Topic Index

- Abdomen
- Controversies in Emergency Ultrasound
- General (Technology & Physics)
- Gynaecology
- Musculoskeletal
- Obstetrics
- Paediatrics
- Physics
- Ultrasound Contrast
- Ultrasound Screening
- UMSA Session
- Urogenital
- Vascular
- Veterinary

Poster Exhibition:

- General Posters
- Professional Issues
- Musculoskeletal
- Obstetrics/Gynaecology
- Physics and Vascular
- Paediatrics

Keyword Search

You can search this document for keywords by using the PDF search function, which can be activated by pressing and holding the ‘control’ (Ctrl) key and then press the ‘F’ key.
Abstracts Index

**Abdomen**

1. *The Imaging of Gallbladder Disease.* Callaway, M (Bristol)  ...view

2. *Acute Pancreatitis—Investigation and Role of Ultrasound.* Jackson S (Plymouth)  ...view

3. *Pancreatic Tumours.* McLean A (London)  ...view

**Controversies in Emergency Ultrasound**

4. *FAST Ultrasound Down Under.* Sarker B (Gateshead) BMUS Australian Exchange Award Winner  ...view

5. *Ultrasound of Appendicitis—is There Anything Else in the RIF?* Peck R (Sheffield)  ...view

6. *The Acute Scrotum.* Elliot S (Newcastle)  ...view

7. *How Appropriate are Urgent Outpatient Ultrasound Requests?* Aw J1, Andrews H1, Philips S1, Cooke D2 (1United Bristol Healthcare Trust 2 Musgrove Hospital (Taunton)  ...view

8. *Fast or ‘F***ing Amateurs Shouldn’t Tinker’: assuring the quality of ultrasound outside of the Radiology Department.* Sarker BA, Rickards M, Jarman R, Halford N, Newby MP (Queen Elizabeth Hospital, Gateshead)  ...view

**General (Professional Issues & Technology)**

9. *Maintaining Quality & Safety—the Benefits of a Trust-wide Ultrasound Group.* Sarker BA, Hughes T (Queen Elizabeth Hospital, Gateshead)  ...view

10. *Consultant Sonographers—Myth or Reality?* Patel S (North West London Hospitals Trust)  ...view

11. *Evaluation of a Novel Device for Ultrasound QA.* Dudley NJ1, Coulthard P2 (1Nottingham University Hospitals NHS Trust, 2Northern Physics Services)  ...view

12. *Colour Doppler Signal to Noise Ratio and Dynamic Range Performance for a Range of Scanners.* King DM1, Moran C M2, Hussey M1, Browne JE1 (1Dublin Institute of Technology 2University of Edinburgh)  ...view

13. *Beam Forming and Transducers.* Whittingham TA (Newcastle)  ...view


**Gynaecology**

15. *The Differential Diagnosis of Ovarian Masses—the Role of Ultrasound.* F. Tranquart1, H. Marret2, S. Sauget2, A Bleuven1 (1INSERMU619, Technical Innovation Centre, CHRU Tours, and 2Department of Obstetrics and Gynaecology, CHRU Tours, France)  ...view
**Musculoskeletal**

16. **The Paediatric Hip.** Johnson K (Birmingham) ...view

17. **The Sonographic Appearance of the Achilles Tendon of Army Recruits—a Prospective Study.** Savage SJ, Gane AS (Yeovil District Hospital) ...view

18. **Ultrasound Assessment of the Thumb.** Lammers G, Spanger M (Knox Private Diagnostic Imaging, Australia) ...view

**Obstetrics**

19. **Ultrasound Assessment of the Influence of Sub-Clinical Maternal Vitamin D Deficiency on Fetal Femur Development—a Pilot Study.** Mahon P, Poole J, Cooper C, Arden N, Godfrey K (MRC Epidemiology Resource Centre, Southampton) ...view

20. **How Accurate are NT Measurements?** Evans JA1, Watson A2, Moore AC3, Brettele DS3 (1Leeds General Infirmary, 2Gartnavel Royal Hospital, Glasgow, 3Leeds Hospitals NHS Trust) ...view

21. **First Trimester Identification of Placental Invasion.** Comstock C (USA) ...view

22. **Second and Third Trimester Ultrasound in Identification of Abnormal Placentation.** Comstock C (USA) ...view

**Paediatrics**

23. **Assessment and Sclerotherapy of Paediatric Vascular Malformations.** Barnacle AM (London) ...view

**Physics: Ultrasound Therapy**

24. **Cancer Treatment with HIFU-Current Status and Future Promise.** ter Haar G (Sutton) ...view

25. **Ultrasound Gene Transfection Experiments: a system to facilitate good dosimetry and high throughput.** Bamber JC, Bush NL, Porter CD, Taylor SL (Institute of Cancer Research, Sutton, Surrey) ...view

**Ultrasound Contrast**

26. **The Value of Contrast Enhanced Ultrasound for Focal Liver Lesions in Clinical Practice: achieving optimal diagnostic yield through this new imaging modality.** Albrecht T (Germany) ...view

27. **Impact of New Guidelines on the Use of Contrast Agents in Liver Ultrasound.** Thorelius L (Sweden) ...view

**Ultrasound Screening**


29. **Testicular Microlithiasis - Ultrasound Surveillance.** Sidhu P (London) ...view
30. **Ergonomics—a Manufacturers View.** Murray C, Miles JB (Siemens Medical Solutions) [view]

31. **Accuracy of 2-D and 3-D Ultrasonic Methods for Determining Bladder Volume.** Miller N1, Mangar S2, Hsu A2, Huddart R2, Bamber J2 (1Royal Marsden Hospital, 2Institute of Cancer Research, Sutton) [view]

32. **Maternal Abdominal Emergencies in Pregnancy: problem solving with MR imaging.** Spencer J (Leeds) [view]

33. **The Scrotum—a Sonographic Challenge?** Clements R (Newport) [view]

34. **Microbubble Ultrasound Contrast in the Assessment of Acute Renal Transplant Recipients.** Kay D, Mazonakis M, Geddes C, Baxter G (Western Infirmary, Glasgow) [view]

35. **Re-organisation of the In-Patient DVT Imaging Service - the Plymouth Experience.** Veitch AM, Shirley J, Vivien G, Nokes TJ C, Freeman SJ (Derriford Hospital, Plymouth, UK) [view]

36. **Value of Repeat Doppler Ultrasound Examination in Outpatients with Suspected Deep Venous Thrombosis.** Narayanaswamy S, Venkatanarasimha N, Lester Z, Nokes T, Dubbins P (Derriford Hospital, Plymouth, UK) [view]

37. **Surveillance Following Carotid Endarterectomy.** Walker R (Bath) [view]

38. **Surveillance Following Endovascular Aortic Aneurysm Repair.** Hartshorne T (Leicester) [view]

39. **Contrast Ultrasound Vessel Mapping in DIEP Flap Surgery—Helping the Surgeon.** Davies AG, Perez-Tehprano A, Wilson P, Morris RJ, Freeman SJ (Derriford Hospital, Plymouth) [view]

40. **Complications of Vascular Closure Devices as Seen by Ultrasound.** Lammers G, Spanger M (Knox Private Diagnostic Imaging, Australia) [view]

41. **3D Ultrasound in Non-Domestic Species.** Hildebrandt T (Germany) [view]

42. **A Comparison Between Radiography and Ultrasonography for the Diagnosis of Abdominal Disorders in the Dog.** Saunders JH, Bissot T (Belgium) [view]

43. **Pre- and Post-Treatment Ultrasonography in Hypothyroid Dogs.** Taeymans O, Duchateau L, Daminet S, Saunders JH (Belgium) [view]

44. **Use of Ultrasonography in the Diagnosis of Medial Coronoid Process Disease.** Newitt A (Liverpool, UK) [view]

45. **Ultrasonographic Findings of the Liver in Goat.** Gahiri A, Hajikolahei MRH (Iran) [view]

46. **Ultrasound at the Zoo.** Hildebrandt TB, Goeritz F, Hermes R (Institute for Zoo and Wildlife Research, Berlin) [view]
Poster Index

General Posters


2. Contrast Enhanced Ultrasound: ‘appearances can be deceiving’. Nair S, Parker P, George C, Byass O (Hull Royal Infirmary)  


4. The Epididymis and Beyond. Davies AG, Anaspure R, Cantin P, Dubbins PA, Freeman SF (Derriford Hospital, Plymouth)  

5. Ultrasound Contrast of Focal Liver Lesions. Davies AG, Anaspure R, Gutteridge C, Dubbins PA, Freeman SF (Derriford Hospital, Plymouth)  


7. Does Abdominal Ultrasound Change the Initial Diagnosis and Influence Management for Patients Admitted with Acute Abdominal Symptoms? Gane AS1, Springett G2 (1Yeovil District Hospital, and 2 University of the West of England)  

8. Transrectal Ultrasound-guided Prostate Biopsy–are We Hitting the Target? Rutherford EE, Lane CE, Smart JM, Dewbury KC (Southampton University Hospitals NHS Trust)  

9. Developing an Existing Ultrasound Practice in Karachi, Pakistan. Dodgeon JR1, Dixon AM2 (1University of Salford, and 2University of Bradford)  

10. Artefacts on Ultrasound: pearls and pitfalls. A pictorial review. Venkatanarasimha NK, Narayanaswamy SM, Cantin P, Mayo M, Freeman S (Derriford Hospital, Plymouth)  

11. Early Experience of Ultrasound-guided Botulium Toxin—a Injection for the Treatment of Sialorrhoea. Johnson JG1, England A2, Hurley E1, Tuffin J1 (1South Manchester University Hospitals 2University of Liverpool)  

12. Is Common Bile Duct Diameter Affected by Respiratory Phase? Johnson JG1, England A2, Sukumar S1, Martin DF1 (1South Manchester University Hospitals 2University of Liverpool)  

Professional Issues

13. Negotiated Work Based Learning—Bespoke Ultrasound Training. Walton JM1, Maraj M2 (1University of Liverpool and 2Liverpool Women's Hospital and Royal Liverpool University Hospital)  

14. Matching Ultrasound Training and Assessment Needs to Stages in Development of Clinical Skills. The Liverpool Experience. Walton JM1, Ford K2, Briggs S3 (1University of Liverpool, 2Liverpool Women's Hospital, 3South Manchester University Hospital Trust, Manchester)  

15. Acquiring Clinical Competencies through Negotiated Workbased Learning. Maraj M1, Walton JM2 (1Liverpool Women's Hospital and Royal Liverpool University Hospital, and 2University of Liverpool)  

16. Developing Ultrasound Education in Oslo, Norway. Dodgeon JR1, Holdcroft D2, Vinorum A3 (1University of Salford, 2University of Derby, and 3University College, Oslo)
17. Audit of the Perceived Ultrasound Scan Experience of Specialists Registrars Working in the Liverpool Women’s Foundation Trust. Chawla S, Drakeley A, Holmes E (Liverpool Women’s Foundation Trust)  ...view

18. Fast Scan and Beyond. Chow H K  ...view

Musculoskeletal

19. Role of Ultrasound in Hip Joint Pathology. Prajapati H, Raychudhari C (H M Patel Medical Care Centre, Shree Krishna Hospital, India)  ...view

20. Shoulder Ultrasound in Rheumatology. Shah V, Heywood M, Shaikh M, Tare P, Srinivasan A (Broomfield Hospital, Mid Essex Hospitals NHS Trust)  ...view

21. Pointer-s or Wavers? Davies RS, Smith R, Wynn-Jones D (Morriston Hospital, Swansea)  ...view

Obstetrics/Gynaecology

22. Diagnostic Pitfalls of Ectopic Pregnancy. Duffin PA, Langstaff K (St James’s University Hospital, Leeds)  ...view

23. Information for Waiting Women. Neale E, Messenger L, Everett S, Chudleigh P (Rosie Hospital, Addenbrookes NHS Trust, Cambridge)  ...view

24. An Audit into the Management of Growth Restricted Fetus. Khashia, DE A, Chanda P, Schram CMH (Royal Blackburn Hospital)  ...view

25. Ectopic Pregnancy: implantation within caesarean section scar. White JA, Haslam C, Gavan D, Martindale EA (East Lancashire Hospitals Trust)  ...view

26. The Impact of Establishing a Dating Service. White JA, Martindale EA, Edington A (East Lancashire Hospitals Trust)  ...view

27. One in a Million — a Case of Proteus Syndrome. Arundale LJ (St James’s University Hospital, Leeds)  ...view

28. An Evaluation of the Routine Four-chamber View in the Detection of Congenital Heart Defects. Holland WD1, Holdcroft D2, Weston J1 (1Derby Hospitals NHS Foundation Trust, and 2University of Derby)  ...view

29. An Audit on the Use of Transvaginal Scanning for Placenta Localization from 34 Weeks Gestation. Towers N, Briers SM (Whiston Hospital, Preston)  ...view

30. Comparative Study of Transperineal and Transvaginal Sonography for Localization of Placenta in Antepartum Haemorrhage. Dahiya P, Sangwan K, Gupta N, Sen J (Postgraduate Institute of Medical Sciences Rohtak, Haryana, India)  ...view

31. Ten Years (1995–2004) Outcome of Fetal Neural Tube Defect. Pathak SP1, Fayaaz HF2, Cameron AC3 (1James Paget Hospital, Norfolk, 2Alexandra Hospital, Paisley, and 3Queen Mother’s Hospital, Glasgow)  ...view

32. Accuracy of Ultrasound Estimated Fetal Weight Measurement. Franklin VE, Crichton F, Ekevall K (Stirling Royal Infirmary)  ...view

33. First and Third Trimester Ultrasound in the Prediction of Birthweight Discordance in Twins. Banks C L  ...view
**Physics and Vascular**

34. Limitations of Displacement Estimation Using 4-D Envelope-Detected Data from a Motorized Curvilinear Array. Miller N1, Harris E2, Symonds-Tayler R2, Evans P2, Bamber J2 (1Royal Marsden Hospital, Sutton 2 Institute of Cancer Research, Sutton) ...view

35. The Potential for High Frequency Ultrasound Velocity Shift in Atherosclerotic Plaque Characterization. Brewin MP, Birch MJ, Srodon P (Barts and London NHS Trust, Royal London Hospital) ...view

36. Skin Elastography in Breast Cancer-related Lymphoedema Patients under Surface Tensile Loading. Coutts LV, Bamber JC, Miller NR (Institute of Cancer Research, Sutton, Surrey) ...view

37. Properties of Doppler Embolic Signals Detected during Cardiac Surgery. Chung EML1, Sumner RL2, Martin MJ2, Fan L2, Evans DH2 (1Leicester Royal Infirmary and 2University of Leicester) ...view

38. Practical Implications of the Temperature Dependence of Speed of Sound and Attenuation in Urethane Test Objects. Dudley NJ, Fairhurst L, Gibson NM (Nottingham University Hospitals NHS Trust) ...view

39. Audit of DVT Requests Based on Risk Score and D-dimer Value. Diment C (St Helens and Knowsley Hospitals NHS Trust, Whiston Hospital, Prescot) ...view

40. Novel Approaches to the Determination of Colour Doppler Spatial and Temporal Resolution. Browne J1, Watson AJ2, Hoskins3, Elliot AT4 (1Dublin Institute of Technology, 2Western Infirmary Glasgow, 3University of Edinburgh, and 4Royal Infirmary of Edinburgh) ...view

41. The Relationship Between Doppler Embolic Signal Intensity and Thrombus Size: an in vitro study. Martin MJ1, Chung EML2, Ramnarine K2, Gittins J2, Evans DH2 (1Leicester University, and 2University Hospitals of Leicester NHS Trust) ...view

42. Performance Analyses of Two Transcranial Doppler Ultrasound Systems Using an Electronic Phantom and a Flow Phantom. Fan L, Ramnarine KV, Gittins J, Evans DH (University Hospitals of Leicester NHS Trust/University of Leicester) ...view

43. Viewing Conditions in Ultrasound: the forgotten variable. Evans JA1, Coulson K1, Tatow Tabe J1, Bettle DS2, Moore SC2 (1University of Leeds, and 2Leeds Hospitals NHS Trust) ...view

**Paediatrics**

44. Urothelial Thickening in the Paediatric Renal Pelvis—a Rare, Underecognized and Important Sign. Cooper JCE, Murphy AM (York Hospital) ...view
Abdomen

The Imaging of Gallbladder Disease. Callaway, M (Bristol)

In an imaging setting, the most frequently encountered gallbladder pathology is stone disease, which affects approximately 10% of the population. Although stone disease is the most commonly encountered pathology affecting the gallbladder, there are several other disease processes that can affect it. The purpose of this talk is to discuss the imaging features of common and less common gallbladder pathologies encountered in radiological practice.

The following areas will be discussed:

- Outline of the anatomy of the gallbladder and variations thereof.
- Stone disease—pathophysiology and outline of imaging features and interventions commonly undertaken using various modalities.
- Pathophysiology and multi modality imaging features of the benign and malignant processes involving the gallbladder. These include adenomyomatosis; cholesterolosis; polyps; milk of calcium bile; porcelain gallbladder; acalculous, xanthogranulomatous and emphysematous cholecystitis; gallbladder cancers; haemorrhage and other systemic conditions affecting the gallbladder.

The learning objectives of this talk are:

- To illustrate the radiological features and interventions associated with stone disease
- To demonstrate the imaging features of the various other less common, but nevertheless important disease processes which affect the gallbladder

Acute Pancreatitis — Investigation and Role of Ultrasound. Jackson S (Plymouth)

The word pancreas is derived from the Greek meaning: ‘pan’ (all) and ‘kreas’ (flesh). The derivation alludes to the fact that the organ lacks a true capsule, which when taken in combination with varied enzymes contained within the pancreatic parenchyma explains why acute inflammation of the pancreas presents with such a varied clinical spectrum of pathology. Acute pancreatitis remains a common disease in the UK and despite modern advances in treatment is still associated with significant morbidity and mortality. Imaging continues to play an important role in patient management, namely: Initial diagnosis, assessment of disease severity and management of complications. Critically early diagnosis and treatment of predicted severe pancreatitis improves patient outcome.

Conventional transabdominal ultrasound (US) plays a limited role in initial diagnosis due to the high incidence of overlying bowel gas obscuring the pancreas in up to 50% of patients. However, US remains the first line investigation for the diagnosis of pancreatitis aetiology (gallstones ± biliary duct dilation), for the detection of free intraperitoneal fluid and other occult intra-abdominal pathology. EUS when available also plays a role in the diagnosis of intraductal calculi although in many UK centres, magnetic resonance cholangiopancreatography (MRCP) is preferred. Whilst CT is considered the gold standard modality for assessment of disease severity, recent research suggests a possible exciting new role for contrast enhanced ultrasound (CEUS) in this area. In addition, US is widely used to facilitate the interventional management of pancreatitis related complications.

The presentation will cover the varied roles of US in this complex disease with reference to the latest literature and recently published UK working party guidelines. In addition the possible future role of CEUS will be covered.

CV

- Simon Jackson received his primary medical degree qualifying from St Thomas’ Hospital Medical School, London. After obtaining a range of surgical experience and the FRCS (Eng) examination he commenced training in radiology on the Southampton University Hospitals scheme. During this period he developed a
specific interest in gastrointestinal radiology and in 1996 successfully completed a fellowship in gastrointestinal and abdominal radiology at Vancouver General Hospital, Canada. Since 1998 he has been a consultant GI radiologist at the Plymouth University Hospitals NHS Trust and Peninsula Medical School. He is an enthusiastic teacher, lecturer and active researcher regularly presenting at both national and international meetings. In addition he currently sits on a number of national and European GI related committees, is an associate editor for the BJR and a reviewer for various scientific journals. His specific interests include the pancreas and he has acted as an invited contributor to the latest UK guidelines for the management of acute pancreatitis.

**Pancreatic Tumours.** McLean A (London)

In modern imaging protocols, ultrasound retains an important role in both the detection and characterization of pancreatic tumours. The key to success is a high index of suspicion and the skill and persistence of the operator. Normal variants may mimic tumours and inflammatory conditions may result in mass lesions indistinguishable from tumour on imaging.

The successful surgical treatment of adenocarcinoma relies on detection of disease at an early stage—usually when it is less than 2 cm diameter. High risk signs for detection include the presence of pancreatic duct dilatation and unexplained cysts and these patients require further imaging and follow up.

CT remains pre-eminent in staging pancreatic adenocarcinoma. However, transabdominal ultrasound may confidently identify advanced disease by the presence of vascular encasement, lymph nodes, liver metastases or the presence of free peritoneal fluid, which usually indicates peritoneal spread. Endoscopic ultrasound can give more accurate staging information, particularly in relation to small tumours and periampullary lesions.

Cystic pancreatic masses are detected on cross sectional imaging with increased frequency and ultrasound often allows better characterization of internal structure than CT. The aim of imaging is to try to separate inflammatory cysts (pseudocysts) from benign (serous) or potentially malignant (mucinous) tumours including duct ectatic tumours (IPMN).

Certain imaging features may suggest more unusual pathology, such as pancreatic lymphoma or islet cell tumour.

The potential risk of tumour seeding has limited the use of percutaneous biopsy to those tumours that are deemed unresectable for confirmation of histology prior to chemotherapy.

**Controversies in Emergency Ultrasound**

**FAST Ultrasound Down Under.** Sarker B (Gateshead) BMUS Australian Exchange Award Winner

We have been training our A&E Physicians to do focused (FAST) scans. The ultrasound department has found the new relationships with Accident and Emergency rewarding. However, working together has exposed different training issues for the emergency ultrasound students and the sonographers and radiologists who act as their mentors.

Modifications in assessment techniques, course content and delivery may be required for future cohorts of students, to achieve the correct balance and encourage all emergency physicians to enrol on an approved course.

Currently FAST and AAA ultrasound training takes place on outpatients and some ward patients. Ideally, a proportion should take place in the emergency room on real trauma patients. Few sonographers have wide experience of such situations and I therefore found it difficult to train effectively.

I was keen to extend my experience in the clinical setting, and hoped this would also help me to support junior medical staff and ultrasound students. I applied to travel to Liverpool Hospital in Australia, where
FAST scanning is widely used, to gain ultrasound experience in the emergency situation and to compare their training methods with ours.

I wanted to explore how annual accreditation and maintenance of ultrasound skills is achieved, and hopefully return with some recommendations for a robust system of training physicians and a credentialing system that could be introduced regionally, if not nationally.

The Trauma and Emergency Department at Liverpool Hospital is renowned inter-nationally for its expert practice and innovation, sees large numbers of trauma patients, and is the source of many publications and textbooks on these subjects. I wanted to develop local clinical networks, but also foster links with our own trauma unit and the unit at Liverpool Hospital.

I was lucky enough to win this award and will present my experiences.

**Ultrasound of Appendicitis – is There Anything Else in the RIF?** Peck R (Sheffield)

Ultrasound of the appendix has been well-described for many years. There still remains a gap between the radiologists and the surgeons as to the value of imaging for this condition.

Unfortunately, many patients do not arrive in hospital with a correctly written label as to what is actually wrong with them. Numerous papers show how imaging performed in those patients who actually went to theatre and were shown to have appendicitis or not. What about the others? Did they need imaging or not?

The speaker will hope to explore some of the difficulties in evaluating the conundrum of RIF pain/appendicitis and illustrate this with numerous examples of how ultrasound can be used.

**CV**

- Dr Robert Peck is a consultant radiologist at the Royal Hallamshire Hospital. His main interest has been ultrasound imaging for nearly 20 years. He has a special interest in ultrasound of the gastrointestinal tract and has written and lectured about this topic (he cannot understand why there remains any controversy!!)

**The Acute Scrotum.** Elliot S (Newcastle)

High resolution ultrasound, combined with colour Doppler imaging, now provides a remarkable amount of anatomical and pathological information in the scrotum. Although the medical literature abounds with figures as high as ‘100% sensitivity’ and ‘100% specificity’ for certain scrotal conditions, the role of ultrasonography in the acute situation remains somewhat controversial: should it be performed, and if so, when?

This talk will describe and illustrate a wide range of acute scrotal conditions. The issues of why, when and how to scan will be discussed, as well as the medicolegal implications of acute scrotal ultrasonography.

**CV**

- Consultant Radiologist and clinical lead in ultrasound
How Appropriate are Urgent Outpatient Ultrasound Requests? Aw J¹, Andrews H¹, Philips S¹, Cooke D² (¹United Bristol Healthcare Trust ²Musgrove Hospital (Taunton)

Purpose: Technological development of ultrasound has allowed quick, mobile and relatively cost effective diagnosis of diseases. These examinations have produced rapid growth in demand, which is not always justified. We evaluated the radiological outcome to determine appropriate use of Urgent ultrasound requests as prioritized by the clinicians versus radiologists.

Materials/methods: All urgent outpatient ultrasound requests as prioritized by clinicians were prospectively reviewed with the scan findings over a 6 months period. Comparison was made with a consecutive series of urgent gynaecological ultrasound requests as prioritized by a consultant Gynaecological radiologist (excluding obstetrics scans).

Results: The interval between the receipt of the request and the scan was a mean of 11.5 days with 53% requested by General Practitioners (GPs). Positive diagnostic rate of scans were equal between GPs and hospital clinicians with a higher rate for significant abnormalities and lower rate of normal scans from the physicians as compared to the surgeons. Scan results showed 14% with clear cut abnormalities and 8% had significant findings warranting subsequent investigations. In comparison, when the priority was downgraded by a consultant radiologist, 76% of the urgent to routine and 61% of the soon to routine priority were all normal results. The overall positive diagnostic rate was 20% for scan requests as prioritized by clinicians and similar results when the priority was downgraded by a radiologist.

Conclusion: Waiting lists exceed 13 weeks for non-urgent referrals. The importance of using urgent slots efficiently and effectively has significant impact from inappropriate prioritization in the presence of finite resources. A high positive rate for urgent referrals was anticipated at the time of the initial request as the utility of this service would influence treatment decisions. However, filtering the priority by a radiologist provided a similar overall positive diagnostic rate with no detrimental clinical impact.

Fast or ‘F***ing Amateurs Shouldn’t Tinker’: assuring the quality of ultrasound outside of the Radiology Department. Sarker BA, Rickards M, Jarman R, Halford N, Newby MP (Queen Elizabeth Hospital, Gateshead)

FAST abdominal scanning is becoming accepted practice in assessing blunt abdominal trauma. Radiology and Emergency departments need to decide who is going to provide this service. If this is to involve non-radiology staff there needs to be agreement over training and accreditation.

The aim of this presentation is to show how the A&E and Radiology Departments at Queen Elizabeth Hospital, Gateshead have worked together over the past two years to develop FAST scanning to be performed in A&E.

FAST stands for Focused Assessment with Sonography in Trauma.

It now includes areas other than the abdomen (chest and heart). FAST abdominal scans only aim to assess the presence of free fluid in 4 areas/views—the right and left upper quadrants, pelvis and pericardium. It acts as an extension of clinical examination, can be done early in the ‘primary survey’ of trauma assessment (i.e. in first 15–20 min), can be repeated and does not affect any subsequent investigations.

In Year 1 we accepted 3 students (2 A&E Consultants, 1 staff) requiring 35 h practical, clinical assessments and practice portfolio. In Year 2 we had two students (one consultant, one staff grade) with a revised assessment strategy (60 h or 100 exams) and the Portfolio was replaced by an OSCE.

We will concentrate not on the pros and cons of scanning by non radiology staff but on the practicalities of supporting another dept to develop focused ultrasound skills. We will explain the initial approach we adopted and the changes that have needed to be made along with our support from Teesside University to develop a recognized course and programme for non radiology staff.

Finally we will discuss the issues we need to resolve around maintaining skills, the credentialing process, the pressures from other departments and their expectations.
Maintaining Quality & Safety—the Benefits of a Trust-wide Ultrasound Group. Sarker BA, Hughes T (Queen Elizabeth Hospital, Gateshead) - BMUS Pump Priming Grant

Poorly performed ultrasound is a clinical risk. Recently, there has been a proliferation of ultrasound machines outside Radiology and an increasingly diverse group of users. Our desire has always been to have an accessible record of the results of all ultrasound scans performed within the Trust and to know that the users are competent.

We have used the requirement to achieve Level 2 CNST (Clinical Negligence Scheme for Trusts) and to fulfil the recent Medical Devices Policy to help define who competent users are and show the need for accessible results.

After gaining support of the principle, we asked all departments using ultrasound to declare their hard assets and list their users. We offered potential support/training if necessary from Radiology, joint/bulk purchasing, an equipment replacement programme, system recycling, support with equipment selection, machine testing and quality assurance.

We requested that all systems should be tested by medical physics annually, have a current maintenance contract, consider PACS connectivity, only be used by recognized competent users, and the scan results to be recorded and accessible. We also asked that any requests for new equipment or services should initially go through Radiology to maximize our own staff cohort and stock of equipment.

This project is still in its early stages, but has already reaped rewards. It has allowed us to find and map new users/systems, extend the concept of an electronic reporting system, ensure testing by Medical Physics, list, recycle, condemn or sell scanners that are no longer fit for purpose and to bulk purchase new equipment.

We have developed relationships with other users, allowing us to extend the understanding of the clinical risks of ultrasound and how we can mitigate them using the Clinical Governance umbrella. We will present our methods and results so far.

Consultant Sonographers - Myth or Reality? Patel S (North West London Hospitals Trust) - BMUS Pump Priming Grant

Bold NHS modernisation plans introduced the role of allied health professionals (AHP) consultant to bring clinical leadership and strategic direction to deliver improved patient outcome. The target of 250 AHP by 2004 has not been met. At the onset of this study in July 2005, 12 consultant radiographers were identified on the Society of Radiographers website, but none were sonographers. The objectives of this study were to assess the progress of sonographers to consultant status, identify barriers and gaps impeding this pathway. The experience of existing consultant radiographers may provide valuable lessons.

This two-stage study with separate groups adopted a multi-method qualitative approach. The first group comprised a focus group of superintendent sonographers who are potential candidates for consultants posts. The second stage utilized telephone interviews to identify lessons from successful consultant radiographers. Mainly qualitative data were generated and subsequently assessed by simple thematic analysis.

The results were both surprising and revealing. By June 2006, only 2/19 consultant radiographer posts were in ultrasound, with another post scheduled for re-advertisement. The focus group had made little progress in initiating business cases for consultant posts. The experience of consultant radiographers demonstrated that prospective consultants need to take charge of their career planning, in both academic and clinical areas. Identification of service gaps within their organization and subsequent subspecialization in these areas is essential and may facilitate the development of consultant posts.

Financial constraints appear to be one of the biggest hurdles to the progress of consultant AHP posts. Even successful business cases may be thwarted as many Trusts face financial crises. Utilization of vacant post monies appears to represent a prudent source of funding, rather than additional monies. The experiences of
existing consultant radiographers also provide clear lessons, guidance and motivation for sonographers to develop strong business cases for consultant posts.

**Evaluation of a Novel Device for Ultrasound QA.** Dudley NJ¹, Coulthard P² (¹Nottingham University Hospitals NHS Trust, ²Northern Physics Services)

**Background and purpose:** Traditional ultrasound imaging Quality Assurance methods are being questioned and new methods are being developed. The TCC test object and software is one of a number of new developments. This study aimed to assess whether this novel image quality analysis device could demonstrate changes in scanner performance.

**Methods:** The phantom consists of layers of vertical echo-free cylinders in tissue mimicking foam material. The ultrasound probe was clamped to the surface and slowly scanned across the phantom. Three-dimensional test object images were captured and analysed, measuring signal-to-noise ratio and functional range. Scanner faults were simulated by deoptimizing controls:
• output was reduced and gain increased to reduce signal-to-noise ratio (two probes);
• focusing was altered to simulate a beam forming fault (one probe);
• dynamic range was altered (two probes).

A perceived difference in performance between two scanners of the same type was investigated.

**Results:** As output was increased there was a small reduction in both functional range and SNR. Functional range increased with the distance and number of focal depths. There was a small increase in SNR when focal depths were added and a reduction as the depth of a single focus was increased. Reducing dynamic range increased functional range (marginally for a linear array) and SNR (marginally for a curvilinear array) for both probes. Functional range and SNR were less for the older of the two scanners compared.

**Conclusions:** Changes in image quality were demonstrated for simulated and suspected faults. The system merits wider evaluation and comparison with other methods, in particular to assess its response to increased side lobes, where it is claimed that this is the only method to show the effects of change.

**Colour Doppler Signal to Noise Ratio and Dynamic Range Performance for a Range of Scanners.** King DM¹, Moran C M², Hussey M³, Browne JE¹ (¹Dublin Institute of Technology ²University of Edinburgh)

**Background:** One of the most important image quality parameters for any imaging system is spatial resolution, the ability of a system to distinguish objects that are close together. Colour Doppler (CD) spatial resolution may be defined as the image of a point source and it can be determined by measuring the point spread function of a point source or the minimum separation in space for which two separate point or line targets can be resolved. Another parameter of significant interest is CD temporal resolution, the minimum separation in time for which two separate flow events can be identified. The aims of this study were to build phantoms for the determination of CD spatial and temporal resolution.

**Methods:** Two different approaches to the determination of spatial resolution were carried out. The first approach used a phantom that consisted of lateral line pairs of fixed separations (0.6, 0.8, 1.0 and 1.2 mm) at varying depth, while the second approach determined the CD point spread function using a string phantom. The CD temporal resolution was determined also using a string phantom. Five ultrasound scanners were tested for spatial and temporal resolution.

**Results:** The two test procedures, spatial and temporal resolution were able to show differences in performance for the range of ultrasound scanners tested. The abdominal probe of the HDI 5000 and the 128 were found to have a spatial resolution of 0.6 and 1.2 mm, and a temporal resolution of 70 and 50 ms, respectively. The full results of spatial and temporal resolution for the range of ultrasound scanners will be presented.

**Conclusions:** Two novel approaches to the determination of spatial resolution as well as a protocol for the determination of temporal resolution were developed and will be presented. The effect of system controls on CD spatial and temporal resolution will also be presented.
Beam Forming and Transducers. Whittingham TA (Newcastle)

Larger and more powerful integrated circuits and an increasing trend towards digital processing are making beam forming more precise, with better control of beam width and side lobe levels. They are also making the electronics more compact and less expensive, so that machines, probes and their cables can all be lighter and more affordable. Intelligent power management electronics are helping to control the greater electrical power and probe self-heating associated with increased in-probe beam forming circuitry. Improvements in elevation beam width have been achieved, using so-called ‘1.25D’ arrays having multiple rows of elements that can be switched in to provide dynamic aperture in elevation, and by ‘1.5D’ arrays having variable delays for each pair of rows, symmetrically positioned about the central row, providing electronically controlled focusing in elevation.

Progress towards full three dimensional real-time beam forming has been considerable. ‘1.75D’ arrays, having independent variable delays and amplitude control for each row, provide both focusing and steering in elevation. Such arrays have also been used to generate high intensity beams for treating prostate cancer. The ideal is a ‘2D’ array having independent phase and amplitude control of each element. These pose problems due to the large number of transducer elements and channels required. One solution is to use the ‘sparse array’ approach, in which only a limited sub-set of transducer elements is used at any time. Unfortunately this leads to high side lobe levels. Another approach is to split the array into clusters of elements, with beam forming for each cluster taking place in the probe. One lead from each cluster connects through the probe cable to the main machine where further delays and amplitude controls are applied for each cluster. Examples of volume scanning and C-scanning using 2D arrays will be shown.

Finally, micro electro-mechanical systems (MEMS), such as capacitive micro-fabricated ultrasonic transducers (cMUT), will be briefly discussed.


Background/purpose: In general, a constant sound velocity of about 1.54 mm/µs is assumed by ultrasound imaging systems in determining system parameters needed for focusing and timing. However, while this approximation greatly simplifies processing, the body’s sound velocity in-homogeneity can lead to defocusing and increased imaging clutter for many patients, obscuring the anatomy of interest. This presentation investigates a method of performing a first order sound velocity correction that is compatible with conventional 1-D transducers.

Methods: Ultrasound channel domain data was processed at various trial sound speeds ranging from 1.40 mm/µs to 1.65 mm/µs. The detected image data lateral power spectrum was then integrated for each range sample. Sums of these values were used to obtain a figure of merit (FOM) for each trial sound speed. These FOM's were used to estimate an optimum sound speed for the patient.

Results: Abdominal imaging using a 3.5 MHz curved array on 19 presumed normal people, we found that on easy to scan individuals, independent of view, the standard velocity of 1.54 mm/µs provided the best image quality, while in difficult to scan individuals, 1.47 mm/µs provided better image quality. When scanning the average individual at the midline subcostally, we obtained the best images with 1.47 mm/µs to 1.51 mm/µs, whereas when scanning intercostally, we obtained the best images using 1.54 mm/µs. In breast imaging with a 7.0 MHz linear array, it was found that in addition to the standard 1.54 mm/µs sound velocity, both 1.47 mm/µs and 1.49 mm/µs sound velocities provided better image quality in some cases.

Conclusions: A first order sound velocity correction has been shown to have the ability to produce significant image quality improvements in difficult to scan patients, resulting in better diagnostic confidence and overall improved health care.
**Gynaecology**

**The Differential Diagnosis of Ovarian Masses—the Role of Ultrasound.** F. Tranquart\(^1\), H. Marret\(^2\), S. Sauget\(^2\), A Bleuzen\(^1\) (\(^1\)INSERM U619, Technical Innovation Centre, CHRU Tours, and \(^2\)Department of Obstetrics and Gynaecology, CHRU Tours, France)

**Objectives:** To investigate the usefulness of contrast-enhanced ultrasound (CEUS) in various gynaecological diseases.

**Ovarian lesions:** Before surgical treatment, patients (28 malignant or borderline tumours and 100 benign adnexal lesions) were prospectively evaluated before and after contrast injection. Time intensity curve was well defined using Levovist® and SonoVue® but SonoVue® described more precisely microvascularization of the tumour with a marked improvement compared to power Doppler. Wash-out times and area under curves were significantly greater in ovarian malignancies than in other tumours. ROC curve analysis provided adequate threshold with sensitivity between 91 and 100%, and specificity between 72 and 100% according to different parameters.

**Fibroids:** Thirty-eight patients were prospectively evaluated by CEUS before and one the day after embolization. Enhancement patterns markedly vary from an absence to a complete and rapid enhancement. Washout was typically complete after 3 min. This washout helps us to identify some tiny fibroids, which are not visible on conventional sonography. After embolization, all lesions except three presented an absence of enhancement. In five cases one or two tiny fibroids were detected after embolization only.

**Cervix cancer:** Ten patients with cervix cancer were prospectively evaluated in comparison with TEP-CT before and under radiochemotherapy. In all patients CEUS demonstrates a strong arterial enhancement from the tumoral site with a progressive decrease according to the reduction in size and metabolism guiding the therapeutic strategy.

**Conclusion:** CEUS is a well adapted method in gynaecological disease by improving the detection of fibroids and the discrimination of benign from malignant adnexal lesions, guiding the treatment and allowing an adapted follow up of patients under specific therapy.

**Musculoskeletal**

**The Paediatric Hip.** Johnson K (Birmingham)

Ultrasound of the hip joint in paediatrics primarily is performed for two reasons; the investigation of development of dysplasia of the hip and in the acutely limping child. Development dysplasia of the hip is a complex subject, which is beyond the remit of this presentation.

In the limping child, hip ultrasound is primarily used for the detection of hip effusions. The causes for this effusion are large and include transient synovitis, infection, juvenile idiopathic arthritis, Perthe's disease, etc. The presence or size of an effusion is non-specific, as is the presence of echogenic debris within the effusion. A child with sepsis may have a small clear effusion while that of a child with transient synovitis be large and full of echogenic debris.

It is distinguishing transient synovitis from septic arthritis that is the area of greatest clinical concern. The latter can be very destructive, leading to long term morbidity and loss of function, however, if diagnosed early enough and adequately treated there may be long-term damage. Where as transient synovitis is self limiting disorder that requires no intervention.

The diagnosis of both transient synovitis and septic arthritis relies on clinical, laboratory and radiological findings. In some centres, all hips are aspirated for microscopy and culture in order that sepsis is not missed. Alternatively, other centres, rely on haematological and biochemical blood markers to exclude sepsis. The approach taken should depend on local resources and expertise.
This presentation will review the practical skills in obtaining adequate images of the hip. It will discuss the various methods used to exclude sepsis arthritis, including joint aspiration. A review of the literature will be discussed. Importantly, other diagnoses that need to be considered when a child presents with a hip disorder will be discussed.

CV

• Consultant Paediatric radiologist at Birmingham Children’s Hospital since 1998.
• Special interest in paediatric musculoskeletal disorders.

The Sonographic Appearance of the Achilles Tendon of Army Recruits—a Prospective Study. Savage SJ, Gane AS (Yeovil District Hospital)

All Army recruits follow the common military syllabus recruit training in recruiting establishments throughout the country. The new recruit is exposed to high intensity rigorous physical exercise whilst undertaking such induction training. Many will wear army boots for the first time.

There is evidence that army recruit training could cause overuse injury to the Achilles tendon and following animal models and previous studies it is expected that the Achilles tendon will enlarge when exposed to regular exercise.

Aim: The aims of this study were:

• To demonstrate overuse injuries in the Achilles tendon in a cohort of army recruits using diagnostic ultrasound.

• To observe the range of detectable changes in the measurement of the Achilles tendon before and after military training.

Method: A simple pre test-post test prospective panel design was used to evaluate the Achilles Tendon of Army recruits. The cohort of recruits was scanned at the beginning and towards the end of basic military training. The tendon was measured at three levels along its length and was further evaluated for the presence of over use injury. An initial cohort of 60 recruits was scanned with 26 recruits subsequently lost from the study due to attrition.

Results: The Achilles tendon did demonstrate thickening throughout its whole length however, only the proximal regions of the tendon demonstrated statistically significant thickening. Only three recruits demonstrated ultrasound appearances considered to be associated with overuse injury. Such a small incidence within this cohort proved not to be statistically significant.

Conclusion: Ultrasound has demonstrated that the Achilles tendon of army recruits enlarges when exposed to military physical training, whether this change in size is a potential precursor to an overuse injury remains unproven. The presence of overuse injuries to the Achilles tendon in army recruits was unconfirmed mainly due to the small sample size used in this study. Larger studies with a much greater sample size are suggested to evaluate the incidence of overuse injuries within Army recruits.

Ultrasound Assessment of the Thumb. Lammers G, Spanger M (Knox Private Diagnostic Imaging, Australia)

In the broad spectrum of orthopaedic fractures, those involving the hand and digits may appear relatively minor. However, given the complexity of the hand and digits and their essential role in human tasks, these injuries require rigorous evaluation, early diagnosis, and appropriate treatment to prevent serious consequences for patients. (Lairmore & Engber; available at: www.physsportsmed.com/issues/1998/06jun/lairmore.htm, accessed July 2006).
High-end ultrasound equipment of the last two years now has the ability to examine soft tissue and bony injuries of the digits and provide information that can help give patients appropriate, successful treatment.

A successful ultrasound will need to bring an understanding of the structural and functional anatomy, an understanding of injury mechanisms, and also an understanding of treatments where some patients present post operatively or delayed presentation. Given the dynamic nature of ultrasound, a complete ultrasound study can provide more valuable information than the gold standard MRI.

This presentation will bring together anatomy, pathology, treatments and sonography of the thumb to provide the information needed for a complete study. Particular attention will be made to the pathologies of:

- Gamekeeper or skiers thumb producing Stener lesions of the ulna;
- collateral ligament of the MCPJ;
- tendons;
- pulleys;
- volar plates.

Ultrasound cases will be presented demonstrating these pathologies.

**Obstetrics**

**Ultrasound Assessment of the Influence of Sub-Clinical Maternal Vitamin D Deficiency on Fetal Femur Development—a Pilot Study.** Mahon P, Poole J, Cooper C, Arden N, Godfrey K (MRC Epidemiology Resource Centre, Southampton) - **BMUS Pump Priming Grant**

Epidemiological studies suggest that maternal vitamin D status during pregnancy has a long-term influence on the bone health of the offspring. We assessed fetal femur shape and noticed widening of the distal femoral metaphysis in some fetuses, similar to that seen in childhood rickets. We therefore hypothesized that sub-clinical maternal vitamin D deficiency may alter fetal femur development.

We used a KretzGE® Voluson-730 3DUS to acquire images of fetal thigh tissues at 19 and 34 weeks gestation in 424 subjects taking part in the Southampton Women's Survey. Measurements of femoral distal cross-sectional area (CSA) were made on stored images. 25-hydroxyvitamin D concentrations were measured in maternal serum samples taken at 34 weeks; values ranged from 8 to 180 nmol/l (median 61 nmol/l) and were log transformed for statistical analysis.

Lower maternal vitamin D concentrations were associated with greater fetal femur distal CSA at 19 weeks gestation ($r = -0.17$, $p = 0.001$) and, more weakly, at 34 weeks ($r = -0.08$, $p = 0.095$). At 19 weeks, associations were similar in both sexes, but at 34 weeks there was an association in female fetuses ($r = -0.16$, $p = 0.023$), but not in males. We derived the ratio of distal CSA/femur length as a measure of femur shape; lower maternal vitamin D levels were associated with a higher CSA/femur length ratio at 19 and 34 weeks gestation ($r = -0.17$, $p < 0.001$, and $r = -0.09$, $p = 0.066$, respectively).

Our findings suggest that lower maternal vitamin D status leads to widening of the distal metaphysis of the fetal femur. Previous data have suggested a greater influence of maternal vitamin D status on female fetuses, and our findings are consistent with this. Our research paves the way for studies to identify fetuses at risk and monitor the outcome of maternal supplementation. Funding is being sought from the Department of Health and the Medical Research Council.

**How Accurate are NT Measurements?** Evans JA¹, Watson A², Moore AC³, Brettle DS³ (¹Leeds General Infirmary, ²Gartnavel Royal Hospital, Glasgow, ³Leeds Hospitals NHS Trust)

The measurement of the nuchal translucency (NT) is becoming increasingly widespread. Care must be taken to ensure that caliper placement is in accordance with national standards. This presumes that:

- all equipment is correctly calibrated;
- the signal processing in each machine is such as to present the inter-face in the same way.
We have conducted a survey to evaluate the extent of the variation that might be present due to the equipment and operators.

Three test objects were created, each consisting of a Perspex staircase embedded in a tissue mimicking background. The step sizes and depth of the staircase differed in each object. A total of seven machines in three centres were measured by eight operators. The protocol required scanning the test object and setting TGC gain, etc., to optimize visualization of the staircase. The calipers were then positioned according to NT criteria and the thickness of each step measured. The actual thicknesses were not revealed to the operators and in fact, they had to be corrected for the sound speed in any event. Three readings of each step were taken and the average value recorded. This was repeated using harmonic imaging if available.

The results show considerable variation. Measurements of a typical 2–3-mm step varied by over 1 mm both between machines and between operators.

Although it cannot be assumed that these variations will necessarily map directly to clinical variation this could have a significant impact on the clinical outcome.

It is also noted that the use of harmonic imaging is unpredictable, but seems to depend on the machine. In some cases an increase in the measurement was found but in others no change or a decrease was noted. These results indicate the need for further investigation.

**First Trimester Identification of Placental Invasion.** Comstock C (USA)

We know that placenta accreta is more frequent in patients with previous uterine surgery and in patients who are over 35. Since both risk factors are on the increase, it would be clinically useful to detect placenta accreta before the obstetrician attempts separation of the placenta. Placenta accreta can start in the first trimester of pregnancy.

It may be encountered at the time of a dilatation and curettage for an early demise or the pregnancy can progress into the second and third trimesters. Early signs include lower than normal implantation of the gestational sac, abnormal vasculature, and thinning of the myometrium in patients who have had previous uterine surgery. Irregular vascular sinuses extending from the placenta into the myometrium are very suggestive.

**CV**

- American Board of Radiology
- American Board of Obstetrics and Gynecology
- Clinical Professor, Obstetrics and Gynecology, University of Michigan, Ann Arbor, Michigan USA
- Director, Division of Fetal Imaging, William Beaumont Hospital, Royal Oak Michigan USA
- American Institute of Medicine, Board of Directors 1997–1999
- *Journal of Ultrasound in Medicine* Editorial Advisory Board 2000–present

**Second and Third Trimester Ultrasound in Identification of Abnormal Placentation.** Comstock C (USA)

The ultrasound signs of placenta accreta can appear either in the first trimester or early in the second trimester in patients with previous uterine surgery. The most accurate sign consists of abnormal placental sinuses that are elongated and irregular. Absence of the echolucent space between the placenta and uterus is not by itself reliable, and can result in over diagnosis. It is not yet possible to distinguish among placenta accreta, increta and percreta in most instances. However, clinically it may not be necessary since all three types result in large blood loss if disturbed.
Paediatrics

Assessment and Sclerotherapy of Paediatric Vascular Malformations. Barnacle AM (London)

Vascular malformations constitute some of the more fascinating and yet most misunderstood conditions in medicine. For many radiologists and clinicians, vascular anomalies remain a heart sink subject. Yet imaging plays an increasingly vital role in the diagnosis and management of these conditions, providing some objective evidence in a sea of confusing terminology and conflicting diagnoses.

This session aims to provide a clear and straightforward strategy for the imaging, diagnosis and nomenclature of vascular malformations. The presentation briefly outlines the classification of vascular anomalies and reviews the clinical and imaging features of the important malformation subtypes. Interventional radiology has a central role in the management of vascular anomalies and current treatment strategies will be discussed.

The key role of ultrasound in differentiating between anomaly types is covered in detail. Ultrasound is central to the planning of treatment strategies in these conditions and has a role to play in monitoring response to treatment, as well as analysing complications. A wide spectrum of clinical and imaging examples will be provided, with the aim of encouraging sonographers to play a more active role in the management of this disease spectrum.

CV

• Interventional radiologist at Great Ormond Street Hospital for Children in London, with a background in clinical paediatrics and paediatric radiology. Currently the radiology lead in the regional Vascular Anomalies service provided through this institution.

Physics: Ultrasound Therapy

Cancer Treatment with HIFU-Current Status and Future Promise. ter Haar G (Sutton)

Therapeutic ultrasound is experiencing an exciting revival in the form of the minimally invasive technique of high intensity focused ultrasound surgery (HIFU) with applications in urology, gynaecology and oncology.

When a high intensity ultrasound beam is brought to a focus in tissue, the cells lying within the focal volume may be killed, while overlying tissues are unharmed. The primary mechanism for cell death is thermal ablation with temperatures above 60°C being achieved and maintained for 1–2 s. This is a ‘trackless’ method highly selective tissue destruction at depth within the body that can be used as a conformal treatment for soft tissue tumours in, for example, the liver. Extensive studies have shown that cell killing is immediate and that no ‘late effects’ appear. Since tissues do not build up tolerance to HIFU, retreatment of sites may be possible. HIFU may be offered where radiotherapy and chemotherapy has been ineffective, or is no longer an option.

The ability of HIFU to target cells with good spatial accuracy can only be used to full advantage when combined with accurate treatment planning and monitoring. Using MR compatible HIFU transducers, it has been demonstrated that MR can be used to monitor tissue damage. Ultrasound imaging techniques may also be used. Methods such as elastography and radiation force imaging are showing good promise for this. Imaging and therapy may be incorporated into one transducer, to enable one to ‘seek out’ and destroy selected tumour volumes during a treatment. With few exceptions, any tumour that can be successfully imaged with ultrasound should be suitable for HIFU treatment.

Focused ultrasound surgery is an exciting new technique that is showing considerable promise for the treatment of soft tissue tumours. Clinical trials for the treatment of the prostate, liver, kidney and uterine fibroids are currently underway in the UK.
CV

- Gail ter Haar was awarded a PhD in Physics from the University of London. Her PhD research was on the biological effects of ultrasound. In 1998, Gail was awarded a DSc in clinical medicine by the University of Oxford for her work on the safety of ultrasonic imaging and her research into the therapeutic applications of ultrasound. Gail ter Haar is currently head of therapeutic ultrasound at the Institute of Cancer Research, Sutton. Her interests are in the development of therapeutic applications of ultrasound for use in the treatment of cancer and the safety of diagnostic ultrasound techniques. She is a fellow of the American Institute for Ultrasound in Medicine, IPEM and the Acoustical Society of America. She is the Associate Editor for Therapeutic Ultrasound for ‘Ultrasound in Medicine and Biology’, and an Associate editor of ‘Ultrasonics’. Gail is chairman on the BMUS safety committee.


If gene therapy is to play a substantial role in treating a broad range of diseases then methods for safe, efficient and specific gene delivery must be developed. Many previous studies have established that the combination of ultrasound and microbubbles has potential as a physically targeted and clinically usable means for site-specific gene delivery. However, a clear understanding has yet to emerge of either the factors that influence delivery or the mechanisms of transfection, and this is needed for the technology of ultrasound gene transfection to reach its potential. To facilitate the large number of experiments needed to improve knowledge in this area, our objective was to assemble and test a system for studying ultrasound transfection of cells in culture, with an emphasis on maximizing both the degree of independent control of acoustic and other variables and the speed of carrying out such experiments.

In the system that we have developed, a monolayer of target cells adherent to one of two acoustically transparent membranes that enclose the cell culture medium and microbubble suspension is placed at any desired position in an ultrasound field with computer-controlled frequency, pressure amplitude, pulse length, pulse envelope, pulse repetition rate and exposure time. The spatial distribution of transfection efficiency in the plane of the monolayer is mapped by counting transfected cells, or by luminescence or fluorescence imaging, depending on the gene delivered.

This distribution is then compared with the co-planar and coregistered distributions of calibrated acoustic field properties. We now have a way to rapidly study and optimize conditions for gene delivery to cells that has, for example, already allowed us to investigate the effect on transfection efficiency of employing focused fields, plane wave fields and acoustic pulse sequences designed to enhance delivery efficiency.

Ultrasound Contrast: Getting Started

The Value of Contrast Enhanced Ultrasound for Focal Liver Lesions in Clinical Practice: achieving optimal diagnostic yield through this new imaging modality. Albrecht T (Germany)

The adequate assessment of liver pathologies requires the evaluation of several parameters, including (1) tissue morphology, (2) vascular density and geometry, and (3) dynamic perfusion pattern. The morphology of liver tissue can be assessed by conventional B-mode sonography. However, in some cases, an iso-echoic appearance of a focal lesion impedes its detection, so that delineation of the lesion based on other characteristics (e.g. vascularity) is needed. The vascularization of liver tissue can be demonstrated by colour Doppler sonography based on the velocity component of flowing blood, but this is limited to larger vessels and in parenchymal tissue only single colour pixels are detectable. For the assessment of dynamic perfusion pattern (i.e. the spatial and temporal pattern of blood flow) a tracer, labelling a particular blood volume, is mandatory. This is particularly important in the liver, where arterialization (i.e. the shift from mainly portal-venous to arterial blood supply) is an essential parameter of neoangiogenesis and tumour formation.

Ultrasound contrast agents allow the demonstration of even minute amounts of blood, not only in large vessels but also in parenchymal tissue, independently from any velocity component. Thus, microvascular blood volume and flow can be demonstrated and assessed. Furthermore, using a contrast agent bolus as
tracer it is possible to discriminate arterial and portal-venous blood supply and to evaluate the dynamic flow pattern of focal lesions with excellent spatial and temporal resolution.

The unique possibilities of contrast-enhanced sonography are closely related to recent technological improvements in the ultrasound machines.

Contrast-specific technology allows the separation of contrast (blood) and tissue signals in real-time with excellent sensitivity and specificity.

Since microbubble contrast agents are real blood-pool agents, pure perfusion imaging becomes possible. Combined with the real-time capabilities of ultrasound, vascularization and dynamic perfusion pattern can be assessed continuously for markedly improved detection and characterization of focal liver lesions.

CV

• 1987 graduation in biology with special focus on physiology, biophysics and biochemistry
• 1990 PhD thesis in neurophysiology, about molecular inter-actions in differentiation, growth and function of central neurons
• since 1992 clinical research and development of ultrasound contrast agents in the pharmaceutical industry
• scientific manager of various inter-national multi-centre studies in radiology, neurology and cardiology
• scientific and educational customer support for contrast-enhanced ultrasound
• author of numerous scientific papers and textbook chapters

Impact of New Guidelines on the Use of Contrast Agents in Liver Ultrasound. Thorelius L (Sweden)

The introduction of a practically useful ultrasound contrast agent (UCA) in 2002 truly brought a new era into diagnostic US liver imaging. The previous barrier that gave contrast enhanced CT and MRI liver imaging an obvious advantage over US was overcome. At our centre contrast enhanced ultrasound (CEUS) became a valuable tool in practical liver imaging at an early stage, being the obvious first choice for characterization of focal liver lesions with an accuracy surpassing multidetector CT and in practice not inferior to MRI. Today CEUS is also an important modality for the detection of liver metastases both percutaneously and in the operating theatre, as well as for the peroperative monitoring of liver tumour ablations. Furthermore, CEUS is used for a variety of other liver conditions such as moderate blunt abdominal trauma, cholangitis, cholangiocarcinomas and portal vein thrombosis. At present 20% of all our US patients and over 50% of our liver patients receive a UCA. After a total of some 5000 CEUS cases in our practice we are certain that the method is here to stay, the main obstacle not being drawbacks of CEUS in itself but rather the reluctance of the community of diagnosticians to adapt to a more standardized way of performing and documenting US which is necessary for the modality to flourish.

CV

• From the early 90's until 2001 predominantly radiological work in the fields of gastroenterology and oncology, with a mix of CT and US.

• Since 2001 full time sonologist and head of the Ultrasound Section of the Radiology Department, Linköping University Hospital, Sweden. Member of EFSUMB’s CEUS expert committee.

• In 2002, with the arrival of UCA, the Ultrasound Section abandoned still imaging for cine loop documentation of all US exams and developed standardized exam patterns aiming at workstation reading, surveillance and teaching. To date there are 30,000 cine based US exams stored and fully retrievable in our hospital PACS.
Ultrasound Screening


Primary carcinoma of the ovary is the fourth most common cause of death as a result of cancer in the United Kingdom, with 4000 deaths each year. As research has shown a relationship between the stage at which the ovarian cancer diagnosis is made and survival rates, concerted efforts have been made to develop an ovarian cancer screening strategy aimed at early detection of the disease (Menon & Jacobs, 2002). However, currently there is a lack of systematic reviews analysing research performed into ovarian cancer screening.

The main aim was to perform a review to investigate the effectiveness of ultrasound examination for the early detection of ovarian cancer in asymptomatic women, with the purpose of deciding whether ultrasound examination alone could offer a reliable screening technique. The secondary aim was achieved by evaluating the performance of ultrasound in differing studies and determining what reasons some studies may report higher sensitivity and specificity values for the detection of ovarian cancer than others. The Cochrane Library Database, Ovid Medline and the Cumulative Index to Nursing and Allied Health Literature were searched using the MeSH terms ovarian neoplasm and mass screening. Experimental and observational studies were identified and appraised for quality using the Scottish Inter-collegiate Guidelines Network (2001).

Two randomized control trials, a single cohort study and nine case series studies were identified in the review. The results of this review indicate that ultrasound as a single screening technique is often limited in the positive predictive value of ovarian malignancy. However, in studies that incorporate more advanced ultrasound examination using three dimensional and colour Doppler, the sensitivity and specificity improved.

Testicular Microlithiasis—Ultrasound Surveillance. Sidhu P (London)

Testicular microlithiasis (TM) has become a well recognized finding on ultrasound, particularly with the advent of higher frequency, better resolution transducers. The estimated prevalence of TM is accepted to be approximately 2% of the ‘symptomatic’ male population although some reports suggest that this may be as high as 6% in the ‘asymptomatic’ male population. Many associations with TM have been established in the literature and include infertility, cryptorchidism, Kleinfelter's syndrome and carcinoma in situ. The association that has received most attention is the reported higher prevalence of primary testicular tumours identified in patients with TM. The prevalence of coexisting malignancy and TM is reported to occur in 0–29% of patients. A recent study suggests that this prevalence is likely to be around 7.5%. In addition, there is also the suggestion that other forms of intra-testicular calcification may be associated with malignancy.

Although there is a documented increase in the prevalence of malignancy with TM, there is no data for the incidence of malignancy in association with pre-existing TM. There is therefore no consensus on the follow-up of patients with TM.

This presentation will review the evidence for the association of TM with malignancy, estimate the risk for the individual patient, assess the evidence for surveillance and suggest a ‘robust’ approach to the problem.

CV

• Paul S. Sidhu is a Consultant Radiologist at King's College Hospital, London, Honorary Consultant Neuroradiologist at the National Hospital for Neurology and Neurosurgery, London, and Honorary Senior Lecturer at King's College, London.

• His main interests are Ultrasound and Vascular Interventional Radiology.

• He has published extensively of many aspects of ultrasound, particularly related to microbubble contrast, liver transplantation and genito-urinary ultrasound.
UMSA Session

Ergonomics—a Manufacturers View. Murray C, Miles JB (Siemens Medical Solutions)

Background: Work-related Musculoskeletal Disorders (WRMSD) is increasingly prevalent amongst ultrasound practitioners. The outcome of treatment for WRMSD is poor. Recent published research, of a UK sonographer survey, indicated that there was little or no ergonomic education in the workplace and little input in equipment choice.

Moreover, in 2003 Industry Standards for the Prevention of Work-related Musculoskeletal Disorders in Sonography were released. Some manufacturers have made significant progress improving the ergonomic design of their systems, and are implementing innovative new features and transducers that will undoubtedly help to reduce the incidence of WRMSD's.

The purpose of this presentation is to inform ultrasound practitioners of the importance manufacturers place on ergonomics, in terms of education and system design. It will show future developments in ultrasound equipment design in the battle to reduce the incidence of WRMSD's and, with this information, allow them to make informed decisions when choosing equipment in the future.

The presentation will follow the trajectory of industrial design, past, present and future, and discuss and explore the co-operation and collaboration required between users and manufacturers of ultrasound equipment. New technological advances will be introduced, including innovative transducer designs and control-free image optimization technology, which significantly reduces time and repetitive movements during exams. It will highlight the important task manufacturers have in the education of ultrasound practitioners and discuss their compliance with the Industry Standards.

Conclusion: The presentation will summarize the importance of working in partnership with ultrasound practitioners; seeing a way to a reduction in exam times and repetitive motions with user-centred, ergonomically designed ultrasound equipment and innovative advanced system and transducer technologies.

Accuracy of 2-D and 3-D Ultrasonic Methods for Determining Bladder Volume. Miller N1, Mangar S2, Hsu A2, Huddart R2, Bamber J2 (1Royal Marsden Hospital, 2Institute of Cancer Research, Sutton)

The bladder is a deformable organ whose size and position vary during a fractionated course of radiotherapy. Changes in bladder position, relative to the CT planning scan, reduce the efficacy of the treatment. The eventual goal of our research was to test the hypothesis that bladder volume, as measured by ultrasound, is correlated with bladder position, as determined by CT. If such a correlation exists, then ultrasound volume measurement might have a role to play in guiding treatment.

The aim of this study was to determine the accuracy of different methods of ultrasonic volume measurement using phantoms (water-filled balloons) and healthy volunteers. For the volunteers, measured volumes were compared with the voided urine volume. The first volume measurement method (‘2-D’) used an ellipsoidal assumption to estimate volume from two perpendicular images. The second method (‘BladderScan’) used an automated hand-held 3-D device known as the BladderScan®. The third method (‘3-D’) used freehand 3-D imaging and operator outlining on 16 intersecting planes. Most of the volunteer data was acquired at small volumes (<200 ml), as these ought to present a greater challenge for ultrasonic measurement. Furthermore, the usual protocol in radiotherapy departments is to treat patients with an empty bladder.

In balloon phantoms, after correcting for the sound speed in water, the volumes measured using the 3-D method were within ±3% of the true volumes, while the 2-D method produced an accuracy ranging from -5 to +11%. The BladderScan could not record volumes from balloon phantoms. In volunteers, the average value of the magnitude of the percentage difference between the measured and voided volume was 6 ± 5% (3-D), 20 ± 17% (2-D) and 13 ± 11% (BladderScan). We conclude that, although the 3-D method is the most accurate, all three methods are sufficiently accurate to warrant investigation in bladder carcinoma patients.
**Urogenital**

**Maternal Abdominal Emergencies in Pregnancy: problem solving with MR imaging.** Spencer J (Leeds)

MR imaging offers a number of advantages for imaging in pregnancy notably not requiring the use of ionizing radiation but also its ability to provide tissue characterization of blood and fat, its multiplanar capacity and depiction of flow related phenomena. In this lecture I will outline its use in two key maternal emergencies: loin pain and pelvic pain due to a suspected adnexal problem.

Ultrasound is the first line imaging investigation of both emergencies. In a pregnant woman with loin pain hydronephrosis is an almost universal finding and thus unhelpful in the distinction of pregnancy related loin pain, urosepsis and calculous obstruction. Identifying a stone in the renal pelvis or lower ureter/bladder can be diagnostic but most stones lodge in the unseen retroperitoneum, and both Doppler indices and ureteric jets can be misleading indicators in pregnancy. MR imaging using heavily T2-weighted ‘water’ imaging can reliably distinguish between calculous obstruction and physiological dilatation of pregnancy. The St James’s imaging algorithm and MR protocol will be outlined.

In a woman with an undiagnosed pelvic mass in pregnancy the key questions are whether this poses any threat to the mother or the pregnancy or will compromise normal vaginal delivery. MR imaging is superior to all other imaging in defining the nature of indeterminate adnexal masses.

**The Scrotum—a Sonographic Challenge?** Clements R (Newport)

Testicular cancer is uncommon, but ultrasound plays an essential role in its diagnosis; a range of testicular cancers will be considered. However most scrotal ultrasound is undertaken for the assessment of benign pathology. Some diagnostic dilemmas encountered in scrotal sonography will be discussed.

**CV**

• Consultant Radiologist, Royal Gwent Hospital since 1987.

• Fellow of European Society of Urogenital Radiology Member of British Society of Urogenital Radiology Member of the Scientific Reference Group, Prostate Cancer Risk Management Programme (NHS Screening Programmes)

**Microbubble Ultrasound Contrast in the Assessment of Acute Renal Transplant Recipients.** Kay D, Mazonakis M, Geddes C, Baxter G (Western Infirmary, Glasgow)

**Purpose:** The role of ultrasound in acute renal transplant assessment is predominately to investigate vascular occlusion and mechanical (usually extrinsic) compression; assessment of more subtle changes in intra-renal pulsed Doppler waveforms is useful in serial measurement of parenchymal disease. The use of sonographic contrast agents in acute transplant assessment has not yet been determined. This study aimed to define methods, relevant values and parameter reproducibility in a group of acute transplant patients investigated with Sonovue sonographic contrast and to correlate values with clinical indices.

**Methods:** A single centre prospective study of 20 consecutive acute renal transplant patients was undertaken within 1 week of operation. Sonovue was administered as a bolus followed by a 10 ml saline flush with imaging using a 4 MHz curvilinear array with low mechanical index. Quantitative analysis was performed offline on proprietary software (Q-lab Philips). Time intensity curves (TIC’s) were generated from ROI’s in inter-lobar arteries, pyramids and cortical areas at upper/mid/lower poles with parameters measured including arrival time, time to peak, peak value, gradient and area under the curve; the latter being an indirect measure of renal perfusion. Parameters were correlated with clinical data including serum creatinine and estimated glomerular filtration rate (eGFR) over a 12-month period. Statistical tests employed included two-tailed \( t \)-test with Bon Ferroni correction and Pearson’s correlation.
Results: Initial data analysis demonstrated high intra-observer reproducibility ($p < 0.01$) for all measured parameters. Inter-observer analysis for 10 of 15 parameters was acceptable (all $p < 0.05$) including cortical perfusion values. Renal perfusion correlated with transplant eGFR at 3 months post transplant ($p < 0.01$).

Conclusion: Real time assessment of acute renal transplants with sonographic contrast media is reproducible and gives perfusion data which correlates with future transplant function and therefore provides important transplant prognostic information.

Vascular

Re-organisation of the In-Patient DVT Imaging Service - the Plymouth Experience. Veitch AM, Shirley J, Vivien G, Nokes TJC, Freeman SJ (Derriford Hospital, Plymouth, UK)

Deep Vein Thrombosis (DVT) is a common problem in in-patients, which may lead to significant complications such as pulmonary embolism (PE) and post-thrombotic syndrome. Prompt diagnosis and treatment is essential to reduce the incidence of these complications. The inpatient DVT imaging service at Derriford Hospital (1150 beds) was audited due to concerns about patient waiting-times for DVT investigations. Data for 51 consecutive inpatients referred for DVT imaging was prospectively collected over a 6-week period. Data included: time for request card to reach department, waiting time for investigation, reasons for delay, nature of radiological investigation, and D-Dimer result. Only 48% of request cards were received on day of writing (maximum delay 4 days). On receipt of request forms, only 73% (22/30) of Doppler ultrasounds and 63%. (10/16) of venograms were performed the same or next day (maximum wait 7 days). D-dimers were inappropriately requested in 18 patients, acknowledging a recent local audit demonstrating elevated D-dimers in 80% of hospital in-patients. The choice of imaging modality did not follow departmental guidelines in 34%. The waste in financial resource identified by the audit was costed in relation to: bed-days (up to £17680), anticoagulation (£855), D-dimer tests (£216), and venography (£240), totalling £18991 in 6-week audit period. Significant changes to practice have been made in response to this audit. Request cards are now hand-delivered directly to designated personnel within the department.

D-dimers are no longer routinely performed on in-patients. Doppler US is accepted as the first-line investigation for all in-patients, with calf vein visualisation where possible. Venography is reserved as second-line imaging in accordance with guidelines produced by the Royal College of Radiologists (RCR). A business plan outlining an in-patient DVT service using sonographer-based imaging to improve efficiency has been submitted to Trust Management. A re-audit will be performed once new service is established.

Value of Repeat Doppler Ultrasound Examination in Outpatients with Suspected Deep Venous Thrombosis. Narayanaswamy S, Venkatanarasimha N, Lester Z, Nokes T, Dubbins P (Derriford Hospital, Plymouth, UK)

Introduction: Doppler ultrasound is the imaging modality of choice in patients with suspected deep venous thrombosis (DVT). Several authors recommend a single study with some suggesting a limited compression study evaluating the femoro-popliteal segment only.

Methods: The Doppler scans were reviewed of 205 consecutive patients over an 8-week period, referred by the General Practitioners to the nurse led DVT clinic with symptoms suggestive of DVT. Plasma d-dimer, modified Wells score and the results of ultrasound examination were recorded for these patients.

Results: Initial ultrasound examination confirmed the presence of DVT in 51 patients (24.8%) and an alternative diagnosis in 16 patients (8%). Of the remaining 154 patients 121 had a repeat ultrasound scan at 7–10 days. 5 patients (4%) had deep vein thrombosis confirmed on repeat scan.

Conclusions: The incidence of DVT in patients presenting to the DVT clinic from primary care in Plymouth is 24.8%. Five patients (4%) would not have been detected if they had not had a repeat scan. In 4 of these patients the DVT was in below knee veins. Consequent to this, we reviewed the repeat scan results on a larger sample of patients (n=2305) from the same clinic. This showed an equal number of DVT's in above
and below knee veins. This represents a higher incidence of confirmed DVT's in this setting, than the literature suggests. A repeat Doppler ultrasound examination may be recommended in patients presenting with symptoms suggestive of DVT, when the initial Doppler is negative and where no alternative diagnosis is made.

**Surveillance Following Carotid Endarterectomy.** Walker R (Bath)

Should patients undergoing carotid endarterectomy be subject to routine post-operative surveillance? What are the significant issues relating to this question and how should we approach them? This presentation will review the recent relevant literature and research on surveillance following carotid endarterectomy. Areas for consideration will include re-stenosis, progression of contralateral disease, treatment of asymptomatic carotid disease and cost-effectiveness of surveillance programmes. The presentation will offer some personal reflection on the issues of debate and discuss the possible resulting recommendations.

**CV**

- Rachel Walker has over 16 years experience as a clinical vascular technologist. She has been involved in various research projects during this time and has a particular interest in the area of pre-, intra- and post-operative scanning of patients undergoing carotid endarterectomy.

- With the Society for Vascular Technology she has been involved in the development and publication of a set of professional standards for clinical practice in vascular diagnostics. She is currently the president of the Society for Vascular Technology.

**Surveillance Following Endovascular Aortic Aneurysm Repair.** Hartshorne T (Leicester)

Endovascular aneurysm repair (EVAR) is an alternative technique for the repair of aortic aneurysms. It is less invasive than open repair as the modular graft system is inserted via the femoral arteries, avoiding the need for a large abdominal incision and dissection required in conventional surgery. Interim results from the UK EVAR 1 trial have reported improved perioperative morbidity and mortality with EVAR compared to open repair. However, there are potential complications with EVAR, the most common being endoleak and EVAR patients must therefore undergo long-term surveillance of the graft. An endoleak is persistent flow within the aneurysm sac outside of the device and this can be associated with aneurysm rupture. Endoleaks have been reported in approximately 15–20% of EVAR cases. Endoleaks have been categorized into five different types and management is dependent on the leak type. Type 1 and 3 leaks are more strongly associated with the continued risk of aneurysm rupture and usually require further intervention. Type 2, 4 and 5 leaks are considered less significant and are normally managed conservatively. Contrast enhanced CT scanning is considered the 'gold standard' for imaging endoleaks, but also involves significant X-ray exposure and is more costly.

There is an increasing volume of published evidence, indicating that duplex scanning is an accurate method for the detection of endoleak and that it is a valuable tool in the long-term surveillance of EVAR patients. Additionally, duplex scanning is able to detect graft kinks and stenoses. At present, there are no nationally agreed guidelines or standards for duplex surveillance of EVAR grafts and this should be reviewed by appropriate ultrasound and vascular organizations.

**CV**

- I have worked in the speciality of vascular ultrasound for more than 20 years and it has been fascinating to witness first-hand the tremendous advances that have occurred in scanning technology and vascular surgery over this period of time. I have been involved in the development of vein graft surveillance programs, research work connected with venous haemodynamics and endovascular graft surveillance. I am a member of BMUS and The Society for Vascular Technology of Great Britain and Ireland. I have also coauthored a book on peripheral vascular ultrasound.

Introduction: We present a new technique for the preoperative imaging of perforator vessels for abdominal free flap surgery using the ultrasound contrast agent SonoVue®. This new technique allows the mapping of these vessels prior to reconstructive surgery.

Background/purpose: An accurate preoperative evaluation of the vascular anatomy of the abdominal wall is extremely valuable in improving the surgical strategy in abdominal perforator flap surgery. The DIEP (deep inferior epigastric artery) flap is routinely used for breast reconstruction in our institution. Predicting the location of the dominant perforator vessel is not possible because of the high variability of the vascular anatomy between individuals and even between hemi abdomens of the same person. By accurate preoperative evaluation of the vascular anatomy of the abdominal wall this can prove extremely valuable in improving the surgical strategy, safety and speed of procedure.

Technique: Patients undergoing DIEP flap surgery are scanned the day prior to surgery. The inferior epigastric arteries are followed up from their origin into the rectus sheath. Perforator vessels are then identified by injecting 1-ml aliquots of SonoVue® contrast media and using power Doppler to locate the dominant vessels. The skin surface is marked with indelible marker over the points where the best perforators emerge from the fascia of the rectus abdominis muscle.

Conclusion: The use of ultrasound contrast allows accurate identification of rectus perforator vessels in patients undergoing DIEP flap surgery. This allows the surgeon to go straight to the chosen perforators safely without wasting time. The potential time saving in theatre can be balanced against the cost of the investigation.

Complications of Vascular Closure Devices as Seen by Ultrasound. Lammers G, Spanger M (Knox Private Diagnostic Imaging, Australia)

This presentation demonstrates 5 cases of a vascular closure device insitu as seen by ultrasound. Two are correctly placed, one is incorrectly placed with no complications and two cases are seen occluding the leg artery.

Most cardiac and vascular laboratories use one of many special devices available to close access after an angiogram. This is in contrast to the traditional 30 minute manual compression. These new methods are seen to be faster and are supposedly providing better seals.

This presentation will demonstrate that a particular vascular closure device can be seen on ultrasound. Cases presented show the device causing occlusion of the leg arteries as one of its possible complications. These cases proceeded to emergency thrombectomy for removal of the device.

This presentation will then give a brief overview of all the different devices now available and discuss the role of ultrasound in follow-up cases that may have complications.

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Invented in the late 1970's, 3D-ultrasound moved in a short time out of the development stages. Due to the benefit of 3D-ultrasound for the identification of morphologic features and accurate distance measurements, the new technique has soon gained a valuable place in human prenatal diagnostics. Even though the costliness of this new method prevents its routine application in veterinary medicine, it has still proven to be a powerful tool for research purposes.

Longitudinal 3D-ultrasound examinations were performed in a variety of different species including domestic dogs, European brown hares, dolphins, rhinoceroses and elephants using three different General Electric Kretztechnik Inc. systems: the stationary Voluson 530 and 730 as well as portable lap-top sized Voluson i. With these ultrasound systems, conventional 2-D-sonography is used to locate the area of interest before switching to volume mode. The selected volume is then scanned by making a series of consecutive 2-D-images.

The stored images can be post-processed offline in different modes. The 3-D model is particularly useful to illustrate the anatomic interrelationship of extra-embryonic organs and allows their morphologic and volumetric analysis. The plastic reconstruction also gives and impression of the foetal surface and shape. In multiplanar mode, the object of interest can be displayed simultaneously in three perpendicular planes (sagittal, transverse and frontal). The free rotation of the object and the choice of different section planes permits the tomographic analysis of the scanned volume. The maximal extension of the designated structures can be defined. The 3-D-ultrasound technology has proven to be a very useful procedure in studying different placentation forms.

CV: Dr. med. vet. Thomas Bernd Hildebrandt

Education


Veterinary registration: Feb. 1992

Univ. course in veterinary medicine: 1986–1992, Humboldt-University Berlin, School of Veterinary Medicine,

Employment

Head, Dept. Reproduction Management, March 1997 – present, Institute for Zoo & Wildlife Research(IZW),

Scientific Awards

Appointment to Honorary Veterinary Fellow of the Zoological Society London, 2004 Appointment to Fellow of the Zoological Society of San Diego, 2001 Appointment to Research Associate of Smithsonian Institution, National Zoological Park, 2000 Several poster awards.

Scientific publications:

90 publications
11 book chapter
80 presentations and 17 international plenary lectures
2 patents for reproductive medicine intervention in elephants and rhinoceroses 30 posters
A Comparison Between Radiography and Ultrasonography for the Diagnosis of Abdominal Disorders in the Dog. Saunders JH, Bissot T (Belgium)

Introduction: Plain radiography and ultrasonography and routinely used for the diagnosis of abdominal disorders. Some radiologists perform only one of these modalities in dogs with suspicion of abdominal disorder and complemented it with the other one in selected cases. Others consider that both techniques have to be systematically performed. The aim of this study was to retrospectively compare plain radiography and ultrasonography for the diagnosis of abdominal disorders in the dog.

Methods: Sixty-eight patients presented at our department for abdominal disorders were used in this study. Mean age was 7.8 years, mean body weight was 21 kg. The study included 37 males (11 castrated) and 31 females (10 neutered). To be included in the study, all dogs had to be submitted to a complete radiographic examination (lateral and verso-dorsal projections) and a systematic US examination of the entire abdomen. The radiographs were interpreted by consensus by two ECVDI board-certificate radiologists. The ultrasonographic examinations were performed and interpreted by the one ECVDI board-certified radiologist. The final diagnosis was a gastro-intestinal disorder in 38 dogs (56%), a urinary tract disorder in 19 dogs (28%), a disorder of the reticulo-endothelial system in 14 dogs (21%), a disorder of the female genital tract in 6 dogs (9%), a disorder of the male genital tract in 6 dogs (9%) and a disorder of another organ (adrenals, lymph nodes, peritoneum, perineal hernia, ...) in 11 dogs (17%).

Results: Ultrasonography showed significant abnormalities not visible on radiography in 41/68 dogs (60%). Ultrasonography and radiography were considered equivalent in 24/68 dogs (35%) as none of the technique provided a final diagnosis. In 7 of these 24 dogs, ultrasonography allowed to identify the diseases organ contrary to radiography but did not provide a final diagnosis. In the 17 other dogs, US did not provide more information than radiography. In 3/68 dogs (5%), radiography was superior to ultrasonography. All 3 cases were gastro-intestinal foreign bodies, 2 located into the stomach and 1 into the duodenum.

Conclusions: Ultrasonography was superior to radiography in the majority of the cases (>70%) and must be considered the technique of reference for the examination of the canine abdomen. Radiography was only superior to ultrasonography in dogs with a gastro-intestinal disorder, particularly a foreign body. This can be explained by the presence of gas in the gastro-intestinal tract that may prevent and adequate visualisation of the gastro-intestinal content with ultrasonography. In dogs with a suspicion of gastro-intestinal disorder, radiography should complement ultrasonography.

Pre- and Post-Treatment Ultrasonography in Hypothyroid Dogs. Taeymans O, Duchateau L, Daminet S, Saunders JH (Belgium)

Primary hypothyroidism is a frequent endocrine disorder in the adult dog. However, false-positive diagnoses are common because of the relatively low accuracy of most commonly used biochemical tests. The purpose of this study was to describe the ultrasonographic features of the thyroid gland in hypothyroid dogs, to calculate its diagnostic sensitivity and to investigate the evolution of the ultrasonographic features after treatment. Eighteen dogs were used in this prospective study. All dogs underwent an ultrasound examination at first presentation and 13 of them were presented for one or two additional ultrasound examinations over time. At first presentation, a sensitivity of 76.5% (95% CI [50.0–93.0]) for echogenicity, 64.7% (95% CI [38.3–85.8]) for homogeneity, 70.6% (95% CI [44.0–89.7]) for capsule delineation, 64.7% (95% CI [38.3–85.8]) for lobe shape and 47.1% (95% CI [23.0–72.2]) for relative thyroid volume was obtained. When considering the five parameters together, the sensitivity was 94.1% (95% CI [71.3–99.9]). These results are comparable to recently published values. A continuous decrease of thyroid volume was seen over time, while the other investigated parameters did not change significantly during the follow-up period. None of the initially abnormal thyroid lobes regained a normal aspect over time and the observed sensitivity at the last presentation was 100% (95% CI [75.3–100.0]) for all parameters combined. Grayscale ultrasound is a cost-effective and reasonably easy test for the diagnosis of primary hypothyroidism in dogs. Its sensitivity increases with time after treatment.
Use of Ultrasonography in the Diagnosis of Medial Coronoid Process Disease. Newitt A (Liverpool, UK)

**Objective:** These cases were recorded as part of a larger study into medial coronoid process disease. This part of the study was undertaken in order to assess the usefulness of ultrasonography as a potential screening tool for medial coronoid process disease.

**Methods:** In order to be included in the study, all dogs had to have forelimb lameness, localised to the elbow. All dogs underwent clinical assessment, radiography and ultrasonography on both elbows, prior to arthroscopy only on elbows in which it was considered to be indicated by the clinical and radiographic findings. Sonographic examination of the medial coronoid process region of both elbows of three dogs was carried out by one sonographer, without prior knowledge of the clinical or radiographic findings. The findings were recorded and then compared with the results of arthroscopy on those joints which underwent the procedure.

**Results:** Six medial coronoid process regions were examined ultrasonographically; only four of these elbows underwent arthroscopy (one dog had bilateral disease). The two elbows that did not undergo arthroscopy were considered normal clinically, radiologically and ultrasonographically. Four elbows underwent arthroscopy; these were all considered abnormal ultrasonographically. On ultrasound, in three of the four elbows, a detached mineral fragment was identified in the region of the medial coronoid, with adjacent regional disruption. In the fourth case, the region was clearly abnormal, and the coronoid process was misshapen and irregular. On arthroscopy, all four elbows were found to have detached mineral fragments, along with associated degenerative joint disease.

**Conclusions:** Ultrasonography appears to be a simple, quick and sensitive test for medial coronoid process disease, and it may be that fragment detection results could improve further with further operator experience. A full double blinded study is needed to better evaluate the sensitivity and specificity of this potentially very useful screening technique.

Ultrasonographic Findings of the Liver in Goat. Gahiri A, Hajikolahei MRH (Iran)

Ultrasoundography is one of the best modality for diagnosis of liver diseases in human and animals. There are numerous references about liver ultrasonography in dogs, cats and horses but about small ruminants the references are a few. The aim of this study was ultrasonographic findings and technique of the liver in the goat. This study conducted on 8 clinically healthy female goats with the same age. Goats were shaved on their right side from the caudal region of elbow up to the flank and from transverse processes of vertebral up to the ventral aspect of the abdomen.

Ultrasound examination of liver performed according to the approved techniques from the caudal aspect of 13th rib to the 7th intercostals spaces (ICS). Items surveyed in this study were the possibility of finding liver from each ICS, distance between the position of liver in each view from the dorsal midline while expiration, echogenicity of liver, depth of liver, depth and diameter of portal vein and caudal vena cava and position and size of gall bladder. The liver tissue was completely accessible from 7th to 12th ICS. The parenchymal pattern of liver consists of numerous weak echoes homogenously distributed over the entire liver. Several vessels were seen while the lumen of these vessels was anechoic and thus appeared black. The caudal vena cava was consistently positioned dorsal and medial to the portal vein. It was usually triangular or droplike on cross-sectional view. It was completely accessible between the 9th to 12th ICS. The diameter and depth was increasing cranially. The portal vein was usually visualized in the 9th to 12th ICS. It was round or slightly oval in shape. The diameter was decreasing toward the cranial while the depth was increasing. The gall bladder was visualized in most of goat. Its shape was mostly often slim and oblong, sometimes pear shape, and rarely round.
Ultrasound at the Zoo. Hildebrandt TB, Goeritz F, Hermes R (Institute for Zoo and Wildlife Research, Berlin)

Ultrasoundographic scanning of terrestrial wild creatures, such as komodo dragon, gorilla, rhinoceros or elephant, as well as aquatic species such as octopus or dolphin in their environment required several technical system modifications and the development of new ultrasound applications, such as the transcloacal approach. Ultrasound is utilized particularly in reproduction medicine and could serve as a vital tool to successfully increase the numbers of pregnancies in more than 200 endangered species, a campaign essential for species survival. In general, the application of ultrasonography in zoo and wild animals presents a number of specific difficulties, which are not usually a concern in human or classic veterinary medicine. First, physical or chemical restraint is necessary for performing ultrasonography in most exotic animals. For example, birds of prey must be held by the wings and legs in dorsal recumbency; poikilothermic animals can be examined at 0°C (in an ice water bath); carnivores must be sedated or anaesthetized. However, elephants and rhinoceroses are trainable for transrectal ultrasound without any chemical or mechanical restraint. Also, certain morphological characteristics of exotic animals can interfere with ultrasonographic examinations. Acoustic coupling of the ultrasound probe is problematic when the body surface is covered by shells, plates, feathers or fur. Avian air sacs, thick leathery skin, large subcutaneous fat pads, airfilled intestinal loops and large body size all decrease the effectiveness of ultrasonographic imaging. Lastly, ultrasound equipment customized for exotic animals requires many additional components in contrast to that used for domestic animals, such as a wide variety of transcutaneous and intra-operative transducers ranging from 2.5 to 28.0 MHz, cable extensions for ultrasound probes, animal-specific scan head adapters for transrectal ultrasound, and battery packs for field exams.
Poster Exhibition

General Posters


Background and purpose of study: Ultrasound (US) is the first line of imaging investigation in suspected cholecystitis or biliary colic. The aim of this study was to compare the US, operative and histology findings in patients who had laparoscopic cholecystectomy. Literature reports an US sensitivity of 37.5–62%, a specificity of 70–100% and an accuracy of 66.6–77% in the diagnosis of cholecystitis.

Methods: Retrospective review of hospital records of 141 patients who underwent laparoscopic cholecystectomy from December 2004 to March 2005. A total of 111 patients were included in this study after exclusion of 30 patients due to inadequate source data. There were 81 females and 30 males with an age range of 19–86 years and a mean age of 52.5 years. Essential data collected included pre-operative ultrasound reports, surgical (operative) diagnosis, and the histology reports. Comparison was made between these three groups with histology results as gold standard.

Results: There was concordance between US and histology in 15 patients with cholecystitis (n = 5, acute; n = 10, chronic). Eighty-seven patients had histological evidence of cholecystitis that were not diagnosed by US. The sensitivity and specificity for ultrasound diagnosis for cholecystitis was 14.7 and 100%, respectively. US detected cholelithiasis in about 94% of patients, which was confirmed during surgery. US did not detect cholelithiasis in seven patients, out of which four had surgical diagnosis of cholelithiasis. US reported gallbladder wall thickening in 23% (n = 25), CBD dilatation in 12% (n = 13), Murphy's sign in 8% (n = 9), sludge in 5% (n = 6) and pericholecystic fluid in 4% (n = 5).

Conclusion: Our study highlights the poor sensitivity, but high specificity for the ultrasound diagnosis of cholecystitis. We discuss our results and its relevance to ultrasound diagnosis of cholecystitis.

2. Contrast Enhanced Ultrasound: ‘appearances can be deceiving’. Nair S, Parker P, George C, Byass O (Hull Royal Infirmary)

Purpose: Focal liver lesions (FLL) frequently cause diagnostic dilemma to the radiologist. Contrast-enhanced ultrasonography (CEUS) has led to significant improvement in FLL characterization. The aim of this study was to evaluate the role of CEUS using sulphur hexafluoride filled microbubbles to characterize FLL. We reviewed all our cases and compared with gold standard comprising CT, MRI and histological data.

Methods: Retrospective review of all consecutive cases of FLL from April 2004–February 2006. During this period CEUS was performed in 128 patients (49 male, 79 female, aged 22–85 years, mean age 59.7 years) to characterize FLL. FLL were interrogated using sulphur hexafluoride filled microbubbles as contrast agent and continuous real time scan of contrast pulse sequence were assessed in arterial, portal and delayed phase for enhancement and distribution of enhancement.

Results: The CEUS diagnosis in 68/128 patients were compared with further follow up CT scan (n = 30), MRI scan (n = 14), ultrasound scan (n = 15), histopathology (n = 7) and CEUS (n = 2). In 88.2% (60/68) there was a concordance between CEUS and further follow up studies. Discrepancy was found in 11.8% (8/68) on further follow up. In seven out of eight patients whose CEUS examination was benign, a follow-up scan confirmed metastasis.

Conclusion: CEUS allows real-time scan with high accuracy and can be used as alternative to other imaging modalities for FLL characterization. However, radiologists should be aware of lesions behaving atypically on CEUS. We present a pictorial review with discussion of all our discrepancies.
3. Role of Ultrasound in Evaluation of Para-testicular Pathologies. Raza A¹, Harrison S², White P² (¹Peninsula Radiology Academy, Torquay ²South Devon Healthcare NHS Trust)

Ultrasound is an extremely useful and effective modality to assess the para-testicular pathologies. The extratesticular scrotal contents include the epididymis, spermatic cord and fascial layers derived from the embryological descent of the testes through the abdominal wall.

One of the first investigations at the hands of clinicians is an ultrasound evaluation of the scrotal contents in various pathologies effecting these organs like epididymitis, cystic masses like hydrocele, varicocele and epididymal cysts, tumours and granulomatous disorders, etc. The purpose of the presentation is to describe the basic anatomy of these organs on ultrasound and to give a pictorial account of various pathologies effecting these organs.

Ultrasound plays a central role in evaluation of the scrotal contents. It can be very effective in providing specific diagnoses to the clinicians especially in case of extra-testicular, cystic pathologies and can help in determining the future management of these pathologies in a time effective and rational way.

4. The Epididymis and Beyond. Davies AG, Anaspure R, Cantin P, Dubbins PA, Freeman SF (Derriford Hospital, Plymouth)

Learning objectives: Ultrasound is the primary diagnostic modality for the investigation of scrotal pathology. We present a pictorial review of extratesticular pathology. We describe the sonographic findings of a variety of extratesticular lesions and discuss their clinical relevance. A précis of a full literature review of this topic is presented.

Background: When a scrotal mass is evaluated, the most important questions to answer are is the mass intra- or extratesticular and secondary is the mass solid or cystic. If the mass is extratesticular and cystic the lesion is almost certainly benign and a specific diagnosis is often possible (hydrocele, epididymal cyst, varicocele). Extratesticular solid masses are most likely benign, with the prevalence of malignancy being approximately 3%. Unfortunately, there is considerable overlap in the ultrasound appearance of many solid extratesticular masses, precluding a specific diagnosis in most cases. Localizing the abnormality to the epididymis, spermatic cord or paratesticular location can shorten the differential diagnosis.

Imaging Findings. We present ultrasound images of:

• Paratesticular pathology including fibrous pseudotumour of the tunica, hernias, scrotal calculi myofibroblastoma tumour and polyorchidism.

• Epididymal pathology including epididymitis, granulomatous epididymitis, abscesses, cysts, adenomatoid tumours and epidermoid cysts.

• Spermatic cord pathology including varicoceles, cord lipomas and epidermoid cysts.

Conclusions: The goal of this review is to provide the radiologist with a better understanding of extratesticular lesions their ultrasound appearance and clinical significance.

5. Ultrasound Contrast of Focal Liver Lesions. Davies AG, Anaspure R, Gutteridge C, Dubbins PA, Freeman SF (Derriford Hospital, Plymouth)

Learning Objective: We present a pictorial review on the use of SonoVue® ultrasound contrast agent in the characterization of focal liver lesions. We demonstrate the enhancement patterns of various benign and malignant focal liver lesions. The recommended indications for the use of contrast agents in liver lesions are reviewed along with its limitations.

Background: The use of low MI (mechanical index) imaging with SonoVue® ultrasound contrast allows good signal enhancement with little bubble destruction. Contrast-enhanced real time imaging is thus possible; this allows dynamic assessment of tumour perfusion. Enhancement patterns are described during
subsequent vascular phases (e.g. arterial, portal-venous and late phase for liver lesions). Up to 90% of all focal liver lesions can be characterized by contrast enhanced ultrasound with regards to their specific diagnosis.

**Imaging Findings:** We demonstrate conventional and colour Doppler imaging of focal liver lesions. The enhancement patterns of benign lesions (haemangioma, FNH, adenoma, focal fatty sparing, regenerative nodule) and malignant lesions (hepatocellular carcinoma, hypo and hypervascular metastases) are illustrated.

**Conclusion:** The use of contrast enhanced ultrasound using real time low MI imaging with SonoVue® allows the correct characterization of the large majority of solid focal liver lesions. Differentiation between benign and malignant lesions is possible in almost all cases. The use of ultrasound contrast can potentially provide not only detection but characterization of a focal liver lesion in a single patient visit. This may save further patient imaging and attendances.


**Background and purpose:** Infra-renal aortic diameter is associated with an increased risk of cardiovascular thrombotic events. Once the aorta exceeds 3cm in diameter it is termed an abdominal aortic aneurysm (AAA). The aim of this audit was to determine if intra-luminal thrombus is present in AAA.

**Methods:** We retrospectively reviewed the radiological data base for all patients referred for an abdominal aorta ultrasound examination for the dates June 2005 to May 2006. Ultrasound reports and images of 48 consecutive patients with an aortic diameter of 2.5–5 cm have been studied to date. The abdominal aorta ultrasound images were classified into three groups: (i) 2.5–3 cm; (ii) 3.0–4 cm; (iii) 4.0–5 cm.

**Results:** Forty-eight patients were reviewed. Thirty-two male, median age 74.5 (range 55–94) years and 16 females, median age 77 (range 66–88) years. In group 1, eight patients had no AAA (<3 cm) and no ILT was present. In group 2, 23 had an AAA with a diameter of 3.0–4 cm of these ILT was present in 8/23 (28.7%). In group 3, 17 had an AAA with diameter a diameter of 4.0–5 cm of these ILT was present in 12/17 (70.6%).

**Conclusion:** This pilot study shows that ILT is more prevalent in AAA greater than 4 cm and supports the concept that increasing diameter is associated with underlying prothrombotic risk, which is associated with increasing cardiovascular mortality.

7. **Does Abdominal Ultrasound Change the Initial Diagnosis and Influence Management for Patients Admitted with Acute Abdominal Symptoms?** Gane AS¹, Springett G² (¹Yeovil District Hospital, and ²University of the West of England)

**Aim:** The sensitivity and specificity of abdominal ultrasound has been well documented, assessing conditions, such as biliary colic, etc. However, the role of ultrasound and the impact regarding changing/confirming diagnosis and the subsequent effect upon management for patients admitted to a small District General hospital with abdominal symptoms remained unexplored. The purpose of this research was to evaluate the role of ultrasound in such a scenario and to consider the implication to practice if a positive benefit to patient diagnosis and management was achieved by ultrasound.

**Method:** A retrospective study was performed to review the notes of patients admitted with abdominal symptoms. The sample selection criteria stipulated that only cases whereby patients underwent initial tests involving chest/abdominal X-rays, blood tests and clinical examination were included. A longitudinal design study was undertaken considering the differential diagnosis and management pre and post intervention, the abdominal ultrasound scan being the intervention. Due to the ethical implications of withholding tests from patients, a control group was not possible.

**Results:** Two-hundred-and-fifty patients met the inclusion criteria, final sample size was 136, unavailability of notes the reducing factor. Ultrasound was shown to reduce the high number of pre-scan differential diagnosis and focus a definitive diagnosis and management plan, unforthcoming from initial tests performed at admission. Of the 136 cases, diagnosis was changed in 66 cases and confirmed in 70 cases.
Conclusion: The findings of the study suggest the association between abdominal ultrasound and patient management as highly significant with $p = 0.001$. The longitudinal design of the study could not attribute changes to ultrasound alone, however, impact of focussing a differential diagnosis was demonstrated. Such significance could not be attributed to the performance of chest/abdominal X-rays, blood tests or clinical evaluation.

Implications: To review the current service of the ultrasound department and increase availability and accessibility for patients admitted with abdominal symptoms.

8. Transrectal Ultrasound-guided Prostate Biopsy--are We Hitting the Target? Rutherford EE, Lane CE, Smart JM, Dewbury KC (Southampton University Hospitals NHS Trust)

Background: The sextant prostate biopsy protocol was described in 1989, although subsequently more extensive biopsy regimes have been developed and found to increase cancer detection. There is a wide variation in biopsy protocols and positive biopsy rates between institutions (e.g. reported cancer detection rates for sextant biopsies vary between 27% and 68%) and this raises concern. There is currently no gold standard for positive biopsy rate, but it is expected that national guidance on prostate biopsy will be issued later this year and hence it has been recommended that all units performing prostate biopsy should audit their performance. In anticipation of national standards, we conducted an audit of our practice at Southampton.

Methods: A retrospective audit of all transrectal ultrasound-guided prostate biopsies performed at Southampton General Hospital between 2004 and 2005 was performed. The positive biopsy rate for each operator was determined and data was collected concerning the PSA, prostatic volume and number of cores obtained.

Results: In 2004–2005, when a sextant biopsy regime was employed, 344 patients underwent prostatic biopsy and the overall positive biopsy rate was 50.1% with no significant difference between two main operators (53.9 v. 48.4%). One-hundred-and-ninety-three patients underwent prostate biopsy following implementation of an octant biopsy protocol during 2005. The overall positive biopsy rate was 38.9% (35.5 v. 40.3 for the two operators).

Conclusions: There is no improvement in the positive biopsy rate following implementation of an octant biopsy regime. The possible reasons for this finding will be discussed including correlation with PSA value and gland volume.

References


9. Developing an Existing Ultrasound Practice in Karachi, Pakistan. Dodgeon JR¹, Dixon AM²

(¹University of Salford, and ²University of Bradford)

Two sonographers from the UK undertook a site-based invited critical evaluation of a five-room Ultrasound suite in the Radiology department of the Aga Khan University Hospital in Karachi, Pakistan. The purpose of the critical evaluation was to make recommendations to improve service delivery.

Method: The evaluation comprised a 1-week visit by two ultrasound qualified radiographers, both of whom are experienced clinical and educational practitioners. They observed clinical practice and held discussions about service delivery with radiologists, radiographers and service managers. A bespoke staff development programme was conducted by the UK sonographers during the week. The visit culminated in a written
evaluation report and action plan for the ultrasound department. The staff development programme was evaluated by the Radiology staff.

**Results:** The Ultrasound suite was well equipped and staffed by skilled, knowledgeable and enthusiastic radiologists and radiographers. Recommendations included the development and implementation of standardized systems of work and examination protocols, consideration of sonographer role extension to incorporate examination reporting, and linking the ultrasound equipment to the digital imaging system within the radiology department. Evaluation of the staff development programme was positive. A programme of periodic review was devised; further audit and educational visits are planned.

**Conclusion:** Areas of service improvement were identified and recommendations were made. The staff development programme was considered effective. The Karachi department considered that further monitoring of service development by UK personnel would be beneficial.

10. **Artefacts on Ultrasound: pearls and pitfalls. A pictorial review.** Venkatanarasimha NK, Narayanaswamy SM, Cantin P, Mayo M, Freeman S (Derriford Hospital, Plymouth)

**Purpose:** Artefacts on Ultrasound imaging are a common phenomenon. Not uncommonly these can simulate pathological lesions causing significant diagnostic dilemma to the ultrasound practitioner. Recognition and accurate characterization of these artefactual phenomena can be of diagnostic advantage and also helps to prevent misdiagnosis.

**Imaging findings:** We present a pictorial review of a wide variety of artefacts encountered on Ultrasound with their characteristic appearances and recognized causes. Also the methods of reducing or eliminating these artefacts will be discussed briefly. We relate some of our experience in this context and briefly review the existing literature.

**Conclusion:** Artefacts on Ultrasound imaging are distracting and can cause diagnostic inaccuracies, but can also be useful in certain disease processes. Accurate knowledge of the cause, appearance, and available remedies for these artefacts prevents unnecessary further imaging and misdiagnosis.

11. **Early Experience of Ultrasound-guided Botulium Toxin—a Injection for the Treatment of Sialorrhoea.** Johnson JG\(^1\), England A\(^2\), Hurley E\(^1\), Tuffin J\(^1\) (\(^1\)South Manchester University Hospitals \(^2\)University of Liverpool)

The objective of this study was to report the methodology and early outcomes of ultrasound-guided of botulium toxin-A injection into the submandibular glands for patients with severe sialorrhea. Sialorrhea (excessive drooling) is common in adults with chronic neurological disorders; treatment can alleviate the associated hygienic problems, improve appearance, enhance self-esteem, and significantly reduce the nursing care time of these sufferers.

**Method:** At the study institution, three patients have been successfully treated by ultrasound-guided botulium toxin A injection into the submandibular glands. All procedures were performed in collaboration with a consultant maxillofacial surgeon and an advanced practitioner in medical ultrasound.

**Results:** The exact procedure and imaging findings for the ultrasoundguided botulium injection procedure are described in this report. Currently, there is a growing body of evidence regarding the efficacy of this therapy. In our limited series, all three patients had improvement of their symptoms and to date have not required any additional procedures.

**Conclusion:** Our early experience of Botulium toxin-A injection under ultrasound guidance corresponds to reports in the literature describing this as an effective, easy and safe treatment for sialorrhea.

12. **Is Common Bile Duct Diameter Affected by Respiratory Phase?** Johnson JG\(^1\), England A\(^2\), Sukumar S\(^1\), Martin DF\(^1\) (\(^1\)South Manchester University Hospitals \(^2\)University of Liverpool)

To prospectively assess the variation in common bile duct (CBD) diameter on ultrasound (US) during different respiratory phases.
Methods: Fifty-nine consecutive patients (43 females) who had upper abdominal US scans for a variety of indications had their CBD diameter measured during inspiration and expiration. All scans were performed on the same ultrasound machine (Sequoia 512, Acuson, USA) using a curvilinear multi-frequency probe operating from 2 to 4 MHz. One observer (an experienced sonographer) used a standard technique to view the CBD. Patients were positioned in a left posterior oblique position with the probe positioned in the mid clavicular line in an 11 o clock position, allowing the CBD to be measured at the porta hepatis. Three CBD measurements were performed per cycle and the mean measurement was recorded to minimize intraobserver error. The differences between measurements for the two phases of respiration were analysed for statistical significance.

Results: Mean CBD diameter was 4.3 mm (1.4–10.2 mm) and 4.6 mm (1.3–9.9 mm) on inspiration and expiration, respectively. Using the Student $t$-test there was no statistically significant difference between CBD diameters ($p = 0.104$). Six (10%) patients were classified as having clinically significant CBD dilatation ($\geq 6.0$ mm) during inspiration and nine (15%) during expiration ($p < 0.05$).

Conclusion: CBD diameter is similar on inspiratory and expiratory phases of respiration. However, more patients had clinically significant CBD enlargement on expiration and this should be considered when imaging the biliary tree. Further investigation is recommended in order to establish the optimum respiratory phase for imaging the CBD.

Professional Issues

13. Negotiated Work Based Learning—Bespoke Ultrasound Training. Walton JM$^1$, Maraj M$^2$ ($^1$University of Liverpool and $^2$Liverpool Women's Hospital and Royal Liverpool University Hospital)

Postgraduate ultrasound training programmes are designed to ensure competence to practice in many clinical areas. They are required to adhere to benchmarks set down by CASE to ensure competence relevant to the clinical speciality studied (obstetrics/gynaecology/abdominal ultrasound, etc.) Within these constraints, there is some opportunity to offer optional modules. However, those available may not provide the most appropriate experience for individuals specific personal development requirements.

Accredited work-based learning is a way of creating university approved learning in the workplace. Learning takes place at, through and is centred upon the work environment, rather than in the University environment. It provides a unique opportunity to create a bespoke learning package for an individual that will fulfil specific requirements for his/her personal development. This may not be achieved through traditional approaches to learning.

Negotiated work based learning (NWBL) provides the opportunity for an individual to identify a specific skills requirement, which can be achieved by the development of a bespoke module by negotiation between the student/the University and the employer. A programme of education, training and assessment is then designed to achieve the specific aims.

NWBL is particularly suited to the development and assessment of advanced clinical skills such as ultrasound. This can be done as an integral part of a programme or as a stand-alone CPD module for qualified staff requiring to develop advanced new clinical skills.

We will review the philosophy for work based learning and demonstrate its effective use in the development of bespoke ultrasound training tailored to specific needs.

14. Matching Ultrasound Training and Assessment Needs to Stages in Development of Clinical Skills. The Liverpool Experience. Walton JM$^1$, Ford K$^2$, Briggs S$^3$ ($^1$University of Liverpool, $^2$Liverpool Women's Hospital, $^3$South Manchester University Hospital Trust, Manchester)

Students develop clinical skills in ultrasound at differing rates. It is important that trainers recognize this and that a bespoke learning experience is provided to facilitate a successful outcome. Pedagogic research at this University has led to the recognition of SIX developmental stages in ultrasound practice education.
These stages are coded (O–E). Stage O is the first stage in training and focuses on the development of hand-eye-brain co-ordination through observational practice. The student must be able to recognize the expected on-screen appearances prior to undertaking any hands-on scanning. The student then progresses to stage A in which there is intensive one-one teaching to further develop hand-eye-brain co-ordination. At stage B the student is able to scan co-operative and ambulant patients under close supervision and recognize onscreen appearances and the presence/absence of an abnormality/variant. This progression continues (codes C–E) until the student achieves stage E, when he/she should be competent in ultrasound as a first post-practitioner. These stages are monitored through a professional development portfolio and assessed by summative practice assessment (PPA1/PPA2/PPA3). PPA1 is an assessment of the students' ability to demonstrate the safe and effective use of an ultrasound system. PPA2 assesses competence in scanning a co-operative and ambulant patient. PPA1 and 2 both occur at stage B after 5 months training. PPA3 is the assessment of the student during a session to ensure competence to practice in first post and is undertaken at stage E.

This poster will discuss the stages in development of the acquisition of clinical skills in ultrasound and how a curriculum has been designed to ensure that the learning, teaching and assessment is tailored to these stages of development.

**15. Acquiring Clinical Competencies through Negotiated Workbased Learning.** Maraj M¹, Walton JM²

¹Liverpool Women's Hospital and Royal Liverpool University Hospital, and ²University of Liverpool

The University of Liverpool offers a Specialist Study Option. (SSO) Module as part of the MSc. Medical Ultrasound Programme. The SSO is negotiated work-based learning and allows the student to focus on an area of particular interest and engage in independent study. It is facilitated by a tripartite agreement between the student, the University and the workplace. The student is expected to plan, document and execute his or her own learning with the help of a University supervisor, and a facilitator or convenor from the workplace. University academic credits can be obtained for this type of learning.

In ultrasound departments, there is a need for acquiring clinical competencies in specialist areas that are not assessed as part of the competencies required for an ultrasound postgraduate certificate or diploma. Negotiated work-based learning is an important way by which these competencies can be can be achieved. Some competencies that have been achieved since the inception of this module include carotid scanning and leg vein assessment for deep vein thrombosis, but this type of learning can be applied to many other areas.

The educational theories that provide the background to this type of learning include Clinical skills training, Competency-based training and work-based learning. The student preparing to undertake this type of learning usually has to define the necessary competencies needed, determine the appropriate learning/teaching/evaluation strategies needed and document these plans in a learning contract. The student then has to execute the plan and evaluate the process.

This type of learning has several advantages. It allows the student to focus on area of personal interest and gain experience in self-directed and self-regulated learning. The workplace can support training in areas that are needed for their local situation and the University can meet the training needs of the workplace.

**16. Developing Ultrasound Education in Oslo, Norway.** Dodgeon JR¹, Holdcroft D², Vinorum A³

¹University of Salford, ²University of Derby, and ³University College, Oslo

**Background and purpose:** University College, Oslo, runs a radiography degree programme. A 1-week compulsory module in Ultrasound is delivered in year 3.

Radiographer performed ultrasound is in its infancy in Norway and this is likely to change in the next 5 years. The purpose of the module is to open the possibility of ultrasound as a career option for radiographers.

**Method:** A team of three UK lecturer-practitioners managed and delivered the module. Mixed-format questionnaires, based on the module content, assessed student knowledge at the end of the week. A student opinion about the module was solicited from an evaluative questionnaire.
**Results:** The assessment of student knowledge showed good student knowledge about the module content following delivery. The evaluative questionnaires showed that 92% students would consider ultrasound as a career option following the module. Results are tabulated and qualitative comments appended.

**Conclusions:** The module delivery was considered successful in that it delivered knowledge of ultrasound imaging and raised an awareness of the potential for future career development.

17. **Audit of the Perceived Ultrasound Scan Experience of Specialists Registrars Working in the Liverpool Women’s Foundation Trust.** Chawla S, Drakeley A, Holmes E (Liverpool Women’s Foundation Trust)

**Introduction:** The initial idea of this audit resulted from risk management evaluation that had identified a potential compromise to patient care. There was untrained and unqualified medical staff, working within the Trust performing ultrasound examinations. In turn, this could lead to clinical error resulting in compromised risk management, complaints and litigation. We therefore conducted an audit on the perceived ultrasound capabilities of the registrars commencing in the Trust in October 2005. Their actual competency was assessed against national standards from the Royal College of Obstetricians and Gynaecologists Competency Guidelines.

**Method:** This was a prospective data collection. A structural interview form was designed and 16 registrars were inter-viewed during their induction week. The proforma was split into three main categories consisting of:

- Which ultrasound examination do you think you are able to perform?
- How many have you performed?
- What level of supervised training/ ultrasound qualification have you received?

**Results and conclusions:** The findings from this audit were:

- The most common scan registrars were confident with were viability scans (94%) followed by early pregnancy scans (88%).
- Yet, only five out of the 16 registrars had performed > 100 viability scans and early pregnancy scans.
- Fifty-six per cent had received core training and 44% without core training.
- Only 44% had supervised training that met the standards accepted by the Royal College. Furthermore, 37% had no supervised training but still performing scans.

As a result, a consultant-led supervised scan session for registrars has been devised which is currently in progress. Future intentions include a set competency level at the start of each registrar year and the development of a Trust Certificate of Competence in Medical Ultrasound for all registrars.

18. **Fast Scan and Beyond.** Chow H K

We describe an unique ultrasound training programme tailored to meet the need of the modern A&E medical staff. This collaborative pilot ultrasound training programme organised by Chesterfield Royal Hospital and University of Derby, was established in June 2005. It is aimed at improving quality and the use of Ultrasound imaging in Emergency medicine, by Consultants, senior medical staff and SPR of the A&E department. The programme is as follow

Day 1: Physics and Clinical Governance.
Day 2,3,4: Consecutive supervise practical ultrasound training and Tutorials.
One month interval: Self study, further practical experience, completion of log book and writing up of 5 cases with annotated illustration.
Day 5: Revision and Examination
Day 1 and Day 5 performed by University of Derby
Day 2, 3 and 4 performed by Chesterfield Royal Hospital. In normal circumstances, each Royal College train and examine its own member. This collaborative training programme form an ideal link between the Royal Colleges of the trainers (Royal College of Radiologists) and the trainees (Royal College of Surgeons). The training is validated by University of Derby who independently examine each student. The students are than given a certificate by University of Derby on the successful completion of training, which make the completed training ‘portable’ when in future, the ultrasound trained medical staff decides to work in a different hospital.

To date, we have trained 8 medical staff and 3 had taken their examination. We hope the remaining 5 students will have completed their examination by December 2006. We will describe our experience to date and will provide a survey of the outcome of our collaborative training programme.

**Musculoskeletal**

19. **Role of Ultrasound in Hip Joint Pathology.** Prajapati H, Raychudhari C (H M Patel Medical Care Centre, Shree Krishna Hospital, India)

**Aims:** (1) To evaluate role of US in various pathologies of hip joint. (2) To diagnose the DDH and assist in follow up cases of DDH. (3) To identify the role of US in the septic arthritis and Koch's hip and to co-relate with the conventional radiographs. (4) To diagnose the joint effusions and their probable aetiology. (5) To diagnose the soft tissue effusions and their probable aetiology.

**Materials and methods:** For the study, US was performed in patients with symptoms of hip pain, limping, fever and infant with suspected DDH. US was done with high frequency transducer 7.0 MHz and also with 3 MHz when required. Scanning was done in supine position and coronal scan was obtained. For DDH both coronal and transverse scans in flexion and neutral positions were obtained.

**Results obtained:** A total of 32 patients were scanned for hip joint; the majority of them were DDH and Koch's hip and septic arthritis of 0–6 years of age group. The overall efficacy of US in detecting joint effusion was 95%. One-hundred per cent of cases of septic arthritis and transverse synovitis and 90% of cases of Koch's hip had joint effusion on US. One-hundred per cent of cases of septic arthritis showed soft tissue collection while 30% showed Koch hip. US was insensitive in detecting articular surface changes in Koch's hip and AVN as seen on radiographs. Characteristic findings of Perthe's disease were found on US study. Compared with US, radiographs could detect joint fluid in only 50% and soft tissue collection in 60% of patients.

**Conclusion:** US is very sensitive in detecting joint effusion of septic arthritis and is useful for the detection of the soft tissue collection. Easy availability, low cost and lack of radiation makes US suitable modality for study of DDH and follow-up.

20. **Shoulder Ultrasound in Rheumatology.** Shah V, Heywood M, Shaikh M, Tare P, Srinivasan A (Broomfield Hospital, Mid Essex Hospitals NHS Trust)

**Introduction:** Treatment of shoulder pain often centres on symptomatic relief, but in many cases involves surgical correction of an underlying rotator cuff defect. Pre-surgical imaging with ultrasound (US) is preferred to magnetic resonance imaging (MRI) in Europe. US is proven to be sensitive and accurate at detecting full thickness rotator cuff tears (FTRCT).

**Aims:** Compare the outcome of shoulder US in relation to clinical diagnoses, and assess impact on further patient management.

**Methods:** Case notes of 34 patients undergoing shoulder US during 2005 analysed using standard proforma.

**Results:** US findings included: 10 FTRCT, six PTRCT (partial tears), and 10 patients with subacromial/subdeltoid bursitis or bursal swelling. 0/34 patients required a subsequent MRI. Of 10 with FTRCT, three were managed conservatively without orthopaedic referral. Of seven referred, one awaits an appointment, four have had surgery (tears confirmed in all cases), one declined surgery and one was unfit.
for surgery. Six out of ten were diagnosed clinically with rotator cuff tear. Of six with PTRCT, three were managed conservatively and three surgically. Four out of six were diagnosed clinically with cuff tendonitis.

**Conclusions**: Clinical diagnoses correlated well with US findings, and allowed prompt referral to orthopaedic services without the need for MRI, saving time and money. US results allow rationalization of treatment; intra-articular steroids may be avoided if a PTRCT is found as FTRCT may be precipitated. Shoulder US is a safe, non-invasive and cost effective technique for detecting rotator cuff pathology prior to surgery. Patients prefer it to MRI; it has a low inter-observer variability and is superior to MRI in post-operative patients.

**Recommendations**: Shoulder US should be performed early in patients with shoulder pain as it:

- allows rationalization of clinic treatment;
- provides the opportunity to inject under image guidance;
- allows early referral to surgical services;
- avoids the need for MRI.

21. **Pointers or Wavers?** Davies RS, Smith R, Wynn-Jones D (Morriston Hospital, Swansea)

Radiology departments are seeing an increasing number of referrals for ultrasound scanning of a variety of lumps and bumps, which previously were not imaged. A large number of these are from GPs and we noticed that patients fell into two broad categories—those who point at the lump with a finger and those who vaguely wave at an area of the skin with the palm of their hand. Many of these turn out to be simple abnormalities such as lipomas and in some there is no abnormality.

We prospectively audited over 50 consecutive patients referred, and recorded whether they ‘waved’ or ‘pointed’ at the offending area, whether there was a clinically palpable lump, the ultrasound findings as well as the build of the patient. Of patients who pointed over 90% have both a clinical and ultrasound abnormality. In those who ‘wave’, the converse is true, i.e. over 90% have no abnormality, either clinically or on ultrasound, and these patients were more likely to be obese.

Clinicians can be reassured that if there is no abnormal mass to be felt and the patient waves rather than points at the area on the skin, it is very unlikely an abnormality will be demonstrated.

**Obstetrics/Gynaecology**

22. **Diagnostic Pitfalls of Ectopic Pregnancy**. Duffin PA, Langstaff K (St James's University Hospital, Leeds)

Ectopic pregnancy is defined as the implantation of the fertilized ovum outside the uterine cavity. It is increasing in prevalence, occurring in 1.9% of pregnancies and is the leading cause of death in the first trimester. Ultrasound plays an important role in the early diagnosis of ectopic pregnancy. This poster is a pictorial review of ectopic pregnancies and the pitfalls that can be encountered when diagnosing them with ultrasound. Several cases of ectopic pregnancy will be discussed and these will include:

- **Case 1**: Early cervical ectopic pregnancy.
- **Case 2**: Ectopic pregnancy within a caesarean section scar.
- **Case 3**: Heterotopic pregnancy.
- **Case 4**: Cornual ectopic and differentiation from a gravid bicornuate uterus.
- **Case 5**: Adnexal ectopic pregnancy and differentiation from collapsing corpus luteal cysts.
- **Case 6**: Pseudo intra-uterine gestation sac.

Discussion will be made into appearances that helped towards a diagnosis with ultrasound, the consequences of the diagnosis and the management of the patient.

**Summary**: Accurate and prompt diagnosis of ectopic pregnancy is very important to avoid unnecessary laparoscopy or unwarranted prescribing of methotrexate treatment to patients with a false positive diagnosis. A false negative diagnosis of ectopic pregnancy may lead to a risk of severe haemorrhage and the need for
surgical intervention. This poster will demonstrate the differing ultrasound appearances of ectopic pregnancy and the diagnostic pitfalls associated with each.


**Background:** The staff of an ultrasound department providing a routine obstetric ultrasound service were asked to design a poster suitable for the waiting area for pregnant women. The poster was to focus around useful information for the 12-week booking scan and the 20-week anomaly scan.

**Methodology:** The level of knowledge regarding booking and anomaly scans was ascertained from 30 low risk pregnant women, using a 7-point questionnaire. These data were used to derive a list of six statements relating to the booking scan and seven statements relating to the anomaly scan. A further 20 low risk pregnant women were asked to prioritize these statements in order of personal importance.

**Results:** The numbers of women selecting each statement as the most important for the two scans are tabulated below.

**Conclusions:** This study raises issues regarding pregnant women's apparent lack of knowledge regarding obstetric ultrasound examinations. It identifies what issues are important to women at booking and at 20 weeks. The selected preferences highlight the differences in perception of the role of ultrasound examinations between pregnant women and health care professionals.

<table>
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<tr>
<th>Statement number</th>
<th>Dating scan</th>
<th>Statement number</th>
<th>Anomaly scan</th>
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<tr>
<td></td>
<td>What you need to do before your scan, i.e. drinking water</td>
<td>13</td>
<td>Baby's appearance and size</td>
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<tr>
<td></td>
<td>What the scan can tell you about baby</td>
<td>6</td>
<td>Why anatomy is checked</td>
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<tr>
<td></td>
<td>Availability and cost of pictures</td>
<td>1</td>
<td>What the measurements mean</td>
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<tr>
<td></td>
<td>Baby's appearance and size</td>
<td>0</td>
<td>Sex of baby</td>
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<tr>
<td></td>
<td>What the scan doesn't tell you about baby</td>
<td>0</td>
<td>What the scan doesn't tell us about baby</td>
</tr>
<tr>
<td></td>
<td>Checking your womb &amp; ovaries are healthy</td>
<td>0</td>
<td>What ‘soft markers’ mean</td>
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<td></td>
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<td>20</td>
<td>What you need to do before your scan i.e. drinking water</td>
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**Background:** Growth restricted fetuses are at a greater risk of stillbirth, birth hypoxia, neonatal complications and long-term sequelae. Gardosi et al. (1992) developed a computer programme ‘Grow’ that used four independent variables of fetal growth (Maternal height, weight, parity & ethnicity) to generate an individualized customized growth chart which improved the identification of the truly growth restricted fetus. A retrospective pilot study comparing standard growth charts (SGC) with customized growth charts (CGC) identified a potential for up to a 50% decrease in induction of labour for growth restriction if CGC's were used.
Aim of the follow-up study: To determine whether the use of customized growth charts has improved our management of truly growth restricted babies and to determine whether the predicted reduction in interventions has taken place.

Objectives:

• To analyse obstetric interventions and neonatal outcomes in a cohort of small for gestational age babies (<10th centile on standard growth charts) who were normally grown on CGC'S.

• To analyse obstetric interventions and neonatal outcomes in a cohort of small for gestational age babies (<10th centile on standard growth charts) who were also small for gestational age on CGC'S.

• To compare results with our pilot study done in 2003

Methodology: Identification through Euroking of 51 women delivered of a baby <10th centile for gestational age on traditional growth charts

Results: Twenty-seven per cent of babies small on standard growth charts, were normal on customized growth charts, this is half of what the previous study showed. In the <10th centile group 65% were Caucasians. 62% were Indo-pak in the 10–90th centile group. Almost 70% of both the truly small and the constitutionally small babies had more than one scan: 65% of truly small, and 30% of constitutionally small babies had reduced AFI; 5% of truly small babies had abnormal Doppler's; and one of the constitutionally small. Only in the truly small babies group were there more than four visits to ADU. IOL for IUGR occurred only in the truly small babies (57% of this group). Eighty-six per cent of emergency caesarean sections for fetal distress were in the truly small babies group. Eleven per cent of the truly small babies had a pH less than 7.20 v. 7% in the constitutionally small group.

Conclusion: Customized growth charts are accurately identifying an at risk group of babies. By doing so, there is less intervention in pregnancies where the baby is small, but constitutionally so.


This lady presented via the early pregnancy unit on 4 January 2006 with bleeding at 6 weeks gestation. The initial scan reported the gestation sac to be low in the uterus close to the cervix. A second scan was performed 2 weeks later on the 18 January 2006 when the report again stated the sac to be very low and suggested implantation to be in the anterior cervical wall and raised the suspicion that the pregnancy may have implanted in the previous caesarean section scar.

Having confirmed our initial suspicions the patient was counselled re termination of the pregnancy. This procedure was performed by injecting methotrexate into the gestation sac under ultrasound control. Post-procedure scan one week later identified that the fetus was still viable although the heart pulsations and fetal movements were much slower. A further dose of methotrexate was given. Follow-up scans revealed IUD and the gestation sac at this stage was around 9 cm. Serial scanning for reduction of sac size showed initial sac reduction followed by a series of static results. MRI was used to determine the size and position of the gestation sac. Surgical removal was performed to remove the sac.

*This poster will show images of U/s MRI & Intra-operative photos.

26. The Impact of Establishing a Dating Service. White JA, Martindale EA, Edington A (East Lancashire Hospitals Trust)

As one of the few hospitals not offering a dating service through lack of local funding, the recommendations from the National Screening Committee 2002 and the SURUSS report in 2003 allowed the Trust to renegotiate its Antenatal Screening service. At the time, two district general hospitals were merging to form the new East Lancashire Hospital Trust and there was disparity in patient care, with dating scans being offered only on one site. Negotiation commenced with the local PCTs and finance was received to commence a dating service.
This poster intends to review the outcome of this implementation looking at the implications for the department, the patients and the staff. We will look at the anomalies identified in the first trimester, discuss the operation of an appointments booking line and the impact of the early scans on patient care and staffing.

27. **One in a Million—a Case of Proteus Syndrome.** Arundale LJ (St James's University Hospital, Leeds)

This poster describes an unusual antenatal presentation of Proteus Syndrome. This is a rare disorder with a prevalence thought to be less than 1 in 1 million live births. Proteus Syndrome is a progressive condition. Children are usually normal in appearance at birth, only developing the characteristic skin and limb disorders over time. The diagnosis of Proteus Syndrome is, therefore, often delayed, sometimes even into adulthood.

A routine 20-week scan revealed a fetus with a large complex soft tissue mass involving the upper torso and the upper limbs. It was initially felt that this was a form of lymphangioma. The parents elected to continue with the pregnancy and a live female infant was delivered at term.

A combination of postnatal ultrasound scans, plain x-rays, magnetic resonance imaging (MRI) and morphological appearance of the child lead to a diagnosis of Proteus Syndrome. The plain x-rays revealed overgrown digits of the hand and MRI confirmed the complex nature of the soft tissue mass.

This unusually early diagnosis of Proteus Syndrome allowed counselling of the parents as to the possible consequences of this condition. Some affected individuals may suffer learning disabilities and some have a significantly shortened lifespan. By far the greatest challenge that most of these children face, however, is the way that society treats them on account of their deformities.

28. **An Evaluation of the Routine Four-chamber View in the Detection of Congenital Heart Defects.** Holland WD¹, Holdcroft D², Weston J¹ (¹Derby Hospitals NHS Foundation Trust, and ²University of Derby)

Examination of the fetal heart is an established part of the routine anomaly scan and the four-chamber view has represented the linchpin for cardiac scanning, since its introduction in the 1980s. However, more recently, its predictive value and sensitivity have been called into question. Anticipated improvements have not been realized and screening for Congenital Heart Disease has provided only limited success.

Cardiac defects continue to have the highest prevalence at birth and the lowest detection rate in utero and even when detected prenatally seem to gain little survival advantage.

Through literature and selective study review, this poster examines and discusses the complex relationship of the various factors that may influence diagnostic ability, within the context of cost effectiveness. This presents a challenge for both fetal and service management. The evidence indicates the solution to this complex diagnostic problem is a national directive for uniform improvement, but in management terms, the feasibility of such an improvement strategy is problematic due to financial and staff constraints.

29. **An Audit on the Use of Transvaginal Scanning for Placenta Localization from 34 Weeks Gestation.** Towers N, Briers SM (Whiston Hospital, Preston)

**Background:** In our unit the placenta is localized at the routine anomaly scan (performed between 19–21 weeks gestation). If the inferior border of the placenta is low lying at this stage (i.e. abutting or overlying the internal os) then the patient is re-booked for a further scan at 34 weeks. The 34-week scan protocol is currently a TA scan (with full bladder) where the placental edge is located. In addition all fetal biometry is completed (BPD, HC, FL, AC) and an amniotic fluid index.

**Aim:** The aim of the audit was to introduce TV scanning to aid placental localization at 34 weeks (often difficult due to overlying fetal parts).

**Method:** In a number of patients the full TA scan was completed then following informed consent a TV scan performed. The results were recorded in a matrix then analysed for accuracy.
Results/conclusions: Preliminary results have shown that the TV scan affected the patients' management in 78% of cases. The TV scan is well tolerated by the patient and is quick and simple to perform. We hope to introduce the TV scan as standard protocol for placental edge assessment at 34 weeks.


Introduction: Haemorrhage is one of the leading causes of maternal mortality and morbidity in the world. Good obstetric care has significantly reduced maternal mortality in the developed countries, but it is still very high in the developing countries. In India, it is about 4.08/1000 live births. Haemorrhage accounts for 22.6% cases. Greater accuracy of diagnosis of placenta praevia by ultrasound plays a major role in reducing maternal mortality and morbidity.

Aims and objectives: To evaluate and compare accuracy of transperineal and transvaginal sonography in localization of placenta in antepartum haemorrhage.

Method: One-hundred patients of APH who were haemodynamically stable were included in study conducted at Postgraduate Institute of Medical Sciences Rohtak (Haryana), India, over a period of 1 year. The patients were first subjected to TVS using high resolution probe (5 MHz and 6.5 MHz) on real time scanner and distance between internal os and lower placental edge was measured in centimetres. Later, transperineal sonography was performed on the patients, using 3.5 MHz convex transducer, which was positioned directly on perineum in sagittal orientation over the labia minora. For optimizing visualization, the transducer angle was adjusted under sonographic control, and distance between internal os and lower placental edge was noticed. After the delivery of the placenta, distance between site of rupture of membranes and edge of placenta was determined. The findings at delivery were used as standards to calculate sensitivity, specificity, negative and positive predictive values of transperineal and transvaginal sonography.

Result: The sensitivity and specificity of transperineal and transvaginal sonography was 100 and 95.2%, respectively, while positive and negative predictive values were 96.2 and 100%, respectively.

Conclusion: TPS is an alternative and superior to TVS. It is easy to perform and well tolerated diagnostic tool for localization of placenta in antepartum haemorrhage.

31. Ten Years (1995–2004) Outcome of Fetal Neural Tube Defect. Pathak SP1, Fayaaz HF2, Cameron AC3 (1James Paget Hospital, Norfolk, 2Alexandra Hospital, Paisley, and 3Queen Mother's Hospital, Glasgow)

Objectives: To evaluate the outcome of all fetuses diagnosed with a neural tube defects in a 10-year period at a tertiary referral centre..

Methods: A retrospective case sheet review of 88 mothers identified as having a fetus with a neural tube defect (NTD) was conducted.

Results: The maternal age ranged from 17 to 42 years. Nine women had taken preconception folic acid, 10 had not taken it and in 69 it was unknown. Four women had previous NTD pregnancies, three had had other fetal abnormalities, three were diabetic, three had twin pregnancies and four had epilepsy. Twelve women had low risk alpha-fetoprotein screening and 21 were high risk. The remainder either did not have or declined screening. The types of NTD identified were myelomeningocele (49), anencephaly (18), meningocele (12), encephalocele (8), lumbo sacral dysmorphism (1). Sixty-two were open defects. The majority of spina bifida cases (38) were in the lumbo sacral spine. Fifty-three fetuses had associated anomalies, the majority being hydrocephalus (35). Fifty-four women opted for termination of pregnancy. In the live births, seven women delivered vaginally and 22 had a caesarean section. Most of the babies had the closure surgery between 0 to 2 day, and were discharged between 3 and 8 weeks. The range of neurodevelopmental disability and its relationship to the antenatal ultrasound will be presented.
Conclusion: In this review, the fetal diagnosis of neural tube defects leads to 61% of women opting to terminate the pregnancy. Of those women who opt to continue with the pregnancy there is a range of paediatric morbidity that reflects the severity of the lesion seen at the fetal ultrasound.

32. Accuracy of Ultrasound Estimated Fetal Weight Measurement. Franklin VE, Crichton F, Ekevall K (Stirling Royal Infirmary)

Background: Fetal growth measurement is an essential tool in modern obstetrics. Abdominal circumference (AC) and estimated fetal weight measurement (EFW) are the most accurate measurements to predict SGA. The aim was to determine how closely EFW correlates with actual birth weight when ultrasound scan is undertaken within ten days of delivery.

Methods: Patients undergoing fetal growth scans within 10 days of delivery were included. EFW, biparietal diameter, femur length, AC, fetal sex, birth weight and gestation at delivery were recorded. Ultrasonographic software calculated EFW using the Shepard formula. The difference between actual birth weight and EFW was expressed as a percentage of the actual birth weight.

Results: Fifty-four cases were examined. Mean birth weight was 2950 g (600–4700 g). Mean EFW was 2992 g (570–4300 g). The range of error from the birth weight was -20.2% to +35.7%. The mean percentage error was 11.9% (range 0.3–35.7%). Statistical analysis showed overall good correlation between the data (p <0.01). Percentage differences in weights were divided into percentile groups above or below birth weight:

<table>
<thead>
<tr>
<th>Percentile</th>
<th>&lt;5%</th>
<th>5–10%</th>
<th>10–20%</th>
<th>20–30%</th>
<th>30–40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number %</td>
<td>9</td>
<td>15</td>
<td>24</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>16.7</td>
<td>27.8</td>
<td>44.4</td>
<td>9.3</td>
<td>1.8</td>
<td></td>
</tr>
</tbody>
</table>

Results were examined according to birth weight:

<table>
<thead>
<tr>
<th>Birthweight</th>
<th>&lt;2.5 kg</th>
<th>2.5kg–3.5 kg</th>
<th>&gt;3.5 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>12</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Mean birth weight (g)</td>
<td>1912</td>
<td>3009</td>
<td>837</td>
</tr>
<tr>
<td>Mean EFW (g)</td>
<td>2083</td>
<td>3118</td>
<td>3584</td>
</tr>
<tr>
<td>Mean error%</td>
<td>+8.9</td>
<td>+3.6</td>
<td>-6.6</td>
</tr>
</tbody>
</table>

Statistically, correlation was good with low and normal birth weights (p < 0.01), but not for higher birth weights (p = 0.1).

Conclusions: A total of 16.7% cases estimated fetal weight to within 5%, but over 50% had an error between 10 and 40%. There was a large variation in the difference between birth weight and EFW, both above and below actual birth weight, although statistically this was only significant when looking at higher birth weight infants. Given the wide range of variation in error for individual cases, caution should be used when interpreting estimated fetal weights.

33. First and Third Trimester Ultrasound in the Prediction of Birthweight Discordance in Twins. Banks C L

Objective: Birthweight discordance amongst twins is associated with an increase in perinatal morbidity and mortality. Clinical decisions regarding the management of twins are often made on the basis of estimated fetal weight in the third trimester. This study assesses the efficacy of routine third trimester ultrasound fetal biometry, third trimester fetal growth velocity and first trimester differences in size in the prediction of subsequent birthweight discordance.

Study Design: Structurally and chromosomally normal dichorionic twin gestations resulting in two live births after 24 weeks gestation were identified. Ultrasound examinations of dichorionic twin pregnancies between 10 and 14 weeks of gestation were evaluated for inter-twin biometric disparity in crown-rump length (CRL). Estimated fetal weight (EFW) was calculated from the last scan before delivery. Fetal Growth Velocity (FGV) was calculated from two estimates of fetal weight between 21 and 35 days apart and incorporating the last EFW before delivery. EFW and FGV were expressed as standard deviation scores (Z scores). Disparity between these ultrasound parameters was correlated to inter-twin birth weight difference. Birth weight
discordance was defined as \( \pm 20\% \) difference in birth weight relative to the heavier twin. Fishers exact and Spearman rho tests were used for statistical analysis. Test performance is expressed as area under the ROC curve and likelihood ratios (LR).

**Results:** 135 dichorionic gestations were identified over a consecutive 3 year period. 108 twin gestations had both crown-rump length (CRL) and sufficient ultrasound measurements in the third trimester to calculate FGV. 26 pregnancies (24%) had discordant birth weight. Only EFW Z score difference was correlated with birth weight disparity \( (r=0.36, \ p=0.001) \).

An EFW Z score difference of 0.6 had an area under the ROC curve of 0.70 (95% C.I. 0.59–0.79) but this did not differ significantly from first trimester prediction of growth discordance which had an area of 0.55 (95% C.I. 0.44–0.66). The LR for first and third trimester prediction of discordance were low.

**Conclusion:** Ultrasound measurement of fetal growth velocity and size both in the first and third trimesters is a poor predictor of birth weight discordance. Disparate fetal growth is exhibited as early as 10–14 weeks gestation and differences at this early stage in fetal development are no less accurate than EFW within one month of delivery. First trimester ultrasound, third trimester growth velocity and third trimester EFW do not accurately predict the delivery of twins with discordant birthweight.

**Physics and Vascular**

34. **Limitations of Displacement Estimation Using 4-D Envelope-Detected Data from a Motorized Curvilinear Array.** Miller N\(^1\), Harris E\(^2\), Symonds-Tayler R\(^2\), Evans P\(^2\), Bamber J\(^2\) (\(^1\)Royal Marsden Hospital, Sutton; \(^2\)Institute of Cancer Research, Sutton)

We propose to evaluate ultrasonic speckle tracking as a method of monitoring organ motion for real-time guidance of radiotherapy. For the technique to be of maximum clinical benefit, it will need to track tissue displacements in 4-D. This study aims to determine the limitations of displacement estimation using 4-D envelope-detected data from a commercial motorized curvilinear array (Medison, Accuvix XQ).

Experiments were conducted using tissue-mimicking gelatine phantoms in a water bath. For convenience, relative object motion was achieved by moving the transducer, rather than the phantom. The transducer was clamped to a motion platform with three axes of translation. In the first set of experiments (‘step-and-shoot’), 4-D B-mode data were acquired before and after the transducer had been moved by a known displacement. In the second set of experiments (‘dynamic’), data were acquired, while the transducer was being moved at a known velocity. Data processing was carried out off-line and consisted of 3-D correlation-based speckle tracking followed by scan conversion of the displacement data from spherical to Cartesian co-ordinates.

The accuracy and precision of the displacement estimates was found to vary with the magnitude and direction of displacement, the size and shape of the kernel used for speckle tracking, and the imaging depth. The step-and-shoot experiments demonstrated that the upper limit on the accuracy and precision, when tracking B-mode data from a motorized curvilinear array, is sufficient to benefit radiotherapy in terms of reduced treatment margins. The dynamic experiments showed that the tracking accuracy varies with the ratio of relative object velocity to temporal resolution (i.e. vols/s). We conclude that the scanning and motion tracking parameters will need to be optimized for the given clinical situation. In particular, the temporal resolution will need to be chosen to be sufficient to cope with the expected speed of tissue motion.

35. **The Potential for High Frequency Ultrasound Velocity Shift in Atherosclerotic Plaque Characterization.** Brewin MP, Birch MJ, Srodon P (Barts and London NHS Trust, Royal London Hospital)

The potential of the shift in pulsed ultrasound pressure wave velocity as an indicator of atherosclerotic plaque material characteristics is under investigation. Both attenuation and velocity shift maps are to be compared with histological results for carotid artery plaque. It is hoped that this may provide a reliable non-invasive ultrasound tool for patients with carotid atherosclerosis. As part of an ethically approved trial, plaque is harvested from consenting adults undergoing carotid endarterectomy. It is then embedded within an EC agar-based water gel of known acoustic properties. The gel is then placed in a sample holder backed with an optically flat plane reflector and scanned using a tightly focussed 20 MHz ultrasound beam.
The holder is moved through the beam in a raster fashion in both $x$ and $y$ direction using actuators and drivers controlled by an in-house LabView programme.

The velocity and attenuation are calculated using a reflective substitution pulse-echo method. Both the attenuation and velocity shift maps will then be compared with both the histology, and in vivo and ex vivo ultrasound images of the plaque. The aim is to be able to classify the types of plaque non-invasively using this novel ultrasound technique.

Initial results from the velocity shift maps have shown that there is a discernable difference against the background velocity of the gel. These results have also been matched against histology in order to give initial results for the acoustic velocity of the various components of atherosclerotic plaque. These results of ongoing work along with initial matching to attenuation and radiofrequency data will be outlined in this poster.

References


Our aim was to evaluate the ability to use elastography to investigate the effects of surface tensile loading, of varying direction, on strain generated within skin and underlying tissue layers in both the unaffected and affected arms of lymphoedema patients ($n = 7$) and in healthy volunteers ($n = 5$).

An extensometer (Cardiff Biometrics, UK) was used to apply a pseudo-static linear tensile strain to the forearm surface, whilst measuring the load and surface strain. Elastograms were produced from a sequence of ultrasound RF images, acquired using a Zonare Ultrasound Scanner at 8.5 MHz, while applying a 20% strain. Incremental tracking formed lateral displacement images, and least squares strain estimation produced normal and shear strain images. Data were acquired in two different loading directions, along and across the arm, to investigate anisotropy.

Pronounced stiffness anisotropy, measured as stiffness along the arm/stiffness across the arm, was observed in both healthy volunteers and unaffected arms of lymphoedema patients, with a stiffness ratio of two. However, in affected arms of lymphoedema patients, the anisotropy had disappeared, with a ratio of 0.90±0.27 (1 SD).

Ultrasound elastography confirmed the previous observation, reported at BMUS 2004, that despite the use of surface tensile loads, strain propagates down into the subcutis. Furthermore, in this new study, lymphoedema was found to increase the amount of strain propagated into the muscle layer. The ratio of the strain in muscle to strain in the subcutis was twice as large for the affected arms of lymphoedema patients as for both patients' unaffected arms and for healthy volunteers.

These preliminary results show that lymphoedema affects the mechanical properties of skin and the underlying tissue layers in ways that can easily be measured. Further work is required to determine the precise role and value of the techniques in diagnosing and assessing lymphoedema.

37. Properties of Doppler Embolic Signals Detected during Cardiac Surgery. Chung EML, Sumner RL, Martin MJ, Fan L, Evans DH (Leicester Royal Infirmary and University of Leicester)

Background and purpose: Patients undergoing cardiac surgery are at high risk of stroke and neurological injury due to the accidental release of thousands of tiny emboli during surgery. Although non-invasive detection of cerebral emboli can be achieved using transcranial Doppler (TCD) ultrasound, discrimination between air bubbles and more dangerous solid emboli remains a considerable challenge. The purpose of
this study was to determine the properties of embolic signals detected during cardiac surgery and to estimate the proportions of solid and gaseous emboli.

Method: TCD data containing over 15,000 embolic signals were collected from the middle cerebral arteries of 15 patients during open-heart surgery. Statistical separation of solid and gaseous emboli was performed by comparing intra-operative signals with reference data from emboli of known composition.

Results: Embolic signals detected during surgery typically produced several peaks in the intensity distribution. Peaks at ~20 and ~40 dB were consistent with signals from air bubbles. A lower peak at ~8 dB had similar properties to reference data collected from solid emboli following carotid surgery. This peak was observed in approximately a third of the patients we studied. Our data suggested that some patients had experienced more than a thousand solid emboli during a single operation.

Conclusions: Comparison of signal properties provides a simple and effective means of estimating the proportion of solid and gaseous emboli detected during cardiovascular surgery. Further studies will be required to determine a relationship between stroke risk and the prevalence of solid and gaseous emboli.

References


38. Practical Implications of the Temperature Dependence of Speed of Sound and Attenuation in Urethane Test Objects. Dudley NJ, Fairhurst L, Gibson NM (Nottingham University Hospitals NHS Trust)

Background and purpose: Investigation of the acoustic properties of a urethane test phantom (Iball et al., 2002) and of a number of samples of tissue mimicking materials (Browne et al., 2004) showed that urethane has greater temperature dependence than other materials. The speed of sound (SoS) and attenuation decrease with increasing temperature. This study aimed to confirm these findings in our urethane phantom (ATS 539) and to assess the practical implications in routine Quality Assurance (QA).

Method 1: The phantom was cooled overnight to 4C, scanned immediately and images captured for the measurement of SoS, resolution and LCP using the Nottingham Ultrasound QA software. Images were captured and analysed until the SoS reached the manufacturer's specification.

Method 2: QA measurements made in the summer and winter were compared for a single probe on each of 13 scanners.

Results 1: The speed of sound decreased and LCP increased (decreasing attenuation) as the test object warmed, confirming the temperature dependence of these variables.

Results 2: The SoS was significantly slower in summer for 11 of the 13 scanners (average difference 1.3%), with results in agreement for four of five probes capable of harmonic mode. For five probes, where the LCP was less than the depth of the test object, LCP was significantly less in winter for three probes (three out of four in harmonic mode), but this did not correlate well with the difference in SoS. No significant differences in resolution were demonstrated.

Conclusions: The acoustic properties of urethane phantoms are sensitive to the temperature changes encountered in a typical hospital setting between summer and winter. Such phantoms should be stored and used in a temperature-controlled environment. If exposed to hot or cold conditions they should be allowed to stabilize before use.

39. Audit of DVT Requests Based on Risk Score and D-dimer Value. Diment C (St Helens and Knowsley Hospitals NHS Trust, Whiston Hospital, Prescot)
Since the introduction of NHS walk in centres there has been an increase in demand for DVT scanning at Whiston Hospital. Limited resources have meant that this increase has placed further burden on the ultrasound service. It had been noted that many of the requests were questionable, with negative d-dimer values and low risk scores. An audit of these examinations was undertaken to assess the DVT rate based on risk score and d-dimer value.

A sample of 300 patients was collected over a 9-month period. These patients had been referred from the NHS walk in centres. In patient referrals and referrals from the accident and emergency department were excluded, as this study focused on referrals from walk in centres. Probability score and d-dimer values were recorded, as were the results of the Doppler examination.

The results show that the total DVT rate over the 9-month period was 15%. All positive DVT patients had a positive d-dimer score. 34% of patients with negative DVT had a positive d-dimer score, and 66% had a negative d-dimer score. Forty-one per cent of patients with a DVT had a high risk score, with 2% of positive DVT patients having a low risk score. Twenty-three per cent of patients with negative DVT had a high risk score, with 56% of patients having an intermediate risk score and 21% of patients having a low risk score.

The study shows that a negative d-dimer score is associated with negative DVT. Risk factor alone cannot be used to exclude DVT as 79% of patients with negative DVT had either a high or intermediate risk score. However, risk score may be used with d-dimer score to assess DVT risk.


Background: One of the most important image quality parameters for any imaging system is spatial resolution, the ability of a system to distinguish objects that are close together. Colour Doppler (CD) spatial resolution may be defined as the image of a point source and it can be determined by measuring the point spread function of a point source or the minimum separation in space for which two separate point or line targets can be resolved. Another parameter of significant interest is CD temporal resolution, the minimum separation in time for which two separate flow events can be identified. The aims of this study were to build phantoms for the determination of CD spatial and temporal resolution.

Methods: Two different approaches to the determination of spatial resolution were carried out. The first approach used a phantom that consisted of lateral line pairs of fixed separations (0.6, 0.8, 1.0 and 1.2 mm) at varying depth, while the second approach determined the CD point spread function using a string phantom. The CD temporal resolution was determined also using a string phantom. Five ultrasound scanners were tested for spatial and temporal resolution.

Results: The two test procedures, spatial and temporal resolution were able to show differences in performance for the range of ultrasound scanners tested. The abdominal probe of the HDI 5000 and the 128 were found to have a spatial resolution of 0.6 and 1.2 mm, and a temporal resolution of 70 and 50 ms, respectively. The full results of spatial and temporal resolution for the range of ultrasound scanners will be presented.

Conclusions: Two novel approaches to the determination of spatial resolution, as well as a protocol for the determination of temporal resolution were developed and will be presented. The effect of system controls on CD spatial and temporal resolution will also be presented.

41. The Relationship Between Doppler Embolic Signal Intensity and Thrombus Size: an in vitro study. Martin MJ, Chung EML, Ramnarine K, Gittins J, Evans DH (Leicester University, and University Hospitals of Leicester NHS Trust)

Background and purpose: Blood-clots moving through the cerebral arteries can be detected using transcranial Doppler ultrasound, but the relationship between thrombus size and the intensity of the returned ultrasound signal has not been well characterized. The aim of this in vitro study was to measure variations in embolic signal intensity with thrombus size. Measurements were performed with sufficient accuracy to allow comparison with existing theoretical predictions.
Methods: Pieces of fresh thrombus were formed from whole blood using a Chandler loop. Thrombi ranging between 0.5 and 2.5 mm were then introduced to a pulsatile closed-flow circuit containing saline and a small quantity of blood-mimicking fluid. Each size of particle was allowed to circulate several times through the Doppler sample volume until an accurate measurement of the average ‘measured embolus-to-background ratio’ (MEBR) was obtained.

Results: The average MEBR produced by the motion of thrombus emboli generally increased with embolus size but did not rise monotonically. Oscillations in MEBR with size were found to be consistent with theoretical predictions.2

Conclusions: These results provide experimental confirmation that the relationship between MEBR and thrombus size is non-monotonic.2,3 Knowledge of the relationship between MEBR and thrombus size will aid future estimation of sizes of thrombi observed during clinical monitoring.

References


Performance Analyses of Two Transcranial Doppler Ultrasound Systems Using an Electronic Phantom and a Flow Phantom. Fan L, Ramnarine KV, Gittins J, Evans DH (University Hospitals of Leicester NHS Trust/University of Leicester)

Background: A series of analyses were carried out using an electronic phantom (EP) and a flow phantom (FP), to compare the velocity estimation and signal-to-noise ratio (SNR) performances of a purposebuilt DSP system with an integrated multi-gate transcranial Doppler (TCD) unit (System I) and a commercial Simed TC22 ultrasound machine (System II).

Method: The analyses were carried out in two phases. In Phase I, an EP was used to analyse the two systems under ideal transmitting/receiving (TX/RX) conditions. The EP was a programmable electronic device that received transmitted signals from a TCD system. These signals were modulated with a desired velocity profile, before being sent back to the TCD system in real-time. The generated velocity profile was also used as a ‘gold standard’ (GS) to check the velocity estimation results from the two systems. In Phase II, a FP was built to test both systems under more realistic TX/RX conditions. The FP consisted of a gear pump, a pump controller and a water tank. The pump generated a desired flow of a blood mimicking fluid (BMF) through a 3 mm C-flex tube within the tank. SNR evaluations and velocity estimation analyses were carried out on both the systems using the FP. The same 2 MHz transducer was used in both phases.

Results: For the typical GS of 1 KHz, both systems produced estimated results of 1 KHz (frequency resolution: 98 Hz) with zero standard deviations over 120 estimates (1.2 s), and results from System I showed better SNR (21 dB vs. 18 dB).

Conclusion: Both systems showed excellent agreement with velocity (Doppler frequency) estimations, and System I had slightly better SNR.

Viewing Conditions in Ultrasound: the forgotten variable. Evans JA1, Coulson K1, Tataw Tabe J1, Brettle DS2, Moore SC2 (1University of Leeds, and 2Leeds Hospitals NHS Trust)

The diagnostic quality of a softcopy display is strongly influenced by the viewing conditions. However, this is rarely monitored, measured or controlled on ultrasound scanners. We have audited the room lighting and monitor outputs of 21 US machines.
The ambient light level in each room was measured under normal clinical lighting conditions by means of a light meter placed in front of the ultrasound display. We measured the illuminance (lux) incident on the display due to the room lighting. The room was also inspected for features that might be deleterious to optimum use of the monitor.

The brightness of the scanner display (luminous intensity, cd m\textsuperscript{-2}) was then measured. Peak displayed white levels were created by scanning a small piece of Perspex at maximum gain and output to create a block of ‘solid’ white. The brightness of the white region on the screen was measured using the meter fitted with a baffle to minimize the contribution from surrounding areas. The black level was measured with the same light meter pointing at an area of the screen where no perceptible signal was found.

The results show considerable variation in ambient lighting varying from 1.4 to 33 lux (mean 12, SD 10.5). In addition, we noted potential difficulties arising from reflective white surfaces, unhelpful positioning of light boxes and desk lamps, and other issues.

The monitors showed similar variation. Peak white levels ranged from 20 to 134 cd m\textsuperscript{-2} (mean 71, SD 43). Black levels ranged from 0.01 to 0.33 cd m\textsuperscript{-2} (mean 0.19, SD 0.10). It was also noted that many monitors were more than 5 years old, which would normally imply deterioration. It is likely that none of these monitors was exploiting all of its potential grey scale range.

It is difficult to translate these findings into consequences for clinical diagnostic accuracy, but this merits further work.

**Paediatrics**

**44. Urothelial Thickening in the Paediatric Renal Pelvis—a Rare, Underecognized and Important Sign.** Cooper JCE, Murphy AM (York Hospital)

Urothelial thickening in the paediatric renal pelvis is a sign known to paediatric radiologists and sonographers. However, it is our experience that its appearance and significance are not widely known amongst generalists, who may also perform paediatric renal ultrasound. Although uncommon it is a useful sign originally described by Avni et al. 20 years ago in the context of Urinary Tract Infection (UTI). However, we have seen it in the absence of UTI and feel it can be an important sign to recognize when scanning infants with antenatal dilatation, which may subsequently resolve postnatally.

We demonstrate the characteristic appearances of urothelial thickening and review previous reports of this finding in the literature. We describe three infants in which the sign was found. In one there was a history of UTI and no history of antenatal dilatation. This baby had high grade vesicoureteric reflux (VUR) at micturating cystourethrography (MCUG).

Two cases with a history of antenatally diagnosed dilatation, which had resolved postnatally had residual urothelial thickening. In one, this sign was unrecognised, and he subsequently developed a UTI and was shown to have high grade VUR on the side of the thickening. The other also had reflux, but has not as yet developed UTI having been placed on antibiotic prophylaxis.

It is important to note that although standard ultrasound is a poor test for detecting reflux when this sign is present following resolution of antenatal dilatation the suspicion of ipsilateral VUR should be raised.