
- Haemorrhoids can be missed by sigmoidoscopy.
- Where there is a rich collateral circulation, embolization must be "front and back" door.
- In the colon, embolization should be at the mucosal level.
- Coils are most useful but gelfoam and PVA can also be used.
- Small areas of colonic infarction are rarely significant.

#### 0930–1030

### Imaging in Orthopaedic Surgery

#### Hall 8

#### 0930

##### Invited Review

##### Satisfying the surgeon, protecting the patient, respecting the radiographer

C D Jeffery

Canterbury Christ Church University College, Faculty of Health and Science, North Holmes Road, Canterbury, Kent CT1 1QU, UK

- The requirements of the orthopaedic surgeon during an operative or manipulative procedure will be identified.
- These requirements will be discussed with respect to the internal conflict arising between them.
- The amended, more realistic, requirements will be discussed with respect to imaging equipment currently commercially available.
- The impact of the new Ionising Radiation Regulations and working practices on the conduct of surgical procedures will be discussed.

#### 1000

##### Invited Review

##### Orthopaedic surgery: challenges to practice

M J Woodford

Clinical Radiology, Salisbury District Hospital, Salisbury, Wiltshire SP2 8BJ, UK

- Increasing use of image intensifiers in theatres.
- Little formal training.
- Operator specific, regardless of procedure.
- Forthcoming new regulations are likely to mean the radiographer will become the practitioner and have more responsibilities.
- Equipment increasing in power and complexity.

#### 1015–1115

### EuroRAD

### Olympian Suite

#### 1015

##### Invited Review

##### EuroRAD: the imaging database of the European Association of Radiology

<sup>1</sup>R Sigal, <sup>2</sup>D Caramella, <sup>3</sup>J C Kurdziel, <sup>4</sup>Y Gandon, <sup>5</sup>M Lemort, <sup>6</sup>G Salcito, <sup>7</sup>G Frija, <sup>8</sup>H Ringertz, <sup>9</sup>A Baert and <sup>10</sup>R Passariello  
<sup>1</sup>Department of Imaging, Institut Gustave Roussy, 94805 Villejuif Cedex, France, <sup>2</sup>Department of Oncology, University of Pisa, Italy, <sup>3</sup>Department of Radiology, Centre Hospitalier Luxembourg, Luxembourg, <sup>4</sup>Department of Imaging, Hôpital Pontchaillou, Rennes, France, <sup>5</sup>Department of Imaging, Institut Jules Bordet, Bruxelles, Belgium, <sup>6</sup>CITEC, Roma, Italy, <sup>7</sup>Department of Radiology, Hôpital Laennec, Paris, France, <sup>8</sup>Department of Radiology, Karolinska Hospital, Stockholm, Sweden, <sup>9</sup>Department of Radiology, University Hospital Pellenberg, Belgium and <sup>10</sup>University La Sapienza, Institute of Radiology Cattedra II, Roma, Italy

- EuroRAD (<http://www.euro-rad.org/>) is a database devoted to diagnostic imaging.
- Exchanges between authors and reviewers are done on the Internet only.
- The project is coordinated by the European Association of Radiology and partly funded by the European Commission.
- EuroRAD contains peer-reviewed clinical cases covering all radiological subspecialties.
- All cases are submitted to a thorough and anonymous review process ensuring the quality and standards established in scientific journals.

#### 1030–1245

### Studies in Breast Imaging

#### Hall 6

#### 1030

##### The contribution played by imaging in the diagnosis of breast cancer

J Patton, D J Leaper and A L G Peel

Professorial Unit of Surgery, North Tees General Hospital, Stockton-on-Tees TS19 8PE, UK

**PURPOSE:** A retrospective study of 5 year survival rates involving women diagnosed with breast cancer, recording details of all breast imaging examinations undertaken during 1994–1995. **RESULTS:** Diagnosis of breast cancer was confirmed by pathology in 397 cases and, of these, 395 had mammography and/or ultrasound examination of the breast. Radiological diagnosis of malignancy was confirmed by pathology in 199 (50%) cases, and "suspiciously" reported mammograms proved malignant in 170 (43%) cases. 22 (6%) cases thought to be benign on imaging were histologically malignant, with the tumours ranging from 10 to 50 mm histologically (2 ductal carcinoma *in situ* (DCIS), 3 special type, 17 ductal cancers, no special type). 18 of these 22 cancers had suspicious/malignant cytology, 3 contained atypical cells and 1 cytology proved inadequate. Imaging played an important part in breast cytology, with 254 fine-needle aspirations being taken under radiological control, 141 (55%) giving Grade 5 cytology and only 29 (11%) proving inadequate. **CONCLUSION:** The fact that these cancers were not detected on imaging and 30 radiologically detected tumours had negative

cytology (8%) highlights the importance of triple assessment for breast cancer, *i.e.* imaging, clinical examination and cytology, particularly as all of these cancers were in symptomatically presenting patients. A higher false negative rate could be possible in screening. Imaging is an invaluable aid to diagnosis, especially with the increase in non-palpable tumours detected via breast screening and the need to localize microcalcifications within the breast.

#### 1040

##### Digital, computer-assisted stereotactic biopsy, a newly developed holder for vacuum biopsy (Mammotome) at the Mammomat 3000

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**PURPOSE:** Vacuum core biopsy (VCB) is usually performed at a special stereotactic table. There is now a special holder available that allows stereotactic-guided VCB at a mammographic unit. **METHODS:** Since February 1999, we performed VCB on 37 patients with only mammographically detectable lesions. Biopsy was performed using a Mammomat 3000 (Siemens) in conjunction with a digital camera (OPDIMA, Siemens) and a newly developed holder for the vacuum biopsy system (Mammotome, Ethicon). Correct sampling was documented by immediate mammographic viewing. **RESULTS:** All of the 37 solid lesions and microcalcifications could be detected and biopsied, the material was representative in all cases. There were no major side effects such as pain, major bleeding or infection. The follow-up mammograms after 3 and 6 months showed no visible scarring. **DISCUSSION:** The newly developed holder for the VCB system (Mammotome) allows, in conjunction with the digital stereotactic unit, a safe, rapid and minimal invasive procedure in the work-up of microcalcifications as well as mammographically detected soft tissue lesions. Owing to the possibility of complete removal of the visible lesions, false negative results are rare.

#### 1050

##### Can radiographer film readers contribute effectively in double reading screening mammograms?

S M Naylor and J Patel

*Helen Garrod Breast Unit, Nottingham City Hospital, Nottingham NG5 1PB, UK*

**INTRODUCTION:** It has been shown that non-radiologists can be successfully trained to interpret mammograms. Can these skills be utilized within the National Health Service Breast Screening Programme? **METHOD:** An audit was carried out on the results of double reading without consensus of 2 radiographers qualified in mammographic interpretation. The films were double read with a consultant radiologist. **RESULTS:** From a total of 5195 examinations read by the radiographer film reader over a 12 month period, 234 women were recalled for further assessment (4.5%). 126 were recalled by both radiographer and radiologist, 47 by the radiologist alone and 108 by the radiographer alone. 41 cancers were detected by the radiographer (7.9/1000), 8 were detected by a radiographer alone and 4 were detected by the radiologist alone (total 45). Radiographer film reading increased the recall rate by 1.2% and the cancer detection by 18% compared with radiologist single reading. Of the cancers detected by the radiographer alone, 6 were invasive; 5 were grade 2 and 1 was grade 3. 4 were less than 10 mm and 2 less than 15 mm. The Nottingham Prognostic Index ranged from 3.04 to 4.26 (mean 3.5). 7 were node negative and 1 node positive. **CONCLUSION:** These results indicate that reading by trained radiographer film readers led to an increase in the cancer detection of good prognosis tumours compared with radiologist single reading. This can be achieved with only a minor increase in recall rate.

#### 1100

##### Observer variability in detecting cancers with 1 and 2 views during incident screening

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*South West London Breast Screening Service, Duchess of Kent Unit, St George's Healthcare Trust, 205 Blackshaw Road, London SW17 0BZ, UK*

**PURPOSE:** To examine the reasons for observer variability in cancer detection using 1 and 2 view mammography at incident screening and determine whether false negatives are due to failure to visualize the cancer or misinterpretation of its radiological significance. **METHODS:** A random selection of mammograms of women with cancer detected during incident screens at SWLBSS were used. These were mixed with controls in 2 test sets and read by 11 experienced film readers with and without cranio-caudal views. **RESULTS:** Overall sensitivity increased from 79% with 1

view to 85% with 2 views. There was substantial observer variability and with 1 view only 50% of the invasive cancers were recalled by all 11 readers, increasing to 60% with 2 views. Most radiological features of larger invasive cancers over 10 mm were noticed and marked with 1 or 2 views, but 31% of invasive cancers under 10 mm were not noticed and no feature was recorded on the proforma with 1 view. This reduced to 13% with 2 views. When a lesion was noted but not recalled (misinterpreted) the commonest findings were asymmetry for invasive cancers and calcifications for *in situ* cancers. **CONCLUSION:** In this study, 50% of invasive cancers were not recalled by at least 1 reader using a single view. This study suggests that for single reading of mammograms with 1 view, the detection of small invasive cancers under 10 mm is a major problem. This is helped by the second view. For invasive cancers over 10 mm, interpretation rather than detection was the major cause of recall failure. Both detection and interpretation of invasive cancers is improved by increasing the number of views and by increasing the number of readers.

#### 1110

##### UK survey of 4th and 5th year specialist registrars' attitudes to careers in breast radiology

<sup>1</sup>P J Cantrell and <sup>2,3</sup>N L Evans

*<sup>1</sup>Department of Radiology, Taunton and Somerset NHS Trust, Musgrove Park Hospital, Taunton, Somerset, <sup>2</sup>Royal Gwent Hospital, Cardiff Road, Newport and <sup>3</sup>Breast Test Wales, Cathedral Road, Cardiff, UK*

The continuation of breast imaging, screening and symptomatic, requires further recruitment of radiologists into relevant consultant posts. Currently many of these advertised posts are left unfilled. We undertook a postal survey of all 4th and 5th year specialist registrars in the UK to ascertain their level of exposure to breast radiology, their attitudes to it and their future career intentions. 240 confidential questionnaires were sent and 135 replies received, giving a response rate of 56%. 18 (13.3%) are considering a future career involving breast imaging, the majority of them (13) wishing to undertake screening and symptomatic work. On average, 157 sessions of breast work had been provided in their training. 98 (72.6%) are definitely not pursuing a consultant post involving breast radiology. The most common reason for this decision was a fear of litigation. Lack of training was another important issue raised by this group. The average number of breast sessions undertaken in this group was 26. 19 specialist registrars (14.1%) may possibly consider a career including breast radiology. Factors which would encourage this choice included obtaining a post in the correct geographical location, with non-breast radiology sessions in addition, and only symptomatic breast work. 14 (10.4%) replies stated that there was no breast imaging routinely included in their training scheme. Of these, the majority (71%) would definitely not choose a career involving breast work. **CONCLUSION:** A minority of responders have expressed a definite interest in pursuing a career involving breast radiology. Fear of litigation is cited by the majority and inadequate experience and exposure to the speciality may be factors in the failure to recruit.

#### 1120

##### Evaluation of mammography in males by BI-RADS

<sup>1</sup>K Bock, <sup>2</sup>J Iwinska-Zelder, <sup>1</sup>V F Duda, <sup>1</sup>P Hadji, <sup>1</sup>A Ramaswamy, <sup>2</sup>K-J Klose and <sup>1</sup>K-D Schulz

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**PURPOSE:** The purpose of our study was to assess the positive predictive value of mammographic features and final assessment categories described by the American College of Radiology (ACR) in the Breast Imaging-Reporting and Data System (BI-RADS) for male breast tumors. **MATERIALS AND METHODS:** We retrospectively (1990–1999) evaluated the mammographies of 26 male patients (aged 15–83 years) with enlargement of the breasts, on which biopsies had been performed. All mammographies were classified and categorized by BI-RADS as categories 1–5. Pathohistologic reports were reviewed. **RESULTS:** Primary male breast cancer was present in 4 cases (16%), metastasis (leiomyosarcoma) in 1 case (4%), atypical ductal hyperplasia in 1 case (4%), gynecomastia in 20 cases (80%). All 5 malignant findings were categorized as BI-RADS 4 (suspicious abnormality) or 5 (highly suggestive of malignancy). 4 cases of gynecomastia (1 with concomitant inflammation) were categorized as BI-RADS 3 (probably benign). The remaining 16 cases of gynecomastia as well as the atypical ductal hyperplasia were considered to be benign (BI-RADS 1-2). **CONCLUSION:** In our patient sample, classification and categorization of mammographies by BI-RADS allowed prediction of malignancy in male breast enlargement with high predictive value (ppv = 1).

1130

**The role of ultrasound-guided core biopsy in the cytology-led one-stop breast clinic**

<sup>1</sup>V J Goh, <sup>1</sup>B Shah, <sup>1</sup>W Teh, <sup>2</sup>H Singhal, <sup>2</sup>M Burke and <sup>3</sup>K Shah  
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**INTRODUCTION:** Triple assessment of the palpable breast lesion requires needle biopsy. Cytology is rapid and suited to the one-stop clinic but core biopsy is increasingly used. We reviewed our practice where clinical fine needle aspiration (cFNA) is supplemented by ultrasound-guided core biopsy (USCB) when cFNA is either non-diagnostic or where histological diagnosis is required following triple assessment. **METHODS AND MATERIALS:** A retrospective study was performed on all symptomatic patients who had USCB preceded by cFNA over a period of 17 months. Information was on 98/103 patients. Clinical, imaging and pathological findings were graded on a 5-point scale. **RESULTS:** There were 34 breast cancers and 64 benign diagnoses. Taking a score of 4/5 to be malignant, the sensitivities of mammography, ultrasound, cFNA and USCB were 59%, 100%, 29% and 91%, respectively. The specificities were 97%, 92%, 100% and 100%. cFNA was inadequate in 16/34 cancers and 24/64 benign cases. In all these cases USCB provided a definitive diagnosis. USCB failed to provide a definitive diagnosis in 4 cases: 2 false negatives and 2 cases of atypical hyperplasia where the final diagnosis was ductal carcinoma *in situ*. **DISCUSSION:** Of 230 cancers in the study period, the addition of USCB increased the pre-operative diagnosis rate from 85.7% to 98.3%. Excision to establish diagnosis was avoided in 25 benign cases with C1 cytology. USCB was also useful in confirming benign pathology in 24 women with C2 cytology who wished to avoid surgery. We conclude that USCB is a cost and clinically effective adjunct to cFNA in the one-stop breast clinic.

1140

**Beware of sensitive articles. An audit of popular magazines in the Breast Care Unit waiting room**

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**PURPOSE:** Women's magazines often contain articles on breast cancer. A variety of magazines are provided in the waiting room of our Breast Care Unit. Ladies are often, understandably, in a high state of anxiety waiting for their mammogram or biopsy results. 1 patient complained that an article about a woman dying of breast cancer had upset her. Following this we decided to remove all magazines containing sensitive articles from our waiting room and check any new magazines. Standard: 0% of magazines to contain sensitive articles. **RESULTS:** 96 magazines. 9 (9.4%) contained sensitive articles. Implementing change: An imaging assistant was assigned to check new magazines. Re-audit after 2 months of 60 magazines revealed 3 (5%) sensitive articles. **CONCLUSION:** Continuous review of Breast Care Unit magazines is recommended.

1150

**Radioguided occult lesion localization (ROLL)—a new method for locating impalpable breast lesions at surgery**

M J C Bagnall, R Rampaul, A J Evans, A R M Wilson,  
H C Burrell, and J G Geraghty  
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NG5 1PB, UK

ROLL is a new technique, devised at the European Institute of Oncology, Milan, for localizing impalpable breast lesions at surgery by injection of <sup>99m</sup>Tc-labelled macro-aggregated albumin (MAA) into the centre of the radiological abnormality, either under ultrasonographic or stereotactic X-ray mammographic control. Potential advantages over other marking methods, such as hook wire, include elimination of the risk of displacement or migration of the marker system, allowing the surgeon improved planning of the skin incision and possible increased accuracy of localization. The technique has been adapted for use in Nottingham by using a lung scintigraphic agent (Pulmocis, CIS UK Ltd) as a readily available form of MAA, and substituting check mammography for check scintigraphy as the means of ensuring correct tracer placement by combining the injection with a small volume of contrast medium. Initial experience with ROLL will be described along with the preliminary results of a prospective randomized trial comparing ROLL with hook wire marking of impalpable breast lesions.

1200

**Combined use of isotope and methylene blue dye in sentinel lymph node mapping**

<sup>1</sup>A Connors, <sup>2</sup>N Relihan, <sup>1</sup>M O'Neill and H P Redmond  
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Hospital, Wilton, Cork, Ireland

**INTRODUCTION:** It is hoped that in the future sentinel lymph node (SLN) identification and histological evaluation may enable

a reduction in the number of axillary clearances being performed in patients presenting with breast carcinoma. Correct identification of the SLN is vital in this endeavour. **METHODS:** 52 patients who presented with breast carcinoma underwent SLN mapping using both Tc-sulphur colloid and methylene blue. Patients received 15–60 MBq injected peritumorally at 4 sites (3, 6, 9 and 12 o'clock). Static imaging was performed at 10 min and 2 h. The SLN was identified and marked. In theatre, the site of the SLN was confirmed with methylene blue and further guided by a hand-held gamma probe. SLNs were resected and assessed for metastases using haematoxylin and eosin stain and CAM5.2. All had level 3 axillary clearances. **RESULTS:** In 39 of the 52 patients a SLN was identified with isotope alone. Of the remaining 13, a combination of methylene blue and intraoperative hand-held probe located 9. In 4 patients the SLN was not identified by either method. **CONCLUSION:** Tc nanocolloid will accurately locate the SLN in most patients. Its successful use is dose dependent. Use of methylene blue and gamma probe further increases the number of SLNs found.

1210

**Upright digital stereotactic vacuum-assisted mammotomy using the lateral approach**

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UK

Vacuum-assisted mammotomy provides a method of obtaining larger tissue samples for diagnosis in patients with breast abnormalities that would otherwise require open surgical biopsy. Stereotactic mammotomy of breast lesions only visible on radiography has been available since 1993 but only using a dedicated prone breast biopsy table. This equipment is not widely available in the UK, with the majority of breast units relying on upright mammography equipment to perform radiographically-guided breast biopsy. In 1999, manufacturers of upright stereotactic mammography units introduced adaptors allowing for the use of vacuum-assisted mammotomy on their equipment. We have been using a prototype lateral arm attachment for mammotomy with digital upright stereotactic equipment since August 1999. To date, we have performed more than 50 mammotome procedures using this equipment. Our initial experience is that this device is easy to use, obtains satisfactory tissue samples, is well tolerated and is associated with minimal morbidity. The technique, indications, advantages and disadvantages, and biopsy results obtained using this new technique will be discussed in detail.

1220

**Excision of breast fibroadenomas using ultrasound-guided vacuum-assisted mammotomy—initial experience**

A R M Wilson  
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Nottingham NG5 1PB, UK

Fibroadenomas are a common benign breast "tumour". Diagnosis is normally made on the basis of typical clinical and imaging findings and confirmed by either fine needle aspiration for cytology or needle core biopsy. Fibroadenomas do not require removal unless they show atypical features or are rapidly growing. However, 10–15% of women request their removal. Traditionally this is done by surgical excision. Percutaneous vacuum-assisted mammotomy was introduced in 1994 to provide larger breast core biopsy specimens but it was soon discovered that it can also be used to remove small breast lesions in their entirety. Since June 1999, women with fibroadenomas less than 20 mm in diameter who request removal have been offered the choice of either surgical removal or vacuum-assisted mammotomy. Mammotomy offers the potential advantage of no residual scar on the breast and minimum morbidity. The procedure is carried out under ultrasound guidance in the imaging department. Patients require no pre-medication. The procedure is carried out as an out-patient, taking approximately 20–30 min. The fibroadenoma is removed piecemeal using an 11 G probe and haemostasis is achieved by manual pressure applied for 10 min. The patient can leave the department after a further 30 min. The procedure, advantages and possible pitfalls, and initial experience of this technique will be described in detail.

1230

**Comparative technical evaluation and its influence on the purchase of ultrasound equipment for breast screening centres**

A J Watson  
Ultrasound Equipment Evaluation Project, Clinical Physics,  
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In October 1999, Ultrasound Equipment Evaluation Project (UEEP) were asked to carry out a technical assessment of the image quality of ultrasound scanners for examination of the breast, as part of the tendering process for the New Opportunities Fund for

Oncology. 11 scanners were evaluated using the guidance notes and protocol prepared by the NHS Breast Screening Programme and methods commonly used by UEEP. Each of the scanners evaluated was tested for each available transducer at each frequency setting. The tests were performed using two different breast/small parts phantom types: a GAMMEX RMI 404GS LE and an ATS Model 550. Results were assessed against the performance criteria listed in the guidance notes and comparative performance scores were calculated for each test. Overall scores were calculated, for each of the 9 systems taking part in the tendering process, to provide background information for the clinical assessments. This paper will examine the outcomes of the comparative technical evaluation and the subsequent correlation with the equipment purchased for the Breast Screening Centres. Comparison will also be made with a previous UEEP comparative evaluation of ultrasound scanners for examination of the breast and the effect of that report on the purchase of equipment.

## 1240

## Discussion

1045–1130

College of Radiographers  
William Stripp Memorial  
Lecture  
Hall 8

## 1045

## Eponymous Lecture

## You've been framed—the Ilizarov way

L Batty-Smith

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In some cases of congenital deformity, severe limb trauma and its complications, Ilizarov techniques are used to effect repair and healing with astonishing and excellent results. Dr Gavriil Ilizarov was a Russian orthopaedic surgeon based in Kurgan in Siberia who, in 1951, helped by having a bicycle factory nearby, evolved types of frames which could be externally fixed to a limb. The essential feature of this type of frame is that it allows the long bone to be lengthened, using wires and rods. As a result, distraction osteogenesis occurs, *i.e.* new bone is formed. The radiographer has a vital role in imaging: the importance of which directly affects planning of the operation. Pre-operatively, true anteroposterior and lateral images are mandatory from which the surgeon decides how to put the frame on. Intraoperatively, the radiographer screens for wire placement and alignment. Post-operatively, as in the pre-operative stage, similar images are produced for assessment using identical imaging factors. Producing these images is plagued and hampered by difficulties, be they technical or gaining the full co-operation of a patient who is deeply affected by wearing a frame for up to 3 years. Therefore, this presents a wonderful challenge for radiographers to develop expertise in this field in the demanding circumstances of plain film imaging.

1100–1200

CT Physics  
Hall 11a

## 1100

## A comparison of the design features of multislice CT scanner models

A L Hill, M A Lewis and S Edyvean

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Since the introduction of CT scanning into clinical practice in the early 1970s, the technology has matured greatly. The latest innovation, multislice CT scanning, allows the simultaneous imaging of 4 slices in a single rotation. This, together with shorter rotation times, results in reductions in examination time of up to a factor of 7, for a similar image quality as a single-slice, 1 s scanner. A significant number of multislice systems are already in clinical use worldwide. In the UK, 4 systems had been installed by November 1999, and it is anticipated that this figure will increase rapidly. 4 CT

manufacturers currently offer multislice scanners, based on 3 different design principles. Primarily due to variations in the detector array design and rotation drive mechanism, the systems have varying capabilities with respect to the length imaged in a single rotation, range of slice widths available and rotation speed. The scanners also have differing specifications for reconstruction times and X-ray tube heat capacity, as well as for the standard image quality and dose parameters. The various multislice scanner designs are presented and their capabilities compared. Implications of the design principles on image quality and dose are discussed.

## 1110

## Development of new phantoms for the physical assessment of multislice CT scanners

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ImPACT, Department of Medical Physics, St Georges Hospital  
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**PURPOSE:** Multislice scanners offer a wide range of slice thicknesses and scan combinations, which should be catered for in developing phantoms for the assessment of these scanners. With nearly 2 decades of experience in developing physical phantoms for CT scanner assessment at ImPACT, we embarked on developing new phantoms suitable for the assessment of multislice scanners. **METHODS:** Quadslice scanners have up to 4 times more volume coverage per rotation than single slice scanners scanned at the same pitch. This needs to be reflected in the extra length of the phantoms required. They also offer a wider range of slice thicknesses between 0.5 mm and 10 mm, requiring consistently high contrast for widely variable partial volume averaging. The new phantoms can be divided into 2 categories; water-filled phantoms for noise and uniformity measurements, and inserts which fit into existing CT dose index (CTDI) phantoms for high contrast spatial resolution and slice sensitivity measurements. The high contrast spatial resolution insert is a 0.1 mm diameter, 140 mm long tungsten wire cast in Perspex. The z-sensitivity insert is a 6 mm diameter, 0.05 mm thick tungsten disk embedded in Perspex. **RESULTS:** The phantoms and the individual inserts provide the tools for the physical assessment of spiral and axial CT image quality, including image noise, uniformity, high contrast spatial resolution and slice sensitivity. Preliminary evaluation data have been obtained from a single slice GE CT/i scanner and the phantoms have been used in the assessment of multislice scanners. **CONCLUSION:** The new phantoms meet the increased demands of spiral multislice CT on phantom design, particularly z-axis length and uniformity.

## 1120

## Can multislice helical CT achieve a better noise-dose relationship than single slice?

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ImPACT Group, Department of Medical Physics and  
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Manufacturers claim that multislice CT scanners exhibit performance peaks at certain helical pitches, whereas in single slice CT the image noise remains unchanged with pitch and the slice sensitivity profile steadily deteriorates with increasing pitch. The inference is that, by combining optimized pitch with a new form of helical interpolation algorithm, an improved relationship between noise and dose at a given effective slice thickness can be achieved in multislice scanning compared with single slice scanning. Most of the evidence that has appeared in the literature is based on computer simulations. The aim of our study was to obtain experimental data for the relationship between noise, dose and slice profile at the available pitches on both a multislice and a single slice scanner. We used standard ImPACT phantoms and protocols to measure noise, dose and slice profiles on a single slice IGE HiSpeed CT/i scanner and on a multislice IGE LightSpeed QX/i scanner. A comparison of the results demonstrates the extent to which the manufacturer's claims for multislice CT performance are borne out.

## 1130

## Biopsy time and operator dose using CT fluoroscopic guidance

A K P Lim, S J Higgins, N J Davies, A Hancock and M E Roddie

Department of Imaging, Charing Cross Hospital, London  
W6 8RF, UK

**PURPOSE:** To measure the radiation dose to the patient and operator during biopsies performed using CT fluoroscopic guidance and to assess procedure time. **METHOD:** 21 patients undergoing CT-guided biopsy were included in the study. A Somatom Plus 4 CT scanner (Siemens) with a CT fluoroscopy upgrade (CARE Vision) was used. Thermoluminescent dosimeters (TLDs) were placed on the patients' skin in the line of the scanner beam, the operators hand, forehead, neck and pelvis. A further TLD was placed on the forehead of the assisting nurse. The time taken to place the needle

into the lesion once it had entered the skin was measured. RESULTS: Lesions biopsied included 12 pulmonary masses, 4 lymph nodes (3 abdominal and 1 mediastinal), 2 pancreatic masses and 3 bone lesions. The average dose to the operator's hand was  $48 \pm 47.1 \mu\text{Gy}$ . The highest hand dose occurred during a case where the needle was advanced into the lesion using a needle holder under continuous CT fluoroscopy ( $149.1 \mu\text{Gy}$ ). The average eye dose to the operator was  $64.8 \pm 42.5 \mu\text{Gy}$  and to the nurse was  $17.4 \pm 14.9 \mu\text{Gy}$ . The average skin dose to the patient was  $83.1 \pm 85.3 \text{ mGy}$ . The average time taken to place the needle tip into the lesion was 1.47 min (range 0.33–4.1 min). CONCLUSION: CT fluoroscopy is a highly effective tool, enabling CT-guided biopsies to be performed more quickly than before. Radiation dose to the operator and nurse occurs and is the main disadvantage of the technique. Radiation dose to the operator can be reduced without significantly increasing procedure time by using an intermittent fluoroscopic technique.

#### 1140

##### A comparison of methods for measuring the limiting spatial resolution of a CT scanner

B Warr, A Hill, N Keat, S Sassi and S Edyvean

Department of Medical Physics (Imaging), St George's Healthcare NHS Trust, Tooting, London SW17 0QT, UK

The use of CT as a widespread diagnostic imaging tool necessitates the accurate assessment of a scanner's capabilities. The test tool provided for the assessment of high contrast spatial resolution is usually a bar pattern for subjective visual analysis. The design of these bar phantoms varies between different manufacturers, and although suitable for QA procedures, the method does not allow for reliable comparisons between different scanner models. Therefore, it is important that these subjective checks can be related to one another, as well as to the more objective methods, such as those used by the IMPACT group. The aim of this project was to determine the correlation between techniques so that fair comparisons can be made when required. Measurements were conducted on an IGE HiSpeed CT/i scanner recently installed at St. George's Hospital, London. We used a range of both objective and subjective methods. These included Fourier analysis of edge spread function data, from our own phantom, to calculate modulation transfer function (MTF), the Droege method of analysis (related to the modulation of a bar pattern) on IGE's own QA phantom and visual analysis on a "Catphan" bar pattern. By upgrading our image analysis software we were able to test a new wire insert made to fit into one of IMPACT's existing phantoms. This insert provides a versatile method for assessing resolution of axial, helical and multi-slice scanning, by calculating the MTF from point spread function data. Results are presented showing the correlation between the different methods.

#### 1150

##### Discussion

## 1100–1200

### Thoracic Irradiation 1

#### Hall 11b

#### 1100

##### Invited Review

##### The new generation of radiosensitizers in non-small cell lung cancer

A Price

University of Edinburgh/ Western General Hospital, Edinburgh, UK

- Local failure remains a key issue in patients with non-small cell lung cancer. Local control with CHART is less than 25% at 2 years. One way of improving this may be the use of chemotherapeutic drugs or novel agents as radiosensitizers.
- Three areas will be considered: full dose concurrent chemotherapy; chemotherapy at "radiosensitizing" but not cytotoxic doses; non-cytotoxic agents as radiosensitizers.
- 1 of 2 trials comparing sequential and concurrent full dose chemoradiotherapy showed a benefit for the latter. An analysis of the RTOG database suggested that this was associated with increased toxicity.
- Only 1 of 5 trials (1176 patients) of radiotherapy with or without concurrent low dose platinum agents showed a survival benefit. 2 trials of hyperfractionated radiotherapy (294 patients) ± concurrent low dose carboplatin and etoposide did show improved survival with the combined modality treatment.

- Phase I trials have established safe doses of the taxanes as radiosensitizers, and are in progress with gemcitabine. Numerous Phase II, but no Phase III, trials have been completed.

- Alternative radiosensitizers, including ARCON, the hypoxic cytotoxin tirapazamine and farnesyl transferase inhibitors are being investigated pre-clinically and require clinical exploration.

- The differing mechanisms of radiosensitization offer the possibility of cocktails of radiosensitizers that will need testing with optimal radiotherapy regimes. In the UK this means CHART, but this may be hindered by logistical and financial difficulties with its implementation. The huge variety of radiotherapy regimes used in previous studies, often to accommodate the radiosensitizer, makes comparisons between trials difficult. We have a unique opportunity in the UK to investigate the radiosensitizing properties of these agents without the confounding effects of chemotherapy, to establish whether the poor local control achieved even with CHART can be improved.

#### 1130

##### Invited Review

##### Thoracic radiotherapy—do we worry too much about myelitis?

F R Macbeth

Velindre Hospital, Whitchurch, Cardiff CF14 7XL, UK

This will be an interactive session to explore the following issues:

- How do we define spinal cord tolerance?
- What is the current best evidence about radiation dose and risk to the spinal cord?
- What risks should we be prepared to take on behalf of our patients?
- What implications are there for how we plan radiotherapy to thoracic tumours and for how we obtain informed consent?
- Should we worry about re-treatment?

## 1115–1245

### Venous and GI Intervention

#### Hall 5

#### 1115

##### Invited Review

##### Gastrointestinal stents

A F Watkinson

X-Ray Department, Royal Free Hospital, Pond Street, London NW3 2QG, UK

The presentation will cover the following:

- The current role of oesophageal stents.
- The emerging role of gastric outlet, duodenal and colonic stents.
- The main focus will be on the management of malignant strictures although some discussion on benign strictures will take place.

#### 1145

##### Invited Review

##### IVC filters

G Plant

Department of Radiology, The North Hampshire Hospital, Aldermaston Road, Basingstoke RG24 9NA, UK

- Indications.
- Choice of filter.
- Methods of insertion.
- Anticoagulation for filters.
- Follow-up: short- and long-term.
- Morbidity and cost.
- Temporary caval filtration.

#### 1215

##### Invited Review

##### Biliary strictures

D F Martin

Department of Radiology, South Manchester University Hospitals NHS Trust, Neil Lane, West Didsbury, Manchester M20 2LR, UK

- Benign and malignant strictures require different approaches.
- Precise diagnosis can be difficult.
- Benign strictures need a careful team approach.
- Surgery may be the best option.
- Avoid metal stents at all cost.

## 1130–1230 PACS 1 Olympian Suite

1130

**Invited Review****Integrating DICOM into the healthcare environment**

C Parisot  
*GE Medical Systems, IIS—Global Connectivity Center,  
283 rue de la Minière, Buc 78530, France*

The Digital Imaging and Communications Standard, known worldwide as DICOM, has expanded since its inception in 1993 to encompass many dimensions beyond the exchange of medical images. This presentation will provide an overview of the 5 dimensions now covered by DICOM and stress their immediate applicability in ensuring not only connect imaging equipment and PACS within the radiology department but also as a strategic means to integrate the imaging department with the health care enterprise information systems. The recent IHE initiative by RSNA to promote standards-based integration in the health care enterprise will be discussed and its relevance to Europe highlighted. This presentation will provide a solid understanding of the benefits of DICOM as offered today in many products as well as the upcoming capabilities of the standard. The presentation will be followed by a question and answer session.

## 1145–1330 Imaging the Lumbar Spine Hall 8

1145

**Invited Review****Imaging the lumbar spine. Is there a role for the plain film examination today?**

M J Warren

*Department of Diagnostic Imaging, Luton and Dunstable Hospital, Luton LU4 0DZ, UK*

This session will discuss the current role of the lumbar spine radiograph by exploring the following topics:

- A historical perspective and the emergence of new technology.
- Clinical scenarios in which radiographs are now obsolete, with particular reference to back pain.
- Problem solving and clinical scenarios in which radiographs still have a valuable diagnostic role—to include more detailed discussion of: trauma; correlation with other imaging techniques; use of the skeletal survey; assessment of scoliosis and post-operative monitoring.

1205

**Invited Review****CT scanning of the lumbar spine**

R Steele

*CT Scanning, Guy's Hospital NHS Trust, UK*

The following points will be discussed:

- Analysis of the plain film.
- Clinical considerations.
- CT or MRI?
- Technical parameters.
- Computerized reconstruction.

1225

**Invited Review****MRI—the technique of choice**

K L Gillmore

*Lodestone Patient Care, Queen Elizabeth the Queen Mother Hospital, Margate CT9 4AN, UK*

- Spinal imaging—why MRI?
- Degenerative disease and the post-operative spine.
- Infection.
- Congenital anomalies.
- Neoplasia.
- Trauma.

1245

**Invited Review****Imaging of the lumbar spine: ultrasound—a useful modality?**

D Chapman-Jones

*Canterbury Christ Church University College/Medway Hospital, Canterbury CT1 1QU, UK*

The following points will be discussed:

- Suitable equipment: how we went about evaluating the efficacy of diagnostic ultrasound; setting parameters.
- An evaluation of spinal anatomy using diagnostic ultrasound: how much can be accurately demonstrated?
- Are symptoms related to pathology in bony or soft tissue structures, or in both? Where are the most significant changes?
- Facet joints: do the imaging findings relate to the clinical symptoms?
- The future MRI: too many false positives? Where do we go from here?

1305

**Discussion**

## 1215–1315 Mammography Physics and Technology Hall 11a

1215

**Breast cancer diagnosis using scattered X-rays. A non-invasive biopsy tool?**

<sup>1</sup>R A Lewis, <sup>2</sup>K D Rogers, <sup>1</sup>C J Hall, <sup>3</sup>A Evans, <sup>3</sup>S Pinder,

<sup>4</sup>A Hufton, <sup>5</sup>D R Dance, <sup>6</sup>C R M Boggis and <sup>3</sup>I Ellis

*<sup>1</sup>CLRC Daresbury Laboratory, Warrington WA4 4AD, <sup>2</sup>Faculty of Medicine and Biosciences, Cranfield University, Shrivvenham, Swindon SN6 8LA, <sup>3</sup>Nottingham City Hospital, Hucknall Road, Nottingham NG5 1PB, <sup>4</sup>North Western Medical Physics, Christie Hospital, Manchester M20 4BX, <sup>5</sup>Royal Marsden NHS Trust, Fulham Road, London SW3 6JJ and <sup>6</sup>Manchester Breast Screening Service, Withington Hospital, Nell Lane, Manchester M20 0PT, UK*

**PURPOSE:** All disease states, without exception, are caused by fundamental changes in cellular and/or tissue biochemistry. Traditional diagnostic methods rely upon detection of such abnormalities by chemical/histopathological techniques or by the appearance of some symptoms and/or signs that are recognized by a clinician. The resulting diagnosis is often highly subjective, equivocal and heavily dependent upon expert training. It follows, therefore, that more direct methods of detecting biochemical and structural changes, preferably at the molecular level, would be a valuable addition to the diagnostic armoury. **MATERIAL AND METHODS:** The coherent scattering of X-rays is routinely used to examine the molecular structure of materials in fields outside medicine. While the technique is more normally associated with the study of crystals, many biological tissues have significant spatial ordering and readily diffract X-rays. In fact, extremely useful information on the molecular structure of tissues can be rapidly and objectively determined from untreated, hydrated and even live tissues. The collagens can be readily studied by this technique and are major components of the extracellular matrix, the degradation and penetration of which are major processes in the morbidity and mortality of cancer. We have used X-ray diffraction to study the coherent scatter from breast tissue having various pathologies. **RESULTS:** We report our initial findings, which demonstrate that it is possible to distinguish malignant, benign and normal tissue using only scattered X-rays.

1225

**Full-field digital mammography—a phantom (RMI) study before clinical use**

R Schulz-Wendtland, U Aichinger, M Säbel and W Bautz

*Institut für Diagnostische Radiologie, Gynäkologische Radiologie, FAU Erlangen-Nürnberg, Universitätstrasse 21–23, 91054 Erlangen, Germany*

**PURPOSE:** The objective of this phantom study was to determine whether the now-available full-field digital mammography (DR) can replace high resolution digital storage plates (CR) and film-screen systems (FSS) in diagnostic mammography. **MATERIALS AND METHODS:** DR conditions: detector with amorphous silicon,



spatial resolution >5 line pair per mm (Siemens). CR conditions: phosphor storage plates (Fuji IP HRV, 24 × 30 mm<sup>2</sup>) in combination with a Mammomat 3 (Mo/Rh, Siemens), read by a Fuji AC 3M (matrix 4170 × 4300, >10 pixels per mm), and all images printed by a Fuji FL-IMD laser printer (line distance <50 μm); FSS conditions: Mammomat 3000 (Mo/Mo, Siemens). RESULTS: 225 right positive details were possible for every system. There were no significant differences between the 3 systems. CONCLUSION: After this phantom study, further studies are necessary to determine whether the same results are found in clinical mammography.

#### 1235

##### Objective imaging characteristics of small field digital mammography systems

<sup>1</sup>D Evans, <sup>2</sup>A Workman and <sup>1</sup>M Payne

<sup>1</sup>King's College Hospital and <sup>2</sup>Northern Ireland Medical Physics Agency, King's College Hospital, London SE22 8PT, UK

PURPOSE: To evaluate the objective imaging characteristics of small field digital mammography devices and use these characteristics to predict the results of contrast detail detectability tests. METHODS: Measurements of the signal and noise transfer properties were made for 4 different models of small field digital mammography systems. These were used to derive objective signal-to-noise ratio transfer properties of the imaging systems [the noise equivalent quanta and the detective quantum efficiency (DQE)]. Threshold contrast measurements were made using a contrast detail test object. A signal-matched noise-integration model together with the physical measurements was used to model the contrast detail behaviour of the imaging systems. RESULTS: The different small field systems exhibit significant differences in low frequency DQE and DQE bandwidth. This reflects the differences in design criteria of the systems relating to the X-ray phosphor, optical coupling and charge coupled device properties. CONCLUSIONS: Physical image quality measurements allow the characterization of the imaging performance of small field digital mammography systems. Measurements indicate that devices designed to undertake similar imaging tasks exhibit significantly different imaging properties. Objective imaging measurements may be also used to model the contrast detail detectability behaviour of these devices.

#### 1245

##### Full field 3D digital mammography using an amorphous silicon array

<sup>1</sup>J A Horrocks, <sup>2</sup>R D Speller, <sup>1</sup>D R Taylor and <sup>2</sup>D Darambara  
<sup>1</sup>Clinical Physics, Barts and The London NHS Trust, London EC1A 7BE and <sup>2</sup>Department of Medical Physics, University College London, London WC1E 6JA, UK

PURPOSE: To evaluate the performance of a proposed system for 3D digital mammography and to investigate methods of evaluating the 3D images. 3D stereoscopic images showing the relative location of structures in the breast may provide additional diagnostic information. MATERIAL AND METHODS: The large area amorphous silicon detector arrays currently available have pixels in the range 120–140 μm. The X-ray source requirements and irradiation geometry needed to provide adequate spatial resolution with this detector type were evaluated. The performance (detector characteristic, modulation transfer function, noise) of an amorphous silicon flat panel array with 4 different intensifying screens used with a minifocus X-ray tube were investigated. Image quality was assessed using the TORMAM test object and compared with film/screen systems. RESULTS: An X-ray system with a 50 μm focal spot and magnification in the range 3–6 (depending on intensifying screen used) was required to provide comparable spatial resolution to film/screen systems. For geometries giving the same spatial resolution in the image, the regular and mammography screens gave similar image quality/dose performance. To evaluate the 3D images a new phantom had to be designed, containing low contrast test objects of different size and shape and spatial resolution meshes placed at different depths in the phantom. Excised tissue samples will also be used to evaluate the 3D images. CONCLUSIONS: A method was developed to optimize a system that could be used for full field digital mammography and a phantom for evaluating 3D images developed.

#### 1255

##### Generating realistic spiculated lesions in digital mammograms

S J Caulkin, S M Astley and C R M Boggis

Imaging Science and Biomedical Engineering, University of Manchester and Greater Manchester Breast Screening Centre, Withington Hospital, Manchester M13 9PT, UK

We are developing a system for generating realistic spiculated lesions in digital mammograms. This will be used for training purposes.

The main advantage of this approach is that a very large number of different realistic lesions may be generated in known positions; this will facilitate a quantitative evaluation of the radiologists' performance. A chronological sequence of 120 abnormal mammograms from the Greater Manchester Breast Screening Centre were digitized and annotated by an expert radiologist. The attenuation pattern due to each lesion was obtained by subtracting the background from the lesion. A statistical model of lesion appearance, combining shape and grey level information was then built. Vectors representing shape and grey level were extracted from each training example and principal component analysis was used to decompose the variation into a set of modes with associated variances. Each example may then be expressed as a set of parameters representing a weighted sum of modes. New examples are generated by randomly selecting appropriate parameter combinations. The shape and grey levels are reconstructed and generated lesions are placed at realistic locations in normal mammograms. A separate statistical model of spicules has been built using data acquired from transverse density profiles and from an analysis of spatial properties extracted from lesions in the training set. Results show that the model is capable of generating lesions consistent with those in the training set.

#### 1305

##### Discussion

### 1300–1345

## British Institute of Radiology Mackenzie Davidson Memorial Lecture Hall 5

#### 1300

##### Eponymous Lecture

##### Radiological management of abdominal trauma

R F Dondelinger

Department of Medical Imaging, University Hospital Sart Tilman, Domaine Universitaire du Sart Tilman, 4000 Liege, Belgium

Management of polytrauma victims requires urgent and efficient diagnosis and therapy. CT with spiral acquisition capability and state-of-the-art DSA are mandatory for radiological damage control. These facilities should be integrated in the emergency department or be located close to it with immediate access. In an optimal configuration, the CT and the angiographic unit should operate in an interactive way, avoiding time loss between diagnosis and treatment and mobilization of the patient and the anaesthesiology team. Senior staff radiologists dedicated to trauma and with a consistent experience in CT and in interventional angiography should be available around the clock. With such prerequisites, the severely injured polytrauma patients including marginally stable victims undergo rapid evaluation with imaging techniques. When active haemorrhage is evidenced on spiral CT, subsequent angiographic embolization is performed. In our experience, hepatic, splenic, phrenic, abdominal wall, renal, retroperitoneal and pelvic bleeding sites were treated in such a way in selected victims. Haemodynamically unstable patients with retroperitoneal and pelvic haemorrhage also undergo primarily angiography and embolization. Pelvic bone dislocations are stabilized by orthopaedic fixation. In some patients with persistent bleeding, an arterial embolization procedure may still be indicated. Haemodynamically unstable patients with visceral bleeding undergo surgery after a rapid ultrasound evaluation. Ultrasound is mainly used to document minor trauma to a single parenchyma or to rule out visceral injury before patient discharge. The majority of victims with hepatic, splenic and renal contusions can be treated conservatively without intervention. Other patients may undergo secondary surgical debridement or delayed coelioscopic aspiration of haemoperitoneum or open repair of other surgical lesions. During follow-up, drainage of infected fluid collections can be performed percutaneously. Peripheral bone fractures and bleeding should not mask an unrecognized thoracic or abdominal source of haemorrhage. Overall, the time devoted to diagnostic work-up in the emergency room with imaging techniques should be inversely proportional to the severity of the lesions. Therefore, an integrated approach with CT and angiography offers optimal radiological patient management.

## 1300–1430 Thoracic Irradiation 2 Hall 11b

1300

**Invited Review****The role of stenting for palliation of SVCO**

R A Morgan

*Department of Radiology, St George's Hospital, London SW17 0QT, UK*

- Metallic stenting is very effective for the palliation of malignant SVC obstruction (SVCO).
- Technical and clinical success is achieved in 95% of patients.
- Relief of SVCO occurs within 12 h in 90% of patients.
- Stents produce better relief of SVCO than radiotherapy.
- Although stents have high material costs, SVC stenting is cost effective.
- Metallic stenting should be the procedure of first choice for SVCO.

1330

**Invited Review****Mesothelioma: is radiotherapy effective?**

N P Rowell

*Department of Clinical Oncology, Royal Marsden Hospital, Downs Road, Sutton, Surrey SM2 5PT, UK***RADICAL RADIOTHERAPY**

- Various techniques of high dose radiotherapy given following radical surgery have been described.
- The effectiveness of these strategies and their relation to radical surgery remain uncertain.

**ADJUVANT RADIOTHERAPY:**

- Patients with mesothelioma commonly undergo invasive procedures to obtain a diagnosis or to achieve pleurodesis and are at risk of recurrence in the biopsy or drain site.
- Radiotherapy within 4 weeks of an invasive procedure effectively reduces the risk of drain-site recurrence.
- 21 Gy in 3 daily fractions is the current recommendation.
- Is a single fraction as effective?

**PALLIATIVE RADIOTHERAPY**

- Pain relief—obtained in approximately 50% of patients; no standard radiotherapy regime; current guidelines; are higher doses more effective?
- Reduction in the size of chest wall masses—seen in approximately 50% patients; breathlessness is not an indication for radiotherapy; insufficient experience in SVCO; SVC stenting recommended.

1400

**Invited Review****Pulmonary radiation toxicity: radiation pneumonitis and changes in lung function**

J Lebesque

*Department of Radiotherapy, The Netherlands Cancer Institute, Antoni van Leeuwenhoek Huis, Plesmanlaan 121, 1015 TT Amsterdam, The Netherlands***OVERALL RADIATION EFFECTS**

- Reduction of lung function (PFTs).
- Incidence and severity of radiation pneumonitis.
- Incidence and severity of radiation fibrosis.

**3D DOSE DISTRIBUTION**

- Reduction to DVH: loss of spatial information.
  - Spatial variation of function.
  - Spatial variation of local radiation effects.

**DVH REDUCTION**

- Kutcher model: local volume effect according to power law.
- Parallel model: local dose effect relation.

**LOCAL DOSE-EFFECT RELATION**

- Perfusion and ventilation: power law (1/n) fit with  $n=0.81$ , 0.88.
- Mean lung dose is a good first approximation for the effective uniform dose.

**MEAN LUNG DOSE**

- Predictive for incidence of radiation pneumonitis.
- Predictive for reduction of pulmonary function.
  - VA, VC and FEV1—3 months after RT, 1% reduction per Gy mean lung dose; 18 months after RT, 0.4% reduction per Gy mean lung dose.
  - TL, Coc—3 months after RT, 1% reduction per Gy mean lung dose; additional effect of chemotherapy; 18 months after RT, recovery for all patients.

## 1345–1515 Studies in the Face, Neck and Cranium Hall 6

1345

**MRI as a first line investigation of salivary disease in primary care**<sup>1</sup>S J Golding and <sup>2</sup>S R Watt-Smith<sup>1</sup>*Department of Radiology, University of Oxford and*<sup>2</sup>*Department of Maxillofacial Surgery, John Radcliffe Hospital, Oxford OX3 9DU, UK*

**PURPOSE:** To evaluate the use of MRI as a first line investigation in salivary disease presenting from primary care. **MATERIALS AND METHODS:** 28 patients referred sequentially from general practitioners were investigated prospectively by MRI in the first instance. A standardized examination protocol covering the parenchyma and ducts of the 4 major salivary glands was employed using a 1.5 T system (General Electric Medical Systems) and findings reported by 1 radiologist. Patients were referred for further investigation, usually sialography, on the basis of the findings. **RESULTS:** MRI has proved effective in demonstrating tumours and established ductal disease. Findings were found to be sufficient for clinical management in the majority of cases. Only 4 patients have required further investigation and the management of none has been changed by these studies; this observation has to be seen in the light of present clinical policy to treat conservatively with sialogogues patients in whom established disease is not definitely shown. The study is ongoing and updated results are presented. **CONCLUSIONS:** MRI appears to be a clinically effective, non-invasive and radiation-free first line investigation in salivary disease, a sufficient basis for managing salivary disease in primary care in the majority of patients. A basis for a costs and benefits study exists.

1355

**High resolution CT in patients with vertigo following stapes surgery**

D Pickuth, S Brandt, R P Spielmann and S H Heywang-Köbrunner

*Department of Diagnostic Radiology, Martin-Luther-University, Halle-Wittenberg 06112, Germany*

**PURPOSE:** To determine the role of high resolution CT in patients with persistent or recurrent vertigo after stapes surgery. **MATERIAL AND METHODS:** 10/30 patients, who had post-operative CT of the temporal bone between January 1993 and June 1999, presented with vertigo. **RESULTS:** In 8/10 patients, the underlying cause for post-operative vertigo could be established with CT. The CT findings included a prosthesis shaft entering the vestibule and compressing the sacculle in four patients, a complete dislocation of the stapes prosthesis in one patient, air bubbles and fluid collections within the vestibule and outside the oval window indicating a perilymphatic fistula in two patients, and bony fragments leading to a compression of the basal sacculle in one patient. **CONCLUSION:** Although immediate post-operative vertigo is often transient, patients with persistent or recurrent vertigo should be imaged, as high resolution CT will determine the underlying cause in the majority of patients.

1405

**Parathyroid adenomas: <sup>99</sup>Tc<sup>m</sup> sestamibi dual phase SPECT imaging concordance with ultrasound**

I S Francis, E L Loney, E A Dick, J R Buscombe, L A Berger and A J W Hilson

*Radiology Department, Royal Free Hospital, Pond Street, London NW3 2QG, UK*

**PURPOSE:** Controversy persists over the role of imaging patients who are undergoing first time neck exploration to parathyroid adenomas. In our institution, there are 2 major techniques to localize parathyroid adenomas—high resolution ultrasound of the neck and parathyroid scintigraphy. In order to evaluate the optimal imaging strategy, we looked at dual phase SPECT imaging concordance with ultrasound. **MATERIALS AND METHOD:** To simplify the scintigraphic technique we use a dual phase SPECT study. The first images are performed 15 min and at 3-4 h post injection of 740 MBq <sup>99</sup>Tc<sup>m</sup> MIBI. Ultrasound was performed with a high resolution (7.5–10 MHz) linear probe. Power Doppler was utilized to improve the identification of inconspicuous lesions. Follow-up was based upon biochemical analysis and histological results. **RESULTS:** A total of 67 parathyroid scintigraphic studies were performed on patients with biochemical evidence of hyperparathyroidism. 37

(55%) of these were positive. Ultrasound was performed in 47 of the original 67 patients and of these, 13 cases showed concordant positive results (including 5 cases of multiple adenomata). Concordant negative results were obtained in 25 patients. 7 cases had positive parathyroid scintigraphy, but negative ultrasound and 2 cases negative parathyroid scintigraphy, but positive ultrasound. All concordant positive cases have undergone surgery and histological examination confirmed a diagnosis of adenoma. CONCLUSION: There is agreement of 80.8% between the results for <sup>99</sup>Tc<sup>m</sup> MIBI parathyroid scintigraphy and anatomical imaging of the neck. The combination of both of these modalities may allow the use of a "targeted approach" to parathyroid surgery.

1415

**Spiral CT prior to and after cricothyroid approximation**

D Pickuth, R P Spielmann and S H Heywang-Köbrunner

Department of Diagnostic Radiology, Martin-Luther-University, Halle-Wittenberg 06112, Germany

PURPOSE: Cricothyroid approximation raises the vocal pitch by simulating the contraction of the cricothyroid muscle with sutures. The aim of this study was to determine the role of spiral CT in patients scheduled for cricothyroid approximation. MATERIALS AND METHODS: 29 transsexual patients were examined with spiral CT prior to and after laryngoplastic surgery. CT findings were correlated with phoniatric findings in all patients. RESULTS: The average reduction of the cricothyroid distance was 6 mm (range 2–10 mm). The vocal pitch elevation was more remarkable in the patient group with greater reduction of the cricothyroid distance. CONCLUSION: CT accurately determines the cricothyroid distance prior to and after surgery and is an ideal method for follow-up purposes, especially in the case of a post-operative reversion towards a lower pitch. In addition, CT provides important data as to the most appropriate extent and site of intracordal intervention to be done for a desired pitch elevation.

1425

**Cavernous sinus thrombosis— which radiological test should we choose?**

V K Jayakrishnan and E Teasdale

Department of Neuroradiology, Institute of Neurosciences, Southern General Hospital, Glasgow G51 4HE, UK

PURPOSE: Cavernous sinus thrombosis (CST) is associated with significant mortality, and early diagnosis and treatment are crucial. There is confusion in the literature regarding the choice of imaging methods in CST. A simple and accurate test that can be performed at the district general hospital (DGH) level is therefore important. METHODS: The radiological tests performed in 8 patients with clinically suspected CST (dynamic CT in 8, MRI in 3, MRV in 2, carotid angiography in 3 and orbital venography in 2) were reviewed for the type and frequency of abnormality. Clinical presentation, time delay to diagnosis and treatment outcomes were noted. RESULTS: High resolution CT (protocol will be described) was consistently abnormal in all patients (5 showed filling defects and 3 no opacification). In 5/8 patients (63%), the diagnosis could be established within 24 h of admission using CT. MRI in 3 patients failed to show a convincing abnormality. MR venography showed non-filling of the cavernous sinuses in 2 patients. Orbital venography done in 2 patients was abnormal in both. Cerebral angiography showed non-filling in 2 patients and filling defects in 1. CONCLUSIONS: High resolution CT is a fast and reasonably accurate initial test in CST. It can be performed in most DGHs so that early treatment can be initiated. Standard MRI is inadequate, while sophisticated sequences are time-consuming and not readily available. Cerebral angiography is unreliable, as a significant number of normal cavernous sinuses are not opacified. Orbital venography is still the most accurate and should be considered when CT is negative or equivocal.

1435

**Endovascular treatment of indirect carotico-cavernous fistulae**

D J Annesley-Williams, M Brannigan, A Goddard, R P Brennan and A Gholkar

Department of Neuroradiology, Newcastle General Hospital, Newcastle upon Tyne NE4 6BE, UK

PURPOSE: To assess the cure rate in patients with indirect carotico-cavernous fistula (CCF) treated by transvenous embolization via the inferior petrosal sinus (IPS) pathway or the superior ophthalmic vein (SOV) approach. METHODS: 12 fistulae in 11 patients (10 women, 1 man; mean age 69) were treated by transvenous embolization; 8 fistulae via the IPS and 4 fistulae in 3 patients via the SOV. The transfemoral or the surgical approach were used for catheterization of the IPS and SOV, respectively. Embolization was

performed with microcoils (Guglielmi detachable coil (GDC) or tungsten) in all patients. Follow-up angiography was performed at 2–7 months with ophthalmic and neurological examinations at 3 and 6 months. Complete cure was defined as angiographic obliteration of the fistula and resolution of clinical signs and symptoms. RESULTS: Complete cure was achieved in 10 of the 12 fistulae treated; 6/8 via the IPS and 4/4 via the SOV. In 1 patient, embolization via the IPS route lead to transient worsening of symptoms due to redirection of blood into the ophthalmic venous pathway. CONCLUSIONS: Our preferred method for treatment of indirect CCF is via the IPS. This approach is technically easier and has fewer potential risks than the SOV approach. Both routes of access lead to a high cure rate and are associated with few complications.

1445

**Coil vs clip: does this influence delayed ischaemic neurological deficit following subarachnoid haemorrhage?**

P P J Raju, D J Annesley-Williams, P Coles, A Goddard, D Birchall, P Haslam and A Gholkar

Department of Neuroradiology, Newcastle General Hospital, Newcastle upon Tyne NE4 6BE, UK

PURPOSE: To compare the incidence and duration of delayed ischaemic neurological deficit (DIND) and outcome in patients with subarachnoid haemorrhage following endovascular treatment with a Guglielmi detachable coil (GDC) with surgical clipping. MATERIALS AND METHODS: 119 of 424 patients (32 men, 87 women, age range 19–84) who presented to our institution over the 2 year period of this prospective study were examined by transcranial Doppler (Multi Dop Haemodyne DW1, 2 MHz probe). The patients were divided into 2 groups: Group 1 (27 patients) were treated by the endovascular route and Group 2 (92 patients) underwent surgery. The following parameters were recorded: mean cerebral blood flow velocities in the internal carotid artery, the middle cerebral artery and the anterior cerebral artery bilaterally, time taken for DIND to resolve and outcome as defined by the Glasgow Outcome Score (GOS) at discharge. RESULTS: DIND was detected in 65/119 patients (55%). The incidence was higher in the surgically treated group [53/92 patients (58%)] compared with the endovascular group [12/27 patients (44%)]. The time taken for the DIND to resolve varied between 1 and 18 days with a mean of 8 days. In 10/65 (15%) of surgical patients the time to resolution was in excess of the mean, as compared to 2/65 (3%) in the endovascular group. 34/92 patients (37%) in Group 2 had a poor outcome (death, vegetative state or severe disability) compared to only 5/27 (19%) patients in Group 1. CONCLUSION: DIND was less common and less prolonged in the endovascular as opposed to the surgical group. Patients in the endovascular group had an improved neurological outcome at discharge.

1455

**Cerebral perfusion studies in cerebral venous sinus thrombosis**

<sup>1</sup>S C Jenkins, <sup>2</sup>J Patterson and <sup>1</sup>E M Teasdale

Departments of <sup>1</sup>Neuroradiology and <sup>2</sup>Clinical Physics, Institute of Neurological Sciences, Southern General Hospital, 1345 Govan Road, Glasgow G51 4TF, UK

PURPOSE: To review the cerebral perfusion abnormalities demonstrated by <sup>99</sup>Tc<sup>m</sup>-hexamethylpropylene amine oxime (HMPAO) single photon emission CT (SPECT) in patients with cerebral venous sinus thrombosis (CVST) diagnosed by CT venography (CTV) and/or cerebral angiography. METHODS: HMPAO SPECT was performed on 6 patients with CVST presenting to our institution between 1996 and 1999. SPECT scans, imaging findings and patient case records were reviewed retrospectively. RESULTS: HMPAO SPECT was performed 2–12 days after the onset of neurological signs. 2 patients had follow-up SPECT. All patients had CTV and/or cerebral angiography within 2–24 h of SPECT. 3 patients had extensive CVST and deep venous thrombosis (DvT), 1 patient isolated superior sagittal sinus (SSS) thrombosis and 2 isolated lateral sinus thrombosis. 4 patients developed venous infarction. Perfusion abnormalities were demonstrated in all patients. Diffuse perfusion abnormalities of variable size were present in 5 patients—1 patient had CT changes of venous infarction in the same area. Focal lobar perfusion defects corresponding to infarction were present in 2 cases. Bilateral perfusion abnormalities were seen in only 2 patients, both with SSS thrombosis. Basal ganglia/thalamic perfusion abnormalities were seen in 2 of 3 patients with DvT without CT evidence of infarction. This finding was not associated with a poorer outcome. CONCLUSION: Cerebral perfusion patterns are highly variable in patients with CVST, and cannot be predicted from the site or extent of the CVST.

1505

**Ultrafast MRI of the fetal central nervous system**

E H Whitby, M N Paley, N P Davies, A Sprigg and P D Griffiths  
Academic Department of Radiology, Floor C, Royal Hallamshire  
Hospital, Glossop Road, Sheffield S10 2JF, UK

**PURPOSE:** To assess ultrafast MR techniques in imaging congenital central nervous system abnormalities of the fetus and compare the results with other antenatal and postnatal imaging techniques. **PATIENTS AND METHODS:** 15 women, 28–34 weeks gestation, with known congenital abnormalities of the fetus 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, acquisition time of 20 s. **RESULTS:** Fetal brain MR was performed in all 15 cases and spine MR in 4. In 8 cases there was agreement between the ultrasound and MR. In 7 cases MR imaging altered the diagnosis; of these, 2 were normal on MR and post-natal imaging, 5 involved hydrocephalus and possible posterior fossa abnormalities. The ultrasound showed the hydrocephalus but the possible associations in the posterior fossa were poorly defined. MR showed the hydrocephalus and any cerebellar abnormality. 2 of these 5 patients also had spinal abnormalities. 1 was thought to be a myelomeningocele on ultrasound but MR did not show any connection of the surface mass to the thecal contents; however, MR did demonstrate a diastomatomyelia at this level that was confirmed at post-natal imaging. The other patient had a lipomyelomeningocele on ultrasound and MR. **CONCLUSIONS:** Fetal MRI in the third trimester yields valuable information that can be used for counselling parents. This work is to be extended in terms of numbers of patients, organ systems imaged and to attempt to investigate pregnant women in the second trimester.

1345–1430

College of Radiographers  
**Welbeck Memorial Lecture**  
Hall 8

1345

**Eponymous Lecture**  
**Imaging that “dark continent”**

P M Kimber  
Flat L, Windsor Court, 14 Winn Road, Southampton SO17 1EN,  
UK

For the pioneers of diagnostic imaging, the brain and the spinal cord posed a unique challenge in that they were mute to the X-ray beam. The radiographers and radiologists involved in the field of neuroradiology applied their skill and initiative in working out methods of imaging “that dark continent” inside the skull and vertebral column. The changes in neuroradiographic practice enabling diagnostic imaging of the brain and spinal cord to be carried out as we know it today have rendered obsolete the techniques of even a decade ago. In the context of the Welbeck Lecture, the speaker will review neuroradiographic practice as she has known it over 40 years and honour those who have worked in the field of neurosciences and steered neuroimaging to today’s state of the art.

1400–1700

**Magnetic Resonance**  
Hall 5

1400

**Invited Review**  
**Imaging of oropharyngeal and oral cavity cancer**

R Sigal  
Service de Radiodiagnostic, Institut Gustave Roussy, Villejuif,  
France

The aim of the presentation is:

- To describe the radiological anatomy of the oral cavity and oropharynx.
- To describe the value of MR and CT in the staging of cancer.
- To describe the imaging strategies for patient follow-up.

1430

**Invited Review****MRI of pelvic cancer**

N M deSouza  
Robert Steiner Magnetic Resonance Unit, Imperial College  
School of Medicine, Hammersmith Hospital, Du Cane Road,  
London W12 0HS, UK

**PELVIC CANCER**

- Encompasses a wide range of malignancies with varying natural history.
- Includes cancer of the rectum, prostate, bladder, urethra, cervix, ovary, endometrium, vagina, vulva, musculoskeletal, neural, vascular, lymphatic.
- Primary disease site, secondary spread and recurrent disease must be evaluated.
- Must assess response to treatment.
- Incidence of common pelvic malignancies.
- Morbidity/mortality of common pelvic malignancies.

**TECHNIQUE FOR MRI OF PELVIS**

- Fasting, Buscopan, empty bladder.
- Choice of receiver coil—optimizing SNR.
- Sequence considerations—optimizing contrast for tissue characterization.
- Use of contrast agents—bowel (negative and positive), intravenous.
- Use of dynamic enhanced scans—evidence in prostate and cervix cancer.
- MR spectroscopy (MRS)—preliminary data and clinical utility.

**DIAGNOSTIC MRS ISSUES IN COMMON PELVIC MALIGNANCIES**

- Prostate, rectum, cervix, vagina, pelvic side-wall.

**MANAGEMENT ISSUES—ROLE OF MR IN ASSESSING TRADITIONAL VS NEWER TREATMENT STRATEGIES**

- Prostate: radical prostatectomy, antiandrogens, radiotherapy.
- Cervix: radical hysterectomy, neoadjuvant radiotherapy.
- Rectum: radical surgery, adjuvant radiotherapy.
- Endometrium: surgery/radiotherapy.
- Pelvic side-wall recurrence and lymphadenopathy: exenterative procedures.

1450

**Invited Review****Spinal MRI**

R W Kerslake  
University Hospital, Nottingham NG7 2UH, UK

- Spinal MRI ranks among the most commonly performed of all MR investigations and should be carried out efficiently and accurately.
- MRI has considerable and obvious advantages compared with plain films in demonstrating or excluding significant spinal pathology.
- A systematic approach to reporting and describing abnormalities is required.
- Asymptomatic age-related “degenerative” changes are common.
- There are technical and clinical pitfalls for the unwary.

1510

**Discussion**

1530

**Invited Review****Introductory body MR angiography**

C N Ludman  
Department of Academic Radiology, University Hospital,  
Nottingham, UK

- Basic principles of MR angiography (MRA).
- Dynamic contrast-enhanced MRA techniques.
- Contrast dosage and administration.
- Timing strategies.
- Optimization for specific clinical applications.

1550

**Invited Review****MRI in the district general hospital**

A H Troughton  
Radiology Department, Princess Margaret Hospital, Swindon  
SN1 4JU, UK

- Most of the MRI scanning done in Britain now takes place in the district general hospital (DGH) setting.

- DGHs typically have lower field strength systems than the teaching centres and so require different scanning parameters and protocols.
- Case mix in the DGH has a very high proportion of neuro and orthopaedic cases.
- Uniform scanning protocols may be easier to obtain in DGHs providing less complicated work practices for the radiographers and a more consistent service for clinicians.
- Imaging protocols are often neglected in large departments but until the widespread take-up of the picture archiving and communication system (PACS), the filmed image is the output upon which a department is judged.
- MRI practice in DGHs and teaching centres is different but complementary. Each can learn from the other.

#### 1610

##### Invited Review MRI of the knee

C Wakeley

*Department of Clinical Radiology, Bristol Royal Infirmary, Marlborough Street, Bristol BS2 8HW, UK*

The following areas will be discussed:

- Techniques.
- Anatomy.
- Pathology.
- Unusual pathology.

#### 1630

##### Invited Review MRI of the shoulder

S C P Blease

*Harley Street Open MRI Centre, Med-Tel Europe Ltd, London W1N 1AE, UK*

The following points will be discussed:

- Key anatomical considerations.
- New pathological concepts.
- Optimum imaging parameters.
- Effect of machine type on image production.
- Common pitfalls in interpretation.
- New techniques.

#### 1650

##### Discussion

## 1400–1600

## Interventional Radiology

### Hall 11a

#### 1400

##### Invited Review

##### Non-vascular interventional radiological procedures of the thorax

R F Dondelinger

*Department of Medical Imaging, University Hospital Sart Tilman, Domaine Universitaire du Sart Tilman, B35, B-4000 Liege, Belgium*

Imaging-guided non-vascular therapeutic procedures in the chest are applicable in the lung, pleura and mediastinum. Guidance systems include uni- or biplanar fluoroscopy, ultrasound, (fluoro-)CT and MR or a combination of these. Percutaneous tissue sampling of a thoracic lesion is indicated when histological diagnosis will modify the stage of the disease or influence therapeutic strategy, and when the diagnosis is not obtained by endobronchial techniques. Cytology and histology obtained by small-gauge needle biopsy confirm malignancy in 80–95% of cases at low cost and carry a reduced incidence of major complications. Thoracic fluid or gaseous collections located in the pleura space, pericardium, lung and mediastinum can be aspirated or drained by a closed percutaneous catheter insertion with imaging guidance techniques using catheters of variable size and design. The potential of percutaneous therapy supersedes blind technique and surgery. Clinical success of catheter drainage of pleural empyema varies from 80 to 100%, when drainage is performed in a first attempt or after failure of other techniques. Minimally invasive drainage of lung abscesses and mediastinal abscesses show similar success rates, but patients referred often exhibit a bad prognosis. Further refinement is achieved by local instillation of fibrinolytic agents in selected cases of empyema and

hemothorax. These procedures are cost effective and complementary to endobronchial procedures and surgery. CT-guided phenol blockage of the upper thoracic sympathetic chain is indicated in the treatment of palmar hyperhidrosis and vasomotor syndromes.

#### 1430

##### Invited Review

##### Interventional magnetic resonance

W M W Gedroyc

*Department of Interventional Magnetic Resonance Imaging, St Mary's Hospital, Praed Street, London W2 1NY, UK*

- MR has ideal soft tissue resolution to distinguish normal from abnormal tissues.
- New open scanners allow procedures to be carried out in the scanning environment using this soft tissue discrimination.
- As a result, MR may develop into the best method of carrying out image guidance for therapy.
- Major areas to be considered for current development are: thermal therapy, both heat and cold deposition to destroy tumours; guidance of open surgery; MR kinematic investigations of joint movement in erect weight-bearing open environments; tracking and control of endoscopic manipulations in difficult environments within the scanner to improve accuracy and safety of minimally invasive endoscopic procedures.
- This talk describes the early application of these techniques in a dedicated interventional MR set up.

#### 1500

##### Invited Review

##### Carotid angioplasty and stenting

T Buckenham

*Department of Medical Radiology, The University of Edinburgh, Royal Infirmary of Edinburgh, Lauriston Place, Edinburgh EH9 3YW, UK*

The following points will be discussed:

- Carotid endarterectomy is a proven treatment for symptomatic patients with high grade ipsilateral extracranial carotid artery stenosis.
- Perioperative (30 days) major disabling stroke or death from carotid endarterectomy is between 2 and 6%.
- Endoluminal carotid repair (ECR) is an experimental procedure that is rapidly evolving as technology changes.
- There is only 1 randomized controlled trial comparing ECR with surgery.
- This trial suggests that stroke and death rates at 30 days are similar.
- The purpose of both techniques is to prevent stroke. Surgery has a proven record of stroke prophylaxis; ECR is yet to be adequately evaluated.
- Current controversies include the role of cerebral protection, patient selection and the role of primary stenting.

#### 1530

##### Invited Review

##### Aortic stenting

A M Belli

*Department of Radiology, St Georges Hospital, Blackshaw Road, London SW17 0QT, UK*

- Aortic stenting encompasses the treatment for aortic stenoses and, with the advent of covered stents, aneurysms of the thoracic and abdominal aorta can be successfully excluded.
- In the thoracic aorta, stent grafting has been successful in excluding aortic dissections as well as aneurysms without the complications associated with surgery.
- In the abdominal aorta, stenting is reserved for stenoses resistant to balloon dilation or for treatment of sources of atheroemboli.
- In the abdominal aorta, stent grafting has become more versatile with the development of modular systems allowing bifurcated systems to be tailored to the patient's needs.
- Most of these interventional procedures on the aorta require large introducers necessitating surgical access to the common femoral or iliac arteries.
- The morbidity and mortality rates of stent grafting have reduced since it was first introduced, but the durability of the currently available devices is questionable.

## 1400–1530 PACS 2 Olympian Suite

1400

**Invited Review****The request for proposal for PACS and evaluation**

H U Lemke

*Department of Computer Graphics & Computer Assisted Medicine, Technical University Berlin, 10587 Berlin, Germany*

- Planning for PACS including project planning, systems requirements and preparation of a request for proposal (RFP).
- Special emphasis is on evaluation using quality function deployment (QFD), total cost of ownership (TCO) and derived methodologies.

1430

**Invited Review****The impact of PACS on workflow: experience at Hammersmith Hospital**

N S Strickland

*Department of Imaging, Hammersmith Hospital, 150 Du Cane Road, London W12 0NN, UK*

Changes in workflow for the radiologist:

- Reporting worklists: default display protocols; soft copy tools; clinical history; increased workload (no lost images).
- Clinicoradiological conference/grand rounds: preparation; demonstration.
- Comparison studies

Changes in workflow for the radiographer:

- New responsibilities: sending to PACS; exam verification—number of images, orientation, contrast; computed radiography differences in technique.
- No film printing (CT windows)
- Changes in workflow for the clinician: immediate image access; 24 image access any location; time saved; teleconsultations.

1500

**A DICOM-based regional teleradiology service**

T K Blanchard, M J Graves and D J Lomas

*Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge CB2 2QQ, UK*

**PURPOSE:** To describe the planning and implementation issues for establishing and maintaining a multivendor DICOM-based regional teleradiology service. **MATERIALS AND METHODS:** In 1997 all the radiology departments in the East Anglian region were approached regarding the development of a standardized DICOM-based teleradiology service without the requirement to purchase dedicated teleradiology servers for each hospital. The service was designed for the transfer of CT and MRI images primarily to support emergency clinical decision making in neurosurgery, oncology and paediatrics. Planning issues involved identifying departments with DICOM compliant workstations or scanner systems, legal IP addresses and their ability to connect to ISDN via secure routers. Centrally, 2 teleradiology servers (1 commercial and 1 CTN) along with 2 ISDN lines were planned to provide redundancy in case of failure. A dedicated teleradiology administrator post was funded to liaise with vendors and regional hospitals, implement and maintain the service and manage future changes and upgrades. **RESULTS:** The service started on April 1 1999 and currently 5 regional hospitals are fully connected and using the service with other connections in progress. The technical problems related to implementing such a multivendor service will be described and reviewed. **CONCLUSION:** The implementation of a regional multivendor DICOM-based teleradiology service is possible.

1510

**Teleradiology in a DGH setting: pleasures, pitfalls and practical pointers**

J Ramessar and A Troughton

*Radiology Department, Princess Margaret Hospital, Swindon SN1 4JU, UK*

The aim was to install a teleradiology system in a district general hospital (DGH) for use after hours in referrals to consultant radiologists' homes, as a prelude to emergency transfer of patients to tertiary care centres and for referrals to teaching hospitals for radiological opinions. The requirements were for a system that: (a) would transmit top quality CT and MRI images, (b) would be sufficiently fast, (c) was suitable for use at home and at the referral centres,

(d) was DICOM compliant and used non-proprietary image formats, (e) was affordable, (f) was easy to use at both ends, (g) was reliable and (h) had the ability to run from a home PC and ordinary or ISDN phone lines. A commercial Windows NT system was chosen that fulfilled the above criteria. There were reservations. Would scanning numbers increase? Would radiographers be safe at night in the department on their own? Would it be more complicated and time consuming for them? Who would give contrast injections? How could plain films be reviewed in multiple trauma? In the absence of a plain film opinion, would more areas be scanned? 2 years following installation none of these concerns have been problematical. The system has been reliable and particularly valuable for on-call transmission to radiologists' homes and for the transmission of brain images to the neurocentre prior to patient transfer. It will be even more useful when a greater number of departments have a similar ability to exchange images.

1520

**Discussion**

## 1445–1615

## Radiographic Professional Development in Practice Hall 8

1445

**Find and deliver: research and practice in therapeutic radiography**

R L Harris

*Department of Radiotherapy, The Plymouth Oncology Centre, Level 2, Derriford Hospital, Plymouth, Devon PL6 8DH, UK*

In recent years the health service has had to face many changes: economic, managerial, social and public expectation, and in therapeutic radiography there has been a vast surge in technological developments. As individual practitioners, we have to accept change and "move with the times" if we want to influence the future of our profession. Research and audit are no longer "extra" or "optional" activities; they have become an integral part of our routine work. There is not necessarily anything wrong with many of our traditional practices, but some are flawed and have little or no objectively based foundation that is regularly monitored. Research is an invaluable tool for the management of change as it aims to prove, disprove or just discover what is relevant or irrelevant to everyday radiotherapy practice. Qualified practising professionals need to be able to use this skill in decision-making processes. The effectiveness of professional methods and that of continuous improvement in standards of care need to be substantiated. As therapeutic radiographers, we can then use our proven specialist knowledge to justify and retain our future. It is, in fact, our mutual findings that should improve our everyday methods and the service we provide. This presentation will illustrate the importance of research and evidence based practice in a clinical environment. Employing investigative techniques constructively to underpin practice is the essential aim of the research radiographer, who should act as a catalyst for departmental work. We can **find** answers and **deliver** results.

1455

**An investigation of radiographers' attitudes towards evidence-based practice, and their knowledge of the research process**

C Gee

*Chesterfield and North Derbyshire Royal Hospital, Calow, Chesterfield S44 5BL, UK*

**PURPOSE:** The Government proposes to improve clinical standards and quality of care through the use of evidence-based practice (EBP). In response to these proposals, radiographers must adopt a new role, leaving behind traditional practices and changing their practice to provide diagnostic procedures and care based on contemporary research evidence. How the concept will be embraced will be affected by many personal and organizational issues and in order to successfully introduce changes in practice, the knowledge and perceptions of those required to undertake EBP must be established. **METHOD:** Using a sample of radiographers employed at one district general hospital, this case study attempts to examine the radiographers' attitudes towards EBP, their knowledge of the research process and identify barriers they perceive to inhibit research utilization. McSherry's (1997) "Research Awareness Questionnaire" was adapted and used. From a sample of 39, 22 (56%) responded to the

questionnaire. RESULTS: The results show similar findings to other larger published studies. The radiographers were shown to have positive attitudes towards the concept, though research awareness is shown to be limited and journal reading poor. Several barriers were identified as factors likely to inhibit the undertaking of EBP, including lack of time, confidence and the authority to change practices. It was felt that little support was offered by colleagues. CONCLUSION: In order to meet with Government proposals, the issues highlighted in the study must be addressed if an evidence-based culture is to be established. Recommendations have been made to help develop, encourage and facilitate the use of EBP.

1505

**Role change, identity and CPD in radiography: dialogues, discourses, directions**

C R Boyes

*MRI Unit, St James's Hospital, Leeds LS9 7TF, UK*

PURPOSE: To describe the relationship between "minor" discourses imminent in interview and other texts from the research site and "major" discourses of power, knowledge and identity exhibited in the wider literature to help radiographers develop individual curricula for CPD and role development. METHODS: The research is a qualitative case study, grounded in accounts given in face-to-face interviews by radiographers and radiologists, and used insider interpretive discourse analysis to examine transcriptions of 15 tape-recorded interviews, diary evidence, institutional documents, audit evidence, notes and abstracts collected from skill mix/role extension study days, survey questionnaires, participant observation notes, and reference to the educational, social theoretical, radiographic and radiological literature. RESULTS: The narrative account of the doctoral thesis engages readers in issues of contemporary radiological practice, describing problems facing radiographers and other professions rooted in basic tensions between professions and the state. Discourses of education, training, flexibility, quality and such-like, work in texts to conceal the economic imperative to reduce unit labour costs through a process of skill mix. This labels professionals as "sets of competencies" rather than people, thereby having implications for identity. Discourses of "external", imposed constructions of quality assurance as "surveillance" contradict self-regulatory professional accounts which emphasize autonomy and individual responsibility. CONCLUSION: Engagement enables readers to explore their own situations reflectively and better understand the dilemmas of contemporary practice and their positioning within wider cultural discourses. Such an understanding is educational and emancipatory, and will better prepare radiographers for dealing with cultural, institutional and personal/professional change.

1515

**The impact of high technology radiology equipment on patients and radiographers**

F J Murphy

*School of Radiography, University of Wales, Bangor, Archimedes Centre, Wrexham LL13 7YP, UK*

PURPOSE: To identify problems that may accompany rapid technological development and subsequent change that occurs in the radiology department. A full understanding of the patients' experience when undergoing a high technology radiological investigation is investigated, together with radiographers' perceptions of the impact of modern technology upon patient care and their own professional development. Possible links between technology, gender, attitudes and the psychological effect upon the patient and the radiographer are also explored. METHODS: Semi-structured interviews using inductive grounded theory to provide rich data from this in-depth qualitative investigation. An initial study of patients undergoing CT and MRI scans followed by a similar number of radiographer interviews. (Subject to final confirmation: a research grant from the HSA/College of Radiographers is pending.) RESULTS: Early results highlight many issues: (1) the absence of any patient explanation; (2) major misconceptions about what the machines actually do. However, fear and anxiety are the major problems. One patient commented, "They strapped me into this machine, I didn't like it: it was really close to my face, I was alone, I didn't know where they (radiographers) had gone. It was noisy, I wouldn't want another one." The radiographers are also concerned about reduced patient contact and there is also conflicting opinion about how technology has influenced their own professional development. CONCLUSION: This unique study provides the profession with the opportunity to listen to, and act upon, the concerns of our patients and to recognize the impact of rapid technological development for all concerned.

1525

**Implementation of a programme of continuing professional development using action research to enable local management of the change**

N Wilson

*Division of Radiography, Queen Margaret University College, Edinburgh EH6 8HF, UK*

Professional emphasis in radiography has recently been on continuing professional development (CPD). Research on this to date, mainly quantitative, has concentrated on the "doing" rather than the "knowing" aspects of CPD. The qualitative methodology was selected to uncover the rich data often concealed in quantitative studies. Questionnaires and semi-structured interviews identified current CPD activity and perceived barriers to it in one Hospital Trust. An action research approach was chosen to echo the sense of continuance, to enable relevant change to the culture at a local level and to involve and develop participants. The tangible "doing" aspects of CPD were found to be preferred whereas work-based learning, underpinned by reflective practice, was chiefly ignored. Additionally, a low level of staff morale was indicated. Barriers to development included lack of time, funding and guidance. Lack of room resources and a dependable means of accessing them were revealed as unrealized barriers. The action research group developed a portfolio and introduced it to all Trust radiographers. The reflective side of development was sparse although unconscious reflection on practice was demonstrated. Other emergent issues included the complexity of action research and the ethics related to it. This exploratory study provided some guidance on CPD and a focus for radiographers' development, and addressed the need for coherent planning of CPD. With the spiral nature of action research, further activity can be ongoing.

1535

**Personal and professional development: a survey of radiographers employed in the Southwest Region**

T W Palarm, K Jones and M Gilchrist

*Faculty of Health and Social Care, University of the West of England, Bristol BS16 1DD, UK*

PURPOSE: To identify the personal and professional development characteristics amongst members of the Society of Radiographers employed in the Southwest Region. METHODS: A survey design was employed to explore the characteristics relating to personal and professional development. Group interviews were conducted on both diagnostic and therapeutic radiographers, employed in a part-time capacity, in 4 hospitals situated outside the Southwest Region. These interviews were analysed thematically, and the emergent themes utilized to design a structured questionnaire. In February 1999, 926 questionnaires were administered to the target population of both full and part-time members. RESULTS: A response rate of 50% was obtained. Radiographers employed in a full-time capacity attended more study days per year (3.0) than their part-time colleagues (2.3) ( $t=3.00, p=0.003$ ). Full-timers spent more hours engaged in personal and professional development (35.5) than part-time radiographers (21.4), respectively. As a proportion of the overall contractual hours for both groups, part-timers spent slightly longer engaged in this activity than their full-time counterparts ( $\chi^2=10.42, p=0.001$ ). A number of other personal and professional characteristics were also identified, which would appear to be common to both full and part-time practitioners. CONCLUSIONS: A significant proportion of radiographers employed in a part-time capacity are either not fully accessing the opportunities to become involved in personal and professional development, or these opportunities do not exist. Part-timers have unique personal and professional development requirements, and should therefore be considered separately from their full-time colleagues. Managers, radiographers, and education providers should consider these findings in their quest for more effective CPD.

1545

**Continuing professional development and clinical reporting**

A M K Thomas and M Rodrigues

*Department of Clinical Radiology, Bromley Hospital, Bromley, Kent BR2 9AJ, UK*

Clinical reporting by radiographers is now established in a number of hospitals. In Bromley Hospital, 2 radiographers have been regularly reporting since 1998. Reporting takes place during the working day and there is a high level of local clinical support. To date, attention has been given mainly to the process for the initial acquisition of the skills necessary for radiographers to report trauma radiographs. There has been less attention given to the continuing development and support that is needed once the radiographer is working in the clinical environment of a busy acute hospital. We

are developing a personal development manager (PDM) for continuing professional development (CPD) for clinical reporting radiographers and this will be described. The PDM helps with the undertaking of CPD and the recording of it and will: (1) formulate an ongoing revision plan; (2) provide a record of courses, conferences, reading of professional journals and the attendance at local meetings; (3) record evidence of any audit carried out with the evaluation of the results; and (4) provide evidence of CPD for the submission to the College of Radiographers, the local NHS Trust and to training institutions for re-certification. The problems encountered in the daily practice of clinical reporting by radiographers are described with possible solutions.

1555

#### Maximizing staff potential: practical staff development strategies to enhance practice

S M Henwood

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This paper stems from a variety of research projects undertaken around the issue of CPD, including a PhD with South Bank University and the Kodak Radiography Management Award (1996), which involved investigating CPD in Florida where CPD has been compulsory since 1984. CPD is now an accepted part of the radiographic profession, although the extent to which it has been introduced and has impacted on practice is variable across clinical sites. There is also considerable discrepancy as to the exact definition of CPD and what CPD is aimed to achieve. This is further confused by different health professions adopting different CPD strategies, while health care professionals are being encouraged to work in multiprofessional teams. Using the previous research undertaken and the literature available, this paper brings together the wealth of information and presents some practical suggestions for good CPD practice in the clinical setting. The paper offers advice on funding issues, time availability, creating opportunities, liaison with providers and having a positive effect on the culture within the department. The emphasis on cost effectiveness and practicality makes this paper valuable to clinical departments who are working in cost, time and staff constrained conditions. Much of the research has demonstrated that the attitude of the individual is fundamental to the success of any CPD policy. This paper explores methods to motivate staff in order to enhance CPD activity. Clinical governance has recommended that staff have CPD policies in place making this paper essential for all health care professionals. Radiographers who are working in departments without CPD policies could use the information provided to return to their department and help instigate a policy. Managers will be able to use this paper to set up a CPD policy to maximize their staff potential, or they can use it to reflect on any policy already in place and make any changes that would further enhance and facilitate CPD activity. CPD is no longer an option, it is a necessity. The option open to individual professionals is how seriously they choose to take it and how effective they want it to be.

1605

#### Image interpretation skills for undergraduate diagnostic radiographers

P C Milburn

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Clinical reporting by radiographers is now vital in the provision of a responsive and flexible imaging service for many departments. Success of this significant role development has at its centre a rigorous postgraduate educational framework for experienced trauma-based practitioners. This paper considers image interpretation skills from an undergraduate perspective. It describes the development, implementation and evaluation of a programme of study designed to equip qualifying radiographers with the knowledge and practice skills required for a "red/green" dot image interpretation programme. The presentation will: (a) describe the aim of the programme in introducing students to basic search pattern techniques and image analysis procedures; (b) provide an evaluation of programme content, organization, delivery and assessment using data derived from students, employers and academic staff; and (c) describe plans for future programme development which will insure radiographers qualifying from Canterbury Christ Church University College continue to have the knowledge and skills enabling them to respond proactively to service needs of the future.

## 1515-1615 Intensity Modulated Radiotherapy Hall 11b

1515

#### Invited Review

#### Intensity modulated radiotherapy—the physics view

P C Williams

*North Western Medical Physics, Christie Hospital NHS Trust, Manchester M20 4BX, UK*

- Intensity modulated radiotherapy (IMRT) promises significant improvement in the delivery of radiotherapy.
- Applications include improvements in conventional techniques and the treatment of re-entrant or invaginated targets.
- Treatment planning for such treatments can be carried out either by inverse or by iterative forward planning techniques.
- The use of "fully dynamic" or "step and shot" operations of linear accelerators with multileaf collimators have been shown to deliver the necessary beam modulations.
- The use of high precision radiotherapy raises questions about the need for tighter tolerances and higher standards of quality control.
- Verification of treatment delivery is an important issue to ensure safety and establish confidence in these new complex techniques.

1540

#### Invited Review

#### The clinical justification

M Robinson

*Department of Clinical Oncology, Weston Park Hospital, Whitham Road, Sheffield S10 2SJ, UK*

No abstract.

1605

#### Discussion

## 1530-1700 Studies in Genitourinary Radiology Hall 6

1530

#### Diagnosing renal artery stenosis by use of MRI—a meta-analysis

K T Tan, E J R van Beek, P W G Brown, O M van Delden and L E Ramsay

*Department of Radiology, Royal Hallamshire Hospital, Sheffield S10 2JF, UK*

**PURPOSE:** To compare the sensitivity and specificity of magnetic resonance angiography (MRA) with and without gadolinium (Gd) in diagnosing renal artery stenosis. **MATERIALS AND METHODS:** A meta-analysis was performed using English language articles, as identified by Medline. No abstracts or unpublished data were included. The following criteria were used for inclusion: 1, blinded comparison with angiography; 2, indication of investigation stated; 3, descriptions of imaging techniques; 4, duration between MRA and angiography less than 3 months. **RESULTS:** 36 studies were identified, of which 28 met the inclusion criteria. Non-enhanced MRA was employed in 18 studies, while Gd-enhanced MRA was used in 12 studies. A total of 1141 patients was studied: 620 non-enhanced and 521 Gd-enhanced MRA. The unenhanced MRA technique yielded a sensitivity and specificity of 94% and 87%, respectively. Gd-enhanced MRA has a sensitivity of 96% and a specificity of 94%. Accessory renal arteries were better depicted using Gd-enhanced than non-enhanced techniques (84% vs 53%,  $p < 0.0001$ ). **CONCLUSION:** There appears to be sufficient evidence to suggest that Gd-enhanced MRA can replace arteriography in the majority of patients with suspected renal artery stenosis. This has major advantages in terms of its non-invasiveness, lack of radiation and non-nephrotoxicity.



1540

**Prospective comparative assessment of non-invasive screening modalities for renal artery stenosis**

C S Boyd, A B Atkinson, J D Laird and I M G Kelly  
Department of Radiology, Royal Victoria Hospital, Belfast BT12 6BA, UK

**PURPOSE:** To prospectively evaluate the accuracy of Captopril renography (CR) and Doppler segmental waveform analysis (DSWFA) in the diagnosis of renal artery stenosis (RAS). **MATERIALS AND METHODS:** A study cohort was established comprising patients referred for investigation of possible renal artery stenosis. Patients underwent DSWFA and CR on the same day. During DSWFA a minimum of 5 traces were obtained from each kidney and acceleration time and acceleration index was calculated for each trace and averaged for the kidney. Renography was performed using <sup>99m</sup>Tc<sup>m</sup> mercaptoacetyl triglycine (MAG3) before and after 50 mg Captopril using a standard protocol. Renal arteriography (IADSA) was performed on all subjects the following day and the results of the non-invasive tests assessed in relation to the arteriogram findings which were considered the gold standard. **RESULTS:** 195 kidneys were studied using IADSA and DSWFA while 153 had IADSA and CR. For prediction of renal artery stenosis, DSWFA had a sensitivity of 76%, specificity 95%, positive predictive value (PPV) 90%, negative predictive value (NPV) 87% and overall accuracy of 88%. CR had a sensitivity of 34%, specificity 84%, PPV 56%, NPV 69% and accuracy 66%. **CONCLUSION:** DSWFA is more sensitive and specific than CR for the non-invasive investigation of suspected renal artery stenosis.

1550

**Investigation of live renal transplant donors: a comparison of gadolinium enhanced MRA/MRU with DSA/IVU**

S A Cooper and P J Guest  
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This study investigates the accuracy of combined gadolinium enhanced MR angiography (MRA) and urography (MRU) compared with digital subtraction angiography (DSA) and intravenous urography (IVU) in the evaluation of potential renal transplant donors. 9 donors have currently been investigated, with the aim of a total of 20. MRU was performed with compression and frusemide using a coronal 2 s HASTE sequence to visualize the kidneys and ureters. This was immediately followed by MRA using a contrast timing run and then a gadolinium enhanced coronal 3D breath-hold volume acquisition. Both source and MIP images were reviewed with particular attention to the number of renal arteries, including accessory and early branching arteries, which is important to the transplant surgeon. DSA and IVU were performed using conventional procedures. The reporters were unaware of the MR results. 1 patient was claustrophobic in the MR scanner. In the remaining 8 patients a total of 23 renal arteries were identified by MRA; 16 dominant and 7 accessory. DSA did not identify 2 accessory renal arteries in 2 patients, which were clearly shown by MRA. In a further discrepancy, MRA showed 2 vessels arising close together and DSA appeared to show a single early branching vessel. MRU showed renal cysts and/or scarring in 3 patients. All IVUs were reported as normal. 5 nephrectomies have been performed with no discrepancies between surgical findings, MRA and DSA. These early results for the combined MRA/MRU procedure are good. The benefits are the avoidance of an invasive procedure and ionizing radiation, added convenience and reduced cost.

1600

**Comparison of unenhanced low dose helical CT and intravenous urography in suspected renal colic**

T Meagher, V P Sukumar, D J A Connolly, K H Lakin, T Crawley, J Giles and J Henson

<sup>1</sup>Department of Radiology, Stoke Mandeville Hospital, Aylesbury HP21 8AL, <sup>2</sup>Northampton General Hospital, Northampton NN1 5BD, <sup>3</sup>Conquest Hospital, Hastings TN37 7RB and <sup>4</sup>Princess Margaret Hospital, Swindon SN1 4JU, UK

**PURPOSE:** To compare unenhanced helical CT with reduced exposure factors and intravenous urography (IVU) in the evaluation of patients who present with acute flank pain due to a suspected obstructing ureteral calculi. **METHODS:** Over a 7 month interval, 50 patients with acute flank pain suspected of renal colic were imaged with unenhanced low dose helical CT using modified protocol followed by excretory urography. Patients presented to the Accident and Emergency department at 4 different sites (Stoke Mandeville Hospital, Aylesbury, Princess Margaret Hospital, Swindon, Northampton General Hospital, Northampton and Conquest Hospital, Hastings). The scan factors used were 120 kVp,

130 mA, slice thickness of 5 mm and pitch of 1.5 with reconstructing interval of 3 mm. Average estimated doses were 3 mSv for CT studies and 4 mSv for IVU studies. The CT results were interpreted by a radiologist without the knowledge of the IVU findings, which was performed within 6 h of the CT scan. Later unblinded reading of both results were compared with each other. **RESULTS:** 44 patients with ureteric calculus were demonstrated on both unenhanced spiral CT and intravenous urography. 5 had stones that were depicted on unenhanced CT only. CT was unable to differentiate VUJ calculus from phlebolith on 1 study. 1 patient had a bowel mass presenting as an acute flank pain. **CONCLUSION:** New CT detector technology allows renal tract CT studies to be performed with low radiation doses while maintaining diagnostic accuracy published in previous studies.

1610

**Hysterosalpingography in infertility: an analysis of 1056 consecutive cases**

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**PURPOSE:** To determine the diagnostic accuracy of hysterosalpingography in the investigation of patients with primary or secondary infertility. **MATERIALS AND METHODS:** From October 1996, 1056 women aged 22–47 years (mean 35 years) were referred to a single operator for hysterosalpingography in the investigation of primary (49%) and secondary (51%) infertility. All patients were examined as out-patients following a standard protocol and procedure. A detailed pro forma was completed on all patients collecting a comprehensive range of data including clinical history; past medical, surgical, obstetric and gynaecological history; previous investigations; and also procedural details relating to cannulae used, screening times, immediate complications and radiological diagnosis. Correlation with clinical investigations, including ultrasound, laparoscopy and hysteroscopy, and subsequent pregnancy is ongoing. **RESULTS:** Of the 1056 women studied to date, 450 (42.6%) have been regarded as normal, 288 (27.3%) have revealed uterine abnormalities, 220 (20.8%) have revealed tubal abnormalities, and a further 80 (7.6%) have had both uterine and tubal abnormalities; 18 (1.7%) were either failed or incomplete studies. The range of congenital and acquired uterine abnormalities, including fibroids, polyps, Asherman's syndrome and adenomyosis, and tubal pathology, including hydrosalpinx, tubal polyps and salpingitis isthmica nodosa, will be discussed together with patient follow-up to date. The incidence of immediate and delayed complications was low. **CONCLUSIONS:** Transvaginal ultrasound, HyCoSy and MRI have improved the diagnostic potential of imaging in the investigation of infertility. However, despite these developments hysterosalpingography continues to represent a safe, accurate and useful diagnostic tool in the investigation of primary and secondary infertility.

1620

**Uterine arterial embolization for leiomyomas: monitoring immediate and late volume and perfusion changes with MRI**

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Robert Steiner Magnetic Resonance Unit, Imperial College School of Medicine, Hammersmith Hospital, London W12 0HS, UK

**PURPOSE:** To determine immediate and late changes on MRI following uterine artery embolization for management of symptomatic leiomyomas. **METHOD:** 7 women aged 29–48 years (mean 39 years) undergoing bilateral uterine artery embolization of fibroids causing menorrhagia were recruited for MRI. T<sub>1</sub> weighted coronal and sagittal images pre- and post-contrast, dual echo sagittal images and dynamic gadolinium enhanced images (temporal resolution 3 s) were obtained before, immediately after and 1 and 4 months after embolization. Uterine and fibroid volumes (in a single representative fibroid), signal intensities and perfusion profiles were measured. After selective catheterization, both uterine arteries were occluded with polyvinyl alcohol (particle size 355–500 µm). **RESULTS:** All patients had multiple leiomyomas (n=2–16). Immediately following embolization there was a 6.4 ± 5.2% reduction in uterine volume. Fibroid volume reduced by 2.5 ± 13.5%. Signal intensity in fibroid and myometrium increased on T<sub>1</sub> weighted and proton density scans but the effect was more pronounced in the fibroid. Perfusion of the myometrium reduced considerably while perfusion of the fibroid virtually stopped. After 1 and 4 months, uterine volume reduced by 16.7 ± 13.5% and 25.5 ± 13.5%, respectively. Fibroids persisted but

also reduced in volume. Their perfusion remained poor while perfusion of the myometrium recovered to normal. **CONCLUSION:** Immediate reduction in uterine/fibroid volume is likely to be a blood volume effect which may partly account for the proton density effect in the fibroids. The persistent proton density effect may be due to the embolization material. Studies at earlier time points would provide insights into rate of myometrial recovery.

**1630****Embolization of residual uterine vascular malformations in patients with gestational trophoblastic disease**

A K P Lim, R Agarwal, M J Seckl, E S Newlands, N K Barrett and A W M Mitchell

*Departments of Imaging and Oncology, Charing Cross Hospital, London W6 8RF, UK*

**PURPOSE:** Gestational trophoblastic disease is a rare but potentially curable complication of pregnancy, which can cause life-threatening haemorrhage. Charing Cross Hospital is one of two national centres for treatment of this disease. We present the largest series of patients to have undergone uterine artery embolization for significant per vaginal bleeding, sufficient to require a blood transfusion, after chemotherapy. **METHOD:** Embolizations were performed under local anaesthetic via a common femoral artery approach. Ultrasound scans of the pelvis documenting the uterine vascularity were performed pre- and post-embolization. The Doppler waveforms and pulsatility indices from the uterine arteries were also analysed. The technique and materials used for each embolization, the control of haemorrhage, need for re-embolization, complications and outcome of subsequent pregnancies in these patients were documented. **RESULTS:** 14 patients were treated over the last 10 years. The procedure was well tolerated with immediate and complete control of haemorrhage in all patients. 4 patients required repeat embolization for recurrence of bleeding. No patients required a hysterectomy and embolization did not preclude a subsequent normal pregnancy. Large vascular malformations and endometrial encroachment were predictive of haemorrhage and re-embolization. The pulsatility indices of the uterine arteries did not change significantly post-embolization. Coils and gelfoam were used as the embolization material initially but this has been replaced by superselective catheterization and injection of Poly Vinyl Alcohol (150–500 µm). **CONCLUSION:** Selective uterine artery embolization is a safe and effective treatment for significant per vaginal bleeding from residual uterine vascular malformations in patients with Gestational Trophoblastic Disease after chemotherapy. The procedure (which may require repeating) avoids the need for a hysterectomy and preserves fertility in this group of young patients.

**1640****MR assessment of dynamic contrast uptake characteristics of normal ovaries using a 2-compartment pharmacokinetic model**

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*Departments of <sup>1</sup>Radiology and <sup>2</sup>Medicine, University of Hull at Hull Royal Infirmary, Hull HU3 2JZ, UK*

**PURPOSE:** The appearance of normal ovaries on static MRI has been well documented but to date the pattern of contrast uptake on dynamic contrast-enhanced MRI (DCE-MRI) has not been described. This study aimed to define contrast uptake characteristics in normal tissue in order to better identify disease. **MATERIALS AND METHODS:** 14 women (10 pre- and 4 post-menopausal) with no ovarian disease underwent DCE-MRI on a Signa EchoSpeed 1.5T scanner. Sequential images were obtained at 5 slice locations over a 35 time point series and data were analysed on a SUN Unix workstation using a linear 2-compartment open pharmacokinetic model. **RESULTS:** Ovarian tissue enhanced

dramatically, with a maximum enhancement factor, amplitude of the upslope and distribution volume greater than muscle tissue in all cases. There was a trend towards higher values in pre-menopausal women, but owing to limited numbers there was no statistically significant difference. **CONCLUSION:** These results are in keeping with rapid perfusion via the ovarian artery and with the known physiological, florid angiogenesis that occurs on a cyclical basis. Knowledge of the dramatic contrast enhancement of ovarian tissue is of great importance in the interpretation of DCE-MRI in ovarian pathology.

**1650****Giant adnexal tumours: CT features, correlation with surgical pathology and patient outcome**

J Foster, S Swift, N Wilkinson, G Lane and J A Spencer

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**PURPOSE:** Women with ovarian cancer typically present with advanced disease requiring radical cytoreductive surgery. Conversely, women with large benign pelvic masses are appropriately treated by removal of mass alone. We describe CT features of giant pelvic masses, correlated with surgical pathology and outcome. **METHODS:** We identified 22 women (age range 27–92 years) with giant masses ( $\geq 10$  cm; range 10–35 cm) without evidence of peritoneal or nodal metastasis by CT assessment. All were examined to an identical CT protocol and managed by a single multidisciplinary team. Retrospective analysis of CT features was by a single radiologist using modifications of Lerner's criteria for wall, septal or nodular dimensions, calcifications, cysts densities and lesion size and performed blinded to the results of surgical pathology or clinical outcome. **RESULTS:** There were 14 benign, 4 borderline and 4 malignant masses (2 Stage 1A, 2 Stage 1C). Using the accepted cut-off of 3 mm for solid elements there was a sensitivity of 63% and a specificity of 57% for borderline and invasive malignancy. There was no discriminant value of overall lesion size. 6 of the 14 benign lesions had solid elements over 3 mm in size (range 1–60 mm). None of the 8 women with borderline and invasive malignancy has developed metastatic disease (follow-up 14–32 months). **CONCLUSIONS:** Excision of the mass alone was considered curative in 20 (91%) of these 22 women supporting a policy of more limited surgery for a woman with a giant pelvic mass without CT evidence of peritoneal disease. The 3 mm cut-off used in morphological scoring systems is an unreliable discriminator in masses over 10 cm.

**1615–1715****Controversies in Interventional Radiology**

Hall 11a

**1615**

Panel Discussion

**1630–1730****Congress Awards Ceremony**

Hall 8

## National Indoor Arena Concourse Area

### Audit

#### POSTER 0101

##### Why are we unpopular? An investigation into the declining popularity of radiology in our region

P Evans

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**PURPOSE:** The popularity of a career in radiology is declining among junior doctors in our region. This is reflected in a decreasing number of applicants for specialist registrar posts in recent years and is occurring despite speciality expansion. The purpose of our study was to investigate the possible reasons for this. **MATERIALS AND METHODS:** A questionnaire was devised and sent to all house officers and senior house officers in the Mersey region. This consisted of 10 statements referring to aspects of a career in radiology which we perceived as being potentially off-putting and asking the juniors to respond by agreeing or disagreeing with them. We also asked about their current career intentions. **RESULTS:** The study again suggested a low level of interest in a career in radiology. While there appeared to be no single definite factor for this, the most strongly expressed views related to a lack of exposure to the speciality as a student/junior (48%) and a perceived high workload (61%). Fears we suggested concerning low peer regard (6%), lack of excitement (11%), postgraduate exams (12%) and calmanization of other specialities (11%) did not appear to be major factors. The results are expressed in table form on the poster. **CONCLUSION:** Recruitment of radiology specialist registrars in the Mersey region looks set to remain a problem. While there appears to be no single definable reason for this, the survey suggests an increasing workload and a lack of exposure to the speciality seem to be 2 of the major factors.

#### POSTER 0102

##### An audit of radiographer first line reporting of radiographer-directed barium enema examinations

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Radiographer-directed barium enemas are an established practice in imaging departments throughout the UK. At the Royal Hospital, 2 senior radiographers have undertaken this role for a number of years, issuing an initial report which is followed by a definitive report by the consultant radiologist. To ensure safe practice and effective radiographer performance, there was a need to establish congruence between these 2 reports. During the 12 month period between September 1998-1999, approximately 400 radiographer-directed barium enemas were performed. 100 (25% of annual total) dual reports were audited (50 by each radiographer). The reports were randomly selected by a non-clinician and assessed by a consultant radiologist not directly involved in the dual reporting practice. Assessment of congruence was according to the following criteria. (1) All pathologies will be identified. (2) The nature of presenting pathology will be defined. (3) False positive statements will be identified and their subsequent impact on clinical management. The findings demonstrated 96% accuracy between the 2 reports with no significant variation between each radiographer. The 4 non-congruent reports were due to "over" reporting by radiographers who demonstrated higher sensitivity when describing pre-diverticular changes, compared with radiologists. This did not constitute reporting false positive pathology and would not compromise the effective management of patients. The findings demonstrate safe and effective radiographer practice. However, congruence between reports could be improved by radiographer/radiologist agreement for reporting pre-diverticular changes. The audit has demonstrated locally that within a dual reporting system, an experienced, appropriately trained radiographer is competent to provide a radiological report.

### Breast

#### POSTER 0201

##### Relationship between breast arterial calcification, scintigraphically-detected myocardial ischaemia and diabetes mellitus

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**PURPOSE:** The goal of this work was to verify the relationship between mammographically detected breast arterial calcification (BAC), scintigraphically detected myocardial ischaemia (SDMI) and diabetes mellitus (DM). **MATERIALS AND METHODS:** A total of 253 women (aged 37-74 years) was studied; 91 underwent both mammography and myocardial scintigraphic study and were retrospectively reviewed to assess BAC, SDMI and DM status. **RESULTS:** In women aged under 55 years (the under 55 group;  $n=27$ ) nearly all those with BAC ( $n=4$ ) had SDMI ( $n=3.5$ ) and DM ( $n=3$ ) as well. Regarding this group, the positive predictive value of BAC for MI was 0.92, whereas the negative predictive value was 0.61. DM was a confounding variable. The positive predictive value of DM for SDMI increased from 0.59 when SDMI was absent to 1.00 when SDMI was present, while it does not result in any significant association between BAC and SDMI for women aged 55 and older. **CONCLUSION:** BAC in women under 55 years may indicate an additional risk factor for SDMI, especially in diabetic women.

#### POSTER 0202

##### A comparison of real and computer-generated breast lesions

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*Imaging Science and Biomedical Engineering, University of Manchester and Greater Manchester Breast Screening Centre, Withington Hospital, Manchester M13 9PT, UK*

As part of a computer-based training system for radiologists, statistical models of breast lesions have been built which allow generation of new lesions consistent with a set of real training examples. We have performed a study to determine whether these computer-generated breast lesions appear realistic to expert radiologists. A chronological sequence of 120 abnormal mammograms from the Greater Manchester Breast Screening Centre were digitized. A statistical model of the appearance of mass lesions was built and used to generate synthetic examples. A mixed set of 25 real and 25 synthetic lesions were printed at photographic quality and shown to 9 expert breast radiologists. They were asked to rate each lesion on a 5 point scale. Receiver operating characteristic (ROC) analysis was performed to determine whether the radiologists could tell the difference between real and synthetic lesions. The areas under the ROC curves ranged from 0.6 to 0.9, with a mean of 0.7. Of the 25 synthetic lesions, 7 were indistinguishable from the real lesions when the average response of all the radiologists was calculated. Although many of the lesions generated are not sufficiently realistic, the results show that this method is capable of producing lesions that are indistinguishable from real examples to a group of expert radiologists. Detailed analysis of responses enabled the identification of the most realistic parameter combinations, and other factors (such as the presence of spicules) which must be incorporated in a successful model.

#### POSTER 0203

##### Cancers on technical recall mammograms

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**PURPOSE:** Technical recall (TR) mammograms are performed for a variety of reasons. We perform craniocaudal (CC) views as standard on our recall mammograms as well as repeating the inadequate lateral oblique (LAO) view. Review of our technical recall mammograms with a cancer found on them was done firstly to see if any cancers were found on the CC view only; and secondly to see if the cancer was in fact visible on the LAO view originally but not appreciated. **RESULTS:** All technical repeat mammograms between September 1991 and March 1999 were reviewed (2120 patients).

5 had histologically confirmed cancer/ductal carcinoma *in situ* (DCIS). In 2 patients the carcinoma was only visible on the CC view. In another microcalcification was present with hindsight on the LAO but not suspicious. In the fourth patient the initial CC was blurred but some suspicious changes were still visible. In the fifth patient the radiographer arranged the TR view, as the CC was fogged. Films were not seen by a radiologist. The cancer was visible on the original films. **CONCLUSION:** The additional CC view improves cancer detection at technical recall adding further evidence of the value of two view mammography. Review of the initial films by a radiologist should prevent patients having more than 2 visits.

**POSTER 0204****The second bite of the cherry—is it worthwhile?**

A J Thomas and G J M Goh

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The presence of new microcalcification in the breast has always posed a diagnostic problem and recent practice has recommended that a more aggressive management approach be adopted to try to detect cancers in the very early stages. We have adopted this approach and have been performing stereotactic guided 14G wide bore needle biopsies on small areas of microcalcification, with less than 10 specks of calcification, that would have previously been reported as benign. Stereotactic guided 14G wide bore needle biopsy is the accepted technique used to biopsy these areas of microcalcification. We performed 42 of these biopsies from April 1998 to April 1999 and diagnostic biopsies with histological concordance were obtained in 32 patients (76%). 10 (24%) of the biopsies were inadequate with no calcification in the cores. Previously, these patients would then have to undergo an open surgical biopsy. We have instead repeated the biopsies and have obtained diagnostic biopsies in a further 5 patients by doing so, thus avoiding surgery and increasing the diagnostic accuracy from 76% to 88%. We feel that repeating a non-diagnostic biopsy is a worthwhile exercise that should be adopted as the norm. The benefits of avoiding unnecessary surgery, increasing diagnostic accuracy and being able to better plan definitive surgery are obvious.

**POSTER 0205****The marker film—a useful technique**

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*Kettering General Hospital NHS Trust, Kettering NN16 8UZ, UK*

Increasing demands of the NHS Breast Screening Programme has placed increasing constraints on time available to radiologists. The more aggressive approach now adopted, performing 14G wide bore needle biopsies both under ultrasound or stereotactic guidance on patients has resulted in an increased diagnostic yield and increased pre-operative diagnosis of malignancy. Many of these lesions are not palpable and will require wire localization prior to surgical excision. Traditionally, this has been placed with stereotactic guidance. However, we have increasingly been using ultrasound guidance to perform wire localizations as much as possible, with considerable time savings obtained. Occasionally, there is difficulty in correlating the sonographic abnormalities to the mammographic findings, e.g. with small masses, stromal deformities and calcifications. In this case, the marker film is a useful technique where what is thought to be the corresponding mammographic abnormality can be confirmed by placing a marker needle in the area in question performing a single view mammogram. We present several examples where this exceedingly useful technique has been put into practice.

**POSTER 0206****Quality control tests by a medical physicist for film-screen mammography: a comparison between the ACR and IPSM protocols**

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Malaysia is a healthcare level II country according to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSAR) definition based on physician densities. A quality control (QC) programme in mammography has been implemented. This programme is subdivided into 2 levels. The first consists of QC tests that must be performed by a medical physicist, while the second deals with the QC tests that must be performed by a radiographer. For the first level of QC, the Ministry of Health of Malaysia has been adopting the Medical Physicist's Manual, of the American College of Radiology (ACR) as a protocol. Meanwhile, the hospitals which have radiologists trained in the UK prefer to follow the Institute of Physical Sciences in Medicine (IPSM) protocol, especially on the image quality requirement. The purpose of this study is

to compare QC tests by the medical physicist adopted by the 2 protocols mentioned above. The details of the measured data will be presented. Both protocols are useful to prove the constant correct functioning of the mammographic machine. The most important differences are: (1) ACR measures average glandular dose (AGD), while IPSM measures mean glandular dose (MGD). AGD is nearly 20% greater than MGD; (2) For the image quality check, the ACR prefers to use an RMI 156 phantom, while IPSM prefers to use Leeds TOR (MAX) phantom; (3) IPSM checks the automatic exposure control in great detail when compared with the ACR. The implication of using these 2 protocols will be discussed. The data will be useful for the healthcare level II country in establishing the national guideline for the QC of a film-screen mammographic machine.

**POSTER 0207****A computer generated model for assessment of lesion edge sharpness in breast MRI**

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**INTRODUCTION:** In breast MRI, small enhancing foci may be difficult to characterize as benign or malignant on enhancement characteristics alone. Morphological features, including edge sharpness, may be useful in such cases. Small lesions, however, may have a diameter of <5 pixels, and edge definition may be difficult to assess for both human observers and automated methods. Pixels on the edge of a lesion contain little fine detail, and include signal from both lesion and adjacent tissues (partial volume effect). The purpose of this study was to develop computer generated images of simulated lesions which could then be utilized to assess perception of edge sharpness for a range of lesion and pixel sizes. **METHODS:** A computer program was written in-house to generate images of spheroids by calculating the proportion of a given spheroid in each image pixel. The pixel size/slice thickness could be varied to generate images of different resolutions. The radial signal intensity profile of the spheroids had a linear slope towards their edge, which could be varied to allow simulation of different degrees of edge sharpness. Gaussian random noise was added to the image. **RESULTS:** This simulation enabled the generation of images of "lesions" with varying edge sharpness relative to the pixel and "lesion" size. These virtual lesions may be inserted into real imaging data sets from breast MRI examinations. The simulation will be used to explore the relationship between lesion size, spatial resolution, lesion edge parameters and perception of lesion edge by observers.

**POSTER 0208****Benefits of high resolution ultrasonography in the diagnosis of DCIS of the breast**V F Duda, K Bock, U-S Albert, A Ramaswamy and K-D Schulz  
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**PURPOSE:** The purpose of this study was to check the ability of high frequency ultrasound to delineate certain lesions in case of consecutive proven ductal carcinoma *in situ* (DCIS) of the breast. **MATERIAL AND METHODS:** From 1994 to 1998, 42 cases of DCIS were examined at the University Women's Hospital of Marburg by 10 13 MHz annular or linear transducers (Esaote Biomedica Corporation). **RESULTS:** Clusters of microcalcifications being the main sign of DCIS in X-ray mammography (81%), we depicted at least 17 cases of malignant-looking sonographical lesions (41%) and 11 suspicious ductal structures (26%). While we assumed a benign finding in 3 cases, 11 were definitely occult (26%). **CONCLUSION:** Sonography being the only method to get a quick but close look at the ductal structures of the breast, our results confirm the importance of high resolution ultrasound in this distinct field of breast imaging.

**POSTER 0209****MRI of Trilucent breast implants**

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14 trilucent implants in 7 patients were examined using MRI to ascertain if there was prosthetic leakage. The Trilucent implants are novel in so far as they contain soya bean oil (similar density to breast fat) and also a transponder. Image sequences tailored for the Trilucent prosthesis will be discussed along with examples and a demonstration of susceptibility artefacts from the transponder. Examples of normal and abnormal scans will be shown.

**POSTER 0210****Male breast cancer: 4 case reports**

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**INTRODUCTION:** Breast cancer represents less than 1% of all malignant neoplasms in men and is thus rare. As in women, size of primary tumour and nodal status are important prognostic markers for survival. Due to the lack of multicentre studies concerning the therapy and prognosis of male breast cancer, case reports are still important. **METHODS:** We present the long time course of 4 men (age 56–76 years) with breast cancer who underwent the diagnosis, therapy and follow-up from 1995 until now in our department. **RESULTS:** Due to suspicious results of clinical and radiological examination, we applied modified mastectomy with axillary lymphonodectomy in all cases. 3 patients with positive nodal status underwent chemotherapy (pathological staging: pT2, pN1biv, M0; pT4, pN1bii, M0; pT2, pN1biv, M0). Because of the favourable staging (pT1c, pN0, M0) and the age of the fourth patient, chemotherapy was dispensable. Meanwhile the follow-up of the patients covers a total range of 1–4 years and are in accordance with special German guidelines (KVH, 1996). **CONCLUSION:** Fortunately, there was no tumour recurrence until now due to the stage-related therapy of the patients. The results emphasize the positive influence of adjuvant therapy on recurrence-free survival.

**POSTER 0211****Mammographic features in male breast pathology**

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**PURPOSE:** Male mammographic study is unusual, as it is performed only in case of clinical symptomatology. **MATERIALS AND METHODS:** In the period between 1989 and 1998, 30 male patients between 13 and 65 years of age and with monolateral or bilateral breast mass were studied. **RESULTS:** The 30 patients showed 15 cases of gynaecomasty, 10 cases of adipomasty, 3 cases of ductal infiltrative carcinoma and 2 cases of fibroadenoma. **CONCLUSIONS:** The most common indication leading to mammography examination in male patients is represented by gynaecomasty which can occur in one or both breasts and more often in young rather than old patients. This pathology is frequently associated to neurological syndromes, hormonal alterations and drug administration, such as diazepam, isoniazide, digitalis and cyclofosfamide. Benign radiographic breast enlargement will show a transparent feature due to the major adipose representation and a retroareolar dense discoid image and a “flame” image of retroareolar and upper outer quadrant (UOQ) enhanced density. Male breast carcinoma represents less than 1% of all detected malignancies in men; showing radiographic characteristics similar to female breast carcinoma, as well as the fibroadenoma that has a regular and clear profile.

**POSTER 0212****Sonographic evaluation of lactating adenoma**K Bock, V F Duda, A Ramaswamy, S Schmidt and K-D Schulz  
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**PURPOSE:** In our patient sample, lactating adenoma occur in 25% of pregnancy-associated tumours of the breast. Owing to physiologically dense tissue, sonography is the method of choice for apparative diagnosis. What is the predictive value of sonography in the diagnosis of lactating adenoma? **MATERIALS AND METHOD:** We report the longitudinal evaluation of 4 patients with histologically proven lactating adenoma, which were diagnosed for the first time during pregnancy and were repeatedly controlled by real-time sonography (7.5–13 MHz), compound sonography (siescapeã) and colour imaging. **RESULTS:** Demonstrating a high interindividual and intraindividual variability, tumour sizes were biggest at parturition. Despite ongoing lactation, the tumours regressed in size but did not show a complete regression even after termination of breast feeding. Evaluation of sonographic features did not allow us to rule out malignancy. **CONCLUSIONS:** Due to the high variability of lactating adenoma, sonography does not give a reliable prediction of the diagnosis. Core cut biopsies can exclude malignancy without negative influence on breast-feeding.

**POSTER 0213****Does breast screening meet the WHO criteria for a screening programme?**

D Adrian-Harris

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The creation of the UK breast screening programme was supported by reference to the World Health Organization (WHO) (1968) criteria for the general principles of screening. In that document, 10 criteria were described. This poster will review each of these criteria in the light of current evidence to see how well they are fulfilled. It concludes that only 3 elements are fully met, the others only partially, or not at all. Consideration is given to the harmful outcomes which have been attributed to both false positive and false negative findings generated by breast screening.

**POSTER 0214****Is the UK breast screening programme meeting its targets?**

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The Forrest Report was published in 1986 and implemented by the then UK government within 3 years. Its main promise was to reduce deaths attributable to breast cancer by “one third or more within a decade” amongst women offered a breast screening service. The prime purpose of this poster is to consider how well the UK programme is fulfilling that original promise and some of its own enabling targets such as compliance, recall and detection rates. A second theme is to revisit the costings of the programme—both in global terms and cost per life saved. Data is drawn from the programme's yearly reports, the National Office of Statistics and the serious medical press. One set of conclusions could be that the breast screening programme does not meet the rigour of evidence-based medicine and that the costings cited by its proponents cannot easily be justified.

**POSTER 0215****Breast imaging in patients with HIV infection**<sup>1</sup>A K Banerjee, <sup>2</sup>A Omrani, <sup>1</sup>A Page, <sup>2</sup>S Taylor, <sup>3</sup>J Taylor and <sup>2</sup>S Drake*Departments of <sup>1</sup>Radiology, <sup>2</sup>GU Medicine and <sup>3</sup>Surgery, Birmingham Heartlands Hospital, Bordesley Green East, Birmingham B9 5SS, UK*

The radiology literature contains very little on breast problems in patients with HIV infection. We present 5 HIV positive (HIV +ve) patients who presented to our unit with breast problems and reviewed their imaging and pathology. They illustrate the wide range of problems in the breast that are seen in these patients. A 49-year-old HIV +ve man presented with swelling under the right nipple 30 weeks after treatment with indinavir, a protease inhibitor (PI). Ultrasound showed a hypoechoic region measuring 2 × 1 cm which was excised and found to be gynaecomastia. This is a recently described complication of PI therapy. Patient 2, a 57-year-old man, also developed gynaecomastia on a protease inhibitor. A 39-year-old HIV +ve male presented with a right-sided breast lump 1 year after treatment with nevirapine. Ultrasound of this region showed a hypoechoic mass which was excised and found to be gynaecomastia. This is a newly described complication of nevirapine. A 52-year-old HIV +ve man presented with right armpit swelling following 16 months of treatment with indinavir. Ultrasound showed fatty tissue in the armpit which is a previously unreported complication of PIs. A 27-year-old HIV +ve woman presented with a breast lump, generalized lymphadenopathy and positive toxoplasma titres. Ultrasound and mammography revealed a smooth, well defined hypoechoic mass of 2 × 1 cm in the breast which was excised and found to be a reactive intramammary lymph node secondary to partially treated toxoplasmosis. This is a highly unusual site of toxoplasmosis.

**POSTER 0216****Scintimammography—a pictorial review of the pathological appearances**<sup>1</sup>D F Sallomi, <sup>1</sup>D C Howlett, <sup>1</sup>R A Ementon, <sup>1</sup>N D P Marchbank, <sup>1</sup>H J Anderson and <sup>2</sup>S M Allan*Departments of <sup>1</sup>Radiology and <sup>2</sup>General Surgery, Eastbourne District General Hospital, Eastbourne BN21 2UD, UK*

**PURPOSE:** Scintimammography has a high specificity and sensitivity in the detection of primary and metastatic breast carcinoma. This review highlights the spectrum of pathological appearances that may be encountered with this technique. **MATERIALS AND**

**METHODS:** Imaging was with an ADAC Vertex plus dual headed gamma camera.  $^{99m}\text{Tc}$  sestamibi was injected into a foot vein and the patient scanned on a dedicated scintimammography pallet. Planar and SPECT acquisitions were obtained. Findings were compared with other imaging findings, clinical review and histological evaluation. **RESULTS:** A wide variety of pathological features are demonstrated and correlation with other imaging modalities is included. These encompass primary malignant uptake, axillary lymph node uptake and uptake within benign lesions. The differences in patterns of uptake between benign and malignant processes is highlighted and illustrated. These features are demonstrated with both planar and SPECT images. **CONCLUSION:** Scintimammography is highly effective in the evaluation of the symptomatic and post-surgical breast. Appreciation of the wide variety of appearances that may be observed within the pathological breast will allow accurate image interpretation and will help avoid confusion with benign processes.

**POSTER 0217****A comparison of second and third round screen detected breast cancers**

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**PURPOSE:** To identify any differences in the nature of cancers detected at second or third screening rounds and to assess the characteristics of cancers missed at earlier rounds. **METHOD:** A retrospective review of all cancers detected at second or third screening rounds was performed. Films were read independently by 2 experienced breast radiologists. Data recorded included location, radiographic appearance and size of the cancer. Features of those cancers definitely or possibly missed were analysed, and a retrospective judgement was made as to whether appearances warranted recall. Full histological details were then recorded. **RESULTS:** Of 205 patients, 66 had third round and 139 had second round cancers. Site and size of the cancers in both groups were similar. There was a trend toward lower tumour grade in those cancers missed. There was no significant difference in the percentage of cancers missed between the 2 populations. In those cancers not missed there was more high grade ductal carcinoma *in situ* (DCIS). In those that had subtle signs at the previous round, the majority were asymmetric densities. **CONCLUSION:** In a unit with a high standardized detection rate, the percentage of missed cancers has remained static despite improvements in technology and increasing experience. Possible reasons for this will be discussed.

## Cardiovascular and Interventional Radiology

**POSTER 0301****Pictorial review of developmental abnormalities of the great vessels with embryological correlation**

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**PURPOSE:** To provide a pictorial review of the commoner developmental abnormalities of the pulmonary and systemic arterial and venous systems in the thorax, and to show the embryological origin. **METHOD:** Examples of developmental abnormalities were identified from film collections and departmental records. Normal embryological development was reviewed and the derivation of the illustrated vascular anomalies demonstrated with accompanying line diagrams. **RESULTS:** Systemic arterial anomalies demonstrated include aortic coarctation, cervical, right and double aortic arches, aberrant right and left subclavian arteries and patent ductus arteriosus. Pulmonary artery anomalies include left and right pulmonary artery atresia and pulmonary sling. Venous anomalies shown include left and double superior vena cavae, partial and total anomalous pulmonary venous drainage. **CONCLUSION:** An understanding of embryology helps explain the variety of vascular anomalies encountered in childhood and adulthood.

**POSTER 0302****Is there a diagnostic benefit of gadobenate dimeglumine for MR angiography?**

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**PURPOSE:** To summarize the observed diagnostic features of gadobenate dimeglumine (Gd-BOPTA) for MR angiography as evaluated in 6 Phase I-IIIb studies. **MATERIALS AND METHODS:** More than 100 MR angiographies with Gd-BOPTA

have been performed. Qualitative as well as quantitative assessment has been done. The efficacy of Gd-BOPTA compared with Gd-DTPA was analysed in a double-blinded intraindividual cross-over comparison ( $n=10$ ). All studies were performed according to GCP and had the approval of the Institutional Review Board. **RESULTS:** Gd-BOPTA revealed a higher and longer vascular peak enhancement than Gd-DTPA ( $p<0.01$ ) at the same dose. Furthermore, a more homogenous vascular enhancement and improved delineation of small vessels was found. Effects due to differences in viscosity could be excluded by automated contrast administration. Clinical cases of different vessel regions will be presented as well as findings using a multiphasic angiographic technique. **CONCLUSION:** Gd-BOPTA improves the vascular enhancement characteristics for 3D contrast enhanced MR angiography. Current findings indicate a more homogenous vascular enhancement, even with smaller doses, which enable an improved visualization of smaller vessels.

**POSTER 0303****Effects of radiographic contrast media on proliferation and apoptosis of vascular endothelial cells**

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**PURPOSE:** To determine the effects of radiographic contrast media on proliferation and apoptosis of vascular endothelial cells. **MATERIALS AND METHODS:** Human umbilical vein endothelial cells (HUVECs) and contrast media (diatrizoate, ioxaglate, iopromide, iotrolan) at equal iodine concentration ( $250 \text{ mg I ml}^{-1}$ ). Controls were complete growth medium (CGM) and saturated mannitol (osmotic control).  $[^3\text{H}]\text{Thymidine}$  incorporation was used to determine cell proliferation at 24 h. Apoptosis was determined at 1 h and 6 h by TUNEL and time lapse video microscopy (TLVM). **RESULTS:** Proliferation rates [as % mean (SEM)] compared with CGM at 1 min and 15 min, respectively, were as follows. Datrizoate: 31.9 (10.6), 5.8 (1.5) ( $p<0.01$ ); ioxaglate: 48.4 (10.9), 20.4 (4.5) ( $p<0.01$ ); iopromide: 63.4 (8.7), 58.2 (10.2) ( $p<0.01$ ); iotrolan: 84.7 (7.3), 72.8 (12.4) ( $p=ns$ ). The percentage of apoptotic cells at 1 h and 6 h, respectively, after 15 min exposure were: CGM: 0.25 (0.13), 0.23 (0.08); diatrizoate: 2.18 (0.19), 2.69 (0.34) ( $p<0.01$ ); ioxaglate: 1.90 (0.23), 1.69 (0.02) ( $p<0.01$ ); iopromide: 0.59 (0.04), 0.33 (0.02) ( $p=ns$ ); iotrolan: 0.30 (0.07), 0.27 (0.1) ( $p=ns$ ). Induced apoptosis at 1 h and 6 h after 15 min exposure to all contrast media, with the exception of iotrolan, was significantly different from CGM ( $p<0.01$ ): [iotrolan: 0.29 (0.17), 0.51 (0.16) ( $p=ns$ ); diatrizoate: 3.19 (0.81), 11.66 (1.75); ioxaglate: 1.88 (0.14), 2.87 (0.20), iopromide: 1.06 (0.11), 1.52 (0.15)]. **CONCLUSION:** All contrast media tested, with the exception of iotrolan (diatrizoate > ioxaglate > iopromide > iotrolan), have an effect on proliferation and apoptosis of HUVECs. Contrast-induced apoptosis of endothelial cells may contribute to thrombosis formation and alteration in blood vessel tone and may accelerate restenosis of angioplasty.

**POSTER 0304****The role of ultrasound in an ambulatory deep vein thrombosis service**

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Deep vein thrombosis (DVT) is a common clinical problem which is usually managed in hospital. The Birmingham Heartlands and Solihull Hospitals NHS Trust has recently shifted the treatment of DVT from the hospital setting to the community by the formation of an anticoagulation team. Patients referred from the community with a clinical suspicion of DVT undergo an ultrasound scan within 24 h and start anticoagulation with subcutaneous heparin in hospital. We present the results after the first 18 months of the project from January 1998 to June 1999. Of the 1415 referrals for DVT (male 81, female 105; age range 21–90 years), 186 of the positive scans were ambulant patients who were suitable for home management by the anticoagulation nurse. The distribution of thrombi were as follows: iliac 19, femoral 78, popliteal 53 and calf 36. 170 patients received tinzaparin for 6 days and the other 16 were put on dalteparin for 5 days. The patients were discharged within 24 h of the scan. Oral anticoagulation was managed at home. Follow-up has been performed and there have been 2 deaths in the patients which were due to ischaemic heart disease and carcinomatosis. 2 readmissions were noted, 1 for haematoma in the same leg as the DVT and the other with a Baker's cyst. A satisfaction survey revealed that 77%

felt the service to be excellent and 23% felt it was good. Our results show that ambulant patients can have their DVT managed in the community with considerable savings to the hospital. However, a prompt and accessible ultrasound scanning service is essential for this type of management to succeed.

**POSTER 0305****The cost effectiveness of adding intravascular ultrasound guidance to coronary stenting procedures**

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**PURPOSE:** Coronary stenting procedures are often performed with intravascular ultrasound (IVUS) guidance, but evidence about the cost-effectiveness of this approach is not available in the literature. A decision analytic model was developed, incorporating information from several sources, to compare the restenosis rates at 6 months with and without IVUS guidance and to determine cost-effectiveness. **METHODS:** An expert panel compiled a decision tree, which represented the possible pathways taken by a patient from presentation to health outcome at 6 months post-stenting. Probabilities were assigned to each event based on values derived from literature included in a systematic review. Costs for the intervention were estimated using local data and costs for decision tree events derived from published sources. Data<sup>®</sup> 3.0 was used to run the completed model. The reduction in restenosis rate at 6 months was extrapolated to estimate any gain in quality adjusted life years (QALY). Sensitivity analysis was included. **RESULTS:** The absolute reduction in restenosis rate from IVUS guidance was 0.11 (95% CI 0.04–0.19). The cost per restenosis event avoided was £1545, ranging from a saving of £4968 to a cost of £23950. The extrapolated long-term incremental QALY gain was 0.03 years. The baseline cost per QALY was under a cost-effectiveness limit of £10 000, but the cost in the worst case was 10 times higher. **CONCLUSION:** The model allowed an estimate of the cost-effectiveness of using IVUS to guide stenting procedures. Sensitivity analysis, however, returned very wide ranges and demonstrated that the model was not robust to changes, particularly in restenosis rate.

**POSTER 0306****Closed underwater coil delivery system for use during transcatheter embolotherapy**

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**INTRODUCTION:** Traditional coil deployment techniques are prone to producing small air emboli. While of no significance in most settings, these emboli can be disastrous when treating pulmonary arteriovenous malformations (PAVMs). Detachable silicone balloons are less likely to create air emboli, but they are substantially more expensive than coils, and for this reason, we set out to design and evaluate an airless coil delivery system for use during transcatheter treatment of PAVMs. We were able to devise a closed underwater delivery system using materials that are readily available in any interventional department. To date, over 400 coils have been deployed in 30 patients using this device, with no air emboli. **CONCLUSION:** This simple system allows coils to be delivered in a completely airless fashion, substantially reducing the likelihood of air emboli during coil embolotherapy of PAVMs. While particularly effective for use during treatment of PAVMs, this system can be used to prevent air emboli during any type of transcatheter embolotherapy.

**POSTER 0307****In low jugular puncture the subclavian artery is the main potential for complication**

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**PURPOSE:** To prospectively assess, using ultrasound, the main anatomical relationships of the low internal jugular vein as preferentially accessed during interventional radiological procedures. **MATERIAL AND METHODS:** All patients presenting for radiological central venous access underwent a full ultrasound assessment. The access point on the skin was marked for the interventional procedure, and the ultrasound assessment of the anatomical relationships was performed at this level, low in the neck. The size

of the jugular vein, its depth from the skin and distance from its posterior wall to the pleura were measured. The distances to the carotid artery and subclavian arteries were also measured. Following the central venous procedure the lowness of access was assessed by the height of the catheter above the ipsilateral clavicle. **RESULTS:** 127 consecutive patients were prospectively scanned and all had Hickman catheters inserted. The size of the internal jugular vein at the insertion was  $1.72 \pm 0.93 \text{ cm}^2$ , its depth from the skin was  $0.95 \pm 0.3 \text{ cm}$  (1 SD). The distance to the carotid artery was  $0.78 \pm 0.4 \text{ cm}$ , and subclavian artery  $0.4 \pm 0.26 \text{ cm}$ . The distance of the eventual catheter position above the clavicle, which reflected the level of puncture, was  $1.47 \pm 0.54 \text{ cm}$ . The distance to the underlying lung was  $1.43 \pm 0.48 \text{ cm}$ . **CONCLUSIONS:** During low puncture of the internal jugular vein in radiological central venous access, the main anatomical source of potential complication is the ipsilateral subclavian artery and not the carotid artery.

**POSTER 0308****Comparison of 6 brands of disposable automated 18 G biopsy needles**

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**PURPOSE:** Numerous automated devices are now available for percutaneous biopsy, varying widely in design and cost. We studied 6 types of 18 gauge devices that are available in the UK for quality of sample using cadaveric organs. **MATERIALS AND METHODS:** The 6 devices tested were Bauer Achieve, Manan Supercore, Meditech ASAP, Temno, Cook Quickcore and Gallini. Biopsies of the excised livers and kidneys of 2 fresh cadavers were performed by an experienced radiologist. Each organ type was sampled 6 times with each of the 6 devices in both cadavers. A histopathologist graded each sample for 7 variables. **RESULTS:** For the liver biopsies, significant differences between manufacturers were found for the preservation of the specimen, the degree of crushing and both the maximum size and composite length of the specimens. For the kidney biopsies, there were no significant differences between manufacturer performance although the general trend was comparable to that shown with the liver biopsies. The Cook and Temno needles tended to provide the least satisfactory biopsy samples. The Cook biopsies were significantly more crushed than the others. The Temno provided the shortest sample length (despite having one of the longest notches—18 mm). The Manan and Meditech had the best preservation of the specimen, but not significantly better than Achieve and Gallini. Achieve and Gallini needles had the greatest single and composite lengths. **CONCLUSION:** There are significant differences in the quality of tissue sample obtained between the biopsy needles tested, the Cook and the Temno needles being the least satisfactory.

**POSTER 0309****CT-guided percutaneous needle biopsy of intrathoracic lesions: outcome of 122 cases**

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**PURPOSE:** To evaluate the influence of location of intrathoracic lesions and method of percutaneous tissue sampling with respect to diagnostic yield and post-procedure complications. **MATERIALS AND METHODS:** Retrospective analysis of 122 consecutive cases of CT-guided percutaneous transthoracic biopsies was performed. Peripheral biopsies were performed in 109 (89%) cases vs 13 (11%) mediastinal biopsies. Fine-needle aspiration (FNA) was used in 67 (55%) cases vs 55 (45%) core biopsies. **RESULTS:** Of 109 peripheral biopsies, diagnostic tissue was obtained in 76 (70%) cases, with 22 (20%) pneumothoraces (6 treated), and 10 (9%) haemorrhages. In 13 mediastinal biopsies, diagnostic yield was obtained in 10 (77%) cases, with 1 (8%) pneumothorax (drained) and no haemorrhages. Of the 67 FNA samples, diagnostic tissue was obtained in 44 (66%) cases, with 14 (21%) pneumothoraces (5 treated), and 6 (9%) haemorrhages. The 55 core biopsies yielded diagnostic tissue in 44 (80%) cases, with 9 (16%) pneumothoraces (2 treated) and 4 (7%) haemorrhages. There was no post-procedure mortality. **CONCLUSION:** Almost all complications occurred after sampling peripheral lesions. Core biopsies gave a greater diagnostic yield than FNA, 80% vs 66%, with a reduced complication rate. 24% vs 30%.



**POSTER 0310****Metallic endoprosthesis in the palliation of malignant airways strictures and fistulae**

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**PURPOSE:** To evaluate the use of Wall-stents in the palliation of malignant airways strictures and tracheo-oesophageal fistulae. **MATERIALS AND METHODS:** 55 Wall-stents were placed in 39 patients (33 had airway obstruction, 6 had malignant fistulae between the airways and oesophagus). Covered stents were placed in trachea, and uncovered in the bronchi. Stents were inserted under general anaesthesia, using combined bronchoscopic and fluoroscopic guidance. The mean follow-up was 15 weeks. Dyspnoea was evaluated using the Medical Research Council dyspnoea score. **RESULTS:** All stents were successfully deployed. 20 patients had an improvement in the dyspnoea score of at least 1 grade (response rate 72%). 13 patients could not be reassessed. All of the fistulae closed initially, but after 1 week a patient with a fistula between the oesophagus and the left main bronchus developed recurrent symptoms (response rate 80%). Only 1 case of stent migration was observed. This was in the fistulae group, however the patient remained asymptomatic. 4 patients died within 2 days of the procedure and 4 other patients died within 30 days of the procedure (unrelated to stent placement). **CONCLUSIONS:** Self-expanding metallic endoprostheses provide safe and effective palliation of malignant airways obstruction. Covered metallic stents are of value in palliating fistulae to the airways where oesophageal stents are unsuitable.

**POSTER 0311****The role of self-expanding metal stents in palliation of gastric outflow obstruction**

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**PURPOSE:** To examine the role of self-expanding metal stents (SEMS) in the management of gastric outflow obstruction. **MATERIALS AND METHODS:** 12 uncovered SEMS (diameters: 18–22 mm, lengths 60–100 mm) were placed fluoroscopically in 9 patients via a per oral approach using standard guidewire and catheter techniques. 5 patients had undergone gastric pull-up surgery for oesophageal carcinoma. Of these, 1 had duodenal obstruction due to tumour spread and the rest had pyloric dysfunction not responsive to balloon dilatation. 4 other patients had duodenal obstruction due to pancreatic carcinoma and 1 had a carcinoma of the pylorus. In 3 patients, 2 stents were needed. **RESULTS:** All patients were able to consume a normal diet after stent insertion. In the patient with pyloric carcinoma, the proximal stent migrated into the fundus at Day 2, he then presented 5 days later with perforation of the antrum at the tumour site, necessitating surgery. 1 patient (gastric pull-up) stented for duodenal obstruction developed tumour ingrowth at 11 weeks and died at 16 weeks. Of the remaining patients (4 have died), none has experienced recurrent symptoms over a mean follow-up period of 14 weeks. **CONCLUSION:** Non-endoscopic insertion of SEMS under fluoroscopic guidance is a safe and effective treatment for gastric outflow obstruction due to pyloric or duodenal stenosis. Particularly useful in malignant disease, it has a role in pyloric dysfunction after gastric pull-up surgery, even when prolonged survival may be expected.

**Chest****POSTER 0401****Staging of lung cancer—a pictorial review**

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Lung cancer is the most common malignant disease in developed countries. There are approximately 40 000 new patients/year in the UK. Over 500 new cases of primary lung cancer are referred to our Cardio-Thoracic Centre each year. Accurate staging is important as surgery remains the best treatment option in suitable patients with non-small cell cancer, cross-sectional imaging is a fundamental part of this process. The extent of the disease is assessed with respect to primary tumour (T), regional lymph nodes (N) and distant metastases (M). CT is used in the majority of patients with the multi-planar capabilities of MRI reserved for problem solving. Bone scintigraphy is only used if there are symptoms of skeletal metastases.

This poster aims to educate by showing different examples of the TNM staging using CT. MRI images demonstrate its use for staging superior sulcus tumours, assessing mediastinal extension and evaluating suspected adrenal metastases. Detection of metastatic disease is shown with examples of both MRI and scintigraphy.

**POSTER 0402****Spiral CT chest clinic for assessment of patients with suspected lung cancer**

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**PURPOSE:** 6 months ago, a 1-stop clinic was put into operation at Stoke Mandeville Hospital. The objective is to ensure that the most appropriate investigation is performed speedily in patients with suspected lung cancer and to improve the effectiveness and efficiency of the diagnostic process. **METHOD:** Patients suspected by their GPs of having lung cancer (either clinically or from a chest radiograph report) have a dedicated proforma faxed to the chest clinic. Patients are seen by the chest physician and are then sent for a CT scan between 9 am and 10 am. Their CT scans are then discussed by the radiologist and chest physician and a decision is made whether to carry out a CT biopsy or proceed to bronchoscopy on the same day. If a biopsy is required, the patient returns to CT and a biopsy is carried out after 11 am the same day. **RESULTS:** The object of this poster is to outline the system of work in place and to show the co-operation between departments. Investigation into the numbers of patients this has involved and the difference in waiting time and diagnosis time before and after the setting up of the clinic will be made. **CONCLUSION:** Conclusions will be reached regarding benefits to patients and clinicians of the 1-stop clinic.

**POSTER 0403****A review of the high resolution CT appearances of pulmonary disease in systemic sclerosis**

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At the Royal Free Hospital, approximately 400 patients with systemic sclerosis are under review. We reviewed the thin section thoracic CT examinations of some of these patients, and reviewed the current literature regarding the features and uses of CT in the lung disease of systemic sclerosis. The poster will illustrate various features of thoracic CT in systemic sclerosis including: the patterns of ground glass attenuation and interstitial disease; enlarged mediastinal lymph nodes; enlarged central pulmonary arteries; oesophageal dilatation; pleural thickening; micronodular changes. Reference is also made to the significance of the radiological findings.

**POSTER 0404****MRI—a way forward in managing fibrotic lung disease**

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Over recent years, high resolution CT (HRCT) has become the most accurate non-invasive method for assessing and calculating lung parenchyma. HRCT has also been used with some success in predicting the response to treatment and outcome in interstitial lung disease. MRI, although producing an inferior anatomical display than HRCT, provides different information. Using MRI, it has been demonstrated that abnormal water content in tissues including lung can be used to infer the degree of activity of the disease process. MRI also has the advantage of being a non-ionizing investigation. Within our department we have performed a pilot study into the potential use of MRI in interstitial lung disease. MRI scans were performed within a short space of time following chest radiography and HRCT. The standard MRI sequences used within the chest were Turbo spin echo  $T_2$  weighted coronal, spin echo  $T_1$  weighted transverse and short tau inversion recovery (STIR) transverse/coronal sequences followed by  $T_1$  weighted post-intravenous gadolinium scans. Breath-holding gradient echo sequences were also used in some cases and cardiac gated video sequences. Pathology studied was varied and included sarcoidosis, cryptogenic fibrosing alveolitis and extrinsic fibrosing alveolitis. MRI proved to be a successful means of assessing disease activity and further ongoing studies in its potential use are being undertaken.



POSTER 0405

**Lung cysts—a pictorial review in both adults and children**  
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The differential diagnosis of lung cysts is very different in adults and in children. In the paediatric population the causes are further divided in the neonatal period and infants and in older children, but there is a degree of overlap. The majority of causes in this group are congenital. In adults, emphysema is a common finding but there are numerous less frequently encountered causes of lung cysts. We present a pictorial review of paediatric and adult lung cysts and discuss an approach to the differential diagnosis. In the paediatric group we include simple lung cysts, congenital cystic adenomatoid malformation, sequestration in addition to rarer conditions including mesenchymoma. Cases in adults include lymphangiomyomatosis, tuberous sclerosis, amyloid and pneumocystis carinii. Pneumatoceles which can occur in most age groups post-trauma or infection are also illustrated.

POSTER 0406

**Evaluation of observer variation in scoring the severity of pleural disease using CT and chest radiography**  
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**PURPOSE:** The aim of the study was to evaluate interobserver variation for the quantification of pleural disease, using chest radiography (CXR) and two CT scoring methods. **MATERIALS AND METHODS:** The chest radiographs and CT scans of 50 patients with pleural disease of various causes were assessed by 2 observers. The CXR system was based on the International Labour Organization (1980) classification. A simple 5 level CT system and a comprehensive CT system (thorax divided into thirds, all sections in each third evaluated) were tested. Interobserver variation was quantified using weighted kappa values (KW) for categorical variables, or the single determination standard deviation (sdSD), for continuous variables. **RESULTS:** For pleural plaques, interobserver agreement was higher using the simple CT system (KW=0.87) than with the comprehensive CT score system (KW=0.74) or CXR (KW=0.45). Interobserver variation for the severity of diffuse pleural thickening differed little between the simple CT system (sdSD=3.0 mm, coefficient of variation 14%) the comprehensive CT system (KW=0.78) and CXR (KW=0.84). **CONCLUSIONS:** In terms of interobserver variation, there is little to choose between CT and CXR in the quantification of diffuse pleural disease. However, in asbestos-related disease a simple CT method is preferable, because of the higher interobserver agreement in scoring plaques and superior assessment of the lung parenchyma.

## Gastrointestinal

POSTER 0501

**Herniography: a prospective, randomized study between midline and left iliac fossa techniques**

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**PURPOSE:** To determine whether an optimal site of contrast injection exists for herniography. **MATERIALS AND METHODS:** Prospective, randomized study in 93 patients who were referred for herniography over a period of 9 months. Patients underwent either a left iliac fossa (LIF) or midline puncture. Parameters assessed included complications, initial adequate needle placement, pain scores and body mass index. The groups were compared using  $\chi^2$  test for parametric and Student *t*-test for non-parametric data, with  $p < 0.05$  considered statistically significant. **RESULTS:** 4 major complications were encountered (4%), and these were equally distributed between the 2 groups. Adequate initial positioning of the needle was similar in both groups. The volume of local anaesthetic used was correlated with the severity on a pain score: a volume of  $> 6$  ml resulted in significantly more pain. More frequent initial adequate needle placement was observed in thin patients (body mass index  $< 45 \text{ kg m}^{-2}$ ) and with experienced operators. Conversely, increased body mass index resulted in more difficult needle placement. **CONCLUSION:** Herniography is a safe procedure with few complications. There was no significant difference comparing the midline and LIF approaches.

POSTER 0502

**Imaging of possible recurrent colorectal tumours**

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**PURPOSE:** To evaluate the role of anti-carcinoembryonic antigen (anti-CEA) monoclonal antibody (MAB) scan in the evaluation of patients presenting with possibly recurrent colorectal tumours. **METHODS:** A 2 year retrospective analysis of patients who had routine radiological cross-sectional imaging and CEA MAB scanning was undertaken. **RESULTS:** 6 patients underwent 7 CEA MAB scans (1 patient had 2 scans). All were males, age range 52-77 years. In all patients, serum CEA was raised, and CT and/or MRI scans of the abdomen/pelvis were equivocal. In 2 cases (same patient scanned twice) the CEA MAB scan was normal and the patient was not considered for further surgery. 2 patients had abnormal CEA MAB scan in areas other than the sacrococcygeal area and recurrent tumour was excluded. In 2 patients, CEA MAB scan was positive and this was confirmed on examination of the excised tissue. In 1 patient, serum CEA and CEA MAB scan were normal; however, CT identified tissue which was later proven to be recurrent tumour. **CONCLUSION:** Although CEA MAB scan is a useful technique in the assessment of patients for possible recurrence of colorectal tumours, further evaluation of its exact role is necessary.

POSTER 0503

**MRI accuracy in determining tumour extent in recurrent pelvic bowel cancer prior to salvage surgery**

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**PURPOSE:** To determine the accuracy of MRI in assessing local disease extent in recurrent/residual pelvic bowel cancer prior to attempted salvage surgery by comparing MRI assessment with examination under anaesthesia (EUA), laparotomy and histopathological findings. **MATERIALS AND METHODS:** 27 consecutive patients with recurrent ( $n=21$ ) or residual ( $n=6$ ) pelvic bowel cancer (rectum 13, anus 11, colon 3) were evaluated. Prior to surgery all patients underwent pelvic MRI (1T) with  $T_1$ SE and  $T_2$ TSE sequences in orthogonal planes using a phased array pelvic coil. Analysis of specific anatomical sites for tumour involvement was performed and the MRI features were correlated with findings at surgery and histopathology. **RESULTS:** Overall MRI accuracy for determining the presence or absence of tumour involvement was 91% with a sensitivity of 86%, a specificity of 92%, a positive predictive value (PPV) of 73% and a negative predictive value (NPV) of 96%. For specific areas the PPV and NPV were: genitourinary tract (anterior extent) 55% and 99%, pelvic side-wall (lateral extent) 67% and 94%, pelvic floor (inferior extent) 81% and 98%, presacrum/sacrum (posterior extent) 50% and 93% and pelvic lymphadenopathy 25% and 98%. MRI assessment was more accurate and had a higher PPV than EUA in all areas. **CONCLUSION:** MRI is an accurate technique for assessing disease extent in recurrent/residual colorectal or anal cancer and will help determine the extent of salvage surgery required.

POSTER 0504

**Anal endosonography—all you need to know**

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**INTRODUCTION:** Anal endosonography (AES) was first introduced in 1989 and has since developed a major role in the investigation of patients with incontinence, anal pain, sepsis and tumour. Unfortunately the anatomy of the sphincter muscles is complex and poorly understood. Misinterpretation of normal appearances can result in unnecessary surgery. The recent development of high frequency crystals and MRI correlation has improved our understanding of the normal anatomy and improved diagnostic accuracy. **METHOD:** This poster aims to explain in detail the normal anatomy of the sphincter muscles. The important differences in sphincter appearances between men and women will be demonstrated as well as the significant effect of age on the appearances of both the external and internal sphincter. A pictorial review of the range of abnormalities encountered at endoanal ultrasound will be demonstrated which includes obstetric sphincter damage, post-surgical trauma to the sphincter muscles, perianal sepsis and tumour. The advantages and disadvantages of AES compared to body coil MR and endorectal MRI of the sphincters will be discussed.

**POSTER 0505****MRI vs EUA in the assessment of fistula-in-ano.****A retrospective study**

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**PURPOSE:** To compare the results of MRI and examination under anaesthetic (EUA) in the assessment of fistula-in-ano. EUA is considered the gold standard; can MRI improve upon this? **METHOD:** A retrospective study of 32 patients who underwent both MRI and EUA. Patients referred by coloproctologists who had previously failed surgery or were difficult to assess clinically. A standard protocol ( $T_2$  and short tau inversion recovery (STIR)) was used in all cases. Results divided into simple or complex tracts. **RESULTS:** 20 male and 12 female patients with an age range of 27–72 years (mean 44 years). EUA and MRI were equivalent in classification of tracts in 28/32 (87.5%). Of the 4/32 MRI demonstrated complex tracts which were later confirmed at surgery. **CONCLUSION:** MRI of perianal fistula tracts is easy to perform and no additional specialist equipment is required. It is well tolerated by patients and has been shown to demonstrate tracts to a greater degree of accuracy when compared with the traditional gold standard of EUA. In addition, no anaesthetic is necessary and it can be performed on an outpatient basis and reduces valuable theatre, anaesthetic and surgical time. MRI is the examination of choice for fistula-in-ano, especially in complex cases where correct surgical treatment can substantially reduce the risk of both recurrent disease and incontinence.

**POSTER 0506****CT imaging of omental and mesenteric abnormalities: a pictorial review**

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The omentum and mesentery have hitherto often been overlooked as distinct radiological entities, but the use of cross-sectional imaging, particularly CT, has led to a growing recognition of their involvement in a wide variety of pathological processes. A pictorial review of the CT appearances of a spectrum of omental and mesenteric disease will be presented, to include omental ischaemia (both as primary segmental omental infarction and in association with bowel ischaemia), traumatic mesenteric haemorrhage, inflammatory conditions (such as sclerosing mesenteritis and mesenteric lipodystrophy) and neoplasia. Cases showing the changes due to carcinoid, lymphoma and metastatic infiltration with omental caking will be shown. Examples of pseudomyxoma peritonei, mesenteric cyst, fibrofatty proliferation secondary to inflammatory bowel disease and tuberculosis-related mesenteric lymphadenopathy and peritonitis will also be included. As will be demonstrated, a knowledge of characteristic omental and mesenteric appearances on CT gives useful information which can lead to specific diagnoses, some of which, such as segmental omental infarction and sclerosing mesenteritis, were previously only made surgically or histologically. In other cases, the omental and mesenteric CT appearances give additional supportive information reflecting the pathology in adjacent structures. Both these aspects have implications for subsequent patient management.

**POSTER 0507****Small bowel ultrasound: a review with comparative imaging and pathology**

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Ultrasound is frequently the first imaging modality of patients with non-specific abdominal pain or possible abdominal mass. With increasing usage, it is clear that ultrasound has a role to play in bringing to light bowel, and particularly small bowel, pathology. Acute inflammatory conditions may be differentiated from disorders of absorption by the pattern of change seen in the small bowel wall. Focal benign and malignant tumours can be separated from infiltrative processes such as lymphoma and carcinoid. This paper takes an overview of small bowel problems which can be diagnosed by ultrasound and correlation is provided with subsequent barium or other cross-sectional imaging. Where appropriate, this is complemented by pathological material to help understand the nature of the process and its imaging.

**POSTER 0508****Blunt abdominal trauma: the role of sonography as a primary screening method**

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**PURPOSE:** The swift recognition and treatment of occult intra-abdominal injury in the multitrauma patient plays a substantial role in decreasing the mortality rate of these cases. The purpose of this study was to examine the role of sonography when used as a primary screening method for blunt abdominal trauma. **MATERIALS AND METHOD:** During an 18 month period, emergency abdominal sonography was performed as the initial diagnostic technique for the examination of 62 patients with blunt trauma. The presence or absence of free intraperitoneal fluid and/or direct visualization of parenchymal injury defined the result as positive or negative, respectively. An incomplete or technically limited outcome defined the result as indefinite. All sonographic results were correlated with surgery, CT, peritoneal lavage or clinical follow-up. **RESULTS:** According to our results, 54 emergency sonograms were interpreted as negative, 6 sonograms as positive and 2 abdominal sonograms were indeterminate. Furthermore, of the 54 sonograms with negative findings, 50 were confirmed by CT, surgery, peritoneal lavage or clinical follow-up, whereas all 6 sonograms with positive results were confirmed. **CONCLUSION:** Sonography can be used effectively as a screening method when evaluating blunt abdominal trauma, since it provides a non-invasive, rapid examination which requires little patient co-operation and eliminates the unnecessary transport of potentially unstable patients.

**POSTER 0509****Acute appendicitis: value of colour Doppler sonography**

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**PURPOSE:** The purpose of this study is to determine the role of colour Doppler sonography when evaluating patients with clinical findings that are suggestive, but not diagnostic, of acute appendicitis. **MATERIALS AND METHOD:** Colour Doppler sonography was used to evaluate 12 children and adolescents in whom the diagnosis of appendicitis could not be definitively established clinically. Colour Doppler sonography of the right lower quadrant was performed as an adjunct to gray-scale sonography and sonographic findings were correlated with surgical outcome or the clinical follow-up. Colour Doppler images were evaluated for hyperaemia of the appendiceal wall and the extent of the hyperaemia within the visualized appendix was graded as focal or scattered. **RESULTS:** According to our results, 7 patients had uncomplicated appendicitis and 1 patient had perforation. Colour Doppler sonography showed appendiceal hyperaemia in 5 patients. The hyperaemia was scattered in 3 patients and 2 patients had focal appendiceal hyperaemia. In 1 case the hyperaemia was located in the appendiceal tip, while in the other it was central and located around the appendiceal stump. In the patient with perforating appendicitis there was an increased colour Doppler signal in the periappendiceal soft tissues and the walls at the adjacent bowel loops. **CONCLUSION:** Colour Doppler sonography, as an adjunct to gray-scale sonography, can be a useful swift, non-invasive means of evaluating the possibility of acute appendicitis in patients with atypical clinical signs.

**Genitourinary****POSTER 0601****The natural history of medullary sponge kidney: a 37 year follow-up**

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Medullary sponge kidney, though present at birth, is usually not diagnosed until the fourth decade. It presents with gross or microscopic haematuria, recurrent urinary tract infections, nephrolithiasis and renal colic. The diagnosis is confirmed by intravenous urography. The radiological features of medullary sponge kidney were first described in 1939 by Lenarduzzi in Italy and since then many cases have been reported in the world literature. This exhibit illustrates early radiographic features of medullary sponge kidney in an 80-year-old male. The patient had an intravenous urography at the age

of 42 to investigate previous tuberculosis of the other kidney. The examination was performed in 1961 by the radiologist NA Chalazontis. This was the first case of medullary sponge kidney described in Greece. 37 years later, the same patient underwent another intravenous urography by the radiologist AN Chalazontis. The findings on plain radiographs, intravenous urography and CT, as well as family history (a sister with medullary sponge kidney) symptoms and renal functional status are presented and discussed. The learning objectives of this poster are to describe medullary sponge kidney early radiographic and urographic findings as well as the natural history of the disease.

**POSTER 0602**  
**Fluoroscopically-guided retrograde ureteric catheterization**

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**PURPOSE:** We report our experience with fluoroscopically-guided retrograde ureteric catheterization. **METHODS:** Retrograde ureteric catheterization was attempted in 9 patients (6 women, 3 men, aged 21–63 years). In 8 cases, the patient's underlying diagnosis was a calyceal calculus. Percutaneous passage of a guidewire antegradely beyond the calculus had either failed previously (2 patients) or was expected to be difficult. The other case was a complex pelvi-ureteric junction obstruction (PUJO). Following introduction of a Foley catheter into the bladder, this was exchanged for a 10 French sheath. Retrograde ureteric catheterization was performed with either a Colapinto or Sos Omni catheter and a hydrophilic guidewire. A ureteric occlusion balloon catheter was then placed. **RESULTS:** Retrograde catheterization was successful in 8 patients but not in the complex PUJO patient. In each case, placement of a ureteric occlusion balloon catheter allowed sufficient retrograde pelvicalyceal distension for successful antegrade passage of a guidewire beyond the calyceal calculus and insertion of a nephrostomy tube. Subsequent percutaneous nephrolithotomy was performed in the operating room. **CONCLUSION:** Fluoroscopically guided retrograde ureteric catheterization is possible with a high success rate in our small series of patients. This technique offers particular promise for calyceal calculi that occupy an entire calyx.

**POSTER 0603**  
**The radiological spectrum of urachal carcinoma**

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**PURPOSE:** The purpose of this study is to demonstrate the importance of considering pathology involving the urachal remnant when there is radiological evidence of an abnormality involving the dome of the bladder. There are 4 types of congenital urachal anomalies. (1) Patent urachus associated with urethral atresia or valves. (2) Urachal cyst, when the urachus closes at the umbilicus and the bladder but remains patent in between. There is an increased risk of carcinoma. (3) Urachal diverticulum, when the urachus closes at the umbilicus, but not at the bladder. There is an increased risk of carcinoma. (4) Urachal sinus, where a cyst becomes infected and drains either into the bladder or the umbilicus. **METHODS:** The radiological manifestations of 10 patients with urachal complications have been reviewed and a range of radiological appearances on multiple imaging modalities will be presented. **CONCLUSIONS:** When an abnormality is demonstrated in the dome of the bladder, it must be considered to be urachal in origin until proven otherwise. Adenocarcinoma that has a poor prognosis is a complication of urachal anomalies.

**POSTER 0604**  
**Salpingitis isthmica nodosa in female infertility**

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**PURPOSE:** Salpingitis isthmica nodosa (SIN) is an uncommon disease of the fallopian tubes and is characterized microscopically by small diverticula present in an irregularly hypertrophied hypertrophied myosalpinx. The purpose of this study was to determine the incidence and distribution of SIN on hysterosalpingography during the investigation of infertility and to evaluate the clinical significance. **MATERIALS AND METHODS:** 1056 women presenting with primary or secondary infertility, referred for hysterosalpingography in a tertiary referral centre, have been evaluated by a

single operator. Patients diagnosed with SIN, age range 27–42 years, have been followed up. **RESULTS:** Out of the 1056 women, 220 had tubal pathology and a further 80 had dual pathology *i.e.* both uterine and tubal pathology, 30 cases of SIN were diagnosed on hysterosalpingography, thus accounting for 2.8% of the whole population and 10% of those with tubal pathology. These findings were correlated with laparoscopy. Subsequent treatment and term pregnancy rate have also been reviewed. **CONCLUSION:** SIN, though uncommon, represents a significant subgroup of patients with potentially treatable tubal pathology, diagnosed by hysterosalpingography in the evaluation of infertility. It is clinically significant and requires positive identification and definitive treatment.

**POSTER 0605**  
**Congenital Müllerian duct abnormalities: incidence and hysterosalpingographic appearances—a pictorial review**

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**PURPOSE:** Uterine malformations, which are the most well recognized of the congenital anomalies of the Müllerian system, are associated with recurrent miscarriages or infertility. The main aim of this study is to determine their incidence during hysterosalpingographic evaluation of infertility. The radiological spectrum is presented. **MATERIALS AND METHODS:** As part of a standard protocol followed at our centre in the evaluation of patients with both primary and secondary infertility, 1056 women were referred for hysterosalpingography. These examinations were performed on an outpatient basis by a single operator. Standard post-procedural advice is given and these cases are being followed up. **RESULTS:** 450 (42.6%) out of the 1056 studies were regarded as normal. Uterine abnormalities alone accounted for 288 (27.3%) of cases. There were 80 (7.6%) cases with both uterine and tubal pathology. The uterine abnormalities included fibroids 199 (54%), polyps 65 (18%), congenital anomalies 54 (15%), Asherman's syndrome 41 (10%) and adenomyosis 9 (3%). The hysterosalpingographic findings of those with congenital anomalies have been correlated with other investigations including ultrasound, laparoscopy and hysteroscopy. The subsequent treatment and term pregnancy rate have also been assessed. **CONCLUSION:** Congenital anomalies of the Müllerian system form an important and interesting subgroup affecting female fertility. Hysterosalpingography still plays a major role in the diagnosis of these conditions and may affect their subsequent management.

**POSTER 0606**  
**Pictorial review: imaging features of endometriosis**

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Endometriosis is characterized by the presence of endometrial tissue in ectopic foci outside the uterus. It may affect up to 10% of women and is a major cause of morbidity. The severity of symptoms is often determined by the site of the disease and the subsequent complications, which include peritoneal implants, endometrial cysts and adhesions. This pictorial review concentrates on the non-invasive imaging techniques useful in the imaging of endometriosis. Diffuse low level echoes in a multiloculated cystic ovarian mass may suggest the diagnosis of endometriosis on a transabdominal or transvaginal ultrasound examination. Multiloculated cysts may also be apparent on CT. Occasionally, bowel contrast studies may delineate areas of peritoneal disease, for example in the rectovaginal septum. Endometriomas exhibit a variable appearance on MRI ranging from hypointense on all pulse sequences to hypointense to intermediate signal corresponding to acute, subacute or chronic haemorrhage. None of these modalities have proved to be sensitive or specific enough to diagnose endometriosis and laparoscopy remains the procedure of choice in the initial diagnosis of the disease, with MRI more frequently being used for staging and monitoring response to treatment.

**POSTER 0607**  
**Policing the peritoneum: pictorial review of transcoelomic, haematogenous and lymphatic spread of metastatic ovarian carcinoma**

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Ovarian carcinoma accounts for 4% of all female cancers and is the fourth most common cause of cancer death in women. It is the most frequent cause of death from gynaecological cancers. There is an

annual increase in the incidence of ovarian cancer of approximately 0.1% and the lifetime risk of developing ovarian cancer has been estimated at 1 in 70. Ovarian cancer spreads by local extension, transcoelomic spread and by the lymphatic and haematogenous routes. It frequently metastasizes to the omentum, undersurface of the diaphragm, the surfaces of the liver, the pouch of Douglas and other sites within the peritoneum. It metastasizes less often to sites such as the adrenal gland, bladder and spleen. This poster illustrates the typical patterns of intraperitoneal spread of ovarian cancer with emphasis on the importance of being aware of the subtle presentations of the disease. Other uncommon sites of metastatic disease will also be illustrated. CT scanning is the mainstay of staging and follow-up of ovarian carcinoma, therefore it is vital that every manifestation of tumour spread is recognized.

**POSTER 0608****Dynamic contrast enhanced MRI in carcinoma of the cervix: correlation with tumour oxygenation, vascularity and angiogenesis**

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**PURPOSE:** To compare dynamic contrast enhanced (DCE) MRI perfusion parameters with cervical tumour oxygenation, vascularity and angiogenesis. **METHOD:** 27 women had staging MRI, and DCE MRI where time/signal intensity curves were generated and the average maximum signal intensity increase over baseline (SI<sub>max-I</sub>) and rate of uptake over time were calculated in 2 regions of interest within the tumour. Tumour oxygen measurements and biopsies were performed at examination under anaesthesia (EUA) in each patient. 9 of these patients had re-assessment immediately after radiotherapy. Tumour vascularity was assessed by measuring intercapillary distance (ICD) and angiogenesis by intratumoral microvessel density (IMD). **RESULTS:** There was significant correlation between SI<sub>max-I</sub> and tumour oxygenation with hypoxic tumours having lower SI<sub>max-I</sub> than well perfused tumours ( $r = -0.48, p = 0.003$ ). There was no correlation between SI<sub>max-I</sub> and ICD ( $r = 0.24, p = 0.39$ ) or IMD ( $r = 0.03, p = 0.88, n = 24$ ). The maximum rate of contrast uptake did not correlate with tumour oxygenation, ICD or IMD. There was a correlation between tumour median oxygen level and tumour volume, and between SI<sub>max-I</sub> and tumour volume. **CONCLUSIONS:** DCE MRI correlates with tumour oxygenation. It enables identification of patients with poorly oxygenated radio-resistant tumours who are at increased risk of early relapse. These patients may benefit from pharmaceutical modification of tumour hypoxia prior to radiation therapy. The technique is non-invasive, readily performed and suitable for most clinical MRI units.

**Head & Neck****POSTER 0701****Normal anatomy and pathology of the parapharyngeal space**

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The parapharyngeal space is a small but important area of anatomy, hidden in the main part from inspection by the clinician. Accurate imaging assessment of this area is of great value in shortening the wide differential diagnosis of pathology, and also for accurate definition of the extent of the present pathologies. We illustrate through CT, MR and digital subtraction angiography (DSA) images the contents, normal anatomy and relationships of this interesting region. We further annotate this anatomy with 15 cases of differing pathology occurring in this small area. These include benign and malignant deep parotid lobe tumours, parotid abscesses, tonsillar tumours and abscesses, tumours of the jugular foramen of neurogenic origin, skull base osseous tumours extending down into this space and squamous cell carcinomas of the head and neck. We emphasize the imaging features that allow differentiation between the pre- and retrostyloid components of the parapharyngeal space and how this is of value in reducing the differential diagnosis. We also demonstrate the extent of these pathologies and their principal routes of spread relevant to potential surgical treatment.

**POSTER 0702****CT and MRI in nasal T/NK cell lymphoma: lethal midline granuloma reclassified**

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**PURPOSE:** This study describes the radiological features of 9 cases with proven nasal T/NK cell lymphoma. **METHODS:** Pre-treatment CT and MR images of 6 men and 3 women (56.5 ± 14 years) with nasal T/NK cell lymphoma were evaluated for site, extent and pattern of spread. A local tumour (T) staging system (T1–T4) was devised. **RESULTS:** Presenting symptoms were nasal obstruction ( $n = 7$ ), nasal or palatal ulceration ( $n = 3$ ), nasal discharge ( $n = 3$ ) and ophthalmoplegia ( $n = 1$ ). T staging was at T3 and T4 for 6 cases. In 3 cases with T1/T2 staging, complete response to treatment was noted. 6 cases had soft tissue masses obliterating the nasal cavity, and which had extended into the paranasal sinuses, alveolar bones, hard palate and soft tissue in 4 cases. 2 cases had superior nasal cavity disease involving the orbit and ethmoid sinus. Bone erosion was present in 7 cases. The medial maxillary wall was commonly eroded ( $n = 6$ ). Extension into the infratemporal fossa, buccinator space, orbits and ethmoid sinus was associated with posterior maxillary wall, alveolar bone, orbital floor and lamina papyracea erosion, respectively. Tumour was isointense to muscle on T<sub>1</sub> weighted imaging and moderately hyperintense with heterogeneous enhancement on T<sub>2</sub> weighted imaging. **CONCLUSION:** Nasal T/NK cell lymphoma is often locally destructive (T stage 3–4), presenting with nasal and maxillary sinus obstruction. Involvement of adjacent alveolar bone, hard palate, orbits and nasopharynx is common and associated with extensive soft tissue masses. The presence of bone erosion is suggestive but not diagnostic of the disease. Both MRI and CT are complimentary modalities in the local staging of this disease. Advanced T-staging appears to confer a poorer prognosis.

**POSTER 0703****X-ray for swallowed fish bone—should we know the type of fish?**

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Fish bone as a foreign body in the upper aerodigestive tract is a commonly encountered emergency in the otolaryngology practice. The detectability of fish bones by standard radiography depends on the type of the fish ingested. Hence information regarding the ingested fish would help to improve the diagnostic value of lateral soft tissue neck radiographs. However, a survey conducted among the doctors working in otolaryngology departments in England and Wales showed that the majority do not enquire regarding the nature of the ingested fish or are aware of its significance while evaluating neck radiographs of such patients. In this study, radio-opacity of the bones (ribs and spines) of the 15 commonly used species of fishes in the UK are compared with each other and to a chicken bone which is kept as a control. This is done by performing plain radiographs of these fish bones which are arranged in groups. According to the degree of radio-opacity of these bones, they are divided into 3 groups *i.e.* highly radio-opaque, moderately radio-opaque and minimally radio-opaque. A guideline is developed to display in the ENT and Casualty departments to help junior doctors in interpreting neck radiographs of patients presenting with fish bone as a foreign body.

**Hepatobiliary****POSTER 0801****Imaging of primary non-Hodgkin's lymphoma of the liver**

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Primary hepatic lymphoma is a rare entity, presenting usually as a localized liver mass. The aim of this study is to present the radiological findings in primary liver lymphoma. We retrospectively reviewed the imaging findings in 6 patients (age 33–71 years, mean 55 years) with biopsy-proven primary liver lymphoma. All patients had presented with hepatobiliary disease without peripheral adenopathy. Imaging prior to diagnosis included ultrasonography (6), CT (6) and MRI (2). Imaging appearances were of either single or multiple

liver lesions simulating liver metastases. This exhibit will demonstrate the spectrum of findings on various imaging modalities in primary hepatic lymphoma. Emphasis will be placed on correlating features on different imaging modalities. Appearances during and after aggressive chemotherapy will also be shown. Our main aim is to emphasize that although primary hepatic lymphoma is a rare condition, it should always be considered in the differential diagnosis of liver metastases without a clinically or radiologically apparent primary tumour.

**POSTER 0802****The role of imaging in pre-eclamptic liver disease**

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Pre-eclampsia is a multisystem disorder complicating 5–10% of pregnancies in the second half of gestation. In addition to hypertension and proteinuria, a small proportion of patients also develop serious liver complications. The severity and extent of liver damage varies greatly and 2 conditions are well recognized within the spectrum; HELLP syndrome, associated with haemolysis, elevated liver enzymes and low platelets and acute fatty liver of pregnancy (AFLP). The clinical and radiological findings are not specific. Symptoms vary from mild right upper quadrant pain to fulminant liver failure and encephalopathy. Imaging findings include haemorrhage, infarction or even rupture. Liver biochemistry is also deranged. Differentiation of these 2 conditions is important with regard to treatment. Both conditions have significant associated mortality and require prompt delivery in the first instance. Post-delivery, however, the liver disease in HELLP syndrome may resolve completely in contrast to AFLP which may require liver transplant. We present 2 cases of HELLP syndrome with the imaging findings on ultrasound, CT and MR. We also illustrate an assessment algorithm incorporating the clinical picture, liver biochemistry and imaging findings to aid in the differentiation of these 2 serious conditions in pregnancy.

**POSTER 0803****Liver metastases which aren't: the importance of biopsy**

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A variety of disorders that mimic the ultrasound appearances of liver metastases are presented. These include leukaemia, lymphoma, myeloma, hyper eosinophilic syndrome and fungal and bacterial infections. All these cases were initially considered to be metastases on imaging grounds, and the true diagnoses were only made following biopsy. In all these cases treatment was available, and in most the prognosis was considerably better than that of metastases. It is essential that tissue is obtained before the decision is made that a patient would not benefit from further treatment.

**POSTER 0804****Delayed MRI of hepatocellular carcinoma with gadobenate dimeglumine: correlation with histopathological findings**<sup>1</sup>L Grazioli, <sup>2</sup>G Morana, <sup>3</sup>M A Kirchin, <sup>3</sup>G Pirovano and <sup>3</sup>A Spinazzi<sup>1</sup>Department of Radiology, Spedali Civili, 25100 Brescia,<sup>2</sup>Policlinico Borgo Roma, 37134 Verona and <sup>3</sup>Bracco Spa, 20134 Milan, Italy

**PURPOSE:** To correlate qualitative and quantitative findings of delayed gadobenate dimeglumine (Gd-BOPTA)-enhanced MRI of hepatocellular carcinoma (HCC) with histopathological findings. **MATERIALS AND METHODS:** 34 patients with histologically-confirmed HCC were imaged at 1.5 T with T1wSE, T1wGE and T<sub>2</sub> weighted sequences before and 60 min after the administration of 0.1 mmol kg<sup>-1</sup> Gd-BOPTA. All but 2 patients had liver cirrhosis. Qualitative blinded assessment of images was performed by 2 experienced radiologists. Quantitative analysis of liver-lesion contrast-to-noise ratio (CNR) and lesion enhancement was performed using standard region of interest methodology. Histopathological assessment comprised the degree of cellular differentiation, presence of fatty metaplasia, necrosis, bile contents and intratumoral peliosis. **RESULTS:** Moderately differentiated HCCs enhanced to a significantly ( $p=0.04$ ) greater extent than poorly differentiated HCCs and at the limits of statistical significance ( $p=0.07$ ) when compared with well differentiated HCCs. Lesion conspicuity improved in 12/34 (35.3%) patients post-dose, while an increased CNR was recorded in 23/34 (67.6%) patients. In 6/34 patients conspicuity worsened with a concomitant CNR reduction. The loss of liver-lesion CNR correlated with a higher degree of fatty metaplasia compared to other lesions. **CONCLUSIONS:** Gd-BOPTA enhancement of HCC

correlates with cellular differentiation. Worsening of MR conspicuity may occur in well differentiated HCCs with significant amounts of intralesional fatty metaplasia.

**POSTER 0805****Low dose gadobenate dimeglumine in MRI of focal liver lesions**

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**PURPOSE:** To assess the value of low dose (0.05 mmol kg<sup>-1</sup>) gadobenate dimeglumine (Gd-BOPTA) in MRI of focal liver lesions (FLLs). **METHODS AND MATERIALS:** Detection: 86 patients (177 FLLs) underwent T2w, T1wSE and T1wGE imaging before and 40–120 min after injection of 0.05 mmol kg<sup>-1</sup> Gd-BOPTA. Pre-dose and delayed post-dose scans were evaluated by 3 blinded readers for FLL number, size and location. Data were recorded on liver maps for lesion-by-lesion matching with intraoperative ultrasound or CTAP findings. Characterization: 86 patients (107 FLLs) underwent T2w, T1wSE and T1wGE imaging pre-dose. T1wGE scans were repeated 30–45 s, 70–90 s, 2–4 min and 5–8 min after bolus 0.05 mmol kg<sup>-1</sup> Gd-BOPTA injection. Pre-dose and dynamic images were read by 2 blinded readers. MRI diagnoses (benign/malignant, specific histotype) were matched against histology on a lesion-by-lesion basis. **RESULTS:** Delayed post-dose imaging significantly increased the accuracy for FLL detection (13%;  $p<0.005$ ). The increase was consistent across readers and T1w scanning sequences. Characterization: The accuracy in differentiating benign/malignant FLLs was 78% pre-dose and 91% on combined pre-dose and dynamic images ( $p<0.02$ ). The accuracy in histotype diagnosis was 55% pre-dose and 73% on combined pre-dose plus dynamic images ( $p<0.05$ ). **CONCLUSIONS:** 0.05 mmol kg<sup>-1</sup> Gd-BOPTA coupled with delayed or dynamic MRI is effective for detecting and characterizing FLLs.

**POSTER 0806****TIPSS: audit and analysis of 50 procedures**<sup>1</sup>A Anbarasu, <sup>1</sup>H Godfrey, <sup>1</sup>P Rowlands, <sup>2</sup>H Smart and <sup>2</sup>S Kadis  
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In our department a total of 50 transjugular intrahepatic portosystemic shunts (TIPSS) attempted in 49 patients in the past 6 years. 39 were done as an emergency procedure. Variceal bleeding is the most common indication and warranted the procedure in 45 patients. All patients were assessed on the basis of Child's criteria—19 in Child's C Group, 24 in Child's B Group and rest in Child's A. The procedure was technically successful in 46 attempts (92%). Wall stent was most commonly used (in 43 patients). In the follow-up period, 21 patients died due to various causes (Child A, 1; B, 10; C, 10). All Child C Group patients died within 48–72 h following TIPSS. It may be inappropriate to do TIPSS in this group as the outcome is poor due to the severity of disease and multisystem failure. The cumulative data of the above along with those of shunt patency and reintervention will be presented.

## Multisystem

**POSTER 0901****Hollow organ pathology within the abdomen: diagnosis by ultrasound**E Twomey, M M Maher, D O'Connell and M Behan  
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Ultrasound is not widely accepted as a valuable imaging modality in the diagnosis and evaluation of hollow organ pathology within the abdomen. The aim of this study is to present a pictorial review of a spectrum of hollow organ pathologies diagnosed by ultrasound examination. The majority of these cases were encountered during a 6 month period from December 1998 to April 1999. The main focus of this exhibit will concentrate on imaging features of hollow organ pathology seen on conventional transabdominal ultrasonography. The sonographic features of a spectrum of hollow organ pathologies within the abdomen will be displayed including stomach, duodenum, small and large bowel, appendix, gallbladder and biliary tree, ureters and urinary bladder. Particular emphasis will be placed on correlation of sonographic findings with features seen on imaging modalities which have more established roles in the imaging of hollow organ pathology such as barium studies, endoluminal ultrasound, endoscopy, CT and MRI.

**POSTER 0902****Imaging features of von Hippel–Lindau disease: pictorial review**

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Von Hippel–Lindau (VHL) disease is an autosomal dominant condition characterized by multiple tumours arising from the central nervous system and the abdominal organs. These include cerebellar haemangioblastoma, retinal angioma, and renal and pancreatic tumours. Lesions in the abdomen particularly may develop as benign cysts and then undergo a multitude of complications including haemorrhage and malignant transformation. The age at onset and the severity of the disease may vary, however there is a significant morbidity and mortality associated with disease progression and, therefore, family screening and follow-up of patients with VHL disease is desirable for early detection and treatment. This pictorial review aims to depict some of the imaging manifestations of VHL disease and their complications.

**POSTER 0903****Phakomatoses—a pictorial review of the radiological findings**

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Phakomatoses are a group of neuroectodermal disorders characterized by coexistent skin and central nervous system tumours. The more commonly recognized phakomatoses include neurofibromatosis, tuberous sclerosis, von Hippel–Lindau disease and Sturge–Weber. The radiological features vary, some with characteristic findings such as cortical calcification in Sturge–Weber. Other disorders in the group have manifestations which can be found in isolation but when multiple or bilateral are highly suggestive of an underlying phakomatosis. Examples include acoustic neuromas in neurofibromatosis Type 2 and renal cell carcinoma in von Hippel–Lindau disease. Imaging, most commonly with CT and MR, plays an important role in diagnosis and assessment of disease extent. Many of these conditions have an autosomal dominant pattern of inheritance and radiology is also employed in the screening of family members. We present a pictorial review of the imaging features of the varied manifestations in this group of disorders.

**POSTER 0904****Can muscular mass and subcutaneous fat thickness estimated by ultrasonography be used as nutritional factor in patients with severe brain injuries?**

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**INTRODUCTION:** Calculation and monitoring of the nutritional status of hospitalized patients is essential. Concerning patients with severe brain injuries, undernutrition is frequently reported. Measurement of subcutaneous fat thickness provides an index of total fat, while measurement of skeletal muscle provides an indicator of the severity of protein energy malnutrition. **PURPOSE:** The aim of our study is to investigate whether ultrasonography can be used as an alternative method to estimate the nutritional status duration of patients with severe brain injuries. **METHOD:** In our double clinical study, 20 patients with severe brain injuries were evaluated. Our patients were on enteral or parenteral nutrition with 30 kcal kg<sup>-1</sup> day<sup>-1</sup> intake and 1g kg<sup>-1</sup> day<sup>-1</sup> protein intake. The mean duration of hospitalization was 21 ± 5 days. Patients with either renal or liver insufficiency were excluded. Creatine-phosphokinase (CPK), aldolase (Ald) and albumin (Alb) levels were measured twice from the blood of each patient admission and exit time from the intensive care unit. Biceps brachialis and subcutaneous fat thickness were estimated by the same ultrasonographer in all cases. A 10 MHz frequency linear high resolution transducer was oriented longitudinally to the biceps brachialis muscle in the plane of maximum thickness. **RESULTS:** All values are expressed as mean ± standard deviation on admission and exit from the intensive care unit. Blood results: CPK (U/L) 350 ± 95–550 ± 65 ( $p < 0.001$ ), Ald (U/L) 10 ± 1.5–11 ± 1.4 ( $p$ , ns), Alb (g/L) 33 ± 1.6–32 ± 1.2 ( $p$ , ns). Muscular mass thickness (cm) measurement results: 2.76 ± 0.5–2.01 ± 0.6 ( $p < 0.001$ ); subcutaneous fat thickness (cm) measurement results: 0.33 ± 0.2–0.27 ± 0.3 ( $p$ , ns). **CONCLUSION:** Since nutritional status can be estimated only approximately by measurement of a variety of parameters, with our study we propose ultrasonographic quantitative measurement of muscular mass and subcutaneous fat thickness as a direct indicator of nutrition. We believe that our ultrasonographic method can

improve the assessment of critically ill patients. However, for application of this method in everyday clinical practice, larger populations must be studied.

**POSTER 0905****MRI quantification of adipose tissue distribution in obese patients**<sup>1</sup>A K Banerjee, <sup>2</sup>A Anwar, <sup>1</sup>R Puni, <sup>2</sup>A H Barnett and <sup>2</sup>S Kumar  
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**INTRODUCTION:** Intraabdominal fat has particularly deleterious consequences to health owing to its association with diabetes, lipid disorders and heart disease. In this study, MRI was used to study patterns of fat deposition in patients and correlated with anthropometric and metabolic variables. **METHOD:** 24 patients (18 males, 6 females) were divided into 3 groups based on their body mass index (BMI) (Group A ( $n = 3$ ), BMI < 25 kg m<sup>-2</sup>; Group B ( $n = 9$ ), BMI 25–30 kg m<sup>-2</sup>; and Group C ( $n = 12$ ), BMI > 30 kg m<sup>-2</sup>). The total (TAT), visceral (VAT) and subcutaneous (SCT) fat were measured on a 1 T Philips gyrosan using a body coil and segmentation software program after a range of anthropometric and metabolic assessments had been made on the patients. **RESULTS:** Mean intraabdominal fat measurements increased to a greater extent than extraabdominal, resulting in an increase in the VAT:SCT ratio (Group A 0.46, Group B 0.800, Group C 0.925). Simple waist measurements were most significantly correlated with MRI measurements of intraabdominal fat ( $p < 0.006$ ) although it also correlated with whole body fat measurements ( $p < 0.001$ ). Strong correlation was also found between urinary markers of glucocorticoid metabolism (THF + 5aTHF)/THE and extraabdominal fat. **CONCLUSION:** Our preliminary results show that MRI provides a simple and accurate means of assessing body fat. MRI measurements of body fat have significant correlations with metabolic aberrations. With increasing obesity, fat is redirected to the intra-abdominal depot preferentially as reflected by the VAT:SCT ratio, which may explain increased disease with increasing obesity. This cannot be assessed by current anthropometric means. MRI therefore provides an important and safe tool in the study of obesity and obesity-related disease.

## Management

**POSTER 1001****Domiciliary radiography: a disappearing service?**

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In a time of primary care-led health services, both past and current availability of domiciliary radiography was assessed by means of a postal questionnaire sent to clinical directors of radiology. 3 groups of departments were identified. Those currently providing a domiciliary radiography service to local general practitioners, those previously offering a service which had ceased, and those which had never offered the service. Comparison of these groups by hospital size and location, departmental staffing and availability of open access plain film services revealed no marked differences. In the group currently offering domiciliary radiography, the process of providing the service was identified. In the other 2 groups, radiologists' attitudes to providing a domiciliary radiography service were assessed. There is a trend of both decreasing frequency of examination and service availability due to several factors, of which lack of interest by radiologists was the most frequently cited. The rate of decline is such, however, that domiciliary radiography will continue to be available in many areas of the UK for many years to come.

**POSTER 1002****Stumbling blocks to research**

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Research is interesting, enlightening, satisfying and hard work. It is occasionally tedious! It can also be frustrating, especially if collaboration between departments is required to set up a study. **PURPOSE:** To highlight the problems encountered when attempting to perform a research project—from concept to final draft. To suggest solutions to the problems. **METHODS:** We will use a recent interdepartmental research project as an example to illustrate the potential problems and pitfalls. The example is an ongoing prospective study undertaken jointly by the radiology, orthopaedic and accident and emergency departments. The aim of

the study is to investigate accidental injury in under 2 year olds, specifically, duration of pain, swelling and bruising. The findings from this study of accidental injury will be compared to published data on non-accidental injury. The success of the study depends on close collaboration between departments involved. Co-operation and communication is required at all levels, i.e. clerical, medical, administrative and nursing. Our poster will illustrate the process required and the difficulties encountered in reaching the starting line.

## Musculoskeletal

### POSTER 1101

#### MRI of congenital spinal deformity—a pictorial review

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**PURPOSE:** Patients with congenital scoliosis should undergo MRI because of the higher incidence of concomitant neurogenic abnormality. The purpose of our study is to present the radiological spectrum of spinal lesions encountered during MR evaluation of congenital spinal deformity. **MATERIALS AND METHODS:** A retrospective evaluation of the MR findings in patients presenting with congenital spinal deformity was performed at one of Europe's leading spine centres. The whole spine has been imaged in all patients with a combination of sagittal, coronal and axial T<sub>1</sub> and T<sub>2</sub> weighted fast spin echo sequences. **RESULTS:** A whole spectrum of abnormalities has been encountered including segmentation anomalies and spinal dysraphism. The imaging features are presented. **CONCLUSION:** MRI is the investigation of choice in the evaluation of congenital spinal deformity. The goals of complete spinal imaging include identification of correctable causes of scoliosis and the evaluation of conditions that should be treated prior to surgical correction of the curve itself.

### POSTER 1102

#### Transitional lumbosacral vertebrae: pitfalls and solutions

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Transitional lumbosacral vertebrae (TLVs) occur in 4–8% of the population and can be easily recognized on plain radiographs. In our institution there is a trend towards investigating patients with low back symptoms using MRI as the primary imaging modality, and without plain radiographs. Transitional spines may be missed on MRI, and this can/does lead to a mismatch in the assignment of vertebral levels. Consequently, operations and interventional procedures performed under fluoroscopic guidance on the spine may be performed at the wrong level. The purpose of this exhibit is to illustrate discrepancies between MR and plain films when imaging TLVs. We will highlight the classification and differing pattern of disc disease in patients with TLV as compared with the normal population. In our institution we advocate that all patients have their plain films and MRI scans correlated formally prior to any surgical or percutaneous interventional procedure on the spine to avoid these errors.

### POSTER 1103

#### Radiologically-guided biopsy of spinal lesions

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**PURPOSE:** To assess the outcome of spinal biopsies performed under radiological guidance with appraisal of biopsy results. **METHODS:** A retrospective study was carried out of image-guided biopsies performed for lesions of the spine at a tertiary referral centre. Between January 1994 and October 1999, 84 patients (51 male and 33 female), age range 7–86 years (average 46.8 years), underwent spinal biopsy by a single operator, under some form of image guidance. A total of 89 procedures was performed, some being repeated for reasons including insufficient material and inadequate response to therapy. **RESULTS:** Of 89 biopsies, 4 were normal. Of the 43 neoplastic lesions, there were 25 primary and 18 secondary lesions. There were 10 non-tumorous lesions like Langerhans' cell histiocytosis and 27 with infection including discitis. There were 5 non-diagnostic samples. **CONCLUSION:** Image guidance, when used judiciously and in experienced hands, results in a high yield for spinal biopsy.

### POSTER 1104

#### Reverse angle CT evaluation of lumbar spondylolysis

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**PURPOSE:** To assess the role of reverse angle CT in the evaluation of spondylolysis. **METHODS AND RESULTS:** Radiology of 22 patients (18 male and 5 female) at a District General Hospital was reviewed. Reverse angle CT examinations had been performed on 25 occasions with 14 of the studies revealing significant abnormality in the pars interarticularis, bilateral in 8 and unilateral in 6 cases. MR correlation was available in 1 patient with pars defect and further investigation was indicated in another. **CONCLUSION:** Reverse angle CT is a relatively short examination in assessing or confirming pars defects. Despite the radiation involved, it may be recommended in the investigation of suspected lumbar spondylolysis.

### POSTER 1105

#### The use of trauma oblique projections in imaging of the cervicothoracic spine

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**PURPOSE:** Imaging of the cervicothoracic junction in trauma is often difficult and presents the potential for further injury due to patient positioning. This study aimed to assess the value of supine trauma oblique cervical spine radiographs against the conventional "swimmers" or shoulder distraction laterals. **METHODS:** Over a 3 month period the radiology department at Glan Clwyd DGH NHS Trust adopted a "new" technique for the visualization of the cervicothoracic junction if it was not adequately demonstrated on the usual lateral projection. The radiology and the accident and emergency departments assessed the resultant images. The clarity of the alignment of the vertebral bodies plus the benefits to the patient and the trauma team were the main considerations. **RESULTS:** To date, over 30 radiographs of varying standards of image quality have been taken. Initially, there was a little confusion over positioning, the optimum exposure factors and the correct assessment of the radiographs. However, once these problems were rectified it was found that the oblique projections provided excellent visualization of the junction with additional information to that provided by the conventional lateral, swimmers or shoulder distraction laterals. The radiographers found the technique to be simple but effective and, most importantly, it involved no patient movement in the trauma situation. **CONCLUSION:** The use of supine cervical spine obliques is proven to be a simple method for visualizing the cervicothoracic junction in the trauma situation. With the latest advanced trauma life support protocols expected to endorse their use, these may become mandatory rather than optional projections.

### POSTER 1106

#### An alternative technique for visualization of the C7/T1 area in trauma

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The C7/T1 junction is an area whose demonstration is required in all cases of trauma to the cervical area. This area is often difficult to demonstrate, particularly in larger than average individuals such as the authors. The difficulty is in safely moving the shoulders in such a way as to clear the projection of the humerus and surrounding soft tissues from the area of interest. In this poster we show photographically the suggested methods of positioning and pulling, demonstrating the movement of the required structures. We present radiographs pre- and post-manoeuvre to show its effectiveness. We discuss the success and failure rate of the manoeuvre to date.

### POSTER 1107

#### The rheumatoid cervical spine—what to look for, when to worry

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The cervical spine is frequently affected in rheumatoid patients, second only to the metatarsophalangeal joints. Instability of the cervical spine occurs in up to 80% of patients and 10% of



rheumatoid patients die from cord compression, often unrecognized prior to death. 61% of rheumatoid patients undergoing total hip or knee arthroplasty have radiographic evidence of cervical instability. The most sinister form of instability in rheumatoid arthritis is atlanto-axial impaction (basilar invagination). The bony landmarks required for evaluating this are often poorly shown on radiographs due to osteoporosis and erosion of the odontoid etc. Our pictorial essay will review the assessment of the rheumatoid cervical spine. Recently described radiological predictors of paralysis and criteria for surgical referral will be highlighted. Newer methods of assessing atlanto-axial impaction (basilar invagination) which can be employed even if the odontoid is eroded or difficult to see will be illustrated (Ranawat and Redlund-Johnell techniques).

**POSTER 1108****Neurogenic claudication: a review of the MRI requests from vascular surgeons, and imaging features**

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**PURPOSE:** University Hospital Aintree is a large acute hospital on the north side of Liverpool. With increasing demand on overall imaging services, various users of the MRI service have been audited to assess its role. The vascular surgical directorate has shown to be a steady but small user of MRI for the diagnosis of neurogenic claudication. **METHODS:** A retrospective study was performed during a 24 month period of all lumbar spine requests from this group. Case notes were reviewed in 64% of all patients investigated. A grading system was used with points for typical history, neurological and vascular examination and examination after exercise. **RESULTS:** Of all patients reviewed only 23% were positive for spinal stenosis on MRI criteria. **CONCLUSION:** We discuss the use of a grading system which may increase the specificity of the use of MRI in the diagnosis of neurogenic claudication. The MRI features of this condition are also reviewed.

**POSTER 1109****MRI of the cervical spine: frequency of degenerative changes related to age**

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**PURPOSE:** Degenerative changes within intervertebral discs affect 70% of people over 70 years of age. The most commonly involved site is the intervertebral disc at the C5-C6 level followed by the C6-C7 level. The C2-C3 level is the least often affected. We wished to assess whether this is true for all age groups. **METHODS:** We retrospectively reviewed  $T_2$  weighted sagittal spin echo images of 42 symptomatic patients. Loss of intervertebral disc signal was considered evidence of disc disease. Patients ranged from 20 to 76 years of age. **RESULTS:** All but 3 patients (7%) showed decreased signal in one or more disc. In the age group 20-49, C3-C4 was the most frequently affected intervertebral disc whilst in the 50-79 age group was at the C5-C6 level. The C2-C3 intervertebral disc showed decreased signal in 31/42 patients (74%). Overall, the most frequently affected disc was C3-C4 followed by C2-C3, C5-C6, C4-C5, C6-C7 and least frequently C7-T1. **CONCLUSION:** Findings in patients over 50 are in agreement with previous studies. However, in younger patients the C3-C4 disc is most commonly affected. The prevalence of degenerative change at the C2-C3 level is higher than expected.

**POSTER 1110****MRI of sternum: a pictorial review**

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The sternum and sternoclavicular joints (SCJs) are difficult to evaluate with plain radiographs. The role of CT in assessing lesions of the sternum and SCJs has been well documented. The potential role of MRI of the sternum has not been emphasized. MR due to its multiplanar capability, good contrast and spatial resolution is ideally suited to image the sternum and SCJs. We will present a pictorial review of a breath-hold MR technique in evaluating the sternum and SCJs. The MR technique consists of a breath-hold  $T_1$ ,  $T_2$  and inversion recovery Haste sequences in the axial, sagittal and coronal planes. The review will demonstrate the normal appearances of the sternum and SCJs. We will also demonstrate a spectrum of abnormalities of the chest including pectus excavatum and Poland's syndrome; sternal infections, pyogenic and tubercular; sternal and chest wall tumours and degenerative changes of the SCJs. We propose to present the technique, normal appearances and a variety of sternal pathology and emphasize that breath-hold MR is ideally suited to image the sternum and SCJs.

**POSTER 1111****Pelvic bone tumours—duration and nature of symptoms before investigation**<sup>1</sup>D B Finlay, <sup>2</sup>D Hajioff, <sup>1</sup>F L Dickinson and <sup>2</sup>W M Harper  
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**INTRODUCTION:** Primary musculoskeletal tumours are rare (20 per million annually). The pelvic bones are not uncommonly involved (5-25% of such tumours). Royal College of Radiology guidelines state that radiography is not routinely indicated in hip pain. It was our impression that patients with pelvic bone tumours presented only after many months of non-specific symptoms. We sought to quantify this and determine what factors may contribute to delay in diagnosis. In particular we reviewed the indications for imaging. **METHODS:** We analysed the notes and investigations of 12 patients presenting with pelvic bone neoplasms over 6 years. Particular attention was paid to the duration and nature of symptoms prior to diagnosis and any factors that may have delayed diagnosis. **RESULTS:** Most had mechanical (5), non-specific (4) or bony (3) hip pain for around a year before the first radiograph irrespective of age or grade of malignancy (median 12 months; range 5-48). Most of these delays occurred despite early medical consultation. **CONCLUSION:** The diagnosis of a tumour should be considered in a patient with persistent hip or pelvic pain. Tumour pain often mimics degenerative disease. 5-25% of musculoskeletal tumours occur in the pelvis. We present an argument for altering guidelines for imaging to include any hip pain persisting beyond 6 weeks whether it is bony or mechanical.

**POSTER 1112****Comparison of "Medic" and FLASH  $T_2^*$  weighted sequences in MR of the knee**

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**PURPOSE:** To compare a recently introduced  $T_2^*$  sequence, the "Medic" sequence, with the FLASH sequence on a Siemens IT Impact Expert, with reference to knee examinations. **METHOD:** Sagittal  $T_2^*$  sequences using both "Medic" and FLASH were obtained in 63 successive patients (64 examinations) undergoing MR of the knee. The quality of demonstration of the major internal structures of the knee was scored for each sequence by 2 experienced radiologists. The results were then compared. **RESULTS:** The "Medic" sequence was superior in demonstrating the PCI and articular cartilage, but was inferior in demonstrating subchondral bony abnormalities. There was a small time penalty (approximately 30 s per sequence) when using the "Medic" sequence. No significant difference was identified between the 2 sequences in demonstration of other structures of the knee. **CONCLUSION:** The "Medic" sequence is equivalent or superior to the FLASH sequence in all areas of knee MR, with the exception of subchondral changes, but all gradient echo sequences have limitations in this area due to susceptibility artefact. We believe the "Medic" sequence should replace the FLASH sequence for routine knee MR.

**POSTER 1113****MRI analysis of the flexor hallucis brevis muscle**<sup>1</sup>R L Ashford, <sup>1</sup>J P Cassella, <sup>1</sup>S McNamara and <sup>2</sup>P J Turner  
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**INTRODUCTION:** To understand the underlying mechanisms of foot pathologies, a knowledge of the anatomy and physiology of the foot is necessary. A study of the flexor hallucis brevis (FHB) muscle, and intrinsic foot muscle in the third layer of the foot, was undertaken. The intrinsic muscles of the foot have not been extensively studied; studies that have been undertaken tend to focus on the electromyographic activity. There are no data about muscle fibre types, length, width or volume measurements of these intrinsic muscles. **METHOD:** MRI scans of the right foot of 10 females (age 20-25 years) with size 5 feet were performed. Images were obtained in the coronal and sagittal oblique planes. The MRI scanner used was the 0.2 T Esaote autoscan unit dedicated extremity scanner. The standard surface coil was used with ankle/foot support attached. The muscle could be visualized in its optimum position on a plane of 20° obliquely from the lateral border of the foot. **RESULTS:** The FHB muscle bifurcates laterally and medially at its insertion of the proximal phalanx of the great toe. Lateral length of FHB muscle: 94.84 ± 2.77 mm. Medial length of FHB muscle: 100.56 ± 2.79 mm. From the MRI measurements of 8 lateral and 8 medial measurements per subject, the data were statistically



analysed. No significant difference was determined between the values for each medial and lateral FHB muscle length within the shoe size studied. **DISCUSSION:** This is the first time *in vivo* foot muscle measurements have been reported. Previously, data have been obtained from cadaveric tissue, which has significant shrinkage due to post-mortem changes. Dysfunction of the FHB muscle is implicated in a number of podiatric pathologies, such as hallux valgus. A better understanding of this muscle will have major implications for foot surgery and palliative foot treatment regimes.

**POSTER 1114****Evaluation of CT scanography as a simple and reliable low dose technique**

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**PURPOSE:** Many radiology departments perform conventional film/screen radiography to assess leg lengths and angles prior to prosthetic surgery. CT scanography is an alternative technique which can provide similar or superior image quality easily and more reliably. To compare techniques, a full body phantom loaded with thermoluminescent dosimeters was used to simulate a patient. **MATERIALS AND METHODS:** The phantom was radiographed at typical patient factors (85 kV, 80 mAs, 200 cm focus-to-skin distance), and was also scanned using 100 kV, 50 mA and 500 cm scan length. Using this model, we were able to calculate and compare effective doses for the 2 techniques. **RESULTS:** In male patients, CT gave effective doses approximately 10 times lower than those for plain radiography; in female patients, 15 times lower. The reduction is due principally to the higher tube potential, higher beam filtration and posteroanterior projection used in CT scanograms. **DISCUSSION:** Under the 1997 Medical Exposures Directive (97/43/EURATOM), diagnostic reference levels (DRLs) should be established for "medical radiodiagnostic practices" in "groups of standard-sized patients" using "broadly defined types of equipment". CT scanners and plain radiography units clearly form distinct types of equipment on which leg lengths can be measured. Given the large apparent dose differences between the 2 techniques, we would recommend that individual departments should determine DRLs for each technique and, where possible, should recommend CT as the lower dose method.

**POSTER 1115****Errors of bone densitometry of the hip in patients with paraplegia**

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**PURPOSE:** To determine the nature of errors resulting from (a) operator-dependent data analysis and (b) patient condition (heterotopic ossification) when measuring bone mineral density in the hip in paraplegic patients from spinal cord injury (SCI) using dual energy X-ray absorptiometry (DXA). **MATERIALS AND METHODS:** The study included 128 hips in SCI patients (age range 20–68, mean age, 39.5, length of injury 6 months to 26 years) performed by 2 technicians using standard DXA techniques and software. Each analysis was reviewed by a radiologist and errors were recorded. Hips with previous surgery and patients with spasticity were excluded from the study. **RESULTS:** There were only 2 (1.5%) hip analysis operator errors (misplacement and incorrect sizing of analysis region), which were easily corrected by a radiologist. On the other hand, there were substantially more errors (13; 10.1%) from false bone densitometry measurements. This was a result of overlying heterotopic ossification of the hip in the region of interest, which resulted in misdiagnosis of osteoporosis. **CONCLUSION:** Operator analysis errors were rare and easily corrected. Errors caused by heterotopic ossification were more common and require a DXA in another region of the lower limb or another method.

**POSTER 1116****Computed radiography: the optimal modality for detecting soft tissue foreign bodies?**

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**PURPOSE:** To evaluate and compare the detection of various soft-tissue foreign bodies (FB) using conventional radiography and computed radiography (CR) on printed film and on a computer workstation. **METHOD:** Foreign bodies of different size, shape and

composition (wood, plastic, metal and glass) were individually inserted into 10 half chicken portions. 1 specimen was left without an FB and all specimens had skin surface markers to indicate the skin puncture site. The 11 specimens were imaged using constant radiographic factors by both radiographic methods producing 33 images. CR images were printed on film (hard copy) and displayed on a workstation (soft copy). 10 experienced radiologists were asked to examine the images in turn for the presence or absence of an FB. Image manipulation of the CR soft copy was allowed. The radiologist was then asked of the 3 modalities, on which modality was the FB best visualized. **RESULTS:** Metal and glass were universally seen on all modalities; however, wood was not identified on any modality. The absence of a foreign body was correctly identified in all cases. Analysis of variance proved a statistically significant difference ( $p=0.023$ ) in FB detection between the imaging modalities. Radiologists felt CR improved their detection of foreign bodies particularly when these were small or plastic. **CONCLUSIONS:** FB detection by CR is superior to conventional radiography, especially when image manipulation is used.

## Neuroradiology

**POSTER 1201****Imaging the skull base**

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The skull base is a complex anatomical area with many perforations carrying vessels and nerves. Surgical skills have developed considerably over the last decade, with collaboration between neurosurgeons and craniofacial cancer surgeons allowing potential surgical cures for lesions previously considered as inoperable. This has placed increased demands on imaging of this complex area. Through plain films, CT, MRI and digital subtraction angiography (DSA) we illustrate the important aspects of skull base anatomy that are particularly relevant to the skull base surgeon. Pathology of the skull base is wide and varied, with an equally wide range of clinical presentations. We present pathological cases using a combination of classification based on position within the skull base in relation to the main 3 cranial fossae, as well as a classification based more on the site of origin of pathology in relation to the skull base itself, either originally from above the skull base, the skull base itself or from below the skull base. We apply this classification to over 15 illustrative cases including congenital anomalies, vascular lesions and chronic inflammatory disorders of the sinuses, infective lesions and tumours including chordoma, glomus tumours, metastases and tumours arising from the paranasal sinuses.

**POSTER 1202****Normal MR variations and variants of the pituitary gland**

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MRI is now the modality of choice in imaging the pituitary gland. The appearance of the normal pituitary gland varies with age, sex and hormonal states. Furthermore, there are normal variants of the pituitary gland which may cause diagnostic errors in the reading of pituitary MR images. In our institution, we have accumulated various normal variants of the pituitary gland and their appearance on MRI. Included among these are appearances of a double hypophysitis, double pituitary stalk, infundibular tilt, empty sella and pituitary cysts. The normal variations of the pituitary with age (infancy and adolescence), sex and pregnancy are also reviewed on MR. To the best of our knowledge, there have been no previous reviews of the MR appearances of the pituitary and its normal variants.

**POSTER 1203****Pituitary apoplexy: a pictorial review**

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Pituitary apoplexy is an uncommon but occasionally serious medical condition, which may pose threats to life and sight. One should be aware that the condition could closely mimic both subarachnoid haemorrhage and meningitis, 2 common indications for imaging. It is often not considered as part of the differential diagnosis and therefore may be missed. Disparity between the clinical features and imaging appearances should prompt a request for review of the images by neuroradiologists. Recently, 3 cases of pituitary apoplexy have been referred to the University Hospital of Wales. In all there was a delay in diagnosis, which unfortunately resulted in permanent visual loss in 1 patient. We present these cases to highlight this uncommon clinical entity and to illustrate the imaging findings.

**POSTER 1204****The use of STIR sequence in MRI in the management of disease activity in thyroid eye disease**

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Thyroid eye disease occurs in 2–7% of patients with Grave's disease. In its severest form this can lead to sight-threatening compressive neuropathy. 80 patients with thyroid eye disease between 1992 and 1999 have been assessed using MRI with particular interest in the short tau inversion recovery (STIR) sequence. In 18 cases, follow-up scans have been obtained. The signal intensity ratio (SIR) of the most inflamed extraocular muscle was obtained by comparison of that muscle (by pixel analysis) with the adjacent temporalis muscle. The SIR was then compared with the disease activity as measured by the Mouton score. The SIR showed a positive correlation with the stage of inflammatory eye disease with the patient. MRI can therefore not only show muscle enlargement in thyroid disease but can be used to assess the level of disease activity and influence further management in patients with this disabling condition.

**POSTER 1205****Diffusion imaging of acute stroke: pictorial review and pitfalls**

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Diffusion imaging is currently the method of choice for the diagnosis of acute ischaemic stroke. However, it is yet to be widely available and routinely used. The aim of this poster is to present our experience using this technique in the imaging of acute stroke. We will present a pictorial review of the various common major arterial territorial, watershed and small deep infarcts. In addition we will also demonstrate the less common infarcts, namely anterior choroidal, AICA, PICA etc. The review will highlight the importance of diffusion imaging in the presence of previous infarcts, chronic cerebrovascular changes and brainstem infarcts. We will also demonstrate the sequential signal changes of an infarct with time. Diffusion imaging is considered highly specific and sensitive for ischaemic infarcts. However, a small number of false negative and false positive results do occur. In a small number of patients with hyperacute infarcts imaged in the first 24 h, diffusion imaging is falsely negative and the infarct is subsequently demonstrated in the next 24–36 h. In another small group of patients, false positive results are seen in patients with necrotic metastases, subdural empyema and focal cerebritis. In conclusion, we will demonstrate the various types, patterns of acute ischaemic infarcts and point out the pitfalls by examples of both false positive and false negative cases. The final diagnosis of a high signal lesion on diffusion imaging should be established after the review of the other MR sequences and the clinical presentation.

**POSTER 1206****A potential role of positron emission tomography in the prevention of secondary brain damage**

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**PURPOSE:** After injury, brain tissue undergoes changes which may result in secondary damage. This may cause pathology (for example ischaemia) more widespread than the original insult. The mechanism of these reactions is poorly understood. Positron emission tomography (PET) may identify these physiological processes leading to new treatments or prophylaxis. **METHODS:** Using novel radiopharmaceutical delivery (developed specifically for critical ventilated patients) a number of useful physiological parameters can be measured with PET. A continuous intravenous infusion of oxygen-15 labelled water enables the measurement of regional cerebral blood flow (rCBF). Continuous administration of oxygen-15 gas through the inspiratory leg of the patient's ventilator enables the measurement of oxygen metabolism. A bolus of oxygen-15 carbon monoxide through the ventilator allows the cerebral blood volume to be estimated. An intravenous injection of fluorine-18 labelled fluoro-deoxyglucose permits the determination of the cerebral metabolic rate of glucose. From the parameters above the oxygen utilized by damaged tissue (oxygen extraction fraction, OEF) and the metabolic ratio can be derived. **RESULTS:** rCBF measurement demonstrated areas of critically low perfusion. Coupled with the OEF it was possible to identify whether these areas were at risk of becoming

ischaemic. Abnormal metabolic ratios were observed in some patients, indicating a high degree of damaging anaerobic metabolism. **CONCLUSIONS:** The above techniques have led directly to a change in some patients' management. Although sufficient patients have yet to be examined, first indications indicate that it is valuable in characterizing the mechanisms which lead to brain ischaemia.

**POSTER 1207****MRI in the memory clinic**<sup>1</sup>M Murphy, <sup>1</sup>C F Loughran, <sup>1</sup>M A Crotch-Harvey, <sup>1</sup>A Baxter, <sup>2</sup>A Blakey and <sup>2</sup>W Braude*Departments of <sup>1</sup>Radiology and <sup>2</sup>Psychiatry, Macclesfield General Hospital, Macclesfield, Cheshire SK10 3BL, UK*

In patients attending the memory clinic it can be clinically difficult to identify those with Alzheimer's disease. However, the development of expensive drug therapies has highlighted the importance of establishing this diagnosis speedily and accurately. Imaging may help to distinguish those with Alzheimer's disease from others who may have a similar clinical presentation, e.g. patients with multi-infarct dementia. Moreover, it is also important to quantify the changes noted on MRI studies so that an objective assessment of the severity of change within the brain can be made. This poster delineates the range of imaging features that may be seen on MRI in patients attending the memory clinic. Examples of the common disorders that present in this setting are illustrated. A scoring system is described that measures the changes on each scan objectively. This helps to reduce the interobserver variability in scan reporting and ensures that features that may be important in establishing a correct diagnosis are not overlooked.

**POSTER 1208****The value of limited CT scanning of the head in the follow-up of treated hydrocephalus**

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**PURPOSE:** Repeated CT scanning of the head for suspected ventriculoperitoneal shunt dysfunction may result in a significant accumulation of radiation dose to the patient. The aim of this study was to establish whether adoption of a scan technique limited to slices performed through the third and lateral ventricles only was associated with any loss of significant diagnostic information. **MATERIALS AND METHODS:** 52 consecutive patients with suspected shunt dysfunction were recruited. Patients with a known brain tumour or a first diagnosis of hydrocephalus were excluded. The patients underwent both a limited study with a single slice performed through both the third and lateral ventricles and a "routine" CT scan of the brain. **RESULTS:** Initially the limited scans were reviewed by a consultant neuroradiologist for the presence of hydrocephalus and any other visible abnormality. The full scans were subsequently scrutinized in a similar manner. After review of the limited scans, hydrocephalus was identified in 8 patients. No further patients were identified as having hydrocephalus after review of the full scans, thus demonstrating that hydrocephalus could be adequately diagnosed using the limited technique. 8 further abnormalities were identified on the full scans only, however these had either previously been diagnosed or were of no clinical significance. **CONCLUSION:** All patients presenting with hydrocephalus should have an initial full scan. Where recurrence of hydrocephalus is suspected clinically, CT scanning should be limited to 2 slices through the third and lateral ventricles only.

**POSTER 1209****MR spectrum in spinal dysraphism: a pictorial review**

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Spinal dysraphism is a general term that encompasses a wide variety of anomalies of the spine, all of which result from imperfect midline fusion of the embryonic neural tube. Patients with spinal dysraphism may be evaluated radiologically with different modalities, such as plain radiographs, ultrasound, myelography, CT with or without myelography and MRI. Recently, MRI has emerged as the most useful non-invasive modality, providing excellent detail of anatomy and characterization of soft tissue anomalies. We present a spectrum of MRI findings selected from a retrospective review of 100 patients with spinal dysraphism evaluated at our institution. The ideal MRI technique, along with most of the known categories and subcategories of spinal dysraphism, is illustrated.

**POSTER 1210**

**A pictorial review of intramedullary spinal cord metastasis**

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Metastasis to the spinal cord is unusual. The MR features have not been systematically described. Syring associated with intramedullary spinal cord metastasis has been detected rarely but marked accompanying cord oedema is a common feature in untreated metastasis. We describe 7 cases of intramedullary metastasis, the series includes 4 cases of breast carcinoma and 3 cases of carcinoma of the lung. The MRI features, optimal imaging sequences and pitfalls are discussed. Intramedullary deposits in our review were neither associated with extradural nor with spread into the subarachnoid space, while cerebral metastasis was seen in 1 case.

## Obstetrics

**POSTER 1301**

**Abdominal pain in pregnancy: recent developments in imaging assessment**

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Abdominal pain in pregnancy may result from conditions affecting the gestation sac and corpus luteum in the first trimester, such as ectopic pregnancy and cyst rupture/haemorrhage. Later in pregnancy pain is more likely to be due to a general surgical or urological condition, some of which are more common in pregnancy. Rarely, pregnancy-related medical conditions, such as the HELLP syndrome, cause pain as a result of visceral haemorrhage or infarction. Because of the need to avoid exposure of the fetus to ionizing radiation, the principal modality for the investigation of abdominal pain in pregnancy is ultrasound. This is usually performed using the transvaginal route to assess first trimester problems. MRI is an alternative method of investigation and offers particular advantages in assessment at certain anatomical sites, such as the retroperitoneum, and in tissue characterization of fat and haemorrhage. In this exhibit we review the causes of abdominal pain in pregnancy and the management options that influence the imaging strategy. We concentrate on ultrasound assessment but illustrate new, fast MRI techniques developed within our institution, including MR excretory urography for loin pain.

**POSTER 1302**

**The role of imaging in the pre-operative assessment of conjoined twins**

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**PURPOSE:** To present the varied imaging findings in conjoined twins and evaluate the role of radiology in planning surgical separation. **METHOD:** The authors reviewed the multisystem, multimodality imaging obtained in 8 sets of conjoined twins (16 patients), prior to separation. Various imaging modalities were used. **RESULTS:** Cohort included 6 pairs joined ventrally, 3 thoracopagus, 2 omphalopagus, 1 ischiopagus and 2 parapagus twin pairs with lateral union, single pelvis and 2 legs. Thoracopagus twins had cardiac, liver and upper GI tract conjunction requiring echocardiography, liver imaging and contrast studies. Omphalopagus pairs shared liver and small bowel. Ischiopagus and parapagus twins had a single pelvis and associated genitourinary and colonic anomalies. They required urological and vascular studies. Bony union was assessed by multiplanar CT reconstruction and solid organ conjunction by MRI. Examples from varied radiological investigations will be used to depict conjoined anatomy and associated congenital anomalies. Anomalies are common, usually occurring in the twin on the right. In our cohort, these included cardiac defects (4 patients), bowel atresias ( $n=5$ ), Meckel's diverticula ( $n=4$ ), diaphragmatic hernia ( $n=1$ ) and anomalous pulmonary and hepatic venous drainage ( $n=1$ ). 3 patients developed pyloric stenosis as neonates. Complex urological anomalies occurred in all pairs with pelvic fusion. **CONCLUSION:** Conjoined twins are rare (estimated incidence 1:50 000 live births) and their pre-operative imaging poses a unique challenge to the diagnostic radiologist. An imaging strategy to accurately define anatomical fusion and vascular anomaly is important for surgical planning and prognostic information.

**POSTER 1303**

**Fetal MRI anomalies**

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**PURPOSE:** To illustrate fetal anomalies in various organ systems evaluated on MRI. **MATERIALS AND METHODS:** Fetal MR images performed for the evaluation of anomalies detected on ultrasound are collected. A pictorial exhibit displaying anomalies in various organ systems will be presented. In addition, cases of twins will be illustrated. The anomalies noted on MR sequences will be compared with respective findings on ultrasound. **RESULTS:** In various organ systems, MRI more clearly defined anomalies detected on ultrasound. Twin-twin relationships were more clearly defined using MRI. **CONCLUSION:** MRI is a powerful tool to further evaluate fetal anomalies detected on ultrasound and thereby improve patient care.

## Paediatrics

**POSTER 1401**

**The plain radiograph in the evaluation of childhood limp: a pictorial review**

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**PURPOSE:** Children complaining of non-traumatic hip pain or limp are the commonest cause of paediatric orthopaedic admissions in the UK. The plain anteroposterior pelvis radiograph is usually the first imaging investigation, yet is often poorly interpreted, or overlooked in favour of more sophisticated imaging modalities. Our aim is to identify diagnostic features present on this primary imaging modality. **METHOD:** The authors reviewed the plain radiographs of children attending with hip pain and a limp in whom there was an established diagnosis. Images have been selected to best illustrate the spectrum of pathologies presenting to a district general hospital department in the context of a limping child. **RESULTS:** We present plain radiographic features of various pathological processes responsible for childhood limp. The majority of cases were attributable to irritable hip or joint effusion. Other well-recognized conditions such as Perthe's, slipped femoral capital epiphysis, avascular necrosis and infection will be discussed together with rarer benign and malignant lesions of bone. Examples where a painful limp was the first manifestation of systemic disease will be included. Where applicable, the plain film findings will be complemented with other imaging modalities. **CONCLUSION:** The plain radiograph plays an important role in the evaluation of a limping child. The film may be diagnostic or yield sufficient information to guide further imaging or clinical management.

**POSTER 1402**

**Clinical value of meniscal oedema in the knee MRI of children**

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**PURPOSE:** To evaluate the frequency and significance of meniscal oedema in paediatric knees. **MATERIALS AND METHODS:** In a prospective study of 91 paediatric knee MRI the features of meniscal oedema without meniscal tear were reported. These children were followed up in orthopaedic clinics. **RESULTS:** 19 knee MRI studies showed only high signal intensity in the meniscus without any meniscal tear. A follow-up clinical evaluation ranging from 4 to 16 months showed significant improvement in symptoms to asymptomatic. 1 child had arthroscopy and surgery for suspected osteochondritis, but no meniscal abnormality was seen. **CONCLUSION:** Meniscal high signal intensity in children without meniscal tear is common. It probably represents meniscal oedema or bruise. We suggest children with similar findings on knee MR studies should be treated conservatively.

**POSTER 1403**

**Safety and efficacy of MultiHance<sup>®</sup> in MRI of paediatric CNS. Comparison with Magnevist<sup>®</sup>**

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**PURPOSE:** To evaluate the safety and efficacy of MultiHance<sup>®</sup> vs Magnevist<sup>®</sup>-enhanced MRI in paediatric patients. **METHODS:** Patients aged 6 months to 17 years with known or suspected CNS

disease were intravenously administered 0.1 mmol/kg MultiHance<sup>®</sup> ( $n=85$ ) or Magnevist<sup>®</sup> ( $n=89$ ). MR images were acquired before (T1 + T2wSE) and after (T1wSE) contrast agent injection. Blinded off-site assessment of images was performed primarily to determine, using a 4-point scale, the proportion of patients with an increase in diagnostic information from unenhanced to enhanced MRI, and secondarily (a) the change from unenhanced to enhanced MRI in the number of lesions detected, and (b) confidence in lesion detection and diagnosis. Physical examination, vital signs, laboratory investigations and incidence of adverse events comprised the safety assessment. **RESULTS:** No significant differences between the study agents were found for any endpoint. In 21–34% of patients given MultiHance<sup>®</sup>, the level of diagnostic information was greater for the combined assessment of unenhanced and enhanced images than for unenhanced images alone. The greatest number of lesions, 92–97% of which had a confidence score of “definite”, were detected during the combined assessment. MultiHance<sup>®</sup> provided an increase in diagnostic confidence for 68–87% of patients. Adverse events were reported for 13% (MultiHance<sup>®</sup>) and 15% (Magnevist<sup>®</sup>) of patients. No clinically significant trends in vital signs and laboratory parameters were observed. **CONCLUSION:** MultiHance<sup>®</sup> and Magnevist<sup>®</sup> exhibit comparable efficacy and safety for paediatric CNS imaging.

## Physics

### POSTER 1501

#### Digitizing radiographs using commercial scanners and PCs

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**PURPOSE:** Modern picture archiving and communication systems (PACS) use expensive medical quality scanners and viewing stations. Images can be reviewed by other disciplines but may not need to be of diagnostic quality, providing relevant clinical information is retained. We compared test images obtained using commercially available scanners and cameras with those from a medical scanner. The images show that it is feasible to scan radiographs using cheap, commercially available scanners and PCs to obtain clinically useful images. **MATERIALS AND METHODS:** A Leeds test object radiograph (TOR RAD phantom) was digitized using a medical scanner (Cobrascan CX-312T, Radiographic Digital Imaging Inc.), 2 commercial flatbed colour scanners (Hewlett-Packard ScanJet 4C with transparency adapter and ScanJet 4100C) and a digital camera (Olympus Camedia C-1000L). Images obtained at various resolutions were stored as bitmaps and reviewed with commercial image manipulation software (Paint Shop Pro version 4.12). Spatial resolution, low-contrast and small detail detectability was recorded for each. This was repeated following compression with JPEG and a new wavelet compression algorithm. **RESULTS:** Results show that commercial hardware can produce images of comparable spatial resolution, low-contrast and small detail as medical scanners. Wavelet compression reduced file size for a given compression ratio more efficiently than JPEG with less loss of quality. **CONCLUSIONS:** Radiographs can be digitized using commercial scanners, PCs and software to produce clinically useful images. Compression using a wavelet algorithm to produce more manageable file sizes has the potential to improve image storage, ease of access and speed of electronic transmission.

### POSTER 1502

#### A low cost flow phantom for quantification of flow and volume from perfusion MRI

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**PURPOSE:** The objective of this study was to develop a flow phantom, with known flow rates, to quantify the resultant residue function after application of the Singular Value Decomposition method of deconvolution for use in perfusion-weighted MRI. **MATERIALS AND METHODS:** The phantom was constructed in-house using 3 principle components; a cylindrical container constructed from Perspex with one end permanently sealed and the other removable; a series of tubes of internal lumen 1–1.8 mm inserted into the cylinder, and gelatine used to embed the tubes. A Laguna Powerjet 2000 fountain pump with a flow rate of 2000 L/h provided a constant flow rate through the tubes, so that quantification of the flow rate could be obtained. Axial EPI perfusion-weighted images were obtained on an

IGE Signa 1.5 T scanner with a total scan time of 2 min 42 s; 5 ml Gd-DTPA contrast agent at a concentration of 0.1 mmol was hand-injected over a maximum of 5 s into the system of tubes. Regions of interest were then drawn around the 1 mm internal diameter tubes and the signal intensity change over the course of the data set recorded. An “arterial” input function was obtained. The fluid flow through the tubes was maintained at an average volume flow rate of  $106 \pm 4 \text{ ml min}^{-1}$  in the 1 mm lumen and  $156 \pm 4 \text{ ml min}^{-1}$  in the 1.8 mm lumen tubes. **CONCLUSION:** Perfusion-weighted MRI is a useful tool for ascertaining tissue perfusion. The development of a perfusion flow phantom to assess post-processing algorithms to quantify flow rates and volume has been described.

### POSTER 1503

#### Geometric distortion in open MRI systems

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**PURPOSE:** The aim of this study was to demonstrate the extent of geometric distortion on 2 low-field MRI systems since the open configuration generally compromises main magnetic field homogeneity compared with closed bore designs. **MATERIALS AND METHODS:** Data were obtained from an Outlook ProView 0.23 T (Picker International) with a 2-pole resistive magnet and from an Opart 0.35 T (Toshiba Medical Systems) with superconducting magnet and 4-post design. Tests were performed with a 400 mm diameter water-filled phantom containing a 30 mm thick Perspex section drilled with cylindrical holes. A cross-sectional image shows a hexagonal array of 41 disks with 50 mm horizontal and vertical spacing. The phantom was scanned in the coronal plane inside the large body coil using a spin echo sequence (TE/TR = 30/2000 ms). Sequence parameters, including field of view (FOV) and phase encode direction, were then varied in turn. The distances between disks in the images were measured and compared with the actual distances. **RESULTS:** Errors of up to 10% in a measurement of 300 mm were recorded for a FOV of 500 mm. Errors were worse in the frequency encoding direction and at larger FOV. **CONCLUSIONS:** The extent of geometric distortion in the images illustrates the care that must be taken in utilizing these images for any application requiring accurate geometric information. In some cases, correction techniques may be necessary or measurements should be limited to a smaller region in the centre of the image. The results also demonstrate how pulse sequence parameters may be manipulated to reduce distortion.

## Radiation Protection

### POSTER 1601

#### Paediatric dose evaluation using high sensitivity thermoluminescent dosimeters (Chinese TLDs)

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The Ionising Radiation (Medical Exposure) Regulations 1999 requires that special attention should be given to the medical exposure of children. The aim of this work is to assess paediatric doses for common radiographic and fluoroscopic procedures using high sensitivity thermoluminescent dosimeters, TLD-100H, and dose area products. The thermoluminescent material is lithium fluoride doped with magnesium, copper and phosphorus (LiF:Mg,Cu,P). These dosimeters are commonly called “Chinese TLDs” which have a detection threshold in the region of  $1 \mu\text{Gy}$  and are ideal for measuring individual paediatric X-ray doses. There is currently a paucity of patient dose data using Chinese TLDs. This dose assessment would lead to the establishment of local paediatric diagnostic reference levels which is an integral part of the optimisation strategy. Initial results show that the mean entrance surface dose for chest radiographs is some tens of micrograys while that for pelvis radiographs is hundreds of micrograys depending on the size of the patient. Dose assessment on fluoroscopic examinations concentrated on barium examinations and micturating cystourethrography (MCUG) using dose area products. Extremity doses of carers who needed to hold the patient during fluoroscopy sessions were assessed. It is envisaged that dose monitoring using Chinese TLDs will produce valuable data on both individual patient doses and finger doses of carers. The results will aid the optimization of equipment and procedures during X-ray examination of children.

**POSTER 1602****Evaluation of the diagnostic efficacy and dose-reducing efficiency of erbium filtration for diagnostic X-ray investigations**

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Over the past 4 decades a number of papers have been published regarding the use of K-edge filters and their effectiveness in reducing patient radiation dose. In recent years, the formulation of specific internationally recognized guidelines and protocols has enabled the diagnostic efficacy of radiographic images produced during such research to be evaluated. This study involved the use of erbium and aluminium filtration of the X-ray beam to evaluate the effect of resultant images. An X-ray beam with 2.6 mm Al equiv. filtration was employed for the control cohort of patients. 2 experimental groups of patients followed, the first group imaged with the addition of a 0.1 mm erbium filter to the X-ray beam. The second experimental group was imaged following the addition of an aluminium filter to the X-ray beam. The additional aluminium filter equalling, in terms of mm Al equiv., the total filtration value of the erbium filter. The anthropomorphic phantom and patient study undertaken involved the use of thermoluminescent dosimetry for the measurement of entrance surface doses during radiographic examination of the abdomen, pelvis, lumbar/sacral spine and chest. The data are currently being analysed and any significant dosimetry results for specific patient examinations will be discussed in the context of the findings from the image quality evaluation.

**POSTER 1603****Study of finger doses in nuclear medicine using AEGIS, an electronic dosimeter**

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**PURPOSE:** Doses to the fingers from manipulations of radiopharmaceuticals in nuclear medicine result from many short exposures. It is difficult to determine the significance of contributions from different actions. Optimization for finger doses is difficult based on measurements using thermoluminescent dosimeters (TLDs) that must be worn for several sessions. **METHOD:** An electronic dosimetry system called the Advanced Extremity Gamma Instrumentation System (AEGIS) has potential for use in dose optimization. AEGIS records instantaneous dose rate from a probe that can be worn at the side of the finger. The instrument is a development of an earlier device (GEMS) incorporating an energy compensating filter ( $\pm 25\%$  over range 80–200 keV) and extended dose range ( $0.05\text{--}30\text{ mGy h}^{-1}$ ). AEGIS has been used to record finger doses for nuclear medicine staff. **RESULTS:** Dose rate patterns associated with drawing up radiopharmaceutical into a syringe show 1 or more peaks from manipulations to achieve the correct volume of liquid. The pattern of dose rate for injections varies with each patient depending on the ease with which a suitable vein could be found. The range of doses recorded for drawing up was 1–15  $\mu\text{Gy}$  per 100 MBq of  $^{99\text{m}}\text{Tc}$  and that for injections varied from 0.5  $\mu\text{Gy}$  to 30  $\mu\text{Gy}$  per 100 MBq. **CONCLUSION:** AEGIS provides data on the pattern of finger tip exposure for nuclear medicine staff. Data for individual manipulations can be evaluated, to determine relative doses using different techniques. AEGIS provides the potential for much greater optimization of finger doses than has previously been possible.

**POSTER 1604****A district-wide intercomparison of staff dose in angiography rooms**

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The purpose of this study was to measure the dose received by different staff groups during peripheral and coronary angiography procedures. The study was also designed to allow the comparison of staff dose between different sites to highlight differences in working practices. Measurements of staff dose were conducted using direct reading electronic dosimeters. The dose monitors were issued to a representative sample of staff who are routinely present during diagnostic and interventional procedures. The main staff groups were clinicians, nurses and radiographers. Registrars, radiography assistants and cardiology technicians were also included where appropriate. The results from each site were collated to give the average reading per procedure for each staff group. The mean doses per procedure for clinicians were as follows: diagnostic peripheral

angiography: 10  $\mu\text{Sv}$ ; interventional peripheral angiography: 50  $\mu\text{Sv}$ ; diagnostic coronary angiography: 27  $\mu\text{Sv}$  (NB: measured outside the lead protection). The dose measurements were also normalized to workload using dose-area product (DAP) measurements. This study has indicated the variation in staff dose between different hospitals. Workload correcting of measurements has been helpful in the interpretation of results. Changes to working practices have been recommended based on this study.

**POSTER 1605****Gonad protection on the pelvic radiograph in an adult hospital setting**

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**PURPOSE:** To assess the use and adequacy of positioning of gonad shields on the pelvic radiograph. **METHOD:** 200 pelvic radiographs randomly selected from a 2 month period were retrospectively reviewed by 3 individuals (radiographer, specialist registrar, consultant radiologist). **RESULTS:** Of the 200 examinations, 135 (67.5%) were female and 65 (32.5%) were male. The source of referral was GP (107), A/E (26), general outpatients (2), general wards (3), orthopaedic department (62). Gonad protection was only used in 53 patients (26.5%) all of whom were male. The gonad shield was incorrectly placed in a significant number (22) giving inadequate protection in 17, obscuring bony detail in 4 and both obscuring detail plus inadequate protection in 1 case. Of the 147 patients where gonad shield was not used, 4 female and 7 male patients were identified where it was felt the protection should not have been omitted. The patients' age groupings and indications were also analysed. **CONCLUSION:** Gonad shields are not protecting the gonads in a large percentage of male patients because of omission or inadequate placement. A small percentage of female patients would also benefit from protection. An avoidable excess of radiation dosage to the gonads is thus produced in these patients. From the collated data, a set of guidelines is presented for the use of gonad shields in pelvic radiography. The results of a postal survey of other hospitals' guidelines will also be presented.

**POSTER 1606****Lens exclusion in CT of the brain—the local practice in Hong Kong**

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Radiation-induced cataracts are a well known problem, and CT can increase the lens dose up to a factor of 10 if the lenses are included. In practice, orbitomeatal (OM) baseline is commonly applied and the lenses are usually included. By exclusion of the lens through manipulating the angle of the CT gantry, the lens dose can be significantly reduced without downgrading the image quality and diagnostic information. The aim of this study is to alert the radiologist to the radiation damage to the lens and to advocate a different scanning plane in performing brain CT. From January 1999, a retrospective study looking into the practice of brain CT, with special attention to exclusion of the lens during routine study, was carried out in 2 major regional hospitals. 600 patients having CT of the brain were studied, excluding those requiring orbital information. The scanning protocols of brain CT in different public hospitals were also reviewed. As with most of the public hospitals in this locality, both hospitals in this study used OM baseline as the reference plane. More than 90% of cases of the studied population were found to have either one or both lenses irradiated despite the difference in machine used and staff. We also found that OM baseline is not always adopted, probably owing to patient or operator factors. In summary, a protocol for brain scan with a baseline excluding the lens should be used.

**POSTER 1607****Neonatal chest and abdominal radiation dosimetry: a comparison of two radiographic techniques**<sup>1</sup>N F Jones and <sup>2</sup>T W Palarm*<sup>1</sup>Directorate of Clinical Imaging, Royal Cornwall Hospitals NHS Trust (Treliske), Truro, Cornwall TR1 3LJ and <sup>2</sup>Faculty of Health and Social Care, University of the West of England, Bristol, Glenside Campus, Blackberry Hill, Stapleton, Bristol BS16 1DD, UK*

Radiographs of both the chest and abdomen are the most commonly requested diagnostic radiographic examinations undertaken in the neonatal intensive care unit. Frequently, for a single child, both radiographs are requested simultaneously. These images can be obtained either as two separate exposures (one of the chest and one of the abdomen) or as a single exposure to include both anatomical areas

on one film. This study determined which of these techniques imparted the lowest effective dose. A neonatal anthropomorphic phantom was designed and constructed, and each radiographic technique simulated. Entrance surface doses were recorded using an ionization chamber, and estimates of the effective dose were made. The mean effective dose for the separate exposure technique was estimated to be 33.27  $\mu$ Sv, compared with 36.06  $\mu$ Sv for the combined exposure technique. An unpaired *t*-test confirmed that this difference in effective dose (7.74%) was found to be significant at the 1% confidence level. As a consequence of each technique, the risk of inducing a fatal childhood cancer was estimated to be 4.32 and 4.69 per million examinations, respectively. Although this difference in risk is small, the results of this study would advocate the routine use of the separate exposure technique in clinical practice.

**POSTER 1608****Radiation protection knowledge amongst medical students**

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**PURPOSE:** Under the 1988 POPUMET regulations, non-radiologists are required to receive formal radiation protection training. Formal lecture-based teaching has been introduced at undergraduate level but it is not yet known if this is beneficial. The aim of this study was to examine the impact of this training. **METHOD:** Medical students in their third, fourth and fifth years of training in the London area were surveyed using a verified questionnaire assessing their awareness of the POPUMET regulations and their knowledge of radiation dose and dose limits. **RESULTS:** 91 questionnaires have been completed to date. Only third year students had received formal lectures and only 66% of those surveyed had attended them. No significant difference was found between attendees and non-attendees. Students were unaware that patients had no annual dose limit, the majority did not know the relative radiosensitivity of different organs and radiation doses were commonly overestimated. **CONCLUSION:** Formal teaching at undergraduate level does not currently appear to improve the knowledge of radiation protection amongst medical students.

**POSTER 1609****Malaysian participation in the IAEA/WHO postal TLD and postal ionization chamber intercomparison programmes: analysis of results obtained during 1985–1999**<sup>1</sup>S B Sumat, <sup>2</sup>C J Evans, <sup>3</sup>T Kadni and <sup>1</sup>M T Dolah

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The SSDL of Malaysia has participated 22 times in the IAEA/WHO intercomparison programmes during the years 1985–1999. Thermoluminescent dosimeters supplied by the IAEA were irradiated 12 times with the 1.25 MeV Co-60 beam, and 7 times with the high energy photons from the linear accelerator (3 times with 6 MV X-rays, twice with 10 MV X-rays and once each with 15 MV X-rays and 18 MV X-rays). They were then returned to the IAEA for the dose to be determined. In the ionization chamber comparisons, which all used the 1.25 MeV Co-60 beam, the NE 2581 chamber was sent to the IAEA on 2 occasions, and the NE 2571 chamber was sent once, both chambers being the property of SSDL Malaysia. The aim of the study was to check the laboratory's precision, accuracy and reliability in the dose measurements at therapy level. All measurements showed a very good accuracy within  $\pm 2\%$ , except for 1 thermoluminescent dosimetry measurement performed in 1987 that yielded a deviation of  $-3.1\%$ . Since the acceptable limit of deviations set by the IAEA for this thermoluminescent dosimetry intercomparison work is  $\pm 3.5\%$ , it is clear that the overall deviations obtained have all been satisfactory. The mean discrepancy for the thermoluminescent dosimetry measurements was  $-0.23$  with a standard error of 0.203, while for the chamber measurements they were  $-0.16$  with a standard error of 0.229. Therefore there is no evidence that these need to be treated as belonging to separate statistical populations, and subsequent analysis will treat them collectively. The overall mean is  $-0.211$  with a standard error of 0.162. For 24 degrees of freedom, and a significance level of 5%, Student's *t* is 1.711. Since  $1.711 \times 0.162$  is greater than  $|-0.2108|$ , there is no evidence at the 5% level that the SSDL results are systematically lower than the IAEA results. Another question is whether the value with the maximum discrepancy,  $-3.1$ , should be treated as an outlier, rather than as a member of the same

distribution as the other results. It has a deviation from the mean equal to  $3.57 \times$  standard deviation of the whole sample, so that there is good evidence that it could be rejected. If it is rejected, the r.m.s. deviation between the SSDL and the IAEA results falls from 0.559 to 0.552, which is a small change. There is a larger change in the mean discrepancy, which falls from  $-0.211$  to  $-0.090$ . All discrepancies were less than the limit specified by the IAEA, the mean discrepancy was 16.6 times smaller than this limit, and the r.m.s. discrepancy was 6.3 times smaller. If 1 outlier (which is itself within the acceptable limit) is removed, the mean discrepancy becomes 38.9 times smaller than the IAEA limit. It is concluded that the laboratory has provided therapy level dose measurements well within the internationally accepted standards.

**Radiotherapy & Oncology****POSTER 1701****Relapse in Stage 1 seminoma: influence of primary radiotherapy field on sites of relapse**<sup>1</sup>M B Taylor, <sup>1</sup>B M Carrington, <sup>2</sup>J E Livsey and <sup>2</sup>J P Logue*Departments of <sup>1</sup>Diagnostic Radiology and <sup>2</sup>Clinical Oncology, Christie Hospital NHS Trust, Manchester M20 9BX, UK*

**PURPOSE:** To evaluate relapse patterns in Stage 1 seminoma related to recent changes in radiotherapy practice. **METHOD:** 406 patients with Stage 1 seminoma were treated with adjuvant radiotherapy following orchidectomy. 338 cases received radiotherapy to the para-aortic region (T10 to L4) and in 68 cases with added risk factors for relapse, the radiotherapy field was extended to include the pelvis. Follow-up was by a defined protocol of regular clinical examination, serum tumour markers and chest radiography. CT scans were only performed when there was clinical suspicion of relapse. All radiology was reviewed in detail and sites of relapse were documented with correlation to the radiotherapy field. **RESULTS:** 14 relapses were identified, 11 (3.3%) occurring in the para-aortic group and 3 (4.4%) in the extended field group. Sites of relapse were: 6 pelvis, 2 mediastinum, 1 lung, 1 scapula, 1 scrotum, 1 multiple sites including pelvis and 1 relapse on the basis of tumour markers with no site identified. All the pelvic relapses occurred in the para-aortic radiotherapy group. **CONCLUSION:** In our patients, the sites of relapse depended on the radiotherapy field and pelvic relapse only occurred when radiotherapy had been confined to the para-aortic region. Since such treatment has become standard practice in Stage 1 seminoma (reduced toxicity, equivalent outcome) and pelvic relapses are therefore more common, it is important to include pelvic imaging when relapse is suspected.

**POSTER 1702****The development of documentation for radiotherapy technologists involved in clinical trials**

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**PURPOSE:** To increase the level of involvement of radiotherapy technologists (therapeutic radiographers) in the design, implementation and management of clinical trials with a radiotherapy component. To improve the accuracy of data collection and provide a dynamic spectrum of side-effect development and management. **MATERIALS AND METHODS:** A steering committee composed of representatives from radiotherapy departments in most of the European Union member states was established. Members were selected based on involvement in EORTC Clinical Trials. The group met on 3 occasions and a drafting committee comprising Mary Coffey and Julie Berridge met in the interim periods to draw up guidelines and a radiotherapy technologist evaluation sheet. The evaluation sheet was piloted in each centre and feedback received on design, ease of use, relevance and omissions. Based on the feedback, the sheets were redesigned and presented to a workshop for further discussion in November 1999. The support of the Radiotherapy Treatment Group of the EORTC was positive and input from representatives of the EORTC Data Centre in progressing the work was invaluable. **RESULTS:** The development of a radiotherapy technologist evaluation sheet that will become an integral component of all EORTC clinical trials which include radiotherapy. **CONCLUSIONS:** The project has raised awareness of the importance of the radiotherapy technologist in ensuring the accuracy, the effective implementation and delivery and the assessment of clinical trials with a radiotherapy component. The final documentation will be incorporated into EORTC clinical trial documentation and the results will be evaluated over the coming years. It is our ultimate aim to have these sheets adopted for routine use for all patients receiving radiotherapy.

**POSTER 1703**

**Choosing a 3D planning system: a multidisciplinary approach**

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Purchasing a new planning system, like any other major purchase, involves a large number of staff from different disciplines each of whom may have different criteria for selecting the best system. When this project was undertaken locally, this resulted in a three-sided balancing act between: a physicist, interested in the quality of the beam algorithms, their accuracy, reliance on true physics and ease of commissioning; a radiographer, interested in the ease of use of the system, speed of throughput, versatility of the tools provided and overall flexibility of the system; an IT specialist, interested in compatibility with current IT equipment, Y2K issues, Dicom conformance and future proofing of the system. The need to balance the conflicting demands of each specialist and provide a paper record that can be independently audited led to a method of assessment that will be of interest to others planning to embark on this process in the future. The process involved a series of on-site company demonstrations, questionnaires, visits to other users and factory visits to fully assess the system. All of these needed to be independently scored by each specialist before a consensus score for each system could be produced. The process eventually resulted in a clear choice for a planning system that was equally influenced by

each of the participants and in which all opinions had been represented. Additionally, for little or no extra effort, a clear audit trail had been produced that was suitable for external scrutiny.

## Miscellaneous

**POSTER 1801**

**CT of wooden musical instruments. A practical method of evaluation for insurance purposes?**

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In the past few years there have been several articles published regarding the use of CT for the study of bowed musical instruments. In the most recent of these, Sirr and Waddle (*Radiographics* May-June 1999) suggested the possible use of this technique for insurance purposes. We attempt to demonstrate the practicality of the technique to see if it is possible to obtain reproducible images without resorting to positioning devices which could potentially damage valuable items. Also, we intend to canvas the opinions of the major insurers in the field within the UK to determine whether such imaging would be acceptable to them as a method of identification and authenticity.

# Notes



## National Indoor Arena

### Exhibit 01

#### **EMERALD image database and multimedia for medical physics training**

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**INTRODUCTION:** Normally, young medical physicists have very limited time for training with hospital radiological equipment. The only solution to this problem is to encourage use of modern educational technology. To provide possibilities for effective training with off-site (distance) study of contemporary radiological equipment, the EMERALD Consortium (a University-Hospital co-operation EC Leonardo da Vinci project) has developed a training scheme using a database of digital images (IDB) and related educational multimedia (MM). These are in three volumes (X-ray Diagnostic Radiology, Nuclear Medicine and Radiotherapy). Detailed project description and IDB samples are available at the EMERALD website: <http://www.emerald2.net>. **RESULTS:** The volume of the IDB, engraved on 3 CD-ROMs, is about 1400 images of radiological equipment; block diagrams and performance parameters; QA procedures and measuring equipment; test objects and image quality examples, etc. A PC-type image browser (Thumbs + Plus for Win95/98) is used for quick search through the IDB. The browser presents each image as an approximately 160 × 120 slide, which can be further viewed in its original JPEG size. Each image is visualized with the corresponding caption, on the basis of which a keyword search of the IDB can be performed. The MM follows the EMERALD training scheme organization, where specific competencies (based on the IPEM training scheme) are obtained through performance of various tasks. Each chapter of the MM is related to one task, with the tasks using interactive digital images. At task completion the trainee has to pass a simple MM test. As work in progress, the MM is being tested for Internet distribution. The IDB and MM will be demonstrated at infoRAD™ 2000.

### Exhibit 02

#### **The double contrast barium enema: an interactive guide for radiographers**

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This is an interactive CD-ROM exhibit designed as an accompaniment to the Leeds Barium Enema Course for Radiographers. Using diagrams, radiographs and video clips, the CD-ROM covers technical aspects of performing the examination, emphasizes safety, describes the full range of pathology encountered, and describes how to set up a radiographer-led service. Quiz cases and multiple-choice questions are included for self assessment.

### Exhibit 03

#### **Use of handheld technologies to support students in the clinical workplace**

M P Tatlow  
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Use of information and communication technology (ICT) in the arena of education and healthcare has always followed behind in its use in the commercial sector. One of the most innovative inventions has been the handheld computer (HPC). The functionality of these HPCs has been seen to mirror their larger cousins the desktop computer. A drop in the cost of such technologies has accompanied this increase in functionality, making them more accessible to a larger user group. Their ease of use due to the graphic user interface facilitates use by less ICT experienced professionals. One of the major difficulties facing any education institution that runs a Professions Allied to Medicine course is the need for an extensive period of clinical placement. Although this clinical experience is recognized as an important and cogent feature of such courses, it does present some problems, the most significant being

communication between peers in remote locations, and between teaching staff and the student cohorts. Within this poster presentation a potential solution to this problem is proposed, by employing HPCs and the current Internet infrastructure to deliver a model of student support in the clinical work placement. This work is currently being carried out with Occupational Therapy students at South Bank University's Division of Professions Allied to Medicine.

### Exhibit 06

#### **Mammographic image processing**

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Digital mammography affords the opportunity for computer-aided image enhancement and diagnosis. However, as with most medical areas, mammography is safety critical and so the introduction of artefacts or removal of important signs could lead to serious consequences for the person involved. In this exhibit we aim to demonstrate the power of model-based image processing. This is image processing based on an intimate knowledge of the physics of mammography, leading to algorithms that are typically unique, reliable and, critically, that are understood and therefore trusted by the users. We will demonstrate a number of applications of this technology, including: xmammo—model-based image enhancement; xsim—interactive disease simulation for teaching and testing; xamine—an image display and analysis tool. We will also show the results of model-based image processing as applied to noise detection and microcalcification detection. Additionally, exciting new results reconstructing 3D representations of clusters of microcalcifications from just 2 views will be shown.

### Exhibit 07

#### **Computer-aided detection for mammography**

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An ImageChecker System has been developed by R2 Technology in co-operation with the University of Chicago. It is intended for use as a detection aid for a radiologist reading mammograms. The system identifies areas that contain features associated with cancer. To interpret a case, the radiologist reviews the mammograms at the ImageChecker Viewer in the conventional manner. The radiologist then activates the display unit to review the marked images on the 2 video display monitors installed on the console below the light boxes. These markers identify likely sites of microcalcifications or masses. The radiologist can then review the original mammograms again, paying particular attention to any areas of the images designated by the markers, and revise their assessment if necessary. The ImageChecker System thus functions as an aid to the radiologist and can replace the second reader. Extensive clinical studies have been conducted within the United States and Europe to evaluate the performance of the ImageChecker System. A prospective, multicentre trial of approximately 40 000 cases has demonstrated that use of the ImageChecker System does not result in increased inpatient work-up rates. Another multicentre study was designed to measure the sensitivity of the system in correctly identifying actionable abnormalities in screening mammograms of cancer patients that were acquired 9–24 months before the cancer was actually detected. The ImageChecker System was able to correctly identify the cancers in over 80% of the actionable cases. Given the importance of early detection, the ImageChecker provides a significant contribution to screening mammography.

### Exhibit 08

#### **Lung volume estimation from chest radiographs**

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*Centre for Industrial and Medical Informatics (CIMI), School of Computer Science and Information Technology, University of Nottingham & Queens Medical Centre/University Hospital, Nottingham, UK*

Measurement of lung volume is important for the following reasons: (a) it provides valuable information about the state of the respiratory system; (b) lung function parameters such as compliance, resistance and forced expiratory flow rates are dependent on the lung volume at which they are measured; and (c) lung volume is a quantitative assessment of lung pathology. Current quantitative methods for determining lung volume are difficult to perform, time consuming and expensive. Patient co-operation is essential, and in small children and infants sedation may be necessary. CT volume scans have been used for making quantitative measurements of lung

volume, since they give the true cross-sectional shape of the lung. However, the high radiation doses involved preclude its routine use. In comparison, chest radiographs are performed routinely on all patients presenting at a clinic with respiratory problems. These images are evaluated on a purely qualitative basis, lung volume being assessed from the rib count and the position of the diaphragm. We are developing a generic model of the lungs represented by a

set of equations. The idea is that patient-specific lung volumes can be computed from measurements taken from their chest radiograph. The current work involves examining the relationship between volumes computed in this way from radiographs with volumes obtained from CT scans. Here, we present a prototype system for lung volume estimation.

infoRAD™

# Monday 22 May

## 0900–1030

### Work in Progress Radiography Education Hall 6

**0900**

#### **Supporting supervising radiographers: improving the student learning experience**

S Ward and H A Best

*Radiography, School of Health and Social Care, Sheffield Hallam University, Sheffield S10 2BP, UK*

**PURPOSE:** Approximately 400 radiographers in 15 different imaging departments are involved in the clinical education of undergraduate student radiographers from Sheffield Hallam University. Reaching each radiographer in a bid to ensure equity in the quality of student support and supervision is challenging. The quality assurance mechanisms of the course have repeatedly indicated room for improvement in 3 areas: how to give constructive feedback; definition of clinical supervision; and identifying student needs. In an attempt to address these perceived weaknesses, a new approach to supporting supervising radiographers has been developed and is currently under evaluation. **METHOD:** A questionnaire was sent to the clinical liaison officer (CLO) of each imaging department asking for answers to 3 main areas. (1) What student/course-related information would help to make the role of supervising radiographers more effective? (2) What questions are CLOs commonly asked by their colleagues? (3) In what format would they want this additional support? **RESULTS:** In addition to the previously identified weaknesses, further information was sought on structure, content and assessment modes for the course as well as further advice on day to day matters. The most popular choices for the format of this information was a comprehensive handbook for each department and a pocket book for each radiographer. These were produced and distributed throughout departments. **EVALUATION:** 6 weeks after distribution of the handbooks and pocket books, evaluation questionnaires were circulated to assess the effectiveness of this written information. The results of this evaluation will be discussed during this presentation.

**0910**

#### **Changes in the learning styles of radiography students: a longitudinal study**

P S Fowler

*Faculty of Health, South Bank University, London SE1 0AA, UK*

**PURPOSE:** This study set out to explore the learning style preference of student radiographers and whether this style changed as they progressed through their undergraduate radiography education programme. Data from the first 2 years of 1 cohort have been obtained. **MATERIALS AND METHODS:** Learning style questionnaires (Kolb Learning Style Inventory 1985) were distributed to the 1998 cohort of undergraduate radiography students at the beginning of their radiography education and again at the beginning of their second year of study. From these questionnaires, the preferred learning attributes, as related to the experiential learning cycle, and learning style preference were calculated. **RESULTS:** 19 students were common to both groups. There was an overall change in learning attribute preference, with only 1 student maintaining the same preference order for the 4 attributes. 52.6% ( $n=10$ ) decreased their preference to learn by "feeling" and 63% ( $n=12$ ) decreased their preference to learn by "thinking". 68.4% ( $n=13$ ) increased their preference to learn by "doing" and 52.6% ( $n=10$ ) increased their preference to learn by "watching and listening". From the related scores for each learning attribute preference, the learning style preference was determined. 68.4% ( $n=13$ ) had changed learning style, the greatest change being an increase towards the convergent style (42.1% vs 57.9%). **CONCLUSIONS:** In this group, there was a trend towards preferences leading to the "convergent" learning style preference. This information can be utilized by teachers to help meet student learning needs. Weaker learning attributes can be developed, thus equipping the student to maximize their learning in a variety of situations.

**0920**

#### **An ongoing evaluation of interprofessional education: 5 years experience of shared learning**

K Booth and H A Best

*Radiography, School of Health and Social Care, Sheffield Hallam University, Sheffield S10 2BP, UK*

**BACKGROUND:** Interprofessional shared learning is now a feature of most health care courses. At the School of Health and Social

Care at Sheffield Hallam University, shared learning has been an integral part of the undergraduate professional education programme (comprising Diagnostic and Therapeutic Radiography, Physiotherapy, Occupational Therapy and Nursing) for 5 years. During that time, evaluation from year to year has enabled students to be partners in development of the programme. There have been many challenges, but the curricula have been enhanced by the multi-professional elements, and students identify a range of positive outcomes. The experience of the last 5 years provides the foundation for a more innovative approach to teaching, learning and assessment strategies for shared learning for a range of professional health courses. **AIM:** The aim of the presentation is to review the 5 years of experience of the shared learning programme at Sheffield Hallam University, focusing in particular on the successful outcomes, the constraints and the challenges for the future. The presentation will outline the shared learning programme and identify key factors that have influenced undergraduate interprofessional education.

**0930**

#### **Managing the challenges of diversity in interprofessional education**

H A Best and K Booth

*Radiography, School of Health and Social Care, Sheffield Hallam University, Sheffield S10 2BP, UK*

**BACKGROUND:** Interprofessional education is currently a key feature of the BSc (Hons) Diagnostic Radiography course at Sheffield Hallam University. 5 undergraduate courses in the School of Health and Social Care are involved in this shared initiative: diagnostic radiography; therapeutic radiography; physiotherapy; occupational therapy; and nursing. This year, social work will be included in a multiprofessional revalidation/review, providing a further challenge for shared learning. Planning for revalidation has been taking place during recent months and a variety of challenges and opportunities have been recognized. **AIM:** The aim of this presentation is to provide an overview of how the complex process of developing interprofessional education is managed. It will identify the challenges faced in bringing together a diverse range of professional courses within health and social care. It will discuss some of the proposed innovations for the future of shared learning.

**0940**

#### **Education and training experiences of health care students from Black and minority ethnic communities**

R Klerm, J Notter, F Reynolds and J Thanki

*Faculty of Health and Community Care, University of Central England in Birmingham, Birmingham B42 2SU, UK*

This paper outlines the research process and presents findings from Phase 1 of an action research study based within the West Midlands. The study is funded jointly by the NHSE Equal Opportunities Unit and NHSE West Midlands. Against a background of national concern regarding the delivery of "culturally competent" health care, attracting individuals from Black and minority communities to careers in the NHS, and retaining them within it, is problematic. This study, which uses quantitative and qualitative methods, identifies and explores factors that affect recruitment and retention of Black and minority ethnic students in Nursing and in Professions Allied to Medicine (PAMs). The study is being conducted in close consultation with Black and minority ethnic communities. The first phase includes analysis of students' education and training experiences and the second includes data obtained from the Black and minority ethnic communities. The final phase will identify and propose strategies to improve recruitment and retention. Focus group interviews over a 9-month period involved a total of 170 students. Data were analysed using a grounded theory approach. The findings reveal instances of good practice as well as examples of both overt and covert racism.

**0950**

#### **Development of a clinical assessment scheme to demonstrate progression commensurate with successive levels of learning for diagnostic radiography students**

J Tonks

*School of Radiography, University of the West of England, Bristol BS16 1DD, UK*

**PURPOSE:** To develop a clinical assessment scheme for diagnostic radiography undergraduate education. **METHOD:** The method used was action research involving participation between clinical staff, academic staff and Trust managers to design and implement a clinical assessment scheme. The aim of this process was to develop a means of measuring progressive levels of student learning in a discriminatory way. The strategy involved successive cohorts of students who would progress their learning through a series of clinical objectives to culminate in assessment points specific to each level. A series of planned discussions resulted in actions that informed

WORK IN PROGRESS

the design of the scheme and of associated measurement tools. The result of this strategy was to produce graduates who possessed knowledge, skills and attitudes commensurate with the needs of the service. **RESULTS AND CONCLUSIONS:** 1 cohort of students has now graduated having experienced all 3 years of the scheme. The scheme is continuously evolving, with ongoing monitoring and evaluation. Early anecdotal evidence collected from all involved parties has highlighted that this scheme has been a success and that it assesses a wider range of knowledge, skills and attitudes throughout all levels. This is particularly evident at level 3, where students are expected to manage their own practice and that of others.

**1000**

**Development of a clinical assessment scheme to demonstrate progression commensurate with successive levels of learning for radiotherapy students**

J Chianese

*School of Radiography, University of the West of England, Bristol BS16 1DD, UK*

**PURPOSE:** To develop a clinical assessment scheme for radiotherapy undergraduate education. **METHOD:** The method used was action research involving participation between clinical staff, academic staff and Trust managers to design and implement a clinical assessment scheme. The aim of this process was to develop a means of measuring progressive levels of student learning in a discriminatory way. The strategy involved successive cohorts of students who would progress their learning through a series of clinical objectives to culminate in assessment points specific to each level. A series of planned discussions resulted in actions that informed the design of the scheme and of associated measurement tools. The result of this strategy was to produce graduates who possessed knowledge, skills and attitudes commensurate with the needs of the service. **RESULTS AND CONCLUSION:** 1 cohort of students has now graduated having experienced all 3 years of the scheme. The scheme is continuously evolving, with ongoing monitoring and evaluation. Early anecdotal evidence collected from all involved parties has highlighted that this scheme has been a success and that it assesses a wider range of knowledge, skills and attitudes throughout all levels. This is particularly evident at level 3, where students are expected to manage their own practice and that of others.

**1010**

**Interactive assessment of diagnostic student radiographers on the World Wide Web**

R Chester and G Glover

*School of Health & Community Studies, University of Derby, Derby DE22 1GB, UK*

The School of Health and Community Studies within the University of Derby has recently established a Web-based assessment for student radiographers to assess their ability to identify skeletal and cross-sectional anatomy. This project was undertaken in conjunction with the Centre for Interactive Assessment and Development using TRIADS (Tripartite Interactive Assessment Delivery System), which is a "tool kit" enabling the production of computer-aided assessment. The team was motivated to look for alternative methods of assessment because of: the high cost of copying large numbers of radiographs; the need to make effective use of staff time; and the increasing use of computed radiography. Selected images were scanned into the system and labelled. The student was required to identify the labelled anatomy using a text entry response. Image quality and precision of labelling was enhanced by the incorporation of a zoom facility. Image resolution was excellent using a 640 × 480 pixel image with a minimum of a 256 colour scale. The assessment ran using Authorware Professional. Students were given an hour to identify 48 bony and anatomical structures. In developing the assessment, responses and appropriate permutations of responses were programmed and questions weighted giving a balance to the more complex CT images. The assessment was delivered over the Web to groups of 15 students and the results were automatically downloaded to 2 FTP servers. Student evaluation from the initial exercise has been positive and the programme team has realized the clear application into other subject areas within the radiography programme.

**1020**

**Discussion**

**0900–1000**

**Work in Progress**

**New Studies in Neuroimaging  
Hall 11a**

**0900**

**Assessment of aortic arch and carotid bifurcation using a neurovascular coil**

<sup>1</sup>N Hoggard, <sup>1</sup>D Wilkinson, <sup>1</sup>P Gaines, <sup>1</sup>T Cleveland, <sup>1</sup>S Thomas, <sup>2</sup>G S Venables and <sup>1</sup>P D Griffiths

<sup>1</sup>*Department of Neurology, Royal Hallamshire Hospital and*  
<sup>2</sup>*Academic Unit of Radiology, University of Sheffield, Sheffield S10 2JF, UK*

**PURPOSE:** To assess a phased array head and neck coil for aortic arch and carotid bifurcation gadolinium enhanced magnetic resonance angiography. This study compares our early results with the reference standard of conventional arch angiography, and contrasts this with our previous findings using a volume neck coil. **METHODS:** 19 men and 6 women, aged between 49 and 85 years (median age 70 years), were referred from a neurovascular clinic for assessment for either endarterectomy or carotid stenting. The sequence parameters were TE 2 ms, TR 5 ms, flip angle 50°, field of view 27 cm, slice thickness 2.5 mm, phase matrix 192 and read matrix. 20 ml of gadolinium-DTPA were used. Separate operators performed blinded readings of the 2 sets of angiograms. **RESULTS:** The aortic arch was demonstrated in 100% of patients scanned, compared with 55% using a volume neck coil. 2 patients with claustrophobia were not scanned. Anatomical variants or vascular disease at the arch or vessel origins were demonstrated in 83%. All true carotid occlusions were identified, with no false positives on magnetic resonance angiography. **CONCLUSION:** The neurovascular coil offers significant advantages over a volume neck coil for the demonstration of the aortic arch and carotid bifurcation, which is essential when endovascular treatment is being considered. No false positive occlusions have arisen so far. Greater matrix sizes and automated bolus tracking are now being assessed to improve the assessment of stenosis at the boundary of surgical intervention.

**0910**

**Short-term cerebral haemodynamic effects of carotid artery stenting monitored by MR perfusion**

I D Wilkinson, P D Griffiths, P Gaines, T Cleveland, N Hoggard, G Darwent and G S Venables

*Academic Radiology, University of Sheffield, Sheffield Vascular Institute, Northern General Hospital and Neurology Department, Royal Hallamshire Hospital, Sheffield S10 2JF, UK*

**PURPOSE:** The combination of percutaneous transluminal angioplasty and vascular stenting of the internal carotid artery (ICA) has the aim of reducing the risk of stroke in patients with severe ICA stenosis. The purpose of this work was to monitor the effects of this procedure on cerebral perfusion within 3 h of intervention. **METHODS:** 12 patients (mean age 71 ± 11 years) with symptomatic carotid stenosis underwent MR investigation at 1.5 T (Eclipse, Marconi Medical Systems) within 2 h prior to and within 3 h following angioplasty/stenting. Parenchymal perfusion was assessed using a multi-time point, multislice, single shot T<sub>2</sub>\* weighted EPI sequence (TE<sub>eff</sub> = 60 ms; TR = 1.4 s). 70 sets of axial images of the cerebrum were acquired over 98 s. A 20 ml bolus of contrast (Gd-DTPA, Magnevist, Schering) and 20 ml flush were administered intravenously by a power injector at 5 ml s<sup>-1</sup> starting at the 10th time point. Post-acquisition processing consisted of baseline subtraction, inversion, gamma variate fitting and calculation of relative cerebral blood volume (rCBV) and time-to-peak (TTP) of the bolus. **RESULTS:** Prior to intervention, TTP showed significant interhemispheric asymmetry in the middle cerebral artery territory (1.3 s slower ipsilateral to the stenosis, *p* < 0.005) but not in the anterior or posterior cerebral artery territory. This asymmetry was still present, but reduced, following intervention (0.8 s slower ipsilateral to the stent, *p* < 0.05). Complex changes in rCBV were observed. **DISCUSSION:** MR perfusion appears to be a marker for the immediate cerebral haemodynamic consequences of ICA disease and intervention. Further follow-up studies are indicated to determine whether the residual asymmetry resolves further post intervention.

0920

**Multimodality MR in subarachnoid haemorrhage**

P D Griffiths, I D Wilkinson, P Mitchell, M Patel, M N J Paley, C A J Romanowski, T Powell, T J Hodgson, N Hoggard and D Jellinek

Section of Academic Radiology, University of Sheffield, Sheffield S10 2JF, UK

**PURPOSE:** In this paper we investigate the role of multimodality MRI in subarachnoid haemorrhage. We compare MR with CT in terms of detection of haemorrhage, locating the source of the haemorrhage and recognizing ischaemic complications. **METHODS:** 40 patients with suspected subarachnoid haemorrhage were studied. MRI was performed within 18 h of the CT and consisted of standard MR sequences, diffusion weighted imaging, time-of-flight MR angiography and dynamic first-pass gadolinium MR perfusion imaging. **RESULTS:** 31 patients had proven subarachnoid haemorrhage, 13 acute and 18 subacute. Subarachnoid haemorrhage was demonstrated in 26/31 CT examinations and 30/31 MR examinations. MR was particularly sensitive at showing subacute subarachnoid haemorrhage (18/18), in contrast with CT (13/18). No vascular abnormality was found in 6/31 cases of proven subarachnoid haemorrhage, ruptured aneurysm was found in 19/31, arteriovenous malformation in 3/31 and sagittal sinus thrombosis in 1. MR angiography had a sensitivity of 95% and specificity of 95% for detecting ruptured aneurysms. MRI showed ischaemic changes in 16/31 cases before any surgical intervention. **CONCLUSIONS:** MRI can be performed safely and efficiently in cases of subarachnoid haemorrhage and provides information not available on CT. Appropriate MR sequences can detect acute subarachnoid haemorrhage with a sensitivity comparable with CT, and with improved sensitivity in cases of subacute subarachnoid haemorrhage. MRI demonstrates oligaemic and ischaemic areas in cases of subarachnoid haemorrhage that may be relevant for planning treatment.

0930

**Rapid acquisition projectional MR angiography for the assessment of cerebral arteriovenous malformation**

D J Warren, N Hoggard, I D Wilkinson and P D Griffiths  
Section of Academic Radiology, University of Sheffield, Sheffield S10 2JF, UK

**PURPOSE:** To develop a non-invasive imaging technique, with dynamic information and rapid data acquisition, for assessment of cerebral arteriovenous malformation (AVM). The technique is termed magnetic resonance digital subtraction angiography (MR-DSA). **MATERIALS AND METHODS:** 30 consecutive patients admitted for stereotactic radiosurgery were assessed with MR-DSA prior to conventional catheter angiography (CCA). MRI was performed with a head coil using a 1.5 T superconducting system. A single thick slice (6–10 cm) was obtained using a RF spoiled FAST sequence at a rate of 1 image per s. 2D FT GE, TR/TE 7/2 ms, flip angle 40°, field of view 23 cm, matrix 256 (read) × 150 (phase). The single thick slab was orientated to produce CCA-equivalent projections (lateral, reverse Townes) and axial images were obtained. A set of 60 images was obtained during the passage of a 6–10 ml bolus of gadolinium-DTPA. Subtraction and post processing was performed and the images were viewed in an inverted cine mode. CCA was performed and Spetzler grading was derived for each AVM based on the MR-DSA and CCA. **RESULTS:** MR-DSA agreed with CCA in 27/30 cases (90%). 1 case was missed on MR-DSA that was seen on CCA. 2 further cases were incorrectly classified on MR-DSA. 2 flow related aneurysms identified on CCA were correctly shown by MR-DSA; 1 intranidal aneurysm, however, was missed. **CONCLUSION:** This technique shows promise as a non-invasive method of dynamic angiography. However, improvements in both the temporal and spatial resolutions are required.

0940

**Cerebral proton MR spectroscopy in children with neurofibromatosis type-1**

I D Wilkinson, J K H Wales and P D Griffiths  
Academic Radiology and Division of Child Health, University of Sheffield, Sheffield S10 2JF, UK

**PURPOSE:** Neurofibromatosis type-1 (NF-1) is the commonest autosomal dominant genetic disorder. Cranial manifestations include glioma and non-specific focal lesions (often termed NF-1 bright objects (NBO)). Differential diagnosis can be problematic. This study aims to determine whether short echo time proton MR spectroscopy (H-MRS) can demonstrate differences between NBO and normal globus pallidi or between non-optic tract glioma and NBO. **METHODS:** 20 children with NF-1 underwent H-MRS at 1.5 T (Eclipse, Marconi Medical Systems). 9 other children who had normal cranial MRI acted as controls. Spectroscopic data were acquired using a stimulated echo technique (TE 20 ms, TR 5 s) from

an 8 ml cubic volume of interest placed over either a lesion or, if no significant lesion was present, over a normal-appearing globus pallidus. Results are expressed as the area under each fitted metabolite peak relative to unsuppressed water. **RESULTS:** 24 spectra were obtained in the NF-1 group: 12 from typical NBO, 4 from normal-appearing globus pallidi (excluded from statistical analysis owing to small numbers) and 8 from lesions typical of tumour. 9 globus pallidus spectra were obtained from the control group. There was a significant difference in N-acetyl (NA) signal between NBO and control groups ( $0.57 \pm 0.09$  vs  $0.73 \pm 0.05$ ,  $p < 0.05$ ). Significant differences in choline (Cho) and myo-inositol (mI) signal were observed between NBO and tumour groups (Cho:  $0.39 \pm 0.09$  vs  $0.55 \pm 0.20$ ; mI:  $0.34 \pm 0.10$  vs  $0.54 \pm 0.20$ ). **DISCUSSION:** The reduced NA in the NBO suggests neuronal involvement in the pathophysiology of these apparently clinically silent lesions. H-MRS appears to be able to delineate between neoplasm and NBO in children with NF-1.

0950

**MR spectroscopic features of cortical tubers in adults with tuberous sclerosis**

W Mukonoweshuro, I D Wilkinson and P D Griffiths  
Department of Radiology, C Floor, Royal Hallamshire Hospital, Sheffield S10 2JF, UK

**PURPOSE:** Cortical tubers occur in 95–100% of tuberous sclerosis patients. Histologically, cortical tubers comprise a heterogeneous population of giant cells with features of neuronal cells, astrocytes or intermediate characteristics. The aim of this study is to describe the MR proton spectroscopic features of cortical tubers. **MATERIALS AND METHODS:** 13 adult volunteers (7 men and 6 women, aged 15–68 years) suffering from tuberous sclerosis were studied. Proton spectroscopic data were obtained using a single voxel PRESS technique (TE 135 ms, TR 1600 ms) from 2 regions, 1 placed over a cortical tuber and the other over a corresponding anatomical area of normal-appearing brain in the contralateral cerebral hemisphere. The results were expressed in terms of ratios of the areas under the 3 prominent resonances representing creatine (Cr), choline (Cho) and N-acetyl (NA). **RESULTS:** 13 tubers were studied. The tubers demonstrated a reduced NA/(Cr+Cho) ratio ( $0.85 \pm 0.16$  vs  $0.97 \pm 0.12$ ;  $p < 0.01$ ) and reduced NA/Cr ratio ( $1.57 \pm 0.30$  vs  $1.81 \pm 0.25$ ;  $p = 0.01$ ) compared with the normal-looking contralateral brain. There was no difference in the Cho/Cr ratios between the tubers and the contralateral brain ( $0.86 \pm 0.14$  vs  $0.86 \pm 0.15$ ;  $p = 0.90$ ). No lactate was identified in any tubers. **CONCLUSIONS:** The observed reduction in NA/Cr could be due to (1) gliosis or (2) the presence of neurons and glia, so primitive that they do not express NA. None of the tubers displayed spectroscopic features of tumour.

WORK IN PROGRESS

1030–1200

Work in Progress

Advances in High Technology and Body Imaging  
Hall 11a

1030

**Functional imaging of neuroendocrine tumours: which agent?**

K S A El-Haddad, J R Buscombe, A J Watkinson, M E Caplin and A J W Hilson  
Radiology and NET Clinic, Royal Free Hospital, London NW3 2QG, UK

**PURPOSE:** To determine the optimal functional imaging modality for suspected disseminated neuroendocrine tumours (NETs). **MATERIALS AND METHODS:** A series of 21 patients with known disseminated NET (all biopsy proven), mean age 58 years (range 32–82 years), received imaging with  $^{123}\text{I}$ -MIBG,  $^{111}\text{In}$  octreotide as well as the best correlative imaging modality (spiral triple phase CT with confirmatory ultrasound) within 6 weeks. Imaging (planar and SPECT) was performed for up to 24 h. The scans were reported with lesions marked in 15 zones. The number of zones with abnormalities consistent with tumours were then compared. **RESULTS:**  $^{123}\text{I}$ -MIBG imaging was positive in 16 patients, with a maximum of 3 zones being affected in a single patient.  $^{111}\text{In}$  octreotide was positive in 26 patients, with a maximum of 6 zones being affected in a single patient, when correlative imaging was able to confirm sites of disease. **CONCLUSION:** The sensitivity of

<sup>123</sup>I-MIBG for identifying patients with disease was 77%, and for <sup>111</sup>In octreotide it was 95%. <sup>111</sup>In octreotide appears to be more sensitive than <sup>123</sup>I-MIBG in mapping disseminated NETs.

## 1040

**Patterns of spread of nasopharyngeal carcinoma**

R Padmanabhan, A F McKenzie and R J Hicks

*Department of Diagnostic Imaging, Peter MacCallum Cancer Institute, Melbourne 3002, Australia*

**PURPOSE:** To demonstrate the various patterns of local, regional and distant spread commonly seen in nasopharyngeal carcinoma (NPC) using CT, MRI and positron emission tomography (PET). **MATERIALS AND METHODS:** Imaging of 40 patients with biopsy-proven NPC was reviewed to demonstrate patterns of spread. **RESULTS:** A variety of patterns of spread were demonstrated, including direct extension into adjacent structures, nodal involvement, bony involvement of the skull base, extracranial and intracranial perineural involvement, and haematogenous metastasis. Typical examples of these are presented, with a discussion of particular imaging findings that influence treatment strategies and prognosis.

## 1050

**CT measurement of perfusion within lung masses: correlation with tumour stage and FDG-PET**

K A Miles, N Somerfield and M Griffiths

*Wesley Research Institute and Southern X-ray Clinics,*

*Auchenflower, Brisbane Q4066, Australia*

**PURPOSE:** Histological microvessel density and FDG-PET (2-[<sup>18</sup>F] fluoro-2 deoxy-D-glucose with positron emission tomography) uptake have been shown to correlate with the aggression of lung cancer. This study aims: (a) to determine whether, by reflecting microvessel density, CT perfusion measurements in lung masses correlate with tumour aggression as indicated by tumour stage; and (b) to determine whether CT perfusion measurements can be used as a surrogate for FDG uptake on PET. **METHODS:** Perfusion within 16 lung masses (15 patients) was determined from the temporal changes in attenuation during a rapid single location dynamic CT sequence with bolus contrast enhancement. 7 patients (8 masses) also underwent attenuation corrected FDG-PET with measurement of standardized uptake value (SUV). **RESULTS:** 2 patients were excluded due to excessive motion on CT images. Median perfusion was higher within 11 malignant lesions than within 3 benign masses (0.49 vs 0.34 ml min<sup>-1</sup> ml<sup>-1</sup>,  $p < 0.03$ , Wilcoxon rank-sum test). A correlation was found between tumour stage and perfusion (rank correlation coefficient 0.95). A significant logarithmic correlation was found between CT perfusion measurements and SUV ( $r = 0.85$ ,  $p < 0.04$ ). **CONCLUSION:** CT perfusion values within lung masses indicate tumour aggression and may have the potential to act as a surrogate for FDG-PET in some cases.

## 1100

**Washout characteristics of adrenal masses on contrast enhanced CT: definitive lesion characterization**

G W L Boland

*Department of Radiology, Harvard Medical School, Massachusetts General Hospital, Boston MA 02114-9657, USA*

**PURPOSE:** This study was performed to determine whether the "washout" characteristics of adrenal masses seen on contrast enhanced CT scans can be used to effectively characterize adrenal masses. **MATERIALS AND METHODS:** 86 patients (49 male, 37 female, age range 29-86 years, mean age 72 years) with 101 adrenal lesions detected on contrast enhanced CT also underwent delayed contrast enhanced scanning. Mean lesion diameter was 2.2 cm (range 1-4.2 cm). Region of interest measurements were performed on dynamic contrast and delayed contrast enhanced CT from which a relative washout percentage was calculated as follows: 1-(HU measurement on delayed scan/HU measurement on dynamic scan) × 100%. **RESULTS:** 99 of 101 lesions were correctly characterized as benign or malignant using a relative washout percentage threshold of 50% on the delayed scan, with benign lesions always demonstrating >50% washout and malignant lesions <50% washout. In the 2 benign lesions that demonstrated <50% washout, absolute density values were consistent with benign disease. **CONCLUSION:** Calculation of relative washout percentage values from dynamic and delayed contrast enhanced CT scans may lead to a highly specific test for adrenal lesion characterization. This should reduce and possibly obviate the need for follow-up imaging or percutaneous biopsy.

## 1110

**Dose reduction to the testes during CT scanning of the abdomen using a gonad shield**

C R Peebles, A Redfern, H M Joy, D Burling, P Halson, M A Sampson and R M Blaquiére

*Department of Clinical Radiology, Southampton General Hospital, Southampton SO16 6YD, UK*

**PURPOSE:** CT scanning is thought to contribute up to 40% of the UK total collective radiation dose for medical examinations, and this figure is likely to rise. A recent phantom study using a wrap-around lead gonad protection device showed significant dose reduction to the testes during CT scanning. Following on from this, we have performed the clinical arm of the study, to assess *in vivo* dose reduction to the testes as well as patient and radiographer acceptability. **METHOD:** 60 patients having routine abdominal or pelvic CT scans were studied with or without gonad shielding. Testicular dose was measured and patient/radiographer acceptance of the device was assessed using a questionnaire. **RESULTS:** Initial results suggest an 83% dose reduction to the testes during abdominal CT scanning and a 72% reduction during combined abdominal and pelvic imaging. Patient tolerance of the device is good. All patients, however, required some assistance with putting on the shield, increasing the length of the examination and making its practical use limited in its current form. **CONCLUSION:** With some modification for ease of application, the gonad shield offers significant and practical dose reduction to the testes during abdominal and pelvic CT scanning.

## 1120

**Diagnostic management of suspected colon obstruction: spiral CT vs water soluble enema**

L B Twohig, E J R van Beek, A Blakeborough, R A Nakielny, A Heseltine and M C Collins

*Department of Radiology, Royal Hallamshire Hospital, Sheffield S10 2JF, UK*

**PURPOSE:** To assess the potential value of contrast enhanced spiral CT, as compared with water soluble enema and surgical findings, in patients with suspected large bowel obstruction. **MATERIALS AND METHODS:** A prospective study of consecutive patients with suspected large bowel obstruction shown by plain abdominal radiography was undertaken. Patients with air in the bowel wall were excluded. Contrast enhanced spiral CT was performed prior to water soluble enema, read blinded for other results. Findings of enema and surgery were used as a reference method. **RESULTS:** Since October 1999, 17 patients have been included: 10 female, mean age 75.6 years (range 57-86 years). Water soluble enema demonstrated obstruction in 14 of 17 patients. CT correctly identified the site of obstruction in all 14 patients. The cause was identified in 12 patients, while 2 showed change in calibre only. Additional information was obtained in 75% of patients, such as local extension (60%), air in bowel wall (42%), metastatic disease (40%) and ureteric obstruction (8%). The management was affected in 75% of patients, resulting in (less extensive) palliative surgery or expedition of surgery. **CONCLUSION:** These preliminary results indicate that CT can identify obstruction and has additional value for the management of patients with suspected colonic obstruction. It seems likely that spiral CT will replace water soluble enema.

## 1130

**Carpal tunnel syndrome: ultrasound observations in patients and normal volunteers**

S A Chhaya, V Morris, J Greening, M A Hall-Craggs and B Lynn  
*Departments of Radiology and Rheumatology, UCL Hospitals, and Department of Physics, University College London, London W1N 8AA, UK*

**PURPOSE:** The purpose of this study was to determine whether ultrasound measurement of the lateral translation of the median nerve at the wrist could be used as a diagnostic test. **METHODS:** 15 patients with clinically diagnosed CTS and 15 age-, sex- and ethnic background-matched normal volunteers were studied. All were assessed clinically by a consultant rheumatologist. Ultrasound was performed using a 12 MHz linear array transducer with image compounding (ATL HDI 5000). The wrists were splinted at 30° of extension and a silicone tape skin marker was applied to the volar aspect of the wrist. A standard section of the wrist was obtained at the level of the scaphoid and lunate. **RESULTS:** The skin marker consistently cast a vertical acoustic shadow and was used for measurement. Images were obtained with the fingers extended and with the fingers tightly flexed into a fist. Post processing was performed off-line. The horizontal movement of the midpoint of the nerve relative to the skin marker was measured for the 2 finger positions. Initial results show the degree of lateral movement of the

median nerve in patients with CTS is reduced compared with normal volunteers.

1140

**The use of bone scintigraphy in the detection of significant complications after total knee joint replacement**

<sup>1</sup>S L Smith, <sup>1</sup>M L Wastie and <sup>2</sup>I Forster

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**PURPOSE:** Post-arthroplasty knee pain is common. Clinically, it can be difficult to identify those patients with complications requiring active treatment. The aim of this study was to determine the usefulness of <sup>99</sup>Tc<sup>m</sup>-MDP bone scintigraphy. **METHOD:** A retrospective study of all patients having a 3-phase <sup>99</sup>Tc<sup>m</sup>-MDP bone scan for a painful knee arthroplasty between 1993 and 1999 was performed. Bone scans were classified as normal, equivocal or abnormal by a single observer. Plain radiographs were considered to be either normal or abnormal. The results of these investigations were correlated with clinical outcome. **RESULTS:** 75 patients (42 female and 33 male) with painful knee arthroplasties were identified. A total of 80 bone scintigrams were performed. The average patient age was 66.2 years. The mean time period between surgery and onset of knee pain was 3.0 years. A final clinical diagnosis was available in all patients. 43 bone scans (53.8%) were normal, 21 (26.3%) were abnormal and 16 (20%) were equivocal. 2 patients (4.7%) with a normal bone scan had loose prostheses. 3 patients (14.2%) with an abnormal bone scan had normal prostheses on follow-up. The sensitivity of an unequivocally normal or abnormal bone scan was 89.5% and the specificity 90.7%. No patient with a normal bone scan and normal plain films had a significant joint abnormality. The pattern of isotope uptake in the abnormal scans was not specific enough to reliably differentiate aseptic from septic loosening. Patients more than a year post surgery had fewer equivocal bone scans. **CONCLUSION:** <sup>99</sup>Tc<sup>m</sup>-MDP scintigraphy is useful in the assessment of the painful knee arthroplasty. A negative bone scan is reassuring and when coupled with normal plain radiographs essentially excludes loosening or infection.

1150

**Discussion**

1615–1730

**Work in Progress  
Role and Career Development  
in Radiography  
Hall 11b**

1615

**The history of technological change and the role of the diagnostic radiographer in gastrointestinal fluoroscopy in the UK**

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**PURPOSE:** Developments in medical technology have given rise to constantly changing diagnostic tests and practice. In addition, there have been great educational developments in diagnostic radiography that have influenced the role of the radiographer in relation to fluoroscopic examinations. With changes in technology and in radiographic practice, it is important for the profession that future developments are informed and influenced by previous experience. This research maps the changing nature of gastrointestinal fluoroscopy in relation to technological innovations and changes in professional roles. **MATERIALS AND METHODS:** The research entails collating documentary and personal evidence regarding fluoroscopic equipment and procedures, and the radiographer's role in gastrointestinal examinations. In depth interviewing will form a large part of the data collection to gather oral histories (life stories) from radiographers. This will enable exploration, understanding and explanation of the range and diversity of attitudes and experiences. Documentary evidence will be obtained from both primary and secondary sources. **RESULTS:** Developments in equipment, contrast materials, techniques and practices (including the radiographer's role) will be collated. The relationship of the radiographer with radiologists and patients will be investigated, and the

conditions for both staff and patients in fluoroscopic examinations will be described. **CONCLUSIONS:** It is envisaged that when completed this research will chart the history of technological change and role development in gastrointestinal fluoroscopy.

1625

**Implementation of a Radiographic Reporting Service for skeletal trauma examinations: final analysis of accuracy**

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**PURPOSE:** To estimate the accuracy of radiographers' reports following the implementation of a Radiographic Reporting Service (RRS). **MATERIALS AND METHOD:** This multicentre study (5 clinical centres, 4 NHS Trusts) was conducted to evaluate the implementation of a RRS. To estimate accuracy, sensitivity and specificity, 10275 reports were issued by radiographers and verified by a consultant radiologist. Examinations were reported independently by another consultant (blinded to any previous reports) in all cases where there was a disagreement. All resultant false positive/false negative (FP/FN) cases were subjected to double independent blind reporting by 2 radiologists external to the study sites. **RESULTS AND CONCLUSIONS:** Of the 10275 reports verified, 151 were judged to be incorrect at initial calculation of accuracy. In 95 cases, 2 radiologists agreed and FP/FN fractions were allocated. The final accuracy of radiographers reported is therefore estimated to be 99%. In 37 cases, at least 1 radiologist agreed with the radiographer's report and in 40 cases 2 radiologists agreed but disagreed with the third. Further analysis, including final estimates of sensitivity and specificity, will be presented. Radiographers were able to report to a high degree of accuracy and to maintain this over time. The degree of accuracy identified is such that the debate about radiographer reporting should begin to be refocused to consider how (rather than if) Radiographic Reporting Services are more widely implemented.

1635

**Implementation and development of radiographic reporting at a range of sites**

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Plain film reporting by radiographers has been the subject of much discussion over the period since educational programmes in reporting were first established. Actual implementation and the means by which it takes place are of interest in exploring the reality of this significant step. Of particular interest is the impact on service delivery, the circumstances under which radiographer reporting takes place and the audit processes applied to monitor standards. As a facet of longitudinal evaluation of the South Bank programme, this research investigates this issue, centred on sites in the south-east of England. Using a semi-structured interview approach, 12 sites providing students for the South Bank course were questioned at the commencement of their involvement in reporting and again 3.5 years later. Evaluation of circumstances at subject sites both then and now was enabled, establishing a view of the development in the service provision on these sites. In the context of audit results, service provision has seen tangible improvement at some sites. The development of radiographer reporting provision has been variable, with limited implementation at some. On 1 site, all radiographs reported by a radiographer continue to be reviewed by a radiologist. Within the context of the study parameters, the results indicate a need to reflect on whether the development and application of the radiographer's role in this area is impacting significantly on the service and maintaining an impetus sufficient to support a view of plain film reporting as a natural aspiration for radiographers in the mainstream of radiographic practice.

1645

**Radiographer-performed intravenous cannulation for pump-injected contrast enhanced CT**

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**PURPOSE:** To assess the safety of delegation to radiographers of the insertion of cannulas for dynamic pump-injected contrast enhanced CT. **MATERIALS AND METHODS:** Following special training of radiographers, a series of patients in May-July 1999 who underwent dynamic contrast enhanced spiral CT were audited. Records were kept of ease of cannulation, site of cannulation, person performing cannulation, means of delivery and adequacy of delivery. Complications were recorded as part of the routine incident

reporting policy. **RESULTS:** A total of 595 contrast injections took place, of which 89 were fully audited while the remainder were checked for complications using the regular "adverse event" procedure. Cannulas were sited by radiographers (68), Specialist Registrars (17) and Consultants (4). Radiographers sited all cannulations that were considered easy, while Specialist Registrars and Consultants sited more difficult cases. Of these patients, 69 received contrast by pump injection. Extravasation of contrast was encountered in 4 patients, of which 2 were related to pump injection. 1 of these patients had a pre-sited cannula. In the absence of other reported incidents, the overall extravasation rate was 0.7%. **CONCLUSION:** Following adequate training of radiographers, it is feasible to delegate intravenous cannulation, even if automatic pump injection of contrast is used. Furthermore, the initial results show that this does not result in increased complications. A further audit is currently ongoing, which will evaluate a larger, consecutive series of patients.

1655

**A sociological enquiry into career progression pathways in radiography: a grounded theory approach**

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**PURPOSE:** The research team from 2 educational establishments present their initial findings of a grounded theory study of career pathways in radiography. This study aims to develop a conceptual and theoretical framework of radiographic careers and will identify the "significant factors" influencing career choices and progression. **METHODS:** 4 in-depth, open pilot interviews were undertaken with radiographers, in addition to a comprehensive literature search to establish the themes for the main interviews. 8 in-depth, semi-structured interviews were undertaken on 2 cohorts of radiographers that qualified in 1993 and 1998, representing: both sexes; diagnostic and therapeutic radiography; and mature students and those entering radiographic undergraduate education at 18. **RESULTS:** Analysis of the data showed some interesting themes, which appear to be common to the majority of interviewees. In virtually all cases, a specific incident or individual was responsible for the initial career choice. This ambassadorial role may not be well recognized within radiography. All interviewees identified an important period of "adaptation" post qualification, where consolidation of professional practice was paramount, raising important issues of initial CPD and support. Following this, a "crisis point" was identified where additional professional stimulation and recognition was sought. It would appear that beyond this "crisis point" individuals may focus on either "internal" or "external" priorities that affect their rate and direction of career progression, after which some individuals again stagnate within their role. **CONCLUSION:** This is a unique study and could prove to be extremely valuable to practising radiographers, educational establishments and the professional body, influencing recruitment, retention and subsequent development and career progression within radiography.

1705

**Attitudes towards personal and professional development: a survey of radiographers employed in the South West Region**

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**PURPOSE:** To identify attitudes that may affect radiographer participation in personal and professional development (PPD), and to evaluate the rating scale employed. **METHODS:** To survey

attitudes, 926 questionnaires were sent to members of the Society of Radiographers in the South West Region. Each questionnaire contained 27 attitudinal statements that respondents rated using a Likert-type scale. Comparisons between radiographers employed in full- and part-time capacities were made using summary statistics. Reliability and factor analyses were also performed on the responses. **RESULTS:** 444 (48%) valid questionnaire returns were made, of which 409 were used after data verification. The summary statistics indicated that the attitudes of both full- and part-time personnel were broadly similar and hence the responses from both employment groups were amalgamated for subsequent analyses. The majority of respondents (76%) appeared to be predisposed towards engaging in PPD, but were less inclined to fund their own development. However, committing their personal time was considered less of an issue. Internal consistency of the scale items was reasonable (Cronbach's alpha = 0.8322), indicating an acceptable degree of reliability of the statements. Subsequent factor analysis revealed 5 potential underlying themes, including personal and institutional opportunities and commitment. **CONCLUSION:** Although the majority of both full- and part-time professionals appear to be willing to engage in PPD, the reluctance amongst the remainder is apparent. This may be an issue for consideration if continuing professional development were to be mandated. The attitudinal scale developed for this study requires further work to improve its overall reliability and validity.

1715

**Promoting academic and personal development using a multidisciplinary portfolio**

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**BACKGROUND:** The shared learning programme in the School of Health and Social Care at Sheffield Hallam University is being reviewed and extended as part of a major revalidation process in December 2000. Because of the increasing diversity of courses involved, a more flexible and innovative approach to learning, teaching and assessment strategies is required. **PURPOSE:** The purpose of the study is to propose a model for an academic and personal development portfolio for multidisciplinary use, which will bring together a number of issues facing professional higher education. These would include: linking learning within an academic framework to clinical practice; facilitating reflective processes; meeting the requirements of the Dearing Report (Academic and Personal Development Record); and providing a foundation for lifelong learning. **METHOD:** A critical review of current literature, policy and practice is being undertaken. The review will look specifically at the areas outline above and will identify those aspects that form essential features of a portfolio for multidisciplinary use. **RESULTS AND CONCLUSION:** This presentation will take place at an intermediate stage of the study. It will offer an overview of the findings of the review to date, suggesting key features to be incorporated in a portfolio for multidisciplinary use across a range of health and social care courses including diagnostic and therapeutic radiography.

1725

**Discussion**



## Tuesday 23 May

1245–1345

### Work in Progress Studies in Oncology Hall 11b

1245

#### Improving efficiency of intensity modulated radiotherapy: an algorithm for optimization of beam orientation

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**PURPOSE:** Delivery of intensity modulated radiotherapy (IMRT) can be complex and time consuming. One challenge in clinical implementation is to develop efficient techniques that use the minimum number of beams to achieve the clinical goals. **METHODS:** A computerized optimization algorithm was developed to determine the best beam-arrangement for a small number of IMRT fields. The algorithm was designed to avoid, when possible, beam orientations that passed through organs at-risk with low radiation tolerance. A fast IMRT algorithm based on the Bortfeld method determined the profile of the intensity modulation, and a fast simulated-annealing algorithm found the "optimal" beam arrangement. The beams produced were used to generate treatment plans on the CORVUS treatment planning system (NOMOS Corporation) and compared with a "gold standard" 9-field equispaced arrangement. **RESULTS:** For 1 patient with a parotid gland tumour, 9-field IMRT significantly reduced the dose to the cochlea compared with conformal radiotherapy. This should reduce the risk of hearing loss, but the dose to the contralateral parotid gland was increased. The beam orientation optimization algorithm produced a plan using only 3 fields that maintained target dose homogeneity, and reduced the cochlea dose without increasing the dose to the contralateral parotid gland. The algorithm also produced non-coplanar beam arrangements, but no significant improvement in the dose distribution was seen. The optimization process took 1–3 h of computation time. **CONCLUSIONS:** Beam orientation optimization for head and neck tumours is possible, and can produce clinically advantageous dose distributions using only a few fields. This should reduce the complexity and time required for delivery of IMRT.

1255

#### A unidimensional dose measurement probe based on plastic scintillating fibres

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**PURPOSE:** In this work we will discuss the development of an *in vivo* real-time dosimetry system for prostate brachytherapy by means of a scintillating fibre detector probe. The aim is to demonstrate the capacity of such a system to provide unidimensional measurement of dose distribution within targets simulating the prostate. We believe this is an important advance that will enable the oncologist to correct any error in the treatment plan immediately. **MATERIALS AND METHODS:** The main detection elements of the system are based on small plastic scintillating optical fibre elements coupled to an optical guide in one end and a multichannel photodetector at the other end. The chemical composition of the plastic-based scintillator renders the detector suitable for dosimetry, especially owing to its water equivalence over a wide range of radiation. **RESULTS:** Preliminary results show the light yield to be linear, as a function of the incident photon energy deposited in the scintillating fibre. In addition, a good spatial resolution is achieved when many fibres are packed into a bundle showing no optical cross-talk. The photo-detection is performed by means of an array of photodiodes or by a multianode photomultiplier.

1305

#### An evaluation of the availability of dietetic services for cancer patients undergoing radiotherapy

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**PURPOSE:** This paper describes work that is currently in progress and that will be completed in August 2000. The study investigates the type, level and extent of information given by therapy

radiographers and dieticians to patients undergoing radiotherapy in an attempt to prevent exacerbation of symptoms such as anorexia and weight loss. **METHODS:** A questionnaire designed to investigate both the information provided to patients, and the level of available support given by radiotherapy and dietetic services has been distributed nationally ( $n=124$ ). The questionnaire design is unique in that it draws upon a central clinical scenario (a hypothetical case study of the treatment of a patient with a head and neck tumour). **RESULTS:** Early results indicate a good response to the questionnaire ( $n=60\%$ ) with a clear picture emerging of trends in the way information is provided, especially in the field of dietetics. Respondents have also indicated how useful the study will be in informing practice.

1315

#### Cervix brachytherapy—placement under ultrasound guidance: a useful new technique

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**PURPOSE:** To highlight ultrasound guidance as a useful new technique for accurate placement of brachytherapy rods used in the treatment of patients with advanced carcinoma of the cervix. **MATERIALS AND METHODS:** Under theatre conditions, 300 ml of normal saline is introduced into the urinary bladder to act as an acoustic window into the pelvis. Longitudinal and transverse ultrasound images are obtained of the uterus, cervix and vagina. The brachytherapy rod is visualized as a highly reflective focus and is advanced into the endometrial cavity under ultrasound guidance, ensuring correct placement. **RESULTS:** Brachytherapy for advanced cervical carcinoma involves dispensing pellets of radioactive caesium through hollow rods placed in the uterine cavity and vaginal fornices. The problem with "blind" placement in patients with necrotic and friable tumours is the risk of uterine perforation or placement in a tumoral fissure, especially in the elderly where the uterus is small and atrophic. Ultrasound guidance allows optimum positioning of the rods and therefore reduces the risk of such complications. **CONCLUSION:** This dynamic examination provides reassurance as to the correct placement of the brachytherapy rods prior to dispensing radioactive treatments through them. It is a simple and reliable new technique that is quick and easy to perform. We recommend its use in the treatment of patients with advanced carcinoma of the cervix.

1325

#### Simulator verification in treatment planning: an important step in delivering high quality radiotherapy

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**PURPOSE:** Current literature suggests that, as a treatment verification tool, the simulator may be replaced with the comparison of digitally reconstructed radiographs and on-set portal images. In an attempt to assess the veracity of these claims, a small departmental study was undertaken, the aim of which was to quantify any planning errors before commencement of treatment. **MATERIALS AND METHODS:** The following details were recorded for each complex treatment verification over a 6-month period: the diagnosis of the patient; the plan type and complexity; the number of images taken; and the number and nature of any modifications made, including any further planning required. **RESULTS:** 363 complex treatment plans were verified over the 6-month period, of which 131 plans (36%) were modified at simulation. There were 153 total alterations made, of which 139 (91%) were alterations to the treatment plan (including addition of shift from the isocentre); 12 (8%) were changes made to beam modification devices (*e.g.* addition of lead shielding) and 2 (1%) were adjustments made to immobilization devices. **CONCLUSIONS:** Physical verification is shown to be useful in decreasing both random and systematic errors prior to treatment. Patient-related problems (*e.g.* positioning) can be identified at this stage, as can early planning failures. Abolishing the simulator verification session eliminates the opportunity to optimize the treatment plan; this provides the chance to clarify set-up instructions, and check lead templates and isocentric shifts, all of which, if not accurate, could result in an incorrect first treatment.

1335

#### Discussion

## Posters

### National Indoor Arena Concourse Area

#### Work in Progress

#### Audit

##### POSTER 0103

##### Audit of quality of information provided on radiology request forms

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**PURPOSE:** A baseline audit designed to study the quality of information provided on radiology request forms. **METHODS:** Prospective data was collected from 79 inpatients' forms at a district general hospital, completed by junior medical staff. The forms were assessed for clinical information provided, legibility, clinical diagnosis compared with radiological diagnosis and time for investigations to be carried out and reporting of films. **RESULTS:** Clerical data (name, date of birth, address, ward) was adequately completed in 54 forms (69%). 61 forms (77%) were deemed legible. 41 forms (52%) had adequate clinical information. 51 patients (65%) had investigations (mostly chest radiographs) done on the same day. 35 forms (44%) were reported within 48 h while 59 (75%) were reported within 5 days. Unexpected diagnoses were found in 8 requests (10%). **CONCLUSION:** A significant number of forms had inadequate clerical data and illegible handwriting. This is consequential for keeping records and for radiographers to carry out the tests quickly and efficiently. Adequate clinical information was missing in nearly half of the forms. Although most of the investigations carried out were chest radiographs, the majority were done on the same day and reported in a reasonable period of time. A significant number of cases revealed unexpected radiological diagnosis compared with clinical diagnosis. Our audit shows that more attention needs to be paid to completing radiograph forms and providing clinical information, as this is vital to the radiologists for giving an appropriate report in view of the clinical problem.

WORK IN PROGRESS

#### Breast

##### POSTER 0218

##### A radiographer's perspective of sentinel lymph node biopsy

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Axillary lymph node clearance during surgery for breast cancer provides control of local disease within the axilla and staging of axillary lymph nodes. However, the procedure carries a significant morbidity, such as seroma formation, infection, parathesia, reduced shoulder movements, lymphoedema and longer in-patient stay. As there are a significant number of patients presenting with early stage breast cancer (60% of patients have disease-free axillary nodes), routine axillary lymph node clearance exposes many patients to unnecessary surgery. Sentinel lymph node biopsy has evolved as a technique to successfully identify the first draining lymph node to accurately predict axillary lymph node status. It is a minimally invasive procedure, which after an initial learning curve is quick and easy to perform. At the University Hospital Birmingham NHS Trust we are now involved in a National Trial for this procedure. This is a review of the technique and imaging modalities involved. If shown to be a successful and reliable technique, sentinel lymph node biopsy will contribute significantly to the management of breast cancer patients.

##### POSTER 0219

##### The West Midlands approach to quality assurance of breast imaging ultrasound scanners

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In the West Midlands a number of medical physics departments are responsible for the quality assurance (QA) of diagnostic ultrasound scanners used for breast imaging. In 1997 these departments developed a regional QA strategy in line with the published National Health Service Breast Screening Programme (NHSBSP) guidelines [1]. A regionally-owned test object was used and a common report form designed. During 1999, revision of the guidance [2] prompted a review of the process. The documentation was modified and reports since the start of the regional strategy were analysed. This work in progress studies the original and revised strategies, together with an assessment of the faults found with ultrasound scanners under both of the published QA protocols. These can be separated into three broad categories: significant faults requiring servicing; minor faults that could either be immediately rectified or kept under review; and faults due to test equipment or procedures. Actions taken to reduce the faults in test equipment and procedures are described. **REFERENCES:** [1] NHSBSP Publication Number 27. A protocol for quality assurance of diagnostic ultrasound scanners used in the breast screening programme. [2] MDA/98/52. Further revision to Guidance Notes for ultrasound scanners used in the examination of the breast, with protocol for quality testing.

#### Gastrointestinal

##### POSTER 0510

##### Developing information for barium enema patients

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**PURPOSE:** To design and compile information about the barium enema examination that is easily understood, widely acceptable and accessible, easily distributable and inexpensive to produce. **MATERIALS AND METHOD:** Data gathered from the literature and from previous qualitative work were used to compile an information leaflet. The leaflet addresses the barium enema examination in a way that will inform the patient from both a procedural and sensation perspective. It was decided that the information would have most impact in the form of a leaflet, which would be distinct from the appointment details and would therefore focus the patient. Although it was felt to be important to give explicit factual and sensory information, it was also felt important to keep the information short and simple. **RESULTS:** The leaflet explains what a barium enema is, what a patient has to do, and what a patient can expect to happen to them. It is stressed in the introduction to the leaflet that it is not intended to be comprehensive, and that specific questions can be posed to the radiographer or radiologist. **CONCLUSION:** This paper addresses the information needs of barium enema patients in an effort to make an impact specifically on the anxiety experienced by barium enema patients, and more generally on the whole barium enema experience.

#### Head & Neck

##### POSTER 0704

##### MRI of pathology within the larynx and trachea

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MRI has advantages over CT when studying the larynx and trachea owing to the greater inherent contrast and the ability to scan in any desired plane. Benign and malignant diseases of the larynx and

trachea have been studied. Pathologies studied include carcinoma of the larynx, sarcoid, amyloid and viral papillomatosis. Extrinsic compression by thyroid goitre and other neck and mediastinal masses has also been observed. Features of examples of the above cases will be displayed. In most cases, the pathology shows moderate signal on  $T_1$  weighted imaging, and high signal on STIR and  $T_2$  weighted imaging. The extent of disease is well shown but the results are not specific with regard to pathology. CONCLUSION: MRI of the larynx and trachea provides a highly sensitive method of displaying the extent of disease, but the features are only rarely specific. MRI is a useful adjunct to other techniques in assessing disease and can replace ultrasound and CT in certain cases.

## Multisystem

### POSTER 0906

#### Radiology of non-CNS primitive neuroectodermal tumours: diagnostic features and correlation with outcome

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**PURPOSE:** To document the varied radiological features before and after treatment in the rare non-CNS primitive neuroectodermal tumours (PNETs). **METHODS:** 33 children with PNETs have been treated at our institution since 1990. We obtained full radiological and clinical follow-up in 29 of these patients (12 male, 17 female). The median age at presentation was 4.4 years. All imaging modalities were reviewed, with particular attention to CT and MR. **RESULTS:** There were 5 main sites of tumour: head and neck ( $n=7$  patients), scapula/axilla ( $n=2$ ), chest ( $n=11$ ), abdomen ( $n=3$ ) and spinal/paraspinal ( $n=6$ ). Overall mortality was 62%. The average size of the tumour at presentation was 5.0 cm. Calcification was rare ( $n=6$ ). Tumours tended to displace adjacent soft tissue structures such as vessels and bronchi rather than invade them. Bony and local invasion was seen in 12 patients at diagnosis. Metastases were seen to the lung ( $n=6$ ), pleura ( $n=2$ ), brain ( $n=5$ ), lymph nodes ( $n=2$ ) and liver ( $n=2$ ). Tumours of the scapulae or paraspinal region were associated with better survival. **CONCLUSIONS:** Imaging characteristics of non-neuronal PNETs are presented. Tumour calcification is uncommon. PNETs tend to displace rather than encase adjacent structures. Bony or local invasion occurs in 43% at diagnosis. Multiple metastatic sites exist. Scapular or paraspinal sites are more favourable.

## Musculoskeletal

### POSTER 1117

#### Bone mineral density in adult cystic fibrosis patients

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**BACKGROUND:** Cystic fibrosis (CF) patients are at risk of osteoporosis secondary to a number of factors, including poor mobility, malabsorption and hypogonadism. **MATERIALS AND METHODS:** A retrospective review was made of the medical records of 19 consecutive patients with CF attending a specialized CF clinic. DXA of hip and lumbar spine was performed using a Hologic 4500C scanner. The mean age of patients was 31 years (SD 3.9, range 24–39 years). Mean height and weight for males ( $n=13$ ) and females ( $n=6$ ) were 1.67 m (SD 9.7) and 64.6 kg (SD 9.9), and 1.58 m (SD 3.9) and 55.1 kg (SD 7.1), respectively. All patients were receiving vitamin supplementation (vitamin caps 1 per day = 300 iu vitamin D). **RESULTS:** Mean bone mineral densities (BMDs) for all patients are presented. Spine: BMD ( $\text{g cm}^{-2}$ )  $\pm$  SD,  $0.88 \pm 0.1$ ; Z-score (median),  $-1.8$ ; range,  $-3.5$  to  $1.0$ . Hip: BMD ( $\text{g cm}^{-2}$ )  $\pm$  SD,  $0.82 \pm 0.13$ ; Z-score (median),  $-1.09$ ; range,  $-2.6$  to  $1.1$ . 2 patients had average BMDs. 4 patients were osteoporotic by T score, 13 were osteopenic. Weight was significantly correlated

with spine and hip BMD, and height was correlated with hip BMD. After correcting for height and weight, there was a weak correlation between lumbar spine BMD and FVC ( $r^2 = -0.5$ ,  $p=0.03$ ) but not with PEFr or FEV1. No correlation was seen between the biochemical variables alkaline phosphatase, phosphate, albumin or calcium. Vitamin D levels were available in 15 patients; however, these did not correlate with BMD. 17 patients had taken oral steroids; 10 were present users (mean dose 6.5 mg). There was no correlation between present dose and BMD. No patients had suffered fractures. **CONCLUSIONS:** This study confirms that adult CF patients have, on average, reduced bone density. In the worst affected patients, this equates with a 7-fold increase in risk of fracture. Although the optimum treatment in these patients is not clear, monitoring and adequate dietary supplementation is important. We are continuing to follow-up these and other patients as they become eligible for the survey.

## Neuroradiology

### POSTER 1211

#### CT angiography in the assessment of carotid stenosis

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CT angiography (CTA) in carotid stenosis is becoming more widely available and accepted as a useful supplementary non-invasive examination in imaging the carotid bifurcation. At our institution, the acquisition of a rapid advanced CT scanner has allowed us to develop our technique for imaging the carotid bifurcation. Advances in imaging technology enable CTA to provide information on plaque morphology, such as the presence of ulceration, calcification and thrombus. The quantitative assessment of stenoses correlates well with other non-invasive imaging techniques. Careful attention to technique with regard to the timing of contrast injection, patient compliance and post processing is extremely important, and we will illustrate this with examples from our practice. We have been able to distinguish high grade stenosis from occlusion accurately by the demonstration of trickle flow. Advances in tube design now allow us to extend our scanning range so that assessment of proximal, distal and extended disease is possible. We will demonstrate the application of techniques to accurately measure stenosis in heavily calcified lesions. The ability to image in the axial plane allows us to select appropriate maximum intensity projections to demonstrate maximum stenosis within elliptical lumens. Post-processing techniques allow removal of structures that overlie the ICA, such as the external carotid artery or its branches. Thus, we can show that there is the potential for inaccuracy in angiography, where standard projections may not necessarily demonstrate maximum stenosis. We feel that CTA is a very promising tool in the imaging of carotid stenosis.

### POSTER 1212

#### Spinal cord atrophy on MRI in diabetics with peripheral neuropathy

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**PURPOSE:** There is some evidence that the CNS is involved in diabetic peripheral neuropathy. The aim of this work was to determine whether atrophy of the spinal cord can be detected in chronic diabetic peripheral neuropathy using a simple MRI-based planimetric assessment of cord area. **METHODS:** 38 subjects were studied; 18 with diabetic peripheral neuropathy (8 with chronic pain, 10 without), 10 diabetics without neuropathy, and 10 normal controls. Imaging was performed axially at 3 levels (C4/5, T3/4 and T9/10) on a 1.5 T system (Eclipse, Marconi Medical Systems) using a 2D gradient-echo technique (TE = 17.9 ms; TR = 800 ms;  $\alpha = 40^\circ$ ; slice thickness = 4 mm; in-plane resolution =  $0.78 \text{ mm} \times 0.96 \text{ mm}$ ). Cord cross-sectional area was measured by a ray-tracing method.

**RESULTS:** Cord area at C4/5 was significantly smaller in diabetics with peripheral neuropathy compared with controls (86.6 mm<sup>2</sup> vs 99.9 mm<sup>2</sup>;  $p < 0.005$ ). At T3/4, diabetics with peripheral neuropathy had significantly smaller cord area than both controls (51.0 mm<sup>2</sup> vs 57.3 mm<sup>2</sup>;  $p < 0.005$ ) and diabetics without neuropathy (51.0 mm<sup>2</sup> vs 57.5 mm<sup>2</sup>;  $p < 0.05$ ). No significant differences were observed between the painless and painful neuropathy subgroups. The coefficient of variation for interobserver measurement was 2.5%, for intraobserver measurement it was 3%, and between scans of the same (control) subject it was 0.5%. **DISCUSSION:** The measurement technique used was simple to implement and, given the measured coefficients of variation, accurate and reproducible. Our findings indicate that the spinal cord is involved in patients with diabetic peripheral neuropathy. This clearly has implications for our understanding of the pathogenesis, clinical assessment and treatment of this condition.

## Paediatrics

### POSTER 1404

#### Spinal imaging of neonates using a dedicated 0.2 T MR scanner

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**AIM:** To extend the role of an established dedicated MR scanner on the neonatal intensive care unit used for imaging neonatal brains (over 100) to include spinal imaging without the need for sedation or anaesthesia. **METHODS:** A Niche MR scanner (0.2 T, 15 mT m<sup>-1</sup> gradient strength) was installed in an area of 9 m sq. The neonate was placed in the coil in the left lateral position and supported by "cushions". Images were obtained in axial, coronal and sagittal planes. Spatial resolution was 1 mm in plane, with 3–4 mm slices. MR compatible pulse oximetry was used. The neonates were in the scanner for 30 min and readily accessible throughout this time. All neonates had a spinal ultrasound scan performed by an independent expert. **RESULTS:** 3 neonates have been imaged. All tolerated the procedure well. In 2 cases the images obtained provided additional information to ultrasound. In the first case the ultrasound showed the neural defect and associated lipoma but the neural tissue was not clearly seen. MR demonstrated the neural tissue and showed it was passing through the lipoma into the subcutaneous tissue. In the second case the cord appeared to be low and tethered on MR, but it was uncertain as to whether it was tethered on ultrasound. In the third case MR confirmed the ultrasound findings. **CONCLUSION:** These preliminary results suggest that the dedicated scanner will provide useful information prior to surgical exploration. The ability to image without the need for sedation or anaesthesia is a distinct advantage over conventional MRI.

### POSTER 1405

#### Spinal ultrasound in cloacal exostrophy

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**PURPOSE:** To assess the value of spinal ultrasound in cloaca, a rare caudal malformation that may be associated with spinal dysraphism. **MATERIALS AND METHODS:** 12 infants under 1 year of age with cloaca underwent spinal ultrasound (7 10 MHz linear probe) on a single occasion. 3 patients also underwent MRI. Ultrasound and MR images were reviewed. **RESULTS:** 4 out of 12 patients had spinal dysraphism (3 had tethered cord and lipoma, 1 had a myelomeningocele and tethering). In all cases ultrasound and MRI appearances correlated. **CONCLUSIONS:** Spinal ultrasound correlated with MRI findings in all cases. Advantages of spinal ultrasound were both practical (a portable machine could be used) and radiological (a greater number of images are obtainable in sagittal sections). We suggest spinal ultrasound should be the first investigation in all babies with cloaca to diagnose occult and non-occult spinal dysraphism.

## Physics

### POSTER 1504

#### Early experience with MR compatible marker devices

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When undertaking MRI-guided interventional procedures, identification of the necessary site for biopsy can be difficult. The devices consisted of a hollow shapes of Perspex containing water dosed with gadolinium chelate contrast media. A variety of MR compatible localization devices was constructed to assist in this task. MR compatible side markers, slice selection markers, site markers and biopsy plate/protractor were all assessed on phantoms and patients. Experimentation was undertaken with a number of different phantoms, including fruit and vegetables, before utilization on patients. The devices permitted precise localization of the slice, biopsy site and required angle of needle on the patient's surface anatomy. Patents have been applied for on the devices on behalf of the National Health Service.

### POSTER 1505

#### A review of problems encountered using a low field system for interventional MRI

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**PURPOSE:** To identify problems of using a low strength MR system to guide interventional procedures, and to overcome these problems to achieve accurate, high quality images. **METHOD:** A 0.2 T Siemens open MR system was used to undertake MR-guided biopsies. Difficulties encountered included patient positioning for needle access, artefacts (geometric distortion and imaging of various interventional tools) and development of fast sequences with good tissue contrast. In a series of 21 patients, patient positioning and angle of needle insertion were found to be crucial to a successful biopsy. **RESULTS:** High quality imaging of MR compatible needles is dependent on orientation, angle of insertion, sequence (as well as parameters) and direction of read and phase. Needles can become almost invisible if the sequence and angle of insertion are incorrect, and may bend whilst *in situ*. Careful patient positioning and appropriate MR markers can identify needle entry points more accurately. **CONCLUSION:** The majority of potential problems can be overcome to facilitate successful interventional MR using a low field system. Patient and needle positioning are as important as sequence set-up to produce accurate, high quality images.

## Radiation Protection

### POSTER 1610

#### The efficacy of breast shielding during intravenous urography

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**PURPOSE:** Owing to the importance of radiation effects to human tissues, a study was performed to measure radiation exposure to the breast area during standard intravenous urography (IVU) examination using the 3 main projections involving the upper abdomen: the full length, the coned renal and the tomogram. The efficacy of reducing radiation dose to breast tissue in these projections using a lead shielding device was also evaluated. **MATERIALS AND METHODS:** A pair of breast phantoms was constructed to be used on a Rando phantom representing a male thorax as the male phantom had no breasts. Thermoluminescent dosimeters were placed on top and under the breast phantoms to measure surface dose and deep doses for each of the projections separately. Actual exposures were then made on the Rando phantom without and with lead shielding over the breast area. **RESULTS:** The average reduction in surface doses using shielding was 43.45%, and reduction in deep doses was 19.15%. Although some results appeared inconsistent, *t*-tests showed significant differences between doses in shielded and unshielded cases. **CONCLUSION:** This study has managed to measure radiation dose to the breast area in the selected projections and has clearly revealed the value of using a lead shield in reducing the radiation dose to breast area during IVU examination.

## Radiotherapy & Oncology

### POSTER 1704

#### What kinds of double radiation breaks of DNA are irreversible? Molecular and electrodynamic approaches

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These investigations were aimed at determining the conditions under which double breakages of DNA chains owing to detrimental action of irradiation become self-eliminable. Quantum electrodynamic considerations suggest that the energy of interaction between the 2 end-pairs of DNA nucleotides on the opposite sites of a double break are totally under the control of: (i) the width  $L$  of the break; (ii) Coulomb interaction of charges, distributed on the surface of these nucleotides; and (iii) dispersion features of dielectric permeabilities of the nucleotides (adenine, thymine, guanine and cytosine) and intermolecular salt-aqueous medium. Formation of hydrated electrons and heavy ions influences the energy of interaction  $V(r)$ . It has been established for the first time that at low concentration ( $a < 10^{-9}$ ) of hydrated electrons, or at high acidity ( $\text{pH} < 6$ ) of intermolecular salt-aqueous medium, the energy of the mutual interaction of some end-pairs of nucleotides (AT-AT, CG-CG) has a repelling barrier with value  $V(L,0) = (1.3) \text{ KT}$  at  $L_0 = 7-8 \text{ \AA}$ , and corresponds to attraction between them at  $L < L_0$ . If this concentration increases, the barrier reduces. At  $a > 10^{-7}$  or at  $\text{pH} = 11$  the barrier disappears. All other transversal end-pairs of DNA nucleotides experience only attraction. The above situation creates the possibility of a total repairing and self-recovery of the main part of potential kinds of DNA double breakages.

### POSTER 1705

#### Mechanism and time-dependent dynamics of hormesis, antagonism and the radioprotective effect of the combined action of ionizing irradiation to DNA and biological systems

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The main result of the action of irradiation to biological system is the creation of double breaks in DNA macromolecules. At a low concentration of hydrated electrons the energy of the mutual interaction of some end-pairs of nucleotides (AT-AT, GC-GC) has a repelling barrier. If this concentration increases, the barrier reduces. All other transverse end-pairs of DNA nucleotides experience only attraction at any concentration of hydrated electrons. One of the results of irradiation action on intercellular liquid is creation of hydrated electrons and heavy ions. One the one hand, this leads to additional DNA breaks. On the other, it leads to the phenomena of controlled nucleotide pair interaction and possible autorepair of AT-AT and GC-GC breaks. The time-dependent dynamics of DNA depolymerization and autorepair at separated and combined action of free radicals, from slight and intensive irradiation (including the problem of DNA radiation antagonism, time-dependent low dose radiation effects and the phenomenon of "hormesis") is investigated. The main results of this consideration are presented. (i) For the case of short-time irradiation, we see the usual linear (additive) radiation effect: the number of double breaks is proportional to radiation dose and the total action of free radicals. (ii) For the case of long-time, weak intensity radiation we see the phenomenon of hormesis: a decreasing concentration of double breaks in DNA caused by free radicals with increase in intensity of ionizing radiation. (iii) For the case of the combined action of 2 kinds of

irradiation, the phenomenon of radiation antagonism is possible: the number of DNA double breaks caused by radiation J1 decreases with the growing intensity of radiation J2.

## Miscellaneous

### POSTER 0802

#### Deconstructing the technical manual—the representation of patient as model

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**PURPOSE:** To investigate the form and content of images and text used to describe standard projections of the chest in Clark's "Positioning in Radiography", 1939-1998. **MATERIALS AND METHODS:** The section in each volume of "Positioning in Radiography" corresponding to the respiratory system was analysed in detail using pre-defined headings relating to both the text and photographs. Data collected concentrated on the link between text and image, with the aim that analysis of the construction of the complete image would be possible. Deconstruction of the text was built around the analysis of gender. **RESULTS:** Content and contextual analysis will be carried out using detailed notes and photocopies of relevant pages. Photocopies were taken to reinforce descriptions and for clarification in analysis. The results will illustrate the changing portrayal of diagnostic imaging of the respiratory system and links will be made with other medical texts. **CONCLUSION:** Although this is work in progress, already the research has shown great change in both form and content of text and images in Clark's "Positioning in Radiography" over the period. The developments will be described in the context of the development of Gray's and general medical journals.

### POSTER 1803

#### Investigating the aetiology of errors in radiographic interpretation

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The purpose of this study is to explore why inconsistencies exist in diagnoses achieved through the visual perception of radiographic images. Understanding the cause of these perceptual differences may provide enlightenment regarding psychophysical factors that govern free search in a complex display such as a radiograph. Investigation into this area may eventually provide a vital insight into the radiological diagnostic process and may lead to improvements in practice and training for all professions concerned. Initially the research will be focusing on quantitative evaluation of the correlation between identified causes of errors and the nature of the adopted search strategy of experienced and trainee observers. Future research will concentrate on psychophysical factors that may have a positive effect upon human perception of abnormalities in radiographic interpretation. At present, the research is in its preliminary stage; however, results of previous research in this field have highlighted some interesting trends. Identified criteria that may lead to diagnostic errors include incomplete scanning, premature termination of film interpretation and recognition or decision failure. Studies have indicated that nodules are frequently fixated on to the fovea, yet remain unreported. Moreover, it has been proposed that fixation duration could be used to identify false positive and false negative decisions. The author aims to illustrate the importance of this area of research, present research to date and some of the key issues that authorities in this area have so far discovered.

# Notes

Tuesday 23 May

1515–1800

College of Radiographers  
Student Radiographer  
Conference  
Hall 8

1515

**Chairman's Address**

R Cannon

Kings College Hospital, London SE5 9RS, UK

1520

**Discomfort experienced by women during screening mammography**

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The Irish National Breast Screening Programme is in its infancy. Retrospective analysis of its pilot programme evaluated the mortality reductions achievable and the feasibility of introducing the programme at a national level. Little consideration was given to women's perceptions of their experience. The present study focused on one aspect of the woman's visit—her reports of discomfort. Discomfort was assessed using a 5-point Likert scale questionnaire. Open-ended questions were also included to highlight areas of particular concern to women. Factors associated with discomfort were statistically analysed using the Mann-Whitney *U* test. 71% of the women surveyed ( $n=33$ ) regarded the procedure as uncomfortable. Statistical analysis of the data showed that satisfaction was significantly reduced in those women who reported high levels of discomfort ( $p=0.02$ ). A cold cassette holder and a lack of information about the procedure significantly increased the discomfort experienced by women ( $p=0.03$  and  $p=0.02$ , respectively). The reassurance offered by the mammographer and the woman's perception of her did not affect levels of discomfort. The results indicate that some areas of the service could be improved to promote women's satisfaction with their visit. This may facilitate the success of the service at a national level by ensuring that fear of discomfort does not erode attendance levels in subsequent rounds of screening.

1530

**Plain film radiography of paediatric cervical spine trauma**

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Paediatric training in many general and district hospitals is through experience; study days are expensive and time off is often difficult to cover. The incidence of paediatric cervical spine trauma is low; many radiographers will only see 3 or 4 cases in their working careers. Damage to the paediatric cervical spine generally falls into 2 groups based on age, which are linked to the development and maturity of the cervical spine, its musculature and ligaments. Children under 10 years of age, who naturally have a larger head-to-body ratio, tend to suffer upper cervical spine damage to C1, C2 and C3. The most common injury is an anteriorly displaced dens fracture, which tends to be caused by motor vehicle accidents. Children over 10 years of age have more adult-type injuries to the lower cervical spine, usually caused by sporting accidents. A common problem in interpreting the radiograph is misinterpreting a synchondrosis, the joint between 2 ossification centres, as a fracture when correctly it is a synchondrotic slip. Another common error is misdiagnosing luxation of C2 over C3, or C3 over C4 when this pseudoluxation is due to lax anterior longitudinal ligaments, *i.e.* developmental anatomy. Plain film radiography has some advantages over other modalities, *i.e.* it is readily available and therefore cheap and comparatively quick. Modalities such as CT and MRI have other advantages. CT will demonstrate bony abnormalities as well as oedema and haemorrhage, while MRI is very good at showing ligament and muscular damage.

1540

**Knowing the differences and similarities between non-accidental injury and osteogenesis imperfecta**

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There has been much media coverage recently about non-accidental injury (NAI) cases in children. These children can present with multiple new, healing and old fractures, retinal haemorrhage, and, in severe cases, subdural haematoma. If a child presents in accident and emergency with unexplained multiple fractures it is the job of the radiographer to put the hospital's child protection policy into practice. Osteogenesis imperfecta (OI) can present with similar findings to NAI. There are 4 types of OI. In the first 3 types the classic signs and symptoms of OI, namely blue sclera, discoloured teeth, triangular face and barrel-shaped rib cage, are all present to varying degrees. Type 4, however, can show few or none of the symptoms that normally classify OI. This is where OI and NAI can sometimes be misinterpreted. Although radiographers do not, at the present time, make the diagnosis of NAI or OI, it is the radiographers' job to put the child protection policy into action for any unexplained injuries on children. Radiographers should know the child protection policy in each hospital where they work and how it applies to the radiography department. As a profession, radiographers should know the differences and similarities between OI and NAI, and the best protocol when performing skeletal surveys for OI and NAI. Radiographers should also be aware of the use of other imaging modalities when trying to help diagnose between the two conditions.

1550

**Ultrasound imaging of the premature neonatal brain**

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Premature and very low birth weight infants are a high-risk patient population, accounting for approximately 46% of infant deaths. Dramatic improvements in neonatal and perinatal care over the past 3 decades has led to the ever increasing number of infants surviving despite being born prematurely. This trend may reflect, in part, the application of specific neonatal evaluation techniques. In this context, high resolution ultrasound has increasingly facilitated accurate diagnosis of many abnormalities. Currently, ultrasound is the initial technique of choice for imaging the brain of an infant with suspected intracranial pathology. Existing evidence shows that use of ultrasound at specific stages after the birth of a premature infant, and in the presence of clinical signs and symptoms, is accurate and beneficial. Although some known abnormalities are specifically sought owing to symptoms or stages after birth, some abnormalities can occur spontaneously without warning or known risk. For these reasons, routine ultrasound as a screening tool for the premature neonatal brain is an appealing concept. However, the value of routine ultrasound screening in apparently normal premature infants is controversial. Furthermore, is the detection of severe malformations using ultrasound in itself sufficient to justify its general use? There is a growing body of evidence from nursing and medical research that indicates that any handling of critically ill premature infants has the potential to cause distress. The advantages of routine scanning must be weighed against these risks.

1600

**Is there an infection control risk when using moving and handling equipment**

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The apparent lack of infection control within a radiology department prompted the study into the possible risks of cross contamination via moving and handling aids. Since the introduction of the Manual Handling Operations regulations in 1992, there has been increased use of the moving and handling equipment in the radiology department. At present, very little research has been performed to establish whether patients are at risk from using this equipment. The study aimed to identify any risks of cross contamination that may be present and to determine whether decontamination of the moving and handling equipment is necessary between patients. This was achieved by taking bacterial swabs from a number of pieces of moving and handling equipment in the radiology department. An investigation into the knowledge of radiology staff using this equipment regarding infection control was also undertaken. Information was obtained by administering questionnaires to all staff who use the moving and handling equipment. Results from the bacterial swabs showed that the equipment provides a suitable environment for bacteria to survive and grow. Bacteria cultured included methicillin-resistant *Staphylococcus aureus* (MRSA),

STUDENT WORK

*Staphylococcus aureus* methicillin strain and *Streptococcus viridans*. Thus, moving and handling equipment may pose a risk of cross contamination to the patient and the user, and should be cleaned correctly after each patient. The responses received from the questionnaires indicated that there was a lack of knowledge with regard to infection control and specifically with regard to the decontamination of the moving and handling equipment.

## 1610

**A pilot study to evaluate the decontamination method used in a radiotherapy department**

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Immobilization during radiotherapy is necessary to obtain an accurate and reproducible treatment position on a daily basis. As the equipment used comes into contact with patients' skin, it is likely to become contaminated with resident and transient flora, and possibly with pathogenic organisms. Patients with malignant disease are more susceptible to infection, either owing to the nature of the illness or to the treatment modality. Therefore, adequate decontamination of equipment is necessary. This small, quantitative, comparative study involved equipment sampling at the beginning and end of 1 day in a radiotherapy department. It tested the type and number of microorganisms accumulated during a typical working day as well as a decontamination method. Of the 9 items tested, it was found that resident skin flora (*Staphylococcus epidermis*, *Corynebacteria*) and transient skin flora (coliform) were present at the end of the day. From the results it was concluded that, within this population of patients, disinfection with 60–70% alcohol would be a more suitable decontamination method. This would reduce the risk of hospital-acquired infection in patients attending the radiotherapy department.

## 1620

**Lymphoscintigraphy for sentinel node detection and removal**

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**PURPOSE:** The lymphatic system is major route for the progression of many malignant and infectious diseases. Its investigation has long been undertaken in an attempt to effectively diagnose the extent of disease and to help plan treatment. In the past, the most frequently used method of investigation was invasive node dissection. As an alternative, lymphoscintigraphy has many advantages: shorter recovery time, shorter lingering effects of swelling and a low risk of infection. The nuclear medicine procedure itself has been shown to be reproducible and effective, with a short procedure time, low cost, minimal invasiveness and minimal patient preparation compared with other imaging modalities. **METHOD:** For this study, the patient was injected subcutaneously around the site of excision. Images were obtained immediately, 20 min and 2 h post injection. Once the sentinel node had been located, the patient was taken into theatre and the sentinel node located using a gamma probe. The node was then removed and subsequently analysed. **CONCLUSION:** Results indicate that gamma probe-guided localization of radiolabelled lymph nodes can non-invasively direct the surgeon to the exact location of the sentinel node, thus achieving a high success rate. Although lymphoscintigraphy is requested infrequently, it is technically simple, minimally invasive and potentially may improve the management of treatment of patients with malignant melanoma.

## 1630

**The evolution and future role of extracorporeal shock wave therapy**

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Since the introduction of extracorporeal shock wave lithotripsy (ESWL), the treatment of calculi has been revolutionized. This is most apparent in the area of renal and ureteral calculi, although the treatment of biliary, pancreatic and salivary duct calculi has also benefited from this new procedure. A new and exciting development of ESWL is extracorporeal shock wave therapy (ESWT). ESWT is set to radically alter the treatment of conditions such as pseudoarthrosis, tendinitis calcarea, epicondylopathy humeri radialis, and plantar and dorsal heel spurs. In the area of pseudoarthrosis, ESWT purports to initiate proliferation of bone tissue combined with ossification; while in the treatment of tendinopathies

it claims to eliminate abnormal calcifications in the human body. Information was obtained from the ESWL centre in Northern Ireland, the Internet, medical libraries, the European Society for Musculoskeletal Shock Wave Therapy (ESMST), and Dornier Med. Tech., the main suppliers of ESWL and ESWT equipment. The main difficulty is that any ESWT literature of note has only been published in the last 8–10 years. Long-standing results and their implications cannot be assessed. Nevertheless, it is a new and exciting area that radiographers should be informed about as it has possibilities for role development.

## 1640

**A comparison between CT angiography and conventional cerebral angiography in the diagnosis of intercranial aneurysms**

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In recent years there have been several advances in the methods used for diagnosing and treating intercranial aneurysms. Berry aneurysms, for example; are a weakening of the tunica media of the arterial wall and commonly arise at the middle cerebral artery bifurcation. This paper seeks to compare 2 methods of diagnosing intercranial aneurysms: CT angiography and conventional angiography. The comparison is based upon literature searches, interviews and observational experience during a 3-week placement. Points of comparison used are technique, radiation dose, cost, time and diagnostic value. Potential developments are also discussed. It is found that with current technology, conventional angiography remains superior in the eventual diagnosis of intercranial aneurysms, although it is noted that with improved software applications, CT angiography may supersede conventional angiography as an imaging modality in diagnosing this common pathology.

## 1650

**Imaging of mechanodegenerative pathology of the lumbar spine: comparison of MRI and plain radiography**

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**PURPOSE:** This study aimed to establish whether more abnormalities are diagnosed on MRI than plain radiography, and whether these abnormalities are treatable or incidental. **METHOD:** A retrospective survey was conducted of all MRI scans carried out at 1 hospital between 1994/95 and 1998/99 on patients whose symptoms indicated a mechanodegenerative pathology of the lumbar spine. 1425 scans were included in the study group, divided between those where the MRI scan was preceded by a plain radiograph (39%) and those where the scan was the first imaging examination (61%). The outcome of each scan was categorized according to a radiologist's report. **RESULTS AND CONCLUSIONS:** The outcomes of radiography and MRI in the same patient were compared using McNemar's test and were found to be different at a significance level of 0.05. The main categories of pathology involved were prolapsed intervertebral disc with nerve or spinal cord compression and stenosis, central or foraminal. The outcomes of MRI scans preceded by radiography and scans that were the first imaging examination were compared using a  $\chi^2$  test; they were also found to be different at a significance level of 0.05. The difference was accounted for by additional cases of degeneration and fewer cases of spondylolisthesis in the latter group. For 66% of all MRI scans no abnormality was demonstrated, or degenerative changes only were recorded.

## 1700

**The use of self-expanding metallic stents to relieve acute bowel obstruction**

C Humberstone

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**PURPOSE:** The presence of a large bowel obstruction in a patient with colorectal neoplasm normally requires surgical intervention. There have been recent developments in the use of self-expanding metallic stents both for palliation and for bowel decompression prior to surgery. This study evaluates the efficacy of these stents in the treatment of acute colorectal obstruction secondary to colorectal neoplasm. **METHOD:** 8 patients between the age of 52 and 92 years in whom attempts were made to insert self-expanding metallic stents under radiological guidance were considered retrospectively. Data concerning age, gender, clinical indications, position of stricture, success of deployment, complications and outcome were obtained from hospital records. **RESULTS:** Stent placement was successfully achieved in 6 out of 8 patients. No complications occurred as a result of the stenting procedure, although 1 patient later complained



of pain. Long-term luminal patency and satisfactory bowel function was achieved in 5 patients. In 1 patient the stent became obstructed due to tumour ingrowth and was uneventfully passed. Stent migration occurred in 2 patients. **CONCLUSION:** Results suggest that stent implantation is an effective method of bowel decompression.

**1710**

**The establishment of diagnostic reference levels for barium enemas and barium meals**

E Carroll and P Brennan

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European legislation stipulates that member states must promote the establishment and use of diagnostic reference dose levels. This legislation should be implemented in Ireland by 13 May 2000. A previous study carried out by our group to establish reference dose levels for common examinations (chest, abdomen, pelvis and lumbar spine) in Ireland demonstrated lower reference dose levels (by up to 40%) compared with those for the same examination established in the UK. This reinforces the importance of each country establishing their own reference dose levels. The study currently underway aims to establish adult national reference dose levels for barium enemas and barium meals. 19 hospitals nation-wide were randomly selected, representing almost 50% of Irish hospitals suitable for this study. Dose-area product meters will be used to provide a dose measurement. Factors linked to patient dose levels, such as equipment type, filtration and duration of exposure, will be collected. All data will then be analysed, determining any intrahospital or interhospital variations. In addition, national reference dose levels for standard-sized patients will be obtained at the level of the third quartile value. These reference dose levels will be distributed to all Irish X-ray departments following discussions with the

Radiological Protection Institute of Ireland. Once the national reference dose levels are in place, it will be necessary for departments to take corrective action if reference levels are being exceeded.

**1720**

**From the horse's mouth? Communication with horses and its application to the human environment**

H Gatenby

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This study reflects upon the methods and techniques of communication used in a large animal hospital, drawing parallels with human practice. The study provides an in-depth discussion based on the author's 3-week placement in an equine hospital, highlighting the importance of verbal and non-verbal communication. The emphasis will be in applying the knowledge gained to the human radiographic environment. The unpredictable disposition of horses may lead to dangerous consequences if an animal is provoked into a reflex of anxiety or aggression. It is therefore important that any situation that may lead to such a reflex action is appropriately controlled. Although methods of immobilization, such as IV sedation, are employed with every animal, this does little when presented with an anxiety flight reflex. Successful communication, incorporating both verbal and non-verbal techniques, is therefore necessary to ensure that the patient and staff are safe.

**1730**

**Presidential Address**

J Reid

*The College of Radiographers, 2 Carriage Row, 183 Eversholt Street, London NW1 1BU, UK*

**1740**

**Debate with the President**

## Posters

### National Indoor Arena Concourse Area

#### Student

##### POSTER 1901

###### Women's satisfaction with screening mammography

C A Doyle and M T Stanton

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Provision of an effective healthcare service demands a comprehensive quality assurance programme. This is particularly salient in breast screening where apparently healthy women are invited to attend for examination. In the present study, 50 consecutive women attending for mammography screening were administered a questionnaire survey to assess their satisfaction with various aspects of the service. Both closed and open-ended questions were included to provide a more comprehensive survey of women's levels of satisfaction. Closed questions were based on a tick-box design, 5-point Likert scale. Results were statistically analysed using the Mann-Whitney *U* test. Overall perceptions regarding staff were particularly positive; women applauded staff for their reassurance and the holistic care shown by them. Less positive were women's views of the facilities provided at the centre. Low levels of satisfaction with the wait for the results of the mammogram were also highlighted. The authors advocate a number of recommendations based on the findings of the investigation, which could help to promote women's satisfaction with their visit. This in turn may facilitate the success of a screening programme by helping to maintain high levels of attendance.

##### POSTER 1902

###### An investigation of dental radiography performed by holders of the Certificate in Dental Radiography

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**PURPOSE:** To determine whether holders of the "Certificate in Dental Radiography" (CDR) are restricted in the amount of clinical practice they can perform in the workplace. **MATERIALS AND METHODS:** A qualitative prospective postal survey of holders of the CDR and of their employers was undertaken to evaluate the amount of dental radiography performed. The CDR course is offered by 15 education centres in the UK, and the study aimed to survey successful past students, and their employers, from courses completed within a 2-year time frame, which encompassing courses completed between 1996 and 1999. 5 of the possible 15 education centres took part in the study and provided contact addresses for the postal survey. The questionnaire design investigated the reasons for the holders studying the CDR, the amount of clinical practice achieved by the holders, the types and frequencies performed, and whether the level of dental radiography performed maintained their clinical competence. **RESULTS AND CONCLUSION:** The study demonstrated that factors may influence and restrict the amount of dental radiography that holders of the CDR can perform. These factors related to the type of dental practice workplace, the types of dental radiography performed (intraoral and extraoral), and the location of dental radiographic equipment (chairside or designated room). The majority of holders performed some dental radiography on a regular basis, but the findings showed that 49% of the 163 respondents said either "no" or that they were unsure whether the level of dental radiography performed by them, or their staff, was sufficient to maintain clinical competence.

##### POSTER 1903

###### Evaluation of staff attitudes and opinions towards the installation of a computed radiography system in A&E

S E Jones

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**PURPOSE:** Computed radiography (CR) is becoming actively incorporated into radiology departments across the country,

in particular Accident and Emergency (A&E) departments. Implementation of CR equipment in A&E will bring the expectation of numerous advantages in trauma imaging. Some of these advantages include ease of use, improved image quality and a reduction in patient dose. Installation of CR will have a major impact on the staff involved in its use. These staff include radiographers, radiologists, clerical workers and A&E staff nurses. Research was conducted in a district general hospital that installed a CR system in A&E in January 2000. The aims of the research were: (a) to ascertain the opinions of the radiology department towards CR before, during and after installation; (b) to highlight any concerns or problems with the system; and (c) to determine whether concerns were resolved. **METHODS:** Data were collected from members of staff in the form of structured interviews, questionnaires and observations. The interviews took place before, during and after installation, to determine the general attitude towards the new technology and to assess its benefits and drawbacks. **RESULTS:** To date, the results show that radiology staff in question highlighted many concerns and fears towards the new technology, and few advantages. The main concerns raised were the slow speed of the system and the poor quality of images produced as well as fears regarding patient dose. These serious concerns raise a question over whether CR can truly be regarded as the future for radiography.

##### POSTER 1904

###### Do healthcare professionals have an accurate perception of radiographers and their role?

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It appears that historically radiographers and their role were held in low esteem by healthcare professionals. A literature review established that radiographers are seen to perform radiographs, to have poor clinical knowledge and to be unable to communicate with patients. The purpose of this research was to determine how healthcare groups perceived the clinical knowledge of radiographers, the extent of their role in clinical imaging and their level of education and training. A sample was chosen from 1 district general hospital and included those professionals who came from areas likely to be in contact with the imaging department on a regular basis and had some existing knowledge or perception of the issues in question. Data were collected using a questionnaire. Results indicate that the knowledge of the study sample was better than previous evidence suggests. They felt positive towards radiography as a profession, although responses varied regarding the academic achievements necessary to study radiography, the length of training and the resultant qualification. They also seemed unaware of the diversity of the radiographer's role and how this role overlaps with that of the radiologist. In conclusion, the survey indicated that the radiographer today is more likely to be perceived as a healthcare professional who has a part to play in the management and treatment of patients. However, further research should be undertaken in this area to gain a national comparison and survey of other healthcare personnel.

##### POSTER 1905

###### What's in a symbol? Medical imaging and the Charter Mark: standards and user satisfaction

D M Hudson

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In the Medical Imaging Department at the Queen Elizabeth the Queen Mother Hospital, quality is of high priority. The department sought recognition for this by applying for the Government's Charter Mark for quality and efficiency in the public services. However, the application was unsuccessful, highlighting the need for the department to assess its standards more thoroughly and to find better ways of consulting users on standards and their satisfaction with services provided. It was decided that, owing to the inherent complexity of quality and its related issues, the tools used should be as simple and usable as possible, providing quantitative scores for continued measurement and assessment, and qualitative

*Radiology 2000—Imaging, Oncology & Science*

feedback for more in-depth review. This was achieved by: (a) a survey of patient satisfaction and consultation on standards using a questionnaire, completed through semi-structured interview; and (b) an observational-based audit into the fulfilment of standards in place within the department. The preliminary results of patient satisfaction show an average score of 95.83%, with some useful feedback obtained regarding areas that need improving; in most cases these

have been rectified. Regarding for the standards, the audit results appear positive, with only minor areas appearing to need attention. From the results reviewed so far, it seems that satisfaction and standards in the department are high. It is anticipated that these results and the methods used will prove useful both in continual assessment, and in meeting the criteria for the Charter Mark and, more importantly, overall service quality provided.

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