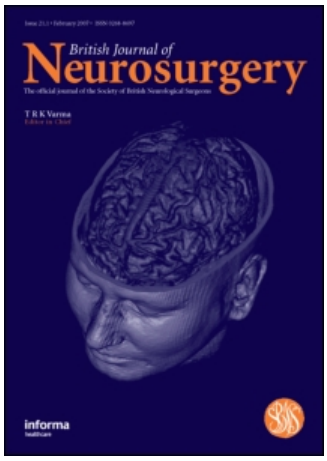

British Journal of Neurosurgery
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713407147

Proceedings of the 150th meeting of the society of British Neurological Surgeons

Online Publication Date: 01 April 2007
To cite this Article: , (2007) 'Proceedings of the 150th meeting of the society of British Neurological Surgeons', British Journal of Neurosurgery, 21:2, 91 - 179
To link to this article: DOI: 10.1080/02688690701329156
URL: http://dx.doi.org/10.1080/02688690701329156

British Journal of Neurosurgery, April 2007; 21(2): 91 – 179

informa
healthcare

PROCEEDINGS

Proceedings of the 150th Meeting of the Society of British Neurological Surgeons

This meeting is being held on 25 – 27 April 2007 at the Novotel Hammersmith, London, and hosted by Charing Cross Hospital.

These abstracts have been published in advance of the meeting in presentation order. If any papers are not subsequently read to the society or are withdrawn, an addendum will be issued in the next issue of the journal. The best three papers from the recent British Neurosurgical Research Group Meeting, held in Manchester, were selected for presentation at the 150th meeting of the SBNS; these three abstracts follow the poster abstracts. The full abstracts from that BNRG meeting will be published in the next issue of the journal.

ORAL PRESENTATIONS

Wednesday 25 April 2007

W4-01: Short term results of the effect of a back functional restoration programme on patients with back pain and sciatica

S. M. R. Kabir, R. Ddyal, J. M. Stanworth & P. A. Stanworth (Walsgrave Hospital, Coventry, UK)

Objective: To determine the short term results of a back functional restoration programme in patients with back pain and/or sciatica secondary to lumbar disc disease.
Design: This was a prospective study and consisted of a three-week full-time programme. Sciatica was defined as pain that extended below the knee. Patients with referred pain to the buttock and posterior thigh, severe muscle weakness, cauda equina syndrome, on invalidity benefit, who had a legal claim relating to their back or who retired on grounds of ill health through back pain were excluded. A new system was devised to assess functional outcome score. This was called the Higham-Grange functional scoring system based on employment, housework, activities of daily living and leisure activities. Patients were scored 0 – 100 based on individual activities. Patients were assessed prior to the course and then at approximately six weeks after discharge.
Subjects: 445 patients were included from June 1994 to January 2002.
Results: Highest group to undertake the course were managers, senior officials and professionals. Majority of the patients had back pain lasting five years or more and sciatica lasting seven weeks to one year. Average pre-treatment score was 58.16 while average post treatment score was 89.05 implying significant

ISSN 0268-8697 print/ISSN 1360-046X online © The Neurosurgical Foundation
DOI: 10.1080/02688690701329156

improvement in functional outcome following the programme. Of the 140 patients who were off work at the beginning of the programme, 90.71% returned to work.

Conclusion: In uncomplicated case of sciatica a back functional restoration programme can accelerate the recovery process over just bed rest alone and natural history. The results also compare favourably with surgical treatment. Return to work after surgery is around 90% at six weeks. Surgery is also costlier and carries a definite mortality and morbidity. One hopes that with more evidence along these lines, these programmes will be more widely available in the UK.

W4-02: 'Have I got cauda equina syndrome?' Which presenting symptoms best predict a positive scan?

K. Deniz, G. M. Spink, A. Anand, J. E. Brecknell & D. Peterson (Charing Cross Hospital, London, UK)

Objective: Review of all emergency referrals for patients with potential cauda equina syndrome (CES), to assess which presentation symptoms correlate with a compressive central disc on imaging.

Design: A retrospective analysis of two computerised referral databases. Analysis was performed over a five-year period (2001 – 2006) in one database, and a two-year period (2005 – 2006) in the other.

Subjects: A total of 134 patients (84 female; 50 male; average age 43) fulfilled the criteria of potential cauda equina syndrome based on the initial referral details. Scan results were known in 122 patients.

Outcome measures: The primary end point was the result of an MRI scan ($n = 122$). Other outcomes assessed were the transfer status of the patient, any surgery undertaken ($n = 36$), and the degree of neurological dysfunction at follow up ($n = 31$).

Results: 54 patients (44%) were found to have a compressive central disc. 30% had normal scans. The remainder had evidence of other pathology (posterolateral disc; infection; vertebral collapse; malignancy). Of those patients transferred to a neurosurgical unit for a scan, only 31% were found to have a central disc. 66% of patients presented with symptoms for over 48 hours. 66% of patients with a central disc presented with altered perineal sensation. 88% of patients complained of bladder dysfunction at presentation (40% had incontinence; 48% had urinary retention). Conversely, whilst only one patient with a central disc had normal sensation, and only four patients had no symptoms of bladder dysfunction, 43% of patients with a central disc had a normal motor examination.

Conclusions: Patients presenting with a large central disc causing cauda equina syndrome were most likely to have perineal numbness/urinary retention at presentation. A normal motor examination does not exclude the possibility of cauda equina syndrome.

W4-03: The value of emergency MRI for cauda equina syndrome in the tertiary referral unit: A two year retrospective study

M. J. N. Crocker, G. Fraser, E. Boyd, J. Wilson, B. P. Chitnavis & N. W. Thomas (King's College Hospital, London, UK)

Objective: The timing of surgery in cauda equina syndrome due to prolapsed intervertebral disc remains controversial.[1] Assessment of these patients requires MRI scanning, which is of limited availability outside normal working hours in the UK. We review the importance of out of hours MRI scanning in patients with suspected or confirmed acute cauda equina syndrome.
Design: Retrospective review.
Subjects: All patients either undergoing emergency MRI within our unit for suspected cauda equina syndrome over a two-year period, and all subjects undergoing emergency lumbar discectomy for cauda equina syndrome within the same period.
Outcome measures: Proportion of positive findings in symptomatic patients: proportion of patients referred with diagnostic MRI scans undergoing emergency surgery.
Results and conclusions: 76 patients were transferred for assessment and 'on call' MRI. 27 were subsequently operated upon. Only five proceeded to emergency discectomy that night (prior to next scheduled list). This may be due to delays in timing—from referral to acceptance, to arrival in the department, to diagnostic scan and to theatre. With the second group of patients, 43 patients had emergency discectomy for cauda equina syndrome during the study period. Of these, six patients had an out of hours MRI scan at our hospital for assessment (one patient living locally). These data support a policy of advising MRI scan for cauda equina syndrome at the earliest opportunity within the next 24 hours in the referring hospital, rather than emergency transfer for diagnostic imaging which has a relatively low yield in terms of patients operated on emergently.

Reference

1 Todd NV. Cauda equina syndrome: The timing of surgery probably does influence outcome. *Br J Neurosurg* 2005; 19(4):301–6;discussion 307–8.

W4-04: A retrospective audit on the management of referrals for impending cauda equina syndrome

M. B. Lee, A. Rooney & P. F. X. Statham (Division of Clinical Neurosciences, University of Edinburgh, UK)

Objective: A retrospective audit on the management of referrals for possible cauda equina syndrome (CES) was undertaken. The influence of admission time, whether during normal working hours or out of

hours, on the time to obtain an MRI diagnosis and the time of subsequent surgery was analysed.
Design: The records of all patients (aged 13 to 85) who were referred to the Edinburgh neurosurgical service over a 12-month period in 2004 were examined to obtain data on the source of referral, accuracy of the referring doctor's assessment, time to obtaining an MRI diagnosis, the pathology encountered, and the time to surgical treatment. A total of 150 patients were admitted for assessment for possible impending CES. 47 were excluded from the study because of data missing.
Results: 73 female and 30 male patients were included in the study. 58% of referral came from general practitioners. The correlations between the reported clinical findings were generally good for the history but poor for neurological signs. 51% were admitted out of hours and 73% were scanned by MRI urgently ((less than) 48 hours). 48% of images revealed a clinically significant pathology and 39% of patients had surgery during the same admission. Patients admitted out of hours waited significantly longer (21 hours vs. 13 hours) to have surgery.
Conclusion: These data indicate that investigation of impending CES form a large part of our neurosurgical referral service. In our practice, we can expect to request an urgent MRI scan in three-quarters of admissions, nearly half of whom will have a significant abnormality. As the optimal timing for surgery for impending CES is controversial, the delay in the surgery when admitted out of hours may not be clinically significant as most surgery was still performed in less than 24 hours from admission.

W4-05: Manual handling: Spinal manipulation and cauda equina syndrome

D. P. Parikh, L. U. Zrinzo & S. Bavetta (Queens Hospital, Essex, UK)

Objective: Enumerate the occurrence of cauda equina syndrome as a complication following spinal manipulation therapy (SMT).
Design: Literature review in English. Based on the work of Schmorl, Mixter and Barr who in 1934 conclusively introduced the concept of compression of neural structures secondary to ruptured intervertebral disc. Patients with low back pain often submit themselves to spinal manipulation. Cauda equina syndrome following spinal manipulation is a rare but serious complication and the incidence may well be under reported. The incidence of cauda equina syndrome after spinal manipulation has been variably estimated to be less than 1 per 1.0 to 3.7 million manipulations. Delay in recognising the symptoms/signs or in initiating treatment can adversely affect outcome and carries considerable medico-legal implications for both practitioners and doctors.
Results and conclusion: A review of the English literature focusing on cauda equina syndrome

following spinal manipulation revealed 31 episodes (three probable and 28 definite) and five review articles of cauda equina syndrome (CES) in association with SMT. One of these cases was added to the literature by the authors. Informed consent requires that a patient be aware of any potentially serious risks that a procedure entails as highlighted by Chester vs. Afshar. The authors argue that practitioners who offer spinal manipulation therapy should be able to recognise the symptoms and signs of cauda equina syndrome as well as for purpose of best medical practice and should include cauda equina syndrome as a possible complication when consenting patients for treatment.

W4-06: Pre-outpatients MRI for lumbar degenerative disease

C. Ulbricht, J. Laban, W. Gossage & J. Van Dellen (Charing Cross Hospital, London, UK)

Objective: To assess feasibility of arranging MRI scans for lumbar degenerative disease based on the information on GP referral letters, therefore reducing the referral-to-treat-time.
Design: Case series study. MRI scans of the lumbar spine were arranged for patients with suspected lumbar radiculopathy or spinal claudication on the basis of the referral letter before outpatient clinic review.
Subjects: 70 consecutive patients referred to the spinal clinic with GP letters stating claudicant or lumbar radicular pain. Patients with previous spinal surgery were not included. Follow up at the time of abstract submission was available in 41 patients.
Outcome measures: Correlation between clinical and MRI findings; subsequent management.
Results: 97.6% of MRIs arranged were indicated, and only in 12.2% were further investigations needed. 70% showed a positive correlation of clinical and radiological findings. The symptoms had resolved at the time of the clinic visit in 14.2% of these patients, 53.6% received further conservative treatment with the view of possible surgery if this failed, and 25% underwent surgery.
Conclusion: There is growing pressure on reducing waiting time and an 18-week target of referral-to-treat will be implemented in 2008. There is also growing financial pressure on hospitals to reduce costs. This study shows that arranging MRI scans for lumbar degenerative disease based on information on the GP referral letter reduced the overall waiting time in our study by about four months. There is no evidence that this will lead to an unnecessary number of 'negative' scans. This evidence should also encourage Primary Care Trusts to allow GPs/GPSIs direct access to MRI for uncomplicated degenerative lumbar disease before the referral which will further reduce waiting time and financial pressure on hospitals.

W6-01: Endovascular treatment of poor-grade aneurysmal subarachnoid haemorrhage, the use of a motor score-driven treatment algorithm

N. R. Mundil, P. C. Whitfield, P. E. Fewings, W. A. Adams & W. Mukonoweshuro (Derriford Hospital, Plymouth, UK)

Objective: To evaluate the outcome of coil embolisation in poor-grade (WFNS 4 and 5) SAH.
Design: Poor-grade SAH patients were prospectively entered into a database. A retrospective analysis of a consecutive series (2003 – 2005) was undertaken. Patients were managed using a treatment algorithm implemented in April 2003. After a period of resuscitation and stabilisation, the intubated Grade 4/5 SAH patient was neurologically assessed. Cerebral angiography and endovascular coiling were performed where appropriate if the patient localised or better at this stage.
Subjects: Patients presenting with WFNS Grade 4 or 5 SAH.
Outcome measures: Duration of ICU and inpatient stay, Glasgow Outcome Score (GOS) at discharge and one year.
Results: 57 consecutive cases were studied; 16 were excluded (incomplete data collection). Four patients had emergency haematoma evacuation and two were treated conservatively. Of the remainder, 30 localised at 12 – 24 hours and 27 proceeded to coil embolisation. At discharge, 13 patients (48%) made a good recovery (GOS 1 or 2), five (19%) were severely disabled (GOS 3 – 5) and nine had died (33% mortality). At six months, two more patients had died of consequential medical complications. The oldest patient with a favourable outcome was 75 years old. Only 13% of cases aged 65 or over made a good recovery (2 out of 15).
Conclusion: Poor-grade SAH continues to have a poor outcome with a mortality rate of 33% in this series. However, using a motor-score algorithm to guide patient selection, a favourable outcome was achieved in 48%. Age appears to be a poor prognostic factor. The given management of poor-grade SAH patients is appropriately targeted at those who localise to a painful stimulus after an initial period of resuscitation and stabilisation.

W6-02: Intraprocedural rupture during embolisation of intracranial aneurysm

S. S. Wahab, N. U. O. Jeelani, F. Robertson & J. Grieve (The National Hospital for Neurology and Neurosurgery, London, UK)

Objective: Endovascular treatment of intracranial aneurysms has become the mainstay of treatment for most of these lesions. In this study, the incidence,

aetiology and management and clinical outcome in patients experiencing intraprocedural rupture during attempted embolisation of intracranial aneurysms are reviewed.
Method: A retrospective analysis was conducted of 251 patients with intracranial aneurysms treated with coil embolisation over a six-year period (between January 2000 and January 2006). The embolisation database was reviewed and all patients who suffered intraprocedural rupture were studied. Procedural and follow up angiograms, as well as clinical outcomes were reviewed from patient medical records.
Results: Of 251 patients undergoing coil embolisation for intracranial aneurysm, 18 patients (17 female, 1 male) experienced an intraprocedural rupture (7%). The mean age was 51 years (range, 23–81 years). We present the clinical and radiographic details of these cases along with their management and outcome.
Conclusion: Intraprocedural rupture during endovascular treatment of intracranial aneurysm remains a risk. Its incidence however is low and the outcome favourable.

W6-03: The management of paediatric cranial aneurysms

L. Salkeld, S. A. Renowden & R. J. Nelson (Frenchay Hospital, Bristol, UK)

Objective: To analyse the management and outcome of paediatric aneurysms treated in a single centre and thereby identify high risk cases and potentially avoidable adverse events.
Design: Case record review of all paediatric aneurysm cases (less than 18 years) identified from a prospective database of aneurysmal management and a retrospective review of paediatric cerebral angiograms. Aneurysms associated with AVMs were excluded.
Subjects: 12 patients (7 boys): age range 1–17 years, mean 11.9 years.
Outcome measures: Clinical presentation, aneurysm morphology, treatment modalities, procedural complications, clinical outcome.
Results: Presentation: SAH 5; haemorrhagic infarction 2; mass effect 4; ischaemic stroke 1. Aneurysm morphology: saccular 3; giant 3; mycotic 1; dissecting 5 (post circulation 3). Treatment modality: coil occlusion 7; surgical clipping 1; parent vessel occlusion 2; EC-IC bypass and coil occlusion 2. Procedural complications: no direct procedural complications. Clinical outcome: excellent 9; disabled 2 (dissecting aneurysms with haemorrhagic infarction 2; dead 1 (dissecting aneurysm with delayed post-treatment re-bleed).
Conclusion: Paediatric aneurysms are rare (1% of aneurysmal caseload). They have heterogeneous

presentations and morphology. Only 25% of aneurysms in this series were saccular. Overall outcome of treatment was excellent in 75%. Dissecting aneurysms were associated with haemorrhagic infarction, early negative angiography, subsequent angiographic and clinical instability and high risk of poor outcome 3/5. We recommend close follow up of these patients. The treatment goal should be obliteration of the diseased arterial segment.

W6-04: Management of multiple mid-carotid aneurysms: a neurovascular challenge

K. A. Choudhari & D. Bhattacharya (Regional Neurosciences Unit, Royal Victoria Hospital, Belfast, Ireland)

Objective: To study difficulties in the management of multiple mid-carotid aneurysms.
Design: Mid-carotid region is defined as portion of internal carotid artery (ICA) distal to the origin of ophthalmic artery but proximal to the carotid bifurcation. Multiple mid-carotid aneurysms include two or more aneurysms arising from the ICA at the origins of superior hypophyseal, posterior communicating (PComA) and anterior choroidal (AChA) arteries.
Subjects: 11 patients with multiple mid-carotid aneurysms admitted over a seven-year period in a tertiary referral neurosurgical centre were analysed. Eight presented with subarachnoid haemorrhage and one with progressive embolic strokes. Five patients had open surgery, two patients with Ehlers Danlos Syndrome (EDS) had ligation of the ICA, three had coiling and one patient with stable unruptured aneurysms had no treatment. Two patients required secondary surgical intervention after initial coiling and ligation of the ICA, respectively, due to aneurysmal regrowth.
Results: The patients of EDS who had ligation of the ICA died from re-bleeds - one within 24 hours and the other due to rupture of a contralateral aneurysm a year later (GOS 1). Out of eight other patients treated, one died due to re-bleed from another aneurysm (GOS 1), one had a post-operative stroke in the AChA territory (GOS 3), and six made good recovery (GOS 5).
Conclusions: Multiple mid-carotid aneurysms are extremely difficult to treat. Once ruptured, there is significant morbidity and mortality. Primary endovascular option may not be always feasible. Surgery poses an equally challenging prospect. However, with adjuvants like clinoid-drilling, ICA-reconstruction and a bypass, satisfactory obliteration of the aneurysms is usually possible. Primary ICA ligation as the sole method of treatment is ineffective and is not recommended.

W6-05: The outcome of aneurysmal subarachnoid haemorrhage (SAH) in the elderly population

P. J. French, C. S. Mathieson, J. Brown & E. Teasdale (Institute of Neurological Sciences, Southern General Hospital, Glasgow, UK)

Objective: To assess the outcome of patients over the age of 70 treated for aneurysmal subarachnoid haemorrhage (SAH) with either clipping or coil embolisation.
Design: A retrospective case note review (July 1999 to July 2006).
Subjects: 61 patients with spontaneous SAH over the age of 70 who underwent either clipping (10) or coil embolistion (51) of their aneurysms.
Outcome measures: Glasgow outcome score, complications, angiographic follow up.
Results: In the whole cohort, 28 patients were WFNS grade 1, 21 grade II, and 12 poorer grades. 75% and 73% of patients with WFNS I and II SAH respectively obtained a satisfactory outcome (GOS grade 4 or 5), as did 5/9 (56%) of those poorer grade patients who rallied following treatment of their hydrocephalus at presentation. 7/10 of the clipping group and 36/51 of the coiling group had a satisfactory outcome. Complication rate in the clipping and coiling group was 20% and 10% respectively. There were four deaths in the coiling group and none in the clipping group. 26/51 of those coiled had angiographic follow up. None of these patients underwent further coiling despite 27% having suboptimal occlusion of the aneurysm. One patient suffered a stroke after follow up angiogram.
Conclusions: Elderly patients with WFNS grade I and II SAH tend to do reasonably well following treatment of their aneurysm either by clipping or coiling. Those poorer grades with hydrocephalus should also be considered for treatment. Clipping of these aneurysms should not be ruled out if coiling is not possible. Angiographic follow up of these patients appears not to alter management and carries a small risk of stroke.

W6-06: Angiogram negative subarachnoid haemorrhage: Five year experience

D. S. Jeyaretna, M. D. Bradley, S. A. Renowden, A. J. Molyneux, D. G. Porter & R. J. Nelson (Frenchay Neurosurgical Unit, Bristol, UK)

Objective: To determine the long term outcome of angiogram negative SAH.
Design: Retrospective review of records and imaging with postal questionnaire follow up of outcome.
Subjects: 65 patients with SAH confirmed by CT, LP or both, whose initial cerebral angiogram revealed no cause. Mean age 49 (range 20–74) years, 33 females and 32 males.

Outcome measures: Distribution of blood, false negative angiograms, complications, Glasgow Outcome Score.
Results: 57 patients were WFNS grade I and 8 grade II. 41(77%) patients had blood confined to the perimesencephalic cisterns. The average number of days from ictus to angiography was three. Full cerebral angiography was not technically feasible in six patients. The mean follow up period was 45 (range 1–84) months. All 53 patients with a perimesencephalic haemorrhage or CT-negative, LP-positive SAH had a favourable outcome. Three out of 12 patients with a non-perimesencephalic distribution of blood harboured an occult aneurysm, of which two rebled, one at a week and one at four weeks after the first admission, both whilst waiting for planned repeat angiography. Repeat angiography revealed the aneurysms. Two patients remain fully independent and one died during readmission after rebleeding.
Conclusions: No cases of rebleeding have been identified in patients with an isolated perimesencephalic or lumbar puncture proven SAH with a normal angiogram. A single angiogram is sufficient. 25% of patients with a non-perimesencephalic SAH in this series harboured aneurysms and early repeat cerebral angiography is strongly recommended to prevent rebleeding.

W6-07: Intracranial vascular malformations: Tractography reveals motor pathway anatomy and integrity

T. J. D. Byrnes, T. R. Barrick, B. A. Bell & C. A. Clark (St George's University of London, Centre for Clinical Neurosciences, London, UK)

Objective: The treatment of intracranial vascular malformations risks injury to the white matter pathways. CT, MRI and angiography are unable to adequately identify and display the position of these pathways. Tractography is an imaging technique which allows the visualisation of the white matter pathways. In this study we have applied tractography to visualise the motor pathways in patients with vascular malformations.
Subjects and design: Between March 2004 and March 2005 a study of patients with intracranial vascular malformation was undertaken. Whole brain tractography was performed on six patients, four presented with intracranial haemorrhage and two were hemiparetic. The motor pathways were segmented automatically by grouping geometrically similar streamlines.
Outcome measures: The reconstructed motor pathways were displayed and examined. A comparison was then made with the clinical examination of the patients.
Results: Our streamline tractography algorithm reliably and consistently reconstructed the descending

motor pathways in all patients studied with the exception of one hemiplegic patient due to presumed Wallerian degeneration.

Conclusions: Where motor function was intact or mildly impaired, the technique was able to delineate the motor pathways, even in the presence of large anatomic displacement. The integrity of the motor pathway demonstrated with tractography corresponds to the presence of clinical deficit. The incorporation of this tractography data into navigation systems may allow the intraoperative localisation of the motor pathways reducing the risks of surgical injury.

W6-08: Radiosurgical treatment of arterivenous malformations in children

D. Bhattacharyya, L. Walton, J. Rowe, A. A. K. Kemeny & M. W. R. R. Radatz (National Centre for Stereotactic Radiosurgery, Royal Hallamshire Hospital, UK)

Objective: AVMs are the leading cause of haemorrhagic stroke in the young, often resulting in lifelong morbidity. Children may differ in their radiosensitivity, and their vascular architecture is immature and evolving. The response of paediatric AVMs to radiosurgery and the attendant complications encountered are of major clinical interest.

Design: A systematic, retrospective analysis of 174 radiosurgery AVM treatments in 151 children between 1985 and 2002.

Subjects: Mean age at treatment was 11.8 ± 3.3 years. Mean AVM volume was 3.1 ± 3.9 cm^3. Mean Spetzler-Martin grade was 3.0 ± 0.7. Seventy-one AVMs (47%) involved the basal ganglia, thalamus or brain stem. All treatments used angiographic localisation and were delivered with the Leksell Gamma Knife prescribing 22.8 ± 2.4 Gy to the AVM margin, with 3.4 ± 2.7 isocentres per treatment.

Outcome measures: were angiographic obliteration (i.e. no early filling vein or persistent shunt) of the AVM, complications attributed to the radiosurgery and evidence of re-haemorrhage. Values are mean $\pm$ SD.

Results: One hundred and fourteen children (76%) were cured of their AVMs. Of the 23 patients undergoing second treatments, nine completed thrombo-obliteration (39%). Two patients (with AVM volumes of 24 and 5 cm^3, and doses of 25 and 20 Gy) had evidence of radionecrosis. Fifteen patients rebled, of whom two died, a mean of 19 months following treatment.

Conclusion: Paediatric AVMs remain a challenging problem, particularly those deemed inoperable. The gravity of the condition is illustrated by the 10% rebleed rate, which significantly increases morbidity and mortality. Radiosurgery as a procedure is safe, only two patients developing complications. The

obliteration rate of 76% illustrates that the majority of these children can be cured.

W6-09: Finite element analysis based on MR plaque geometry of carotid stenosis predicts inflammatory burden: A study comparing symptomatic and asymptomatic individuals

S. P. S. Howarth, Z. Li, J. U-King-Im, M. Graves, N. Antoun, P. Kirkpatrick & J. H. Gillard (Department of Neurosurgery and Department of Radiology, Cambridge University, UK)

Background: It is well described that 'vulnerable' atheromatous plaque has a thin, fibrous cap and extensive lipid core with associated inflammation. This inflammation can be detected as areas of signal loss on T2* weighted high resolution MR imaging using the contrast medium Sinerem, an Ultrasmall Super-Paramagnetic Iron Oxide (USPIO). A well established engineering technique, finite element analysis (FEA), can be used, based on MR plaque geometry, to predict points of highest stress within the plaque. Our objectives were to look at the correlation of biomechanical predicted stress with inflammatory burden as assessed by USPIO uptake in symptomatic and asymptomatic individuals.

Design: 20 patients with carotid stenosis (10 symptomatic, 10 asymptomatic) were imaged at 1.5T, pre and 36 hours post USPIO infusion. Images were anonomysed, plaque seen was manually segmented into quadrants (CMR Tools, London) and focal regions of signal drop post contrast. Signal change was normalised to adjacent muscle. FEA was performed based on manually delineated plaque geometries from the MR imaging using specialist engineering software (Patran & Abaqus).

Results: There were 9 males and 11 females and mean ages were 71 (symptomatics) and 73 (asymptomatics). Mean stenoses were 82% (symptomatics) and 72% (asymptomatics). Symptomatics had significantly more quadrants with signal drop post USPIO than asymptomatics (75% vs. 32%, $p < 0.01$) and more focal regions of signal drop (0.68 vs. 0.26 regions/image, $p < 0.01$). Plaques that showed most quadrants with signal drop also correlated with those that had the highest predicted stresses on FEA ($p < 0.05$), usually predicted at the shoulders of the plaque.

Conclusions: Symptomatic plaques had more focal areas of signal drop than asymptomatic plaques, suggesting that they harboured a greater inflammatory burden. Some asymptomatic plaques also showed signal drop indicating possible vulnerability.

FEA predicted that plaques showing the greatest inflammatory burden as predicted by USPIO enhanced MR imaging were also those that had the highest stresses and were therefore likely prone to rupture. Thus an engineering technique based on plaque morphology has predicted plaque pathophysiology. If validated by larger studies, a combination of USPIO enhanced MR imaging and FEA analysis may greatly assist in the risk stratification of individuals with carotid stenosis, with particular utility in the asymptomatic population.

W6-10: Tissue engineering a small diameter vascular graft

C. Derham, J. Ingram, A. Tyagi, E. Ingham & S. Homer-Vanniasinkam (Leeds Vascular Institute and Institute of Medical and Biological Engineering, University of Leeds, UK)

Objective: To develop a biocompatible, biomechanically stable, small diameter (<6 mm) vascular graft combining vascular cells and a xenogeneic acellular matrix that could be used for extra-cranial—intra-cranial bypass surgery.

Design: A novel detergent-based protocol was modified to remove all cellular components from porcine ureters to render them non-immunogenic. Ureters ($n=12$) were treated with 0.1% (w/v) sodium dodecyl sulphate, hypotonic tris buffer, protease inhibitors and nuclease treatment. Fresh and treated ureters were analysed histologically for the presence of cells, deoxyribonucleic acid (DNA), and quantitatively assessed for levels of collagen, glycosaminoglycans and elastin. Tissues were also assessed for preservation of major structural components of the matrix using immunohistochemical methods. The biomechanical properties of the ureters were investigated using uniaxial tensile testing to failure, compliance and burst pressure. The *in vitro* biocompatibility of the decellularised grafts was assessed with contact and extract cytotoxicity assays. Endothelial cells were seeded onto the luminal surface of decellularised ureters.

Results: Histological analysis of treated ureters showed complete removal of cellular components from the tissue; the histioarchitecture remained intact. All major structural components of the matrix were retained, including collagen type IV, laminin and fibronectin. Decellularised matrices were shown to be biocompatible *in vitro*; cells grew in contact with the tissues and there was no decrease in cell viability after incubation with soluble tissue extracts. In addition, there was no significant reduction in ultimate tensile strength, elasticity or compliance (fresh $=7.32$ MPa, 9.93×10^{-3} GPa,

12.53%; decel = 5.48 MPa, 2.03×10^{-3} GP, 8.36%; $p > 0.05$) after decellularisation. Endothelial cells were observed to attach to the luminal surface of decellularised ureters after 24 hours incubation.
Conclusion: This study demonstrates proof of concept for using decellularised porcine ureteric scaffolds in tissue engineering small diameter vascular grafts that could be used for neurovascular bypass procedures.

W6-11: Impact of multislice CT scan study in neurosurgical management of patients

S. Basu, T. Wilhelm, N. Dorward, R. Bradford, C. Shieff & R. Maurice-Williams (Royal Free Hospital, London, UK)

Design: Retrospective images and charts.
Subjects: Three groups. Group 1 vascular. Group 2 tumours. Group 3 spine. All patients undergoing neurosurgical intervention in 2005.
Outcome measures: Achieve detail imaging in 2D and 3D planes with surgeon satisfaction during surgery and neuroradiologist satisfaction during intervention.
Results: 124 cases were reviewed in all the groups: Group 1: vascular cases 74(59.677%), Group 2: spinal cases 31(25%), Group 3: tumour cases 19 (15.322%). Vascular group: 61 aneurysm and 13 AVM and two dural fistula images were reviewed by neuroradiologist and neurosurgeons, depending on the pathology, patients were managed accordingly. Spinal group: 31 cases, 13 cervical, 18 lumbar, three thoracic cases reviewed and managed accordingly. Tumour group: 19 cases, 14 brain and five spinal cases reviewed. The tumour invasion, blood vessel relation and bony anatomy studied in details. Vascular cases had detail study in 3D evaluation of aneurysm, surrounding vessels and assessment of aneurysms obtained. Virtual images of various surgical approaches were available. In AVM feeding arteries, draining veins, reviewed in 3D and management planned. In tumour cases its extension related vasculature and bony anatomy for surgical approaches were demonstrated. This information was helpful in surgery. Maximum surgeon and neuroradiologist satisfaction, along with improved management of patients were obtained. No complications noted from CT and CT angiogram. There was significant reduction in number of digital subtraction cerebral angiograms.
Conclusion: Multislice CT is an excellent new tool in imaging neurosurgical patients. The number of conventional cerebral angiograms has been reduced in our unit. The multiplanar and volume rendering images obtained helped neuroradiologist and neurosurgeon improving management of patients.

Thursday 26 April 2007

T2-01: Pituitary surgery for acromegaly: Benefits of sub-specialisation

K. Gnanalingham, P. Rao-Balakrishna, J. Leggate, H. Buckler, J. Davis, D. Ray, F. Wu, P. Trainer, S. Shalet & T. Kearney (Greater Manchester Neuroscience Centre, UK)

In acromegaly, the surgical excision of the pituitary adenoma remains the best option to attain a cure. In a 1998 study, the surgical cure rate of 18% in our region was noted to be low compared to other UK and European centres. The involvement of nine different surgeons was felt to be a contributory factor. We report on the impact of the development of a dedicated pituitary surgical team of two surgeons, offering endoscopic, transsphenoidal, pituitary surgery. Sixteen consecutive Acromegalics with radiologically confirmed adenomas underwent endoscopic surgery in 2005/6. On post-operative day 3 and 4 a growth hormone (GH) day curve and an oral glucose tolerance test (OGTT) with GH levels were performed. Patients were considered cured if the mean GH on day curve was < 5 mU/l and the nadir on OGTT was < 2 mU/l. If not cured in these tests, a re-operation by the second week was considered. Those with borderline results (i.e. GH raised by 1 mU/l above the cut off values) were kept under review without re-operation. Pituitary function was reassessed at six weeks after surgery. The overall cure rate was 81% (i.e. 13 of 16 patients). Eight of 16 (50%) patients were biochemically cured after the first operation. Four (25%) had borderline results of whom three were biochemically cured at six weeks. The remaining four (25%) underwent an early re-operation resulting in a biochemical cure in two. Post-operative CSF leak was seen in one case. Two patients developed sinusitis. Self limiting diabetes insipidus was noted in five patients with one requiring DDAVP on discharge. These early results suggest improved surgical cure rates in acromegaly following the development of a dedicated pituitary surgical team in our region. These results compare favourably with other large centres.

T2-02: Dysembryoplastic neuroepithelial tumour: A review of surgical outcome in 91 children

N. Biyani, J. Wadley, D. Thompson, B. Harding, R. Hayward & W. Harkness (Department of Neurosurgery, Great Ormond Street Hospital for Children, London, UK)

Introduction: Dysembryoplastic neuroepithelial tumours (DNET) represent a group of low grade intracranial neoplasm presenting with epilepsy whose management still remains controversial.
Objective: To determine the seizure outcome after resective surgery.

Methods: A retrospective review of 91 children surgically treated DNET between 1990 and 2006 at a single institution.
Results: There were 61 males and 30 females patients who presented at a mean age of six years (three months-15 years) presenting with seizures in 89 cases(97.8%), principally complex partial seizures. Neurological deficit was the exception, seen in only four patients (4.3%). In 59 children (64.8%) DNET was located in temporal lobe, with 32 (35%) location being mesial temporal. Tumor growth was evident in three children preoperatively and seven children who underwent subtotal resection in post-operative period. The mean age at resection was 10 years and total resection was carried out in 50 (55%) and subtotals resection in 41children (45%). The mean follow up six years (10 months – 14 years).
Outcome: Among 50 children (55%) who underwent total resection, seizure-free outcome (Engel I) at 12 months was 48 (96%) and two (4%) children were (Engel II & III) and it continued to be same at their last follow up. Among 41 children (45%) who underwent subtotal resection the seizure outcome at 12 months were Engel I in 12 (29%), Engel II in seven (17%), Engel III in 19 (46%), and Engel IV in three children (8%).Thirteen of these patients with recurrent medically refractory seizure underwent further resective surgery. At their last follow up seizure outcome was Engel I in six, Engel II and III in five and no improvement in two cases. Overall seizure free rate after primary surgery (total and subtotal resection) and secondary rescue surgery was 72.5%.
Conclusion: On the basis of this study a paradigm for surgical treatment for DNET is proposed.

T2-03: Expression of stem cell factor and its receptor in meningiomas: An indication for medical treatment

L. M. Hickey, A. Dinichert, C. Gandi, L. B. Moran, K. O'Neill & F. Roncaroli (Department of Neuropathology, Imperial College, London, UK)

The stem cell factor (SCF) is a haematopoietic growth factor that activates a type III tyrosine kinase transmembrane receptor (KIT). KIT is expressed in a variety of normal and neoplastic tissues but activating mutations of its gene, c-kit, have only been pathogenetic in mast cell leukaemia, gastro-intestinal stromal tumours (GIST), and seminomas. Tumours expressing SCF and KIT or showing activating mutations of c-kit may respond to medical treatment with the drug imatinib mesylate. No detailed data is currently available on expression of SFC and KIT in meningiomas. We investigated 102 consecutive meningiomas (mean age 59 years, range 19 – 87 years) (71 females) operated on at Charing Cross Hospital, London, between 1998 and

2005. Lesions were graded according to WHO classification: 92 were grade I, 6 grade II and 4 grade III. Immunohistochemistry was performed using the ABC/peroxidase method with an anti-SFC and two anti-KIT antibodies. As controls, we studied three seminomas, three GISTs, and five normal arachnoid villi. Western blots were performed in eight meningiomas, arachnoid villi and GISTs using the same antibodies. Analysis was additionally carried out with anti-SCF and anti-phosphotyrosine to confirm presence of ligand and activation status of the KIT receptor. Fibroblastic and transitional meningiomas showed weak or no KIT expression; meningothelial meningiomas and arachnoid villi showed moderate expression whereas atypical and anaplastic meningiomas were intensely positive. SFC was expressed in 30% of cases irrespective of their grade. Arachnoid villi and GISTs were negative for SFC. Western Blot analysis revealed activated KIT expression in all meningiomas but differences were observed between cases. Our results indicate that meningiomas, particularly aggressive examples, express SCF and KIT. The presence of an autocrine/paracrine loop suggests that KIT activation is important in tumour growth and that imatinib mesylate can be used to treat SCF/KIT positive tumours.

T2-04: Intracranial meningiomas: Recurrence related to clinical management and tumour localisation

S. Ayala-Soriano, A. Tarnaris, J. Lafuente & L. D. Watkins (National Hospital for Neurology and Neurosurgery, London, UK)

Objective: Grade of surgical excision of meningiomas was shown in other series to be associated with rate of recurrence. Outcome and survival in relation to management have not been established upon large series. We studied the relation between surgical removal (Simpson grade) and other factors with recurrence.

Design: Retrospective review of medical records of 1565 patients with surgical removal of intracranial meningiomas in the National Hospital for Neurology and Neurosurgery. Study period 1975 to 2000. We collected relevant demographic data, neurological examination, and reviewed radiological and operative records. Chi-square test was used to test for significance among categorical variables.

Subjects: Age range 13–96 years. F:M ratio was 65:35. Mean follow up was 2.5 years.

Outcome measures: Completeness of excision was assessed by Simpson grading and outcome was assessed using GCS and Karnofsky scale. Any recurrence of previous subtotally resected tumours or regrowth was confirmed by imaging (CT/MRI).

Results: Total rate of recurrence was 17.51% ($n = 331$). Recurrence according to location: parasagittal and falx 25.0%, subfrontal 20.0%, convexity 26.0%. Recurrence by grade of surgical resection (Simpson grade) Grade I 19.0%, Grade II 23.0%. 49.9% of the patients present with Karnovsky > 80 one year postoperatively. In 8.6% of patients recurrence occurs within the first two years. Age was an important factor to predict recurrence ($p < 0.001$), since in one third of cases it happened in patients aged 40 – 60.

Conclusions: Intracranial meningioma recurrence occurs in up to 17.52% in our series. We found that there was clear evidence that grade of resection was an important factor with respect to further recurrence being higher in Simpson grades 3, 4 and 5. Localisation was important in the sense that tumours within a difficult to access brain region had a less aggressive excision and therefore are more likely to recur. Most of the recurrences occur within the first two years. Age seemed to have an impact in recurrence being more common in the group of patients aged 40 to 60.

T2-05: Atypical meningiomas: WHO moved the goalposts?

S. J. Smith, S. Boddu & D. C. Macarthur (Queen's Medical Centre, Nottingham, UK)

The histological grading of meningiomas underwent substantial revision and standardisation in a WHO review of 2000. Prior to this the histological definition of atypical and malignant meningiomas was less tightly defined. We conducted a retrospective analysis of all meningiomas operated on between 1993 and 2003 in our unit ($n = 565$), to assess whether the WHO changes had altered the proportion of tumours diagnosed as atypical. The percentage of tumours graded WHO II (atypical meningiomas) has increased significantly since these changes were adopted (18.3% to 23.1% $p = 0.0408$). We also examined the epidemiology of meningioma, finding that previous irradiation is associated with atypical meningiomas ($p = 0.038$) and surgeons find that complete excision is also more difficult with atypical tumours ($p = 0.010$), reporting poorer Simpson grades intraoperatively before the tumour grade is known. The WHO grading changes are strongly associated with an increased number of atypical lesions. It is possible that studies conducted on atypical meningiomas prior to 2000 were examining a partially different patient population. There may be a corresponding increase in the numbers of patients referred for radiotherapy/radiosurgery and we examined the evidence base for this strategy and whether our experience is replicated in other studies reported in the literature.

T2-06: Trends in the diagnosis of cerebral lymphoma

H. N. Simms, C. Mathieson, W. Stewart & E. J. St George (Institute of Neurological Science, Southern General Hospital, Glasgow, UK)

Objective: To look at the demographics and methods of diagnosis in patients with cerebral lymphoma.
Design: Retrospective study.
Subjects: All patients who had a diagnosis of cerebral lymphoma made between March 1993 and May 2006.
Outcome measures: We looked at the incidence, patient characteristics, method of diagnosis, radiological features and pathology.
Results: There were 58 patients with confirmed cerebral lymphoma over the 158-month period. The incidence increased from 0.8 per million per year in 1995 to 4.4 per million per year in 2005. Nineteen were diagnosed by craniotomy, 37 by stereotactic biopsy and two on post-mortem. Thirteen of the stereotactic biopsies performed in which lymphoma was considered in the report were inconclusive on the first biopsy. Five of these later proved to be lymphoma. We could not show a relationship between an uncertain diagnosis on stereotactic biopsy and duration on steroids pre-operatively. In those with a definite diagnosis at biopsy, the mean duration on steroids was 5.3 days with a mean dose of 15mg daily. In those with a false negative biopsy result, the mean duration was 5.8 days, with a mean dose of 12.8 mg. Only 40% of patients in whom lymphoma was confirmed pathologically had lymphoma mentioned as a possible diagnosis in the CT report. The pathology was B cell in 92% of patients.
Conclusion: Cerebral lymphoma is increasing in incidence. This may be due to an increase in awareness, improved diagnostic techniques or more immunocompromised patients in society. It can be a difficult diagnosis to make pre-operatively with a significant rate of non-diagnostic biopsy which seems unrelated to steroid use.

T2-07: Endoscopic biopsy during third ventriculostomy in paediatric pineal tumours

Y. Z. Al-Tamimi, D. K. Bhargava, F. Novegno, S. Bucur, D. C. Crimmins, A. T. Tyagi & P. Chumas (Leeds General Infirmary, Leeds, UK)

Objectives: To establish if endoscopic biopsy contributes to morbidity in the management of paediatric pineal region tumours presenting with hydrocephalus and requiring cerebrospinal fluid (CSF) diversion.
Design: Retrospective descriptive study on patients less than 18 years of age who have presented with a pineal region tumour between 1996 and 2006. Data was obtained from case notes.

Subjects: Nineteen patients (12 males, 7 females). Mean age 115 months (interquartile range 66 – 153 months, range 198 months). All tumours involved the pineal region. Extension was seen into the third ventricle ($n = 3$), lateral ventricle ($n = 1$), tectal region ($n = 3$) and sellar region ($n = 2$). All patients presented with symptomatic hydrocephalus. Eighteen patients initially underwent a CSF diversion procedure: 3rd ventriculostomy alone ($n = 4$), 3rd ventriculostomy and biopsy ($n = 9$), ventriculoperitoneal shunt ($n = 4$) and external ventricular drain ($n = 1$). Histological diagnosis: germinoma ($n = 9$), pineoblastoma ($n = 4$), mature teratoma ($n = 2$), astrocytoma ($n = 2$), pinealocytoma ($n = 1$) and glioblastoma multiforme ($n = 1$).
Outcome measures: Morbidity from endoscopy, diagnostic sensitivity of biopsy, number of patients who were CSF tumour marker positive.
Results: No complications were seen following third ventriculostomy alone. For third ventriculostomy and biopsy, three developed postoperative diplopia. Two cases demonstrated raised CSF and plasma tumour markers (available following biopsy) with subsequent histological diagnosis of germinoma. One biopsy was insufficient for diagnosis (subsequent resection confirmed germinoma).
Conclusion: For this cohort of patients, there was additional morbidity associated with biopsy during third ventriculostomy. Approximately 20% of these procedures may have been avoided once tumour markers were available.

T2-08: Intraoperative ultrasound and its guided interventions in neurosurgery: Our experience from an increasing case series

A. L. C. Dias, R. Summerfield, C. K. Jadun & P. S. Dias (University Hospital of North Staffordshire & Imperial College School of Medicine, Stoke on Trent, UK)

Background: Although the use of ultrasound (U/S) has been an established practice in neurosurgery, its use in real-time image-guided surgery is only recently being recognised. CT and MRI stealth navigational data is used for frameless neuronavigational intraoperative procedures in order to carry out minimally invasive neurosurgery. However, they do not allow for brain shift from decompressive effects. This is where real-time ultrasound can prove its value as an additional guide.
Method: Ultrasound was used under strict sterile conditions in the neurotheatre following opening of the craniotomy bone flap and the dura. An ALOKA SSD1000 portable U/S machine was used with a 5 MHz curvilinear probe. Eight procedures were diagnostic, four were therapeutic and three therapeutic with estimation of brain shift.
Results: A series of 15 patients in which intraoperative ultrasound was utilised. There were two groups

of patients. In the first, ultrasound (U/S) was used for visualisation and localisation of intracerebral and intraspinal mass lesions. In the second, U/S guided real-time intraoperative interventions such as aspirations and biopsies were undertaken. In the latter group, a further subgroup had real-time image-guided ultrasound to estimate brain shift compared with MRI/CT stealth images during operative procedure.

Conclusion: Intraoperative U/S provides real-time images and as such can be a useful intraoperative tool. It can be selectively used not only for lesion localisation but also for access to deeper tissue undergoing biopsy and aspirations. Estimation of brain shift is its major utility of real-time intraoperative image-guided neurosurgery, since U/S is the least costly option in comparison with intraoperative MRI/CT.

T2-09: Image-guided surgery for high grade glioma: An eight year retrospective analysis

N. U. Barua, L. R. Salkeld & D. R. Sandeman (Frenchay Hospital, Bristol, UK)

Objective: To describe patient characteristics, treatment modalities, outcomes and prognostic indicators in 201 patients with high grade glioma.

Design: A retrospective study of 201 consecutive patients with histologically confirmed high grade glioma, managed by a single consultant neurosurgeon.

Subjects: 168 patients had grade IV tumours. Six patients underwent biopsy alone, the remainder underwent surgical resection.

Outcome measures: Outcome measures were discharge status, length of inpatient stay, clinical condition, complications and survival. Survival curve comparison and calculation of hazard ratios identified factors associated with increased survival.

Results: Of 195 debulking procedures, 161 were image-guided. 141 resections were for primary tumours. Data regarding adjuvant therapy was available for 178 patients. 89 patients received post-operative radiotherapy alone, and a further 51 patients received radiotherapy and chemotherapy. Median survival for patients receiving maximal therapy—surgery, radiotherapy and chemotherapy was 13.9 months. Survival was significantly increased in patients receiving adjuvant radiotherapy and chemotherapy ($p = 0.0262$). No significant increase in survival was seen in patients undergoing surgery for recurrent tumour ($p = 0.1141$). Factors associated with increased survival were age (less than) 55, female sex, Grade III histology, tumour location, and presentation with motor deficit or seizures.

Conclusions: Despite technological and chemotherapeutic advances, the prognosis for patients with high grade glioma remains bleak. The authors believe that this signals an urgent need to invest in the

development of innovative therapies including viral vectors and gene therapy.

T2-10: High grade glioma in the eighth and ninth decades: Is there a role for treatment?

M. K. Lee, S. Clark, A. Bacon & A. R. Brodbelt (The Walton Centre for Neurology and Neurosurgery, Liverpool, UK)

Objective: To assess factors affecting outcome in patients 70 years and older with malignant glioma.
Design: Retrospective case note and histopathology review.
Subjects: All patients aged 70 years and above, admitted to a single regional neurosciences unit between 01 January 2001 and 30 June 2006, who had a histological diagnosis of high-grade glioma (WHO grade III and IV—both astrocytic and oligodendroglial), were included.
Outcome measures: Survival rate in relation to demographics, surgical modality (biopsy or debulking), ± adjuvant treatment/s, and performance status (ECOG—Eastern Cooperative Oncology Group score). Analysis by Kaplan-Meyer plots and log-rank test.
Results: Total of 121 patients (109 biopsied, 12 debulked). Age range was 70 to 83 years with an average of 74, median of 73. Tumours investigated included 96 glioblastoma multiforme, 20 anaplastic astrocytoma, and 5 anaplastic oligoastrocytoma. Mean survival was 249 ± 112 days with debulking and 98 ± 85 days for biopsied patients. The median survival of ECOG groups and subgroups are: ECOG 1 with debulking and radiotherapy was 226 days versus 97 days with radiotherapy alone ($p = 0.0018$); ECOG 1 with radiotherapy was 97 versus 77 without ($p = 0.0083$); ECOG 2 with radiotherapy was 146 versus 60 without ($p = 0.0015$); ECOG 3 with radiotherapy 184 versus 63 without ($p = 0.09$); ECOG 4 was 35 days. Age was not a predictor of survival.
Conclusions: In a subgroup of elderly patients with high grade glioma, aggressive debulking and radiotherapy may be justified. Performance status should be more important in deciding treatment than absolute age. In patients not deemed fit for a debulking procedure, does a three month average life expectancy justify radiotherapy?

T2-11: Outcomes of bone-anchored hearing aid provision for unilateral deafness following acoustic neuroma surgery

C. L. Ward, A. D. Morley, S. Hogan, A. Burchett, N. C. Saunders, R. M. Tranter & C. Hardwidge (Hurstwood Park Neurological Centre, UK)

Objective: Bone-anchored hearing aids (BAHA) appear an effective but expensive tool in the hearing

rehabilitation of patients with unilateral deafness secondary to acoustic neuroma surgery. In this study we have primarily evaluated patient uptake, satisfaction and compliance with BAHAs.
Design: A retrospective and prospective review of patient case notes, audiometric data, imaging and subjective patient outcome measurements.
Subjects: All patients who have been have been offered audiological assessment for a bone-anchored hearing aid following acoustic neuroma surgery.
Outcome measures: Patient demographics—sex, age, tumour size and site. Surgical factors—surgical approach, percentage resection of tumour, complications, length of hospital stay. Audiometric—pure tone audiogram, air bone gap, speech discrimination, vestibular tests, pre/postoperative trial of BAHA, Freefield audio, alternative hearing aids used, abbreviated profile of hearing aid benefit (APHAB) and Glasgow hearing aid benefit profile questionnaires (GHAB).
Results: We present 41 patients undergoing surgical intervention for acoustic neuromas and assessment for BAHA. 21 BAHAs fitted (concurrent 12, delayed 9), 6 awaiting fitting, 10 declined and 3 awaiting decision. 11 patients have completed a postoperative questionnaire (APHAB 5, GHABP 5, both 1 patient). APHAB scores 63-71/168, GHABP scores 34/60, 98/100, 95/100, 75/100 and 115/120.
Conclusion: BAHAs for unilateral deafness following acoustic neuroma surgery appear to offer considerable patient benefit in hearing rehabilitation. From our study we present our patient's experience of BAHA and ultimately aim to identify factors relevant to patient selection and timing of fitting for BAHAs.

T2-12: Small and medium sized vestibular schwannomas: Management strategies, outcome and quality of life

H. El-Maghraby[1], C. Collis[2], R. Quiney[3], A. Wright[4] & R. Bradford[1] ([1]Department of Neurosurgery, [2]Department of Radiotherapy and Oncology, [3]Department of Ear, Nose and Throat Surgery, Royal Free Hospital, and [4]Royal National Throat, Nose and Ear Hospital, UK)

Objective: Management of small and medium sized vestibular schwannomas presents a therapeutic dilemma.[1] The aim of this study is to review the different management strategies, outcome and quality of life.
Design: Retrospective chart review of the management strategies and prospective cohort study of the quality of life of the treated patients.
Subjects: Small and medium sized vestibular schwannomas are defined as maximum tumour dimension of 3 cm or less. 184 patients were treated between 1990–2005.
Outcome measures: Good facial nerve function (House-Brackmann Grade 1–2), serviceable

hearing, treatment efficacy (no need for additional treatment) and quality of life (Glasgow Benefit Inventory questionnaire).
Results: Of the 184 patients, 90 (49%) treated with microsurgery, 49 (26.6%) treated with wait & scan and 45 (24.4%) treated with fractionated stereotactic radiotherapy. Mean follow up 7.3 years. Good facial nerve function was 87/89 patients (95.5%) in microsurgery, 49/49 patients (100%) in wait and scan and 44/45 patients (97%) in fractionated stereotactic radiotherapy. Serviceable hearing was 35/74 patients (47%) in microsurgery, 22/25 patients (88%) in wait and scan and 33/35 patients (94.2%) in fractionated stereotactic radiotherapy. Treatment efficacy was 85/89 patients (95.5%) in microsurgery, 47/49 patients (96%) in wait and scan and 44/45 patients (97%) in fractionated stereotactic radiotherapy. Glasgow Benefit Inventory questionnaire was sent to 168 living patients. The replay rate was 76%. There was deterioration of quality of life after microsurgery, particularly for small sized tumours, wait & scan did not lead to change of quality of life, and there was trend towards better quality of life following fractionated stereotactic radiotherapy.
Conclusion: Good facial nerve outcome, serviceable hearing, treatment efficacy and quality of life were all significantly in favour of fractionated stereotactic radiotherapy.

Reference

1 Myreseth E, Moller P, Pedersen P, Vassbotn F, Wentzel-Larsen T. Vestibular Schwannoms: Clinical results and quality of life after microsurgery or gamma knife radiosurgery. *Neurosurgery* 56:927–35.

T2-13: Large sized vestibular schwannomas: Management strategies and outcome

H. El-Maghraby[1], C. Collis[2], R. Quiney[3] & A. Wright[4]
([1]Department of Neurosurgery, [2]Department of Radiotherapy and Oncology, [3]Department of Ear, Nose and Throat Surgery, Royal Free Hospital, Pond Street, Hampstead, and London, and [4]Royal National Throat, Nose and Ear Hospital, London, UK)

Objective: Large sized vestibular schwannomas remain a challenging condition.[1] The aim of this study is to review the different management strategies and outcome.
Design: Retrospective chart review.
Subjects: Large sized vestibular schwannoma is defined as maximum tumour dimension of 3 cm or more. 218 patients were treated between 1990–2005.
Outcome measures: To assess extent of tumour resection, neurological function preservation, tumour control and recurrence.
Results: Of the 218 patients, 83 (39.5%) underwent total resection (TR), 101 (49.5%) near total resection (NTR), 24 (11%) radical subtotal resection with

fractionated stereotactic radiotherapy (R-STR & FSR) and 14 (6.4%) subtotal resection (STR). Good facial nerve function was 61.4% after TR, 84% after NTR, 88.2% after R-STR & FSR and 75% after STR. The recurrence rate was 1.2% after TR, 8.9% after NTR, 4.1% after R-STR & FSR and 61.5% after STR. Good facial nerve function was statistically better in R-STR & FSR compared to TR ($p = 0.028$), however recurrence rate was statistically less in TR compared to R-STR & FSR ($p = 0.043$). NTR and R-STR & FSR showed no statistically significant difference in terms of good facial nerve function ($p = 0.620$), however the recurrence rate was higher in NTR compared to R-STR & FSR ($p = 0.043$). STR showed high recurrence rate compared to other management strategies ($p = 0.002$).

Conclusion: Radical subtotal resection with fractionated stereotactic radiotherapy is an acceptable option for large sized vestibular schwannoma with good facial nerve function and maximum tumour control.

Reference

1 Iwai Y, Yamanaka K, Ishisguro T. Surgery combined with radiosurgery of large acoustic neuromas. *Surg Neurol* 2003;59:283–91.

T2-14: Role of Angiopoietin-2 in regulating growth and vascularity of astrocytomas

G. Zadeh, K. Koushan, P. Shannon & A. Guha (National Hospital for Neurology and Neurosurgery, London, UK)

In this study we have focused on deciphering the functional contribution of Ang2 to the vascular growth of astrocytomas. Ang2 has demonstrated a complex role in tumour biology as investigated in various tumour models and its exact role in tumour angiogenesis is not clearly understood. We have previously shown that Ang2 expression, together with Ang1 and their endothelial cell specific receptor Tie2/TEK is upregulated in malignant astrocytomas, compared to low-grade astrocytomas and normal brain. Ang2 expression is primarily restricted to endothelial cells, with some evidence to suggest that tumour cells may also be a source of Ang2. In order to decipher the functional contribution of Ang2 to tumour angiogenesis in astrocytomas we generated stable astrocytoma cell lines over-expressing Ang2 and studied their growth and vascularity in both subcutaneous (SC) and intracranial (IC) xenografts. We demonstrated that Ang2 significantly enhances their vascular growth, playing a pro-angiogenic and growth-promoting role. Additionally, constant up-regulation of Ang2 through all phases of tumour growth generated abnormal vascular structures not seen in human astrocytomas, suggesting that Ang2 is upregulated plays a tumour stage dependent role.

T2-15: Serum AHSG level is a novel prognostic factor in patients with astrocytoma

V. Petrik, S. Saadoun, A. Loosemore, J. Hobbs, K. Opstad, J. Sheldon, E. Tarelli, F. Howe, B. A. Bell & M. C. Papadopoulos (St George's University of London, London, UK)

Objective: We used proteomics to identify a new serum marker that predicts survival in patients with high-grade astrocytoma (HGA) and early recurrence in low-grade astrocytoma (LGA). Design SELDI-ToF Mass Spectra (192 protein peaks per patient) were generated from serum samples collected before starting treatment. We hypothesised that any peaks that correlate with the degree of malignancy are potential prognostic markers. A peak, identified as alpha2-Heremans Schmid Glycoprotein (AHSG), was less prominent with increasing malignancy (control vs. LGA vs. HGA).
Subjects: 200 serum samples were obtained from 58 control subjects, 36 patients with LGA, and 106 with HGA.
Outcome measures: We measured serum AHSG concentration using turbidimetry/ELISA. Outcome measures for HGA patients were survival (from the time of sample collection) and indices of malignancy including tumour proliferation (Ki67 immuno-labelling), and necrosis (tumour lipid content on Magnetic Resonance Spectroscopy).
Outcome measure: for LGA was MRI evidence of recurrence within a year of excision.
Results: Survival of HGA patients correlated with serum AHSG levels ($p < 0.005$), independent of other prognostic factors. LGA patients with tumour recurrence within a year of resection had less serum AHSG than patients with stable disease ($p < 0.001$). Serum AHSG levels inversely correlated with Ki-67 immunolabelling ($p < 0.001$) and lipid peak size ($p < 0.05$). A prognostic index combining serum AHSG with two established prognostic factors (patient age, Karnofsky score) separated HGA patients with short (<4 m) and long (>2 y) median survival.
Conclusions: Serum AHSG level, measured before starting treatment, predicts survival in patients with HGA and early recurrence in LGA.

T4-01: Vaccination against inhibitory myelin based molecules: A trial of vaccination therapy to stimulate axonal regeneration and sprouting in adult mammalian spinal cord injury

K. Rezajooi, N. Khan, K. Hossain-Ibrahim, P. Anderson & P. J. Hamlyn (University College London, UK)

Objectives: Myelin-based axon growth inhibitors are believed to play an important role in the failure of axonal regeneration following spinal cord injury (SCI). The aim of this study was to investigate a

novel vaccination therapy in which an animal's own immune system was stimulated to block myelin-associated inhibitory molecules and thus to enhance axonal regeneration and sprouting following spinal cord injury.

Design: Prospective randomised controlled trial. Animals were immunised with homogenated injured spinal cord (rich in myelin-associated inhibitory molecules) or with liver homogenate (used as a control) for a total of 6 weeks. A cervical cortico-spinal tract (CST) transection injury was performed after three weeks of immunisation. Corticospinal tract axons were anterogradely labelled via the contralateral sensory-motor cortex using Biotin-dextran-amine (BDA). Fluorescent immunohisto-chemistry and confocal microscopy were used to analyse the extent of axonal regeneration and sprouting at the lesion site.

Subjects: Adult female Sprague-Dawley rats. Nine rats were immunised with homogenated injured spinal cord, six rats were immunised with liver homogenate as a control and a further seven rats were non-immunised controls.

Outcome measures: Extent of axonal sprouting was systematically and blindly quantified using the branching index (BI) for each experimental group. (BI = number of labelled branches/number of labelled CST axons). Statistical significance was determined using ANOVA and post-hoc Mann-Whitney U-tests.

Results: No evidence of axonal regeneration past the lesion site was found, but axonal sprouting rostral to the injury site was found to be significantly higher in the vaccinated animals. Average branching index (BI) for immunisation with homogenated injured spinal cord = 0.74, BI for immunisation with liver homogenate = 0.52, and BI for non-immunised controls = 0.5 ($p < 0.001$). No adverse events occurred with vaccination.

Conclusions: Axonal sprouting following spinal cord injury, believed to be a prerequisite to axonal regeneration, can be significantly enhanced using this novel vaccination therapy to block myelin-based inhibitory molecules.

T4-02: A new system to measure the oxygen concentration of CNS tissue

K. J. George, J. P. Phillips, R. M. Langford & P. J. Hamlyn (Queen Mary College, Royal London Hospital, UK)

Objective: To develop a new system to address the unmet need of real-time measurement of oxygen saturation in the central nervous system (CNS) for patients recovering from neurosurgery or trauma.

Design: We have developed a fibre optic signal acquisition system for internal placement through small apertures. The development and testing of a two-wavelength optical fibre reflectance

photoplethysmography (PPG) system is described. The system was tested on the human fingertip ($n = 6$) and also on the exposed spinal cord of rats after laminectomy and static spinal cord compression injury ($n = 6$).
Results: It was found that good quality red and near-infrared PPG signals could be consistently (100%) obtained from the human fingertip ($n = 6$) and rat spinal cord ($n = 6$) using the fibre optic probe.
Conclusions: These findings justify further development and clinical evaluation of this fiber optic system.

T4-03: Non-missile penetrating intracranial injuries in psychiatric inpatients

A. K. Demetriades, M. C. Papadopoulos, H. Marsh, F. Johnston & B. A. Bell (Atkinson Morley Hospital, St George's Medical School, London, UK)

Objective: While self-inflicted pathology in the psychiatric population is common, intracranial injuries are rare and if missed potentially lethal. Institutional disputes are another cause for concern in mental health institutions. We identified some patterns of penetrating injury amongst the psychiatric inpatient population treated in our neurosurgical unit.
Design: Prospective data collection with case note analysis of inpatient stay and outpatient follow up.
Subjects: Inpatients from regional psychiatric hospitals referred to the neurosurgical unit.
Outcome measures: Glasgow Outcome Score, persistent neurological deficit.
Results: All patients were male. Mean age 45 years. Presenting GCS was 15 in the majority of cases (80%) with hemiparesis the commoner sign. All but one made a full neurological recovery. No seizures. One abscess. Five types of injury were identified: (1) ocular or orbital lesions with unclear history of mechanism of injury were associated with non-missile penetrating injuries to the ipsilateral frontal lobe and ipsi/contralateral temporal lobe. Visual acuity was not necessarily affected; (2) frontoparietal injuries mainly presented with lateralising signs and depressed consciousness; (3) patients with repetitive injuries such as variety of entry points and angles (e.g. intracranial nails) were not suicidal but driven by a sensation of guilt and prepared to use a variety of tools to achieve 'punishment': power tools, hammer, various sizes of nail; (4) posterior entry points (e.g. posterior fossa, occipital) may be extremely difficult to see due to small scalp wounds hidden by hair; (5) opportunistic, involving the use of a nearby object as a weapon during a rage, e.g. miniature Eiffel Tower. Radiological findings included pneumocephalus, contusion, haematoma, ventricular casts. Skull fracture was not always present.
Conclusions: (1) The possibility of an intracranial penetrating lesion must be considered when

neurological compromise accompanies an apparently trivial ocular/orbital injury. (2) Complex repetitive self-destructive behaviour without apparent suicidal intent needs a multidisciplinary approach as extraction of foreign bodies can be difficult and the patient's subsequent repetition cannot be excluded. (3) In injuries suggestive of malicious intent the police should be involved. (4) Skull fracture may be absent.

T4-04: Interpretation of CT scans by neurosurgical registrars: Reliability and its consequences

N. Mukerji, D. Holliman, P. S. Bhattathiri & P. J. Kane (James Cook University Hospital, Middlesbrough, UK)

Background: Neurosurgical registrars are increasingly being called upon by A&E staff to interpret head CT scans out of hours. This is due to the reduced threshold for scanning patients and the frequent lack of availability of a radiologist to report these scans out of hours. We undertook this study to investigate whether neurosurgical registrars were up to the challenge!

Methods: Three neurosurgical registrars blinded to each other and the reports from the radiologist, interpreted 50 CT scans chosen randomly from A&E head CT scans over the past year. These were then rated as normal or not. Furthermore, abnormal scans were assessed for the presence of intracranial blood, intracranial air, fractures, contusions, mass effect, midline shift, ischaemia and hydrocephalus. The agreement of the observers' recordings with the report issued or approved by a consultant radiologist, taken as the gold standard for this study, was evaluated using SPSS.

Results: There was a good general agreement between the reports and the neurosurgical registrars on normal scans, presence or absence of intracranial blood, mass effect, contusions, midline shift and fractures (Kappa value between 0.66 – 0.84) and this was statistically significant. The agreement was poorest for grey white differentiation, which had not been commented on in most radiology reports. The agreement was poorer for pneumocephalus, presence of ischaemia and on whether the lesion was new (Kappa value between 0.45 – 0.59).

Conclusions: Neurosurgical registrars compared well with consultant radiologists when it came to assessing emergency head CT scans. Some parameters evaluated by neurosurgical registrars as routine, such as grey/white differentiation, were not regularly commented on by radiologists. Despite these findings it is our belief that in the current medico-legal climate all head CT scans should be promptly reported on by a suitably qualified radiologist.

T4-05: The natural history of post-traumatic hypopituitarism: Implications for assessment and treatment

A. Agha[1], R. Crowley[1], J. Phillips[2] & C. J. Thompson[1] ([1]Department of Endocrinology, and [2]Department of Neurosurgery, Dublin, Eire)

Hypopituitarism occurs in 28–50% of survivors of traumatic brain injury (TBI). We attempted to define the natural history of post-traumatic hypopituitarism in order to inform the optimal timing for pituitary assessment and hormone replacement. Pituitary function was prospectively studied in 50 patients with severe or moderate TBI during the acute phase, at six months and, at 12 months following trauma. Growth hormone (GH) and corticotropin reserves were assessed using the glucagon stimulation test. Baseline serum concentrations of other anterior pituitary hormones were measured. Results were compared against the normative data of matched healthy controls. Nine patients (18%) had GH deficiency in the acute phase; at six months, five patients recovered function and two new deficiencies were detected; at 12 months, one patient recovered leaving five patients (10.4%) with GH deficiency. Eight patients (16%) showed subnormal cortisol response in the acute phase; at six months, four had recovered and five new deficiencies were detected; all nine patients (18.8%) had persistent abnormalities at twelve months. Forty patients (80%) had gonadotrophin deficiency in the acute phase, of whom, 85% recovered by six months and 88% by 12 months. Thyrotrophin deficiency was present in one patient in the acute phase, which recovered by six months; one new case was diagnosed at six months, which persisted at 12 months. Following TBI, early neuroendocrine abnormalities are sometimes transient while late abnormalities present during the course of rehabilitation. A follow up strategy with periodic evaluation is a necessary part of the optimal care for patients with TBI.

T4-06: Acute traumatic brain injuries with abnormal admission CT scan: Comparison of Galasko Guidelines with management in a district general hospital

I. Collins, A. Tong, A. Khan, T. Cadoux-Hudson & D. Woods (Neurosurgery, Radcliffe Infirmary, Oxford, UK)

Objectives: To compare observed transfer rates in those patients admitted to a district general hospital (DGH) with acute traumatic brain injury with those expected if the Royal College of Surgeons recommendations (Galasko Report, 1999) were fully implemented.

Design: A prospective cohort study of acute head injury patients admitted to a DGH between

1998 and 2003. The referral and transfer rate to a neurosurgical unit and patient outcome were recorded.

Subjects: 87 patients (12 children, 75 adults) with acute traumatic brain injury demonstrated on CT, from a local population of over 160,000.

Outcome measures: Expected or unexpected death at the DGH or neurosurgical unit, patients transferred and Glasgow Outcome Scores (GOS) (obtained in August 2006).

Results: Of 87 patients, three adults had incomplete notes. According to Galasko recommendations 82 of the remaining 84 patients qualified for transfer to the Neurosurgery Unit. However, only 35 of these were accepted for transfer. Of the 49 patients not accepted, 15 had poor prognosis and subsequently died. The median inpatient stay for non-transferred patients was four days for children, (range 1 – 14), and five days for adults (range 1 – 31). GOS were obtained for 33 patients (6 children, 27 adults). 64% had a GOS of 5, 21% had a GOS of 4, and 15% had a GOS of 3.

Conclusions: This study demonstrates that the Galasko recommendations have not been implemented. Implementation would require approximately 25% more resources in the regional neurosurgical unit. Further work is required in defining a protocol that is agreed by healthcare funding authorities and hospitals caring for head injury patients.

T4-07: Surgical treatment of chronic subdural haematoma in 119 consecutive cases: Clinical characteristics, surgical outcome, complications, and recurrence rate

A. Bahl, J. Barton & J. McMullan (Department of Neurosurgery, Royal Hallamshire Hospital, UK)

Chronic subdural haematoma (CSDH) is one of the most common clinical entities in daily neurosurgical practice. The diagnosis and treatment are well established, but complications including causative factors for post-operative recurrence remain a subject of constant debate. This study evaluated the clinical features, radiological findings, and surgical results in a large series of patients treated at the same institution over a period of 18 months. 119 patients with 143 CSDHs, who were operated between April 2005 and September 2006, were studied. Causes, clinical and computed tomographic findings, surgical results and haematoma recurrence were statistically analysed to elucidate the potential risks of CSDH and its treatment. Age, sex, cause of CSDH, anticoagulant therapy, preoperative neurological presentation, concomitant disease, variables on preoperative CT scans as well as surgical factors including seniority of primary surgeon, method of anaesthetic employed, number of burr holes used and whether a subdural drain was placed were

examined and matched against haematoma recurrence requiring re-operation. The series included 49 males and 70 females, age range 21 – 94 years, mean age 71.5 ± 12.4 years. The principal symptom was behavioural disturbance (63.8%). 38 patients were on anticoagulant therapy prior to presentation. There were no mortalities in the study group. Post-operative complications occurred in 22 patients (18%). 16 patients (14%) required re-operation including two patients requiring a craniotomy. Mid-line displacement > 6 mm and the presence of acute subdural clots on CT scans prior to surgery were significantly associated with a higher recurrence rate. A higher recurrence rate tended to occur in cases where a subdural drain was not placed and/or if only one burr hole was made but these findings were not found to be statistically significant. Prior anticoagulant therapy and seniority of primary surgeon did not have any bearing on the recurrence rate.

T4-08: Does specialist neurocritical care improve mortality after head injury?

J. A. Hyam, C. A. Welch, D. A. Harrison & D. K. Menon (Department of Neurosurgery, Charing Cross Hospital, London; Intensive Care National Audit & Research Centre, London & Department of Anaesthesia, University of Cambridge, Cambridge, UK)

Introduction: It is suspected that specialist neurocritical care given by staff experienced in management of traumatic brain injury may improve outcome from this potentially lethal condition. The aim of this study was to compare mortality from traumatic brain injury in intensive care units (ICUs) with varying access to neuroscience expertise.

Method: A secondary analysis of the Intensive Care National Audit and Research Centre Case Mix Programme was conducted which contains 374,594 admissions to 171 intensive care units (ICU) across England, Wales and Northern Ireland between 1995 and 2005. The mortality within each type of critical care unit was compared and adjusted for factors known to predict mortality after head injury.

Results: There were 11,190 admissions following traumatic brain injury. Patients who underwent any form of surgery were excluded. 153 general ICUs with no routine neurosurgery onsite contributed 5032 admissions, nine general ICUs that routinely admit neurosurgical patients contributed 1634 admissions, seven general ICUs with a separate neurosurgical ICU onsite contributed 377 admissions and two neurocritical care units contributed 459 admissions. Crude mortality was 34.0% in non-neurocritical care units (35.1% where there was no routine neurosurgery on-site, 32.5% where neurosurgical patients are routinely admitted and 26.7%

where there was a separate neurosurgical ICU onsite) and 25.7% in the neurocritical care units. Adjusted odds ratio in non-neurocritical care units was 1.37 (1.39, 1.32 and 1.42 respectively) compared to 1.00 in neurocritical care units.

Conclusion: The results of this study suggest that risk of mortality from traumatic brain injury is lower in specialist units even after adjustment for multiple factors known to predict mortality after head injury. However, the sample size in the specialist neurocritical care category is relatively small, and these data require confirmation in larger datasets.

T6-01: Transoral surgery in the paediatric population

C. E. G. Uff & D. N. P. Thompson (Great Ormond Street Children's Hospital, London, UK)

Introduction: Experience of the transoral approach is well documented in the adult neurosurgical literature. Its application to craniocervical junction pathology in the paediatric age group has been less well studied. In the largest paediatric series morbidity was predominantly restricted to cases of mobile but irreducible atlanto axial subluxation. In a subsequent cohort of patients modifications have been introduced in an attempt to reduce the risks of this procedure.

Objective: To audit a ten year experience of transoral surgery in paediatric patients. Has the out look for high risk patients been improved?

Patients and methods: 20 children (age range 1.9 – 15.2 years) underwent a transoral procedure between 1995 and 2006. Presentation was myelopathy in 12 patients, torticolis in six patients and pain in 2. The transoral approach was used to access ventrally placed tumours (five cases) and to decompress the cervicomedullary junction in cases of irreducible atlanto axial subluxation (15 cases). The transoral procedure was performed with a halo body orthosis in place in 15 cases, six with image guidance.

Results: All patients ultimately improved following surgery. Three patients with severe weakness were able to walk unaided at follow up. There was one case of early postoperative deterioration. Complications included one failed posterior fusion and one halo displacement. No child without preoperative craniocervical junction malalignment required posterior fixation. All children with irreducible AAS required posterior fixation.

Conclusions: The transoral approach can be safely and effectively used in the paediatric population. In cases of atlantoaxial subluxation, per operative immobilisation permits the use of image guidance and appears to reduce the risk of neurological complications. Posterior fixation may not be required in the absence of preoperative malalignment or instability.

T6-02: Cervical disc arthroplasty with Prodisc-C and Prestige LP: A single-unit, two-year experience

G. Barbagallo, L. Corbino, P. Foti, N. Platania, G. Olindo & V. Albanese (Departments of Neurosurgery and Radiology, University Policlinico Hospital, Catania, Italy)

Objective: Prospective, non-randomised study analysing the early (1 – 6 months) and intermediate (1 – 2 year) results, both clinically and radiologically, of single and multiple level cervical arthroplasty in patients with symptomatic degenerative disc disease. All patients had previously undergone conservative treatment without clinical benefit.

Design and subjects: From October 2004 to October 2006 51 patients (32 males and 19 females), affected by either radiculopathy or myelopathy or myeloradiculopathy, associated in all cases but 15 with neck pain, secondary to soft disc herniation and/or spondylosis of various stages per single level, underwent surgical treatment with arthroplasty only (Group A) or with a hybrid technique combining arthroplasty and arthrodesis in a single-stage procedure (Group B, 16 patients). Group A included 35 patients (20 males), (28 to 68 years), affected by radiculopathy (14), myeloradiculopathy (16) or myelopathy (five). Soft disc herniation in 19 cases, spondylosis in 10 and a combination of both in 6 patients, respectively, were the recognised diseases. The Prestige LP (Medtronic) artificial disc was used in five cases and the Prodisc-C (Synthes) prosthesis in 30. A single-level procedure was carried out in 22 cases and a double-level one in eight. Four patients underwent a three-level surgery and only in one patient four intervertebral discs were replaced with artificial discs. A total of 54 levels were treated with seven Prestige LP and 47 Prodisc-C artificial discs, respectively. Group B included 16 patients (12 males), ranging in age from 45 to 73 years, presenting with either myelopathy (five) or myeloradiculopathy (eight) or radiculopathy (three), secondary to spondylosis (eight cases), spondylosis and soft disc herniation (seven) or multiple level degenerative disc disease (one). In eight patients we treated only two levels, in six, three levels and in two patients a four level procedure was carried out. In total 42 disc spaces were treated, using 19 artificial discs (16 Prodisc-C and three Prestige LP) and 23 carbon fibre cages (CFRP, DePuy). Various device combinations were used: one cage and one prosthesis, two cages and one prosthesis, two artificial discs and one cage, one artificial disc and three cages. As per our study protocol, preoperatively patients were clinically evaluated by means of neurological examination and NDI and SF-36 (MCS, PCS) questionnaires and radiologically by means of radiographs, including flexion/extension views, CT and MR scans. All patients were reviewed at 1, 3, 6, 12, 18 and 24 months after surgery using the same clinical

measures and radiographs with flexion/extension views. Imaging studies were analysed by an independent radiologist, blinded to the clinical outcome, using a specifically designed software (Osirix Medical Imaging) to assess either the range of motion (ROM) or changes in the sagittal alignment, particularly with regard to lordosis, or presence of heterotopic ossification. Data were statistically analysed using the two-sided t-student test.

Outcome measure and results: All patients reported improvement of either radiculopathy or myelopathy, with statistically significant ($p < 0.05$) values according to the self-assessment questionnaires used. The mean NDI score decreased from 40.8 to 8.8 in Group A, and from 31.57%, before surgery, to 5.14% after surgery in Group B. The mean MCS score ranged from 39.2 before surgery to 75.3 after arthroplasty in Group A, and from 33.55% to 64.74% in Group B; the mean PCS value improved from 39.6 to 70.8 in the first group, and from 29.07% to 45.83% in Group B. Follow up radiographs showed moving devices, with a motion ranging from to 4Â to 16Â in Group A and from 3Â to 18Â in Group B. Fusion through the cages was evident in all cases. Lordosis at operated level was maintained or improved in the majority of patients. Heterotopic ossification was registered in three cases: one McAfee grade 3 and two McAfee grade 2, respectively. Complications included one split fracture. No patients were re-operated for persisting symptoms or device-related complications.

Conclusions: Cervical arthroplasty with Prodisc-C and Prestige LP artificial discs appears to be a safe and effective treatment option, as demonstrated by the clinical and radiological results in our series both in single level and in multiple level cases. Motion was maintained in 71 out of 73 levels, and clinically relevant heterotopic ossification was demonstrated in one patient (3.5%).

T6-03: Prospective study of outcomes following surgery in patients with cervical myelopathy

Y. Z. Al-Tamimi, H. Seeley & R. J. Laing (Department of Neurosurgery, University of Cambridge, UK)

Objectives: To assess outcome in cervical myelopathy treated surgically.

Design: Prospective cohort study in patients referred for surgery with cervical myelopathy. Patients completed a battery of outcome measures presurgery and at three months, 12 months, two years and five years following surgery. Outcome scores were analysed with the SPSS package and for SF36 compared to age matched, normative data. Statistical significance was evaluated using Wilcoxon's matched pairs signed ranks.

Subjects: 170 patients, median age 60 years interquartile range 45 – 69 years. All patients had myelopathy with cord compression confirmed on MRI and

underwent surgical decompression. Outcome at three months was obtained on all patients. Outcome at 12 months, two years and five years was obtained in 147, 101 and 35 patients respectively.

Outcome measures: Visual analogue scales (VAS) for pain, paraesthesia, and numbness; Short-Form 36 (SF-36), Neck Disability Index, Myelopathy Disability Index.

Results: All outcome measures showed statistically significant improvements at three months ($p < 0.005$) except for neck pain and general health scores. At three months SF-36 PF was improved in 65%, the myelopathy disability index in 65% and the neck disability score in 69% of patients. Between three months and five years, further significant improvements occurred.

Conclusion: Patients with cervical myelopathy have shown improvement in both generic and condition-specific outcome measures following surgical decompression. Significant improvements were seen in this study throughout the follow up period of five years.

T6-04: Occipito-cervical joint destruction secondary to BCG (*Bacillus Calmette-Guerin*) vaccination

A. Bahl, J. Greig & J. Bosma (Department of Neurosurgery, Royal Hallamshire Hospital, Sheffield, UK)

We present a case of a 17-year old Caucasian gentleman who presented with gradual onset occipital headaches, neck pain and right hypoglossal nerve palsy following a skiing accident. BCG had been cultured from a painful and weeping BCG injection site one year prior to presentation. He had been prescribed standard anti-tuberculosis therapy but was non-compliant with his medication. Imaging revealed a destructive lesion involving the CO/C1 junction and parapharyngeal tissues. Biopsy of the cervical lesion revealed inflammatory changes. Further imaging revealed similar destructive lesions of the iliac crest and ninth rib. Biopsy from the iliac crest confirmed mycobacterium on culture. The patient was treated in a halo device and started on appropriate long-term anti-mycobacterial treatment. Follow up imaging at two months and four months shows evidence of bony fusion at the atlanto-occipital junction and no evidence of disease progression. The patient remains in a halo and is undergoing detailed immunological investigations. BCG is a live vaccine and contains a weakened strain of the *Mycobacterium bovis* bacteria. Disseminated BCG infection as a result of TB vaccination is a rare complication with an incidence of 0.06 to 1.56 cases per million vaccinations usually related to an underlying immunological abnormality. A detailed scrutiny of the medical literature shows this to be the first reported case of disseminated BCG infection involving the cervical spine.

T6-05: Hereditary cervical spondylosis: Is it a distinct entity?

N. Mukerji & E. J. Sinar (James Cook University Hospital, Middlesbrough, UK)

Background: Degenerative cervical spondylosis is a common neurosurgical problem, yet not much has been published about the hereditary factors responsible for it. In fact, the genetic angle to this disease is often not considered. We report a set of identical twins that presented to our service at almost the same, relatively young age with myelopathy due to degenerative cervical disc prolapse and needed surgery for the same, and re-kindle this discussion on the genetics of cervical spondylosis.
Methods: Case report and review of literature.
Results & conclusion: To the best of our knowledge a similar instance of identical twins with cervical myelopathy at a young age needing curative surgery has not been described in literature so far. The early age of presentation, identical twins, similar site and pathology suggests an eerie coincidence, the presence of a genetic element to this common problem. The literature on this interesting topic and the evidence so far for hereditary cervical spondylosis will be discussed.

T6-06: Management of halo devices under three years of age: 'Do not over screw'

C. O. Oluigbo & G. A. Solanki (Birmingham Children's Hospital, Birmingham, UK)

Background: Halo-vest orthosis is an important tool for cervical stabilisation. Significant complications are known to occur in 39% of cases. Less well known is that the increasing size of a skull constrained by head-pins may cause fractures and dural penetration by the pins. Its occurrence and means of avoidance have not been previously reported.
Aim: Evaluate growth of skulls constrained by the halo ring and manage pin fixation so as to avoid skull penetration and fractures.
Outcome measures: Head growth by occipito-frontal-circumference (OFC) and serial cranial-CT(CT).
Patients and methods: Two girls aged one and two years, with traumatic C1-C2 cord transection, ventilator-dependence, quadriplegia and life-threatening cervical-instability requiring external immobilisation prior to surgery were reviewed. External orthosis alone was unsuccessful and posterior cervical fusion was required to achieve stability.
Result: Unexpected increase in body hair, weight, height and OFC was noted in one case. Nine weeks post-orthosis the head had rapidly grown to the smallest halo size requiring change to a larger size. From the outset, regular OFC monitoring with scheduled cranial CT helped pinpoint pin migration through skull. Intermittent unscrewing of

the head-pins and pin rotation was vital to compensate for this head growth. There have been no complications related to skull fracture, pin site penetration or loosening.

Conclusion: (1) Regular OFC, pin-site CT monitoring is required in this age group to avoid skull fractures. (2) We recommend careful halo head-pin nscrewing/withdrawal or pin-site rotation in the very young child with increasing OFC. This procedure when guided by cranial CT does not appear to compromise halo stability and prevents skull fractures. (3) Regular halo head-pin tightening remains appropriate in children whose head circumference has already stabilised.

T6-07: Speed with precision: CT fluoroscopic selective cervical nerve root block in cervical spondylosis

M. J. Asha, D. Kombogiorgas, C. K. Jadun, R. F. Price & H. L. Brydon (University Hospital of North Staffordshire Royal Infirmary, UK)

Background: Cervical selective nerve root block (CSNRB) is a non-surgical routine treatment for severe radicular pain. CT Fluoroscopy (CTF) is a new technique combining the precision of CT with the flexibility of fluoroscopy to reduce the procedural time. It further reveals an excellent foraminal anatomy with dynamic confirmatory contrast injection. This study highlights the outcome of CTF-guided CSNRB in our institution over the last 12 months.

Aim: To study the outcome of treated patients, with this new technique at our institution over the last 12 months.

Design: The case-notes and MRI scans of 15 patients with cervical spondylosis and radiculopathy undergoing CSNRB under CTF were reviewed retrospectively. Verbal Pain Relief Score (VPRS) three-months after the injection was assessed by a telephonic survey.

Outcome measures: Pain relief onset, duration and complications were retrospectively recorded. Results were correlated with severity of the underlying disease as reported on the pre-procedure MRI.

Results: Fifteen patients (seven males and eight females) underwent 17 procedures. Age at the time of diagnosis ranged from 34 to 73 years (mean: 53.59, standard deviation: 11.31). The total procedural time was 10.20 minutes on average (standard deviation 2.78). Onset of postoperative pain relief was immediate in five cases (29.4%). Pain relief occurred the first postoperative week in seven cases (41.2%) and between first week and first month in five cases (29.4%). All procedures were uncomplicated. Pain relief was scored by the patients as mild in five cases (29.4%), moderate in six cases (35. 3%), and significant in six cases (35.3%). Duration of pain relief lasted up to six months.

Conclusion: Cervical selective nerve root block using CT fluoroscopy is safe and effective, achieving 100% nerve root block with varying degrees of pain relief. It brings the advantage of precision with speed, facilitating patient throughput in a busy unit.

T6-08: Cervical skip laminectomy: Is it an option in elderly patients with cervical spondylotic myelopathy?

R. A. Hussain, T. Pigott & B. Weldon (Walton Centre for Neurology and Neurosurgery, Liverpool, UK)

Introduction: Cervical skip laminectomy has become a surgical option for enlarging the spinal canal in cervical spondylotic myelopathy with low morbidity. The majority of these patients are elderly and have comorbidities. The risk profile of this procedure has not been addressed.
Objective: To investigate the morbidity of cervical skip laminectomy.
Patients & methods: We have retrospectively analysed the case notes of 35 patients who underwent cervical skip laminectomy. Clinically all of them had cervical spondylotic myelopathy of whom 26 were males in the age range 33–84 (mean 69.6) and nine females in the age range 63–81 (mean 71.4 years).
Results: Four patients had operative complications, wound infection in three (8.5%) and CSF leak in one (2.8%). At the end of one year (mean 20.9 months) follow up of the neurological recovery was grouped in to three categories: improved - 63%, static - 26% and worsening - 11% (one patient had motor neurone disease and the other had Parkinson's disease).
Conclusion: Cervical skip laminectomy is a safe surgical option to treat elderly patients with cervical spondylitic myelopathy. The neurological outcome in terms of symptom relief or stability was satisfactory.

T6-09: A biomechanical investigation of vertebroplasty in osteoporotic compression fractures and in prophylactic vertebral reinforcement

N. R. Furtado, R. J. Oakland, R. K. Wilcox, J. Timothy & R. M. Hall (Institute of Medical and Biological Engineering, School of Mechanical Engineering, University of Leeds, UK)

Objective: Percutaneous vertebroplasty (PVP) is a treatment option for osteoporotic vertebral compression fractures (VCFs). Short-term results are promising but longer-term studies have demonstrated an accelerated failure rate in the adjacent vertebral body (VB). Limited research has been conducted into the effects of prophylactic PVP in osteoporotic vertebrae. The objective of this study

was to investigate the biomechanical characteristics of prophylactic vertebral reinforcement and post-fracture augmentation.

Methods: Twenty-seven human vertebrae were assigned to two scenarios: Scenario 1 used an experimental model for simulating VCFs followed by cement augmentation; Scenario-2 involved prophylactic augmentation using vertebroplasty. ÂμCT imaging was performed to assess the bone mineral density (BMD), vertebral dimensions, fracture pattern and cement volume. All augmented VBs were then axially compressed to failure.

Results: Product of BMD value and endplate surface area gave the best prediction of failure strength when compared to actual failure strength of specimens in scenario 1. Augmented VBs showed an average cement fill of 23.9%Â $\pm$ 8.07% S.D. In scenario 1, there was a significant post-vertebroplasty factorial increase of 1.72 and in scenario 2 a 1.38 increase in failure strength. There was a significant reduction in stiffness following augmentation for scenario 1 ($t = 3.5$, $p = 0.005$). Stiffness of the VB in scenario 2 was significantly greater than observed in scenario 1 ($t = 4.4$, $p = 0.0002$).

Conclusions: Results suggest that augmentation of the VB post-fracture significantly increases failure load, whilst stiffness is not restored. Prophylactic augmentation was seen to increase failure strength in comparison to the predicted failure load. Stiffness appears to be maintained suggesting that prophylactic PVP maintains stiffness better than PVP post-fracture.

T6-10: Unusual intracranial lesions managed with skull base neurosurgical approaches – Why we need to continually emphasise cerebrovascular/skull base training in neurosurgery

D. J. Chang (Davis Medical Center, University of California, USA)

Introduction: American neurosurgey has evolved into the surgery for spinal fusion primarily by economic incentives. Contemporaneously, the introduction of 'minimally invasive' treatments such as radiosurgery and endovascular therapy has resulted in a marked de-emphasis on the microsurgery of complex intracranial diagnoses. Statements rife in the current neurosurgical environment such as 'the death of cerebrovascular neurosurgery' are unjustified. The current environment underscores the need to further emphasise cerebrovascular/skull base training to facilitate the appropriate continuing treatment of complex intracranial diagnoses that present clinically and to prevent suboptimal neurosurgical treatment in the context of payer schemes that reimburse with no specific regard for 'subspecialised' or 'general' neurosurgeons.

Methods: The author presents the microneurosurgical management of 13 unusual intracranial

diagnoses with skull base approaches: cerebellomedullary angle arachnod cyst, anterior optic chiasmal/tuberculum sellae sarcoid, gyrus rectus lymphoma, medullary glioma, pontomesencephalic lymphoma, medullary abscess, orbitocranial penetrating trauma with a tree branch, distal SCA aneurysm, distal PICA aneurysm, mesial occipital lesional epilepsy, concurrent deep frontal AVM and cribriform plate mucoepidermoid carcinoma, posterior parahippocampal metastasis, and bilateral distal anterior cerebral artery aneurysms.

Results: Five major intracranial approaches and variations were used in this clinical series: pterional transylvian approach with skull base modifications, anterior and posterior interhemispheric approaches, subtemporal approach with variations, far lateral transcondylar approach which incorporates the suboccipital approach and variations.

Conclusions: Adequate exposure and control of haemorrhage are the major tenets of any intracranial operation. The author contends that mastery of the five aforementioned major intracranial approaches addresses most if not all categories of intracranial pathology that a neurosurgeon might encounter in clinical practice. It is easy to abdicate responsibility of 'difficult' intracranial cases to minimally invasive and 'novel' therapeutic modalities. However, abdication will assure that a fraction of the patients who are referred for 'nonsurgical' treatment will receive suboptimal therapy. Future progress in intracranial neurosurgery requires a revival in enthusiasm and commitment to push the frontiers of surgical progress by further emphasising the critical elements of cerebrovascular/skull base neurosurgery.

T6-11: Separating craniopagus twins: First successful procedure in the UK

R. D. Hayward & D. Thompson (Great Ormond Street Hospital for Children NHS Trust, London, UK)

Craniopagus (conjoined twins fused at the head) is a condition that attracts attention out of proportion to its incidence. Media interest is usually both oppressive and prurient—cf events in Singapore when Iranian craniopagus sisters died during surgery. The surgical challenge is to preserve brain function during separation not only of brain but also their shared cerebral vasculature. There then remain large defects of dura, skin and bone to be repaired. Our experience in the management of severe craniofacial deformity associated with disorganised venous drainage meant that we were well placed to undertake the separation of Craniopagus twins in whom complex anomalies of (in particular) venous drainage are inevitable. Twins A1 and A2 were born to UK parents. They were joined vertex to vertex with an axial rotation of 40 degrees. They had one small area of brain connection, a shared segment of superior sagittal sinus and otherwise grossly abnormal cerebral

venous drainage. We report their successful separation following a staged approach that required five major neurosurgical/craniofacial procedures. There were no life-threatening complications and the children suffered no neurological damage as a result of their separation. They have now returned home. There is controversy over whether separation should be undertaken in one lengthy (>24 hours) procedure or staged. Our experience and a recent review of the literature strongly support the latter approach. This case demonstrates how basic clinical/surgical research not only improves the care of more common conditions, it also provides the knowledge and experience necessary to deal with the most complex of surgical challenges. This case also raises important questions about the resourcing of rare conditions that require a lengthy and expensive medical input.

Friday 27 April 2007

F2-01: Deep brain stimulation for pain: indications and insights

E. A. C. Pereira, A. L. Green, D. Nandi & T. Z. Aziz (Oxford Functional Neurosurgery, Department of Neurosurgery, Oxford Radcliffe Hospitals, UK)

Objective: For the treatment of chronic pain refractory to medical therapies, few centres worldwide have published findings from patients treated by deep brain stimulation (DBS) during the last decade using current standards of imaging and stimulator technology. Here we review contemporary studies including our own experience of DBS of the sensory thalamus and periventricular/periaqueductal grey matter. Translational insights into pathophysiological pain processes and DBS related changes from our investigations are also summarised.
Design: Propective case series including intensive study of selected patients.
Subjects: Fifty patients with chronic pain treated by DBS at a single UK neurosurgical centre from 1999 to 2006.
Outcome measures: Subjective reports and quantitative assessments of pain and quality of life.
Results: DBS for chronic pain is particularly efficacious for patients with pain after amputation and stroke, cranial and facial pain including anaesthesia dolorosa. Other carefully selected groups with pain due to multiple sclerosis, malignancy and trauma may benefit from DBS but efficacy in pain after spinal injury is limited. Overall, 70% of our patients gained postoperative benefit and proceeded to full implantation, with 64% gaining relief at one year follow up. Complications were similar to those of other DBS procedures.
Conclusions: DBS is an effective treatment for certain chronic pain aetiologies in carefully selected patients. Its usage has driven fundamental insights into pathophysiological pain processes and DBS

related changes. Progress made from detailed studies of prospective case series translates into better patient selection and improved efficacy, auguring well for larger clinical trials.

F2-02: Deep brain stimulation for isolated cervical dystonia (spasmodic torticollis)

N. de Pennington, C. A. Joint, A. L. Green, R. P. Gregory, P. G. Bain & T. Z. Aziz (Radcliffe Infirmary, Oxford, UK)

Objective: We present the results of 20 consecutive patients in whom we have inserted deep brain stimulators to treat isolated cervical dystonia (spasmodic torticollis).
Design: Patients were selected from those with medically intractable isolated cervical dystonia referred to our movement disorder services. They underwent insertion of bilateral quadripolar electrodes into the postero-ventral globus pallidus internus. The procedures were carried out between 1999 and 2006 by a single surgeon at two centres: 14 at the Radcliffe Infirmary, Oxford and seven at Charing Cross Hospital, London.
Subjects: Sixty per cent of patients were female. The median age at surgery was 49 years. Nineteen patients had onset of their dystonia during adult life. The median interval between onset and surgery was nine years.
Outcome: Objective assessment of the severity of dystonia was made using the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS). The mean pre-operative total was 54.9 (S.D. 10.9). Two patients have been lost to follow up. Three patients have had their stimulator systems removed as they subjectively gained no benefit. The median length of follow up of the remaining 14 patients is 26 months (range 2–73 months).
Results: 75% of all patients had an improvement in their symptoms (Wilcoxon Signed Ranks Test $p = 0.07$). In the 14 patients followed-up the mean improvement in the TWSTRS score was 37%. The improvements in the sub-components were: severity 37%, pain 36% and disability 37%.
Conclusions: This series—the largest reported worldwide—shows that deep brain stimulation of the globus pallidus internus is a safe and efficacious treatment of medically intractable isolated cervical dystonia.

F2-03: Post-mortem neuropathological findings in a patient with both subthalamic nucleus stimulator and subthalamic nucleus lesion

J. T. Laban, M. Nowell, T. Aziz, M. B. Graeber, F. Roncaroli & P. Bain (Charing Cross Hospital, London, UK)

We describe the post-mortem neuropathological findings in a patient with a right subthalamic

(STN) stimulator and left STN lesion and no evidence of a central nervous system cause of death. Microscopic findings were consistent with clinical Parkinson's and Lewy body disease with the confounding pathologies of oedema and hypoxic changes. The anterior basal ganglia showed some loss of nerve cells, patchy gliosis and glial 'unrest' in several white matter areas. Also in the accumbens area were haemosiderin-laden macrophages; calcospherites in the white matter; arterioles with calcified pericytes; and numerous subpial corpora amylacea. There was perivascular oedema, nerve loss, calcospherites and perivascular calcification in the external segment of the globus pallidus. The nucleus basalis of Meynert demonstrated nerve loss and gliosis. Preserved nerve cells showed abnormal morphology with eccentric nuclei and cytoplasmic inclusion material. In addition, alpha-synuclein cytoplasmic and nuclear neuronal staining was observed. Numerous Lewy bodies, occasionally extracellularly, were also seen. The number of pigmented cells in the substantia nigra was reduced. There was free-lying pigment and gliosis. Adjacent cross-sectioned myelin tracts were damaged. Alpha-synuclein staining revealed Lewy bodies both in nerve cells and free-lying. To our knowledge, there are no previous descriptions of the neuropathological findings in patients with both STN stimulator and lesion. These findings add to our knowledge and understanding of the microscopic effect of these different treatment modalities.

F2-04: Vagus nerve stimulation (VNS) improves seizure control for over five years

G. J. Tawari, P. Epaliyanage, S. A. Barazi, C. E. Polkey & R. P. Selway (Kings College Hospital, London, UK)

Introduction: Medically intractable epilepsy carries a high morbidity and mortality. VNS has been shown to benefit such patients for up to two years but long-term data remains sparse. A retrospective study examined the effect of VNS, more than five years after its insertion for epilepsy, on seizure frequency and quality of life.

Method: 62 patients with the mean age of 29 years (6–59 years), duration of epilepsy for 20 years (4–56 years) and mean follow up period of 76 months (51–114 months) were included. A questionnaire assessed seizure frequency, treatment continuation and a previously published range of quality of life outcome measures. Pre-implantation seizure frequency was obtained from a prospectively maintained database.

Results: 35 patients continued to use VNS (retention rate of 59%). The pre- and postimplant monthly seizure frequency of these patients was median 24 (3 to 1800) and 4.5 (0 to 1000). The corresponding

median monthly seizure frequency in all patients was 22 (1 to 1800) and 9.5 (0 to 1000). 26 patients (44.1%) showed more than 50% improvement in their seizure frequency including four seizure-free patients. Five patients (8.5%) had less that 50% improvement. 26 patients (44.1%) exhibited no improvement and two patients (3%) were worse. Three patients died (7 per 1000 patient-years). Quality of life showed improvement in all domains.
Conclusions: VNS seems to have long-term results that compare extremely favourably with medical therapy in severe intractable epilepsy.

F2-05: Vagus nerve stimulation in the treatment of refractory epilepsy

D. Bhattacharyya, A. Saxena & A. A. Kemeny (Royal Hallamshire Hospital, Sheffield, UK)

Objective: A significant proportion of patients with epilepsy have poor control, in spite of treatment with multiple antiepileptic drugs. Some experience unpleasant side effects with pharmacotherapy. For those without a surgically respectable focus and poor pharmacological control, vagus nerve stimulation is an acceptable form of therapy.
Design: Systematic retrospective analysis of all vagus nerve stimulators implanted at our institution between 1995 and December 2005, by a single surgeon.
Subjects: 230 patients aged between two and 75 years, underwent the procedure, the median age being 28 years. Most of the patients in the study were on three antiepileptic drugs and 19% were being treated with a four-drug regime. Complex partial seizures were the commonest seizure type on presentation.
Outcome measures: Reduction in the number of seizures and decrease in antiepileptic drugs were the main outcome measures. Complications from the procedure were also recorded.
Results: 161 patients had complete follow up. Two patients were rendered fit free and 57 patients (36%) had significant improvement i.e. more than 50% reduction in the number of seizures. Thirty-one per cent had minor improvement while 30% observed no change in their seizure activity. Three patients had worsening of seizure activity for which the stimulators were removed. Twenty-five patients (15.5%) were taking a reduced number of antiepileptic drugs after vagus nerve stimulation. There were nine procedural complications including two wound infections.
Conclusions: Epilepsy which is not controllable with drugs poses a particular challenge to the clinician. The severity of the condition often causes behavioural problems and difficulty with social adjustment. Vagus nerve stimulation is a safe and effective procedure which has significant beneficial effects in a proportion of these patients, not only in

reducing seizure frequency and medication, but often improving neuropsychological status (86% in our study).

F2-06: Outcome and complications of vagal nerve stimulator in children with intractable epilepsy

S. M. R. Kabir, C. Rajaraman, D. Bhattacharya, C. Rittey, H. Zaki & P. J. McMullan (Sheffield Children's Hospital, London, UK)

Objective: To determine the outcome and complications of vagal nerve stimulator in children with intractable epilepsy.
Design: This is a retrospective study and data has been collected from the patient's notes. Data collected describes age and sex of the patient, age of first fit, type of epilepsy, preoperative and postoperative antiepileptic medications, preoperative and postoperative seizure frequency, date of insertion of vagal nerve stimulator and any complications. Patients were followed up in a combined paediatric epilepsy clinic lead by a consultant neurologist specialising in childhood epilepsy.
Subjects: 94 children (59 males, 35 females) with various types of childhood epilepsy who had insertion of vagal nerve stimulator between June 1995 and September 2006 have been included in the study. Mean age was 10.5 years. Maximum follow up was nine years and minimum follow up two months.
Results: The commonest cause for insertion of vagal nerve stimulator was multifocal epilepsy. Age of first fit varied from neonate to 11 years. Sixty patients (63.8%) had significant decrease in the number and/or frequency of seizures. In 17 patients (18.8%) it was possible to reduce the dose and/or number of antiepileptic medication and in two patients (2.12%) it was possible to withdraw all antiepileptic medication. Complications included infection (two cases), wound breakdown (one case), lead fracture (two cases), fluid collection around the stimulator (two cases), and difficulty swallowing (one case).
Conclusion: Our study, which is the largest in UK, confirms that vagal nerve stimulation is a relatively safe and potentially effective treatment for children with medically intractable epilepsy.

F2-07: Ventriculoperitoneal shunt audit in Sheffield Children Hospital

M. K. Teo, S. Kabir, H. Zaki & P. J. McMullan (Sheffield Children Hospital, Sheffield, UK)

Objective: In paediatric patients, hydrocephalus is most commonly managed with a ventriculo-peritoneal (VP) shunt placement. To reduce the failure rate of these mechanical devices, recent investigations

have been focused on programmable shunt valves. In Sheffield Children Hospital, we gradually moved towards using programmable shunt from 2003. The aim of this audit is to investigate the revision and complication rate of programmable versus non-programmable shunts in our unit, and also to compare the data with that published by the UK National Shunt Registry.

Design/subject: A retrospective study of VP shunts implanted from Jan 2000—Jan 2006 in Sheffield Children Hospital was performed. Patients were analysed for demographic data, implantation diagnosis, valve type, opening pressure adjustments, and incidence of shunt complications. The end point of the study was a surgical shunt revision.

Results: In 70 patients, 37 had non-programmable shunt (21 NMT integral, 16 Delta valve), and 33 had programmable shunt (24 Codman Hakim, nine Strata) implanted. The one-year revision rate was 27% for non-programmable shunt, 24% for programmable shunt and both results were comparable to the national one-year revision rate of 28%. 49% of non-programmable shunts compared to 30% of programmable shunts subsequently required shunt revision during the study period. In non-programmable shunts, the most common reason for revision was infection (16%), overdrainage (16%), followed by disconnection (8%), underdrainage (5%), and wound breakdown (5%). For programmable shunts, the most common reason for revision was underdrainage (15%), followed by overdrainage (9%), infection (6%) and disconnection (3%). Opening pressure adjustments were performed in 39% (13/33) of this group of patients.

Conclusions: Our audit found that the one year revision rate was similar for both programmable and non-programmable VP shunt valves at Sheffield Children Hospital. However there is noticeably higher overall revision rate, infection rate, overdrainage and disconnection rate for non-programmable shunts. Our result was also comparable to UK National Shunt Registry data.

F2-08: Initial experience with proGAV, a new programmable valve for hydrocephalus

A. Tarnaris, S. M. Joshi, N. D. Kitchen & L. D. Watkins (National Hospital for Neurology and Neurosurgery, London, UK)

Objective: The proGAV (Aesculap/Miethke) valve is a relatively new programmable valve protecting against unintended pressure changes following MR imaging, whilst at the same time incorporating an integrated gravitational unit to reduce the incidence of overdrainage. The purpose of the study was to assess the function of this shunt *in vivo*.

Design: Prospective recruitment of patients with various types of hydrocephalus needing cerebrospinal fluid diversion procedures. Patients with different

types of hydrocephalus and previous shunt procedures were included. There was no age restriction. Study period March-October 2006.
Subjects: There were nine females and four males in total. Mean average age was 60 years. Three patients had obstructive hydrocephalus, eight had chronic communicating hydrocephalus and one patient had benign intracranial hypertension. Mean age of patients was 60 years. The mean duration of hydrocephalus was 25 months. Three patients had a previous implanted valve, two of them programmable ones. One patient had two previous revisions. The mean follow up time was 3.4 months.
Outcome measures: Rate of surgical or non surgical revisions, infection or complications.
Results: The setting most often used upon implantation was 6 cm H20. The hydrostatic component most often used was at 25 mm Hg. No patient during the follow up time had an infection, need for surgical revision, or complication of overdrainage. One patient needed a non-surgical revision (non-surgical pressure adjustment). However, this patient had a previous valve *in situ* and needed multiple previous non-surgical revisions in the past. No unintended adjustments (e.g. during imaging) were observed.
Conclusions: Our initial experience with this new valve is very promising, even though longer follow up is needed to make final conclusions. Main advantages are the multiple adjustment points (twenty in total), the incorporated gravitational component, and the compatibility with 3T MRI scanners. We suggest that all forms of hydrocephalus may be treated successfully with this shunt.

F2-09: Comparison of complications of external ventricular drainage and ventriculo-peritoneal shunts for acute hydrocephalus

B. Dhamija, K. Deniz & J. R. Van Dellen (Charing Cross Hospital, London, UK)

Background: The treatment criteria for acute hydrocephalus following intracranial haemorrhage remains unclear. In general neurosurgical practice, there is a tendency to use external ventricular drainage (EVD) for these patients, whilst some surgeons advocate the insertion of a ventriculo-peritoneal shunt (VPS) as definitive treatment. Each treatment modality has its own inherent advantages and disadvantages. The aim of this study was to ascertain the relative risk of complications associated with the different treatment modalities.
Method: A retrospective study was performed by way of notes review. The complications and outcome following ventricular drainage for acute hydrocephalus were analysed in 40 patients admitted to a neurosurgical unit over the past five years. Twenty patients underwent external ventricular drainage,

whilst the remaining twenty underwent insertion of ventriculo-peritoneal shunt. Complications of CSF infection, drain/shunt blockage, malposition of catheter and re-operation were analysed for both groups.

Findings: The infection rates were 5% in the EVD group and 10% in the VPS group. Rates of catheter blockage were 10% in the EVD group and 5% in the VPS group. In both groups, 5% of patients required re-operation. Five per cent of the EVD procedures were complicated by extra-ventricular placement of the catheter. Statistical analysis demonstrated no significant difference in the complication rates between the two patient groups ($p = 0.7$).

Conclusions: This study has shown that early short-term external ventricular drainage and early ventriculo-peritoneal shunting are associated with a low risk of infection. The findings confirm that there is no significant difference in complication risk between external ventricular drainage and ventriculo-peritoneal shunting for acute hydrocephalus secondary to intracranial haemorrhage. This may have implications regarding choice of ventricular drainage for acute hydrocephalus secondary to intracranial haemorrhage.

F2-10: Long-term need for permanent cerebrospinal fluid diversion in patients with subarachnoid haemorrhage: Comparison between endovascular coiling and surgical clipping

N. Haliasos, A. Tarnaris, G. Prezerakos, J. Norris, L. D. Watkins & N. D. Kitchen (National Hospital for Neurology and Neurosurgery, London, UK)

Objective: The purpose of this study was to assess the need for ventriculoperitoneal shunting in patients suffering from subarachnoid haemorrhage and study the effect of the management modality (coiling versus clipping of an aneurysm).

Design: Retrospective review of medical records in two UK centres. Chi square test was used for comparison of categorical and student's t-test for comparison of numerical parameters. Study period 2001 – 2005. Epidemiological factors, neurological status, radiological findings at presentation were recorded.

Subjects: 180 patients suffering from subarachnoid haemorrhage of any aetiology and requiring either external ventriculostomy or permanent CSF diversion post-ictal were included in the study.

Outcome measures: Need for a permanent CSF diversion procedure.

Results: The incidence of a need for a VP shunt was 24.8%. Patient's sex, age at presentation, Fisher's grade and Evans index on initial CT scan, artery involved, size of aneurysm ($p = 0.056$), multiple aneurysms, presence of hydrocephalus on admission, intraventricular extension on presentation, and

rebleeding are not significant predictors for a need of permanent cerebrospinal diversion. Instead, intraventricular/intraparenchymal extension of initial haemorrhage ($p < 0.005$), WFNS score at presentation ($p < 0.005$), need for external ventriculostomy on presentation ($p < 0.001$), time of patient requiring external ventriculostomy ($p < 0.001$), infection following ventriculostomy ($p < 0.05$), vasospasm ($p < 0.01$), and management modality ($p < 0.05$) are significant predictors of a need for a VP shunt.
Conclusions: Severity of ictus at presentation and need for external ventriculostomy on admission are predictors for the long term need of a VP shunt. Patients having coiling of aneurysms that present with subarachnoid haemorrhage have a lower chance of requiring permanent cerebrospinal fluid diversion when compared to patients undergoing surgical clipping of an aneurysm. Contributing factors to these findings are discussed.

References

1 Dehdashti AR, Rilliet B, Rufenacht DA, de Tribolet N. Shunt-dependent hydrocephalus after rupture of intracranial aneurysms: a prospective study of the influence of treatment modality. *J Neurosurg* 2004;101(3):402–7.
2 Dorai Z, Hynan LS, Kopitnik TA, Samson D. Factors related to hydrocephalus after aneurysmal subarachnoid hemorrhage. *Neurosurgery* 2003;52(4):763–9.

F2-11: Experience with a web-based neurosurgical referral database

L. M. Alakandy, S. A. Rutherford & A. T. King (Greater Manchester Neurosciences Centre, Hope Hospital, Manchester, UK)

Background: The advent of shift systems both within neurosurgical units and their referring district general hospitals mandates a reliable system of communication for acute referrals. Such a system should ensure continuity of care of patients, provide a permanent record of the referral for audit and governance purposes, and allow accurate written feedback to the referring team.
Objective: To introduce a web-based database for acute neurosurgical referrals and share our experience of using it.
Design: A retrospective review of the process of collection, storage and retrieval of referral information using the database. Approximately 6000 entries were recorded during the 21 months since inception.
Results: The database is created on Microsoft Windows SharePoint Services™, which runs on Windows Server 2003. This has a secure web browser-based interface and runs on the hospital's intranet, allowing access from any computer in the hospital. The initial information is entered by the registrar at the time of taking the call and supplemented by the consultant's decision the following day at the radiology meeting. Following this, a mail

merge letter incorporating a summary of the referral information with the consultant's management decision is faxed or e-mailed back to the referring doctor within 24 hours of the referral. The information is immediately accessible and editable allowing the next shift to pick up the referral if necessary. Filtered lists are also being accessed by the relevant personnel for bed management, audit and monitoring the workload of the unit.
Conclusions: We have in place a highly successful referral database, which is user-friendly and easily accessible on the hospital intranet. This has improved the documentation of all acute referrals to the department, created a far safer handover system, and has facilitated communication of clinical details and decisions back to the referring doctor.

F2-12: Analysis of pattern and quality of emergency referrals to a regional neurosurgical unit

M. Foroughi, A. Dodds, C. Patel, R. Williams, S. Griffiths, R. Nannapaneni & R. Hatfield (University Hospital of Wales Cardiff, UK)

Objective: To prospectively assess the pattern and quality of referrals to the on-call neurosurgical registrar.
Design: A purpose designed form.
Subjects: A total of 500 consecutive referrals over a 111 day period.
Outcome measures: Data fields included patient details, pathology, time of referral, referring unit, details of referring doctor, details of clinical and radiological assessment, degree of urgency and quality (using a simple scoring system) of referral.
Results: A total of 1420 calls (range 1 – 14 calls per referral, mean 2.8) were analysed for the 500 referrals. Thirty six per cent of referrals were made out of hours (between 1800 hrs-0900 hrs) and 13% were made between midnight and 0900 hrs. Junior staff (SHO & HO grade) and middle grade staff made 43% and 37% of the referrals respectively. The referring doctor had discussed the case with the referring consultant in 46% of cases. Approximately 18% of referring doctors had not seen the patient prior to the referral. A total of 45% of referrals were scored as reaching a high standard in communication, and 19% of referrals were judged to be inappropriate. In 35% of cases previously discussed the details of the consultation (details of neurosurgical team and clinical advice) were not correctly noted.
Conclusions: There is significant scope for improvement in the quality of emergency referrals to the on-call neurosurgical team. Areas for improvement include involvement of senior referring staff, adequate preparation and gathering of appropriate clinical details by the referring team, good record keeping, and improvement in communication during handovers and shift changes.

F2-13: Audit of the neurosurgery referral database in Oldchurch Hospital

S. C. Burn & J. Benjamin (Oldchurch Hospital, Essex, UK)

Objectives: To assess the number of referrals received, provision of neuro ITU beds, and appropriateness of the referral (with respect to type of referral and timing of referral in view of the European Working Time Directive).
Design: Prospective study carried out between 1.4.6 – 30.9.6. All referrals received by the on-call neurosurgery registrars were entered into the neurosurgery referral database, by the neurosurgery registrar on-call, between the chosen dates.
Subjects: All patients referred to the neurosurgery department during the audit period. These patients largely originated from Essex.
Outcome measures: The total number of referrals received per month were analysed along with the number of referrals received per hospital per month. Diagnosis was recorded. Demand and provision of neuro ITU beds was examined. Inappropriate of referrals were defined as those seeking an opinion from the wrong specialty, or non-urgent referrals being made during EWTD sensitive time (10 pm – 8 am). Results: 985 referrals were made during the audit time period (range 126 – 199 per month). The top three diagnoses were head injury (30%), vascular abnormalities (20%) and oncology (15%). Forty-six patients requiring neuro ITU were referred and 13 patients could not be admitted due to lack of capacity. Inappropriate referrals were made at a rate of 7% per month.
Conclusions: There is a demand for an increase in provision of neuro ITU beds which will be met by an increase in capacity in the new Queen's Hospital. Continual education of referring units is required to reduce the number of inappropriate referrals. An additional observation found was the increase in speed of dealing with referrals with the teleradiology image transfer system. The importance and usefulness of the database was recognised. Funding has been provided to fund an improved version of the database which will facilitate data entry and data processing. The database will be reaudited once Oldchurch Hospital has relocated to Queen's Hospital to ensure improved provision of neurosurgery on-call services.

F2-14: Sir Victor Horsley's operations at the National Hospital 1886 – 1900

D. Frith, N. Kitchen & M. Powell (The National Hospital, London, UK)

Sir Victor Horsley was appointed to the National Hospital in February 1886 to carry out brain surgery, the first appointment of its type in the world. Sachs of St Louis described him as the true father of

neurosurgery, although he was not the first to carry out planned brain surgery in the UK, this honour being held by McEwen in Glasgow. There are a number of reports of Horsley's operations, such as the first ten performed at Queen Square, with only one death, recorded in his biography.[1] Because patients were only admitted under neurologists, his operations can only be discovered by studying the records of all the various physicians in the annual collections of their patient records. Fortunately these records exist. This study has been done and a catelogue of his operations with particular reference to outcome and mortality made. They provide a glimpse into a time of heroic surgery when definitions of outcome were, perhaps, a little more flexible than they are today. Horsley was clearly an optimist as well as being a skilful and resourceful surgeon and an outstanding scientist.

Reference

1 Lyons JB. *Citizen surgeon.* London: Dawnay; 1966.

F5-01: Intraoperative transpedicular vertebroplasty for lytic vertebral body metastasis adjacent to subtotal vertebrectomy and circumferential instrumented stabilisation for vertebral collapse

N. D. Haden & N. R. Patel (Frenchay Hospital, Bristol, UK)

Objective: We present a novel case of intraoperative, transpedicular vertebroplasty of a large osteolytic vertebral metastasis adjacent to a collapsed vertebra, requiring decompressive subtotal vertebrectomy and instrumented spinal stabilisation.
Method: A 47-year-old male with metastatic melanoma presented with progressive paraparesis and spinal pain from kyphotic T9 vertebral collapse. The preserved T8 vertebral body contained a large osteolytic metastasis. A trans-pedicular approach, a T9 subtotal vertebrectomy and circumferential stabilisation with interbody titanium mesh cage and pedicle screw fixation (T7 to T11)was planned. The T8 lytic lesion precluded adequate pedicle screw purchase with the risk of craniad telescoping of the T9 interbody mesh cage into T8. An intraoperative transpedicular vertebroplasty of T8 under fluoroscopic guidance was performed. Pedicle screws were inserted into T8. An interbody mesh cage was used to reconstruct the body of T9.
Results: The patient mobilised independently on the fourth postoperative day with pain and complication free hospital discharge on the seventh day. Imaging confirmed a satisfactory vertebroplasty of T8 with rigid circumferential spinal fixation.
Discussion: Intraoperative transpedicular vertebroplasty for structural reinforcement of lytic malignant lesions adjacent to a subtotal vertebrectomy and

reconstruction has not been previously reported. The procedure enabled excellent screw purchase at T8 and rigid support for the interbody cage.
Conclusion: This technique should be considered for osteolytic vertebral metastases to optimise screw fixation, reinforce anterior column support adjacent to interbody mesh cages and reduce the risk of construct failure.

F5-02: The X-Stop interspinous device: a safe and reliable option or a surgical illusion? Analysis of indications, results and complications in a cohort of 37 patients with a 6 to 18 months follow up

G. Barbagallo, G. Olindo, L. Corbino, N. Platania & V. Albanese (Department of Neurosurgery, University Policlinico Hospital, Catania, Italy)

Objective: In the past few years the X-Stop interspinous process distraction system has been acccepted as a surgical option to treat neurogenic intermittent claudication secondary to lumbar canal stenosis. Low-grade degenerative spondylolisthesis and facet joints syndrome are other accepted indications. According to the suggested surgical technique, neither the X-Stop is anchored directly to the spinous processes nor spinous process bony trimming is advised to accomodate the distractor. These features might facilitate changes in the position of the device and, therefore, alter the long-term clinical outcome.
Design and subjects: From April 2005 to October 2006, 61 patients (27 males) underwent surgery with the X-Stop IPD. Out of the total a cohort of 37 patients, affected by lumbar canal stenosis (30), degenerative spondylolisthesis (eight), facet joints sindrome (three), or a combination of two pathologies (four), with a follow up ranging from six to 18 months have been selected. A single-level procedure was carried out in 24 patients, whilst in 13 cases two levels were operated, accounting for a total of 50 interspinous distractors implanted. Preoperatively, all patients completed both the SF-36 and Oswestry Disability Index questionnaires; neuroimaging evaluation included X-rays, with flexion-extension views, CT and MRI scans. After surgery, the same clinical and radiological parameters were used to assess patients at one, three, six, 12 and 18 months visits. Among single-level procedures, the L4-L5 level was treated in 22 cases and the L3-L4 interspace in two patients. In the double-level group 10 patients had surgery at L3-L4 and L4-L5. Only once the L2-L3 and L3-L4, L2-L3 and L4-L5, L4-L5 and L5-S1 were operated, respectively.
Outcome measures and results: 79% of patients improved at six months. However, at 18-month follow up seven patients (19%) presented clinical worsening. The six-months evaluation revealed that eight patients (21%) did not have any improvement in some evaluation parameters in comparison to their

values before surgery. All results are statistically significant according to the two-sided student t-test. Complications included: intraoperative fracture of the spinous process in one patient, device dislocation following post-traumatic fracture of the L5 spinous process in one case; non-traumatic fracture of the L4 spinous process in two patients treated with double-level surgery (sandwich phenomenon); device dislocation, not clinically significant, in two cases; complete migration of the X-Stop in three patients. Three of these patients underwent further surgery with spinal decompression and pedicle screw fixation. None of the patients who sustained spinous process fractures were osteoporotic.

Conclusions: About 60% of patients report a satisfactory and persisting clinical outcome. We believe that complications might be related to the morphology of the spinous processes, particularly the shape of the inferior surface, to the interspinous distance, to the space between the hypertrophic facet joints and the tip of the spinous process (the space available to implant the X-Stop), and to the mechanical properties of the device. In conclusion the X-Stop IPD system is a safe and reliable treatment option. However, our analysis suggests that it should not be considered a panacea for all patients suffering from lumbar canal stenosis; patient selection should consider not only the pathology to be treated but also the anatomical features of each single patient.

F5-03: Posterior spine fusion in very young children: Early experience with recombinant human bone morphogenetic protein-2 (rhBMP-2)

G. A. Solanki, C. Oluigbo & D. Marks (Birmingham Children's Hospital, Birmingham, UK)

Introduction: BMP is a genetically engineered protein that recruits bone-forming cells to the surgical area and converts local cells to bone. In clinical studies rhBMP-2, successfully enhanced anterior/posterior spinal fusions in adult humans without bone-grafts. Efficacy in paediatric spinal fusion is not yet reported.

Patients & methods: Non-metal and metal instrumented posterior spinal fusions were performed using rhBMP-2 applied to an Absorbable Collagen Sponge(ACS) matrix in three children: An 11-month with diaphragmatic hernia, obstructive jaundice and split notochord and cord duplication syndrome with cervico-thoracic instability; a two-year-old with ventilator-dependence, quadriplegia and severe cervical spinal instability; and a child with Hurler's disease and scoliosis. They underwent respectively, C1-C2, multilevel cervico-thoracic and thoracic fusions.

Outcome measure: The primary outcome measure was radiographic spine fusion. **Results:** Bony fusion

began at three weeks. Within eight weeks solid spinal fusion was confirmed by CT-Scan. At one year follow up there was no evidence of spinal canal encroachment and no adverse effects related to the rhBMP-2/ACS-carrier matrix.

Discussion: rhBMP-2 converts immature local soft tissue to bone-forming cells. While fusion rates are very good, it is critical to ensure bone formation remains localised and the spinal canal is kept bone-free. While bone graft is unnecessary with rhBMP-2, calvarial bone was used to create a safe anterior casing upon which the ACS soaked in rhBMP-2 was laid down at C1-C2 interspace. The minimum amount was used to avoid local tissue reaction and bony-overgrowth. Paediatric experience suggests faster fusion than in adults.

Conclusion: rhBMP-2 enhanced posterior spinal fusion at an impressive rate in very young children. This finding is encouraging both to effectiveness and speed. However with all new developments we highlight the need for further experience and longer follow up in children.

F5-04: Spinal cord blood flow in an animal model of post-traumatic syringomyelia

A. R. Brodbelt, M. A. Stoodley, P. Storer, A. Watling, J. Tu & N. Jones (The Walton Centre, Liverpool)

Objective: To examine the role of ischaemia in post-traumatic syrinx pathogenesis.

Design: Changes in local spinal cord blood flow (SCBF) were examined using laser Doppler flowmetry immediately after and in the six weeks following initiation of a post-traumatic syrinx model.

Subjects: Forty-eight male Sprague-Dawley rats were divided into five groups. (1) The post-traumatic syrinx model combines intraparenchymal quisqualic acid (QA) at C7/T1 with subarachnoid kaolin. The influence of the (2) laminectomy alone, (3) QA alone, and (4) kaolin alone were investigated in separate groups. Animals survived for 1 hour, 24 hours, or 6 weeks and had SCBF recordings at initial and final explorations. (5) Four animals had a syrinx induced and were fixed six weeks later for histological examination.

Outcome measures: Comparison of group means was performed by analysis of variance and significance taken as $p < 0.05$. Haematoxylin and Eosin staining in group 5 was used to assess cord vascularity.

Results: Laminectomy, QA, or kaolin alone all demonstrated significant increases in SCBF at six weeks ($p < 0.05$). There was no significant change in SCBF in the syrinx model, or between the other groups at earlier time points. Spinal cords demonstrated marked neuronal loss, inflammatory infiltrate, and vascular arachnoidal adhesions at the level of the syrinx with no alteration in cord vascularity.

Conclusions: The lack of a hyperaemic response following syrinx development, coupled with histological preservation of cord vascularity, suggest an ischaemic spinal cord secondary to syrinx pressure effects. These findings support early decompression of a syrinx to restore spinal cord blood flow and potentially improve neurological recovery.

F5-05: Outcome of surgery for post traumatic syringomyelia

S. O. S. Ushewokunze, Y. C. Gan, N. Hamid & G. Flint (Queen Elizabeth Hospital Birmingham, Birmingham, UK)

Introduction: Syringomyelia is a rare condition with an annual incidence of 8 per 100 000. In contrast post traumatic syringomyelia affects up to one in twenty spinal cord injury victims, further threatening an individual's independence. Many surgical strategies have been devised for treating this condition but the optimum method has yet to be established. We treated 31 patients with laminectomy and reconstitution of the spinal subarachnoid channels and have reviewed the outcome.

Method: Retrospective study of patients undergoing surgery between 1996 and 2006. There were 31 patients; 29 males and two females, mean age 33 years (range 17 – 61). The mechanisms of injury were 24 road traffic accidents (eight motorcycle), six falls and one stabbing. The mean time interval to surgery from the accident was 8.9 years. Twenty-seven procedures were primary operations and four patients had undergone previous surgery. Follow up was available for 21 patients at six months and 10 patients at one year.

Outcome measures: Limb power and sensation, bladder and bowel function were all assessed at six and 12 months. Radiological appearances were assessed at six months.

Results: At six weeks, 14 out of 21 patients (2 in 3) described improvement in symptoms, one reported no change and six experienced mild deterioration. At six months, nine out of 21 patients (2 in 5) had maintained clinical improvement, five (1 in 4) were in the same state as preoperatively and seven (1in 3) were worse than before surgery. At one year, four out of 10 patients reported improvement of symptoms, three were as prior to surgery and three were worse than before surgery. Radiological review at six months revealed a reduction in the size of the syrinx in 18 out of 25 (3 in 4) patients.

Conclusions: Laminectomy for syringomyelia with reconstruction of the spinal CSF channels resulted in a good reduction of syrinx size by six months in three quarters of our patients with two thirds experiencing stabilisation of symptoms in the medium to long term.

F5-06: A review of experience of spinal dermal sinus tract in 52 children

N. Biyani, A. Davies, D. Saunders, R. Hayward & D. Thompson (Department of Neurosurgery, Great Ormond Street Hospital for Children, London, UK)

Introduction: Congenital lumbosacral dermal sinus (LSDS) is an unusual form of occult spinal dysraphism. Untreated there is a risk of meningitis, local sepsis and dermoid formation with the potential for long-term neurological sequelae. Our policy has been to recommend surgery for asymptomatic as well as symptomatic cases.
Objective: To audit a ten-year cohort of cases of LSDS in children.
Methods: Clinical presentation, neuroimaging findings and surgical outcomes were reviewed for all children treated for LSDS 1997 to 2006 at a single institution.
Results: 52 patients (age range three days - 14 years) underwent surgery for LSDS. 28 patients were (less than) one year of age at the time of surgery. Cutaneous stigmata were present in all. Additional presenting symptoms included abscess formation (five), purulent discharge (five), dermoid content (two), CSF discharge (one), meningitis (three), motor deficit (four), sphincter involvement (five) and pain (two). Neuroimaging revealed intraspinal dermoid in 13 (25%), hydromyelia in nine children and evidence of an intradural track 20 children (38%). Associated dysraphic anomalies were present in 16 cases. There was no correlation between the presence of a dermoid and infections as a presenting feature. At surgery an intradural tract was identified 47 (90%), Complete excision of the dermal sinus tract was performed in all cases, complete excision of a dermoid was possible in eight children. At mean follow up of 42 months, 46 (88.6%) children remained neurologically normal. Three patients (5.7%) with preoperative deficits were unchanged. Three (5.7%) children have neurogenic bladder disturbance. No asymptomatic child developed a neurological deficit.
Conclusion: Midline skin lesion is the marker of the occult spinal dysraphism. MRI may underestimate the extent of the dermal sinus track. Outcomes are worse for those patients presenting with infectious complications or neurological deficit. Prophylactic removal of the entire track has minimal morbidity and is recommended for LSDS.

F5-07: Spinal infection: What influences functional outcome?

G. A. Wynne-Jones, J. Ling, J. Hutchinson, N. Patel & I. W. Nelson (Department Orthopaedic Surgery, Frenchay Hospital, Bristol, UK)

Background: Spinal infections are rare, the reported incidence in the UK is between 1:50,000 and 1 in

250,000. Functional outcome following spinal infection is not widely reported in the literature.
Methods: Over a seven-year period, all adult patients presenting to a tertiary referral centre with a diagnosis of primary pyogenic spinal infection (epidural abscess, osteomyleitis or spoindylodiscitis) were identified. Data at presentation was collected and included: C-reactive Protein (CRP), white cell count (WCC), time interval between onset of symptoms and presentation to tertiary referral centre causative organism, level of spinal infection and surgery. Functional outcome was assessed using a validated tool—The Oswestry Disability Index (ODI).
Results: 96 patients were identified, mean age 61 years (22–87), 51 (53%) male. ODI was available for 78% of live patients; the mean follow up period being 5.5 years (21–120 months). The median ODI was 42 (0–84). An elevated CRP was significantly associated with a poorer functional outcome ($p = 0.05$). Surgical intervention was related to improved functional outcome but did not reach statistical significance. WCC and the presence of an abscess were not related to functional outcome.
Conclusion: In our study we have found that the higher the CRP at presentation the poorer the functional outcome.

F5-08: Intramedullary spinal cord astrocytomas in childhood: Clinical features, management and outcome

D. A. Bell, K. Phipps, D. Thompson & R. D. Hayward (St George's Hospital, London, UK)

Objective: To assess the clinical features and outcome in all children diagnosed with intramedullary spinal cord astrocytomas treated in a single institution over a 20-year period.
Methods: Retrospective case-note review of a longitudinal series of patients.
Outcome measures: Death, functional mobility at last review.
Results: 43 patients were treated. The mean age at presentation was six years nine months.The mean duration of symptoms at presentation was 13.6 months with a median of five months. Low grade tumours typically had a longer history with mean duration 15.7 months prior to presentation compared with six months for the high grade tumours. Axial pain was the most common symptom being present in 20 (47%) patients. The mean duration of pain was 9.8 months. Gait dysfunction was present in 14 (33%) patients. Spinal deformity was present in 10 (23%) patients at presentation. Progressive focal limb weakness was present in six (14%) patients. Total macroscopic resection was performed in six patients, subtotal debulking in 31 patients and biopsy alone was performed in six patients. In patients with high grade tumours biopsy was performed in

one patient with debulking performed in the others. At six months five out of seven patients with high grade tumours had died, two patients were wheelchair bound. Of the low grade tumours, 75% of patients mobile at diagnosis retained mobility at a mean follow up of eight years.

Conclusion: Low grade spinal cord astrocytomas in childhood are indolent tumours where long term deterioration free survival is possible in up to 75% of cases. Subtotal debulking with or without adjuvant radiotherapy appears to be as effective as gross total resection in providing long term disease control.

POSTER ABSTRACTS

VASCULAR

V1: Spontaneous thrombosis of a dissecting middle cerebral artery aneurysm

F. Altaf, S. Pushpananthan, S. M. Joshi & J. P. Wadley (Deparment of Neurosurgery, Royal London Hospital, London, UK)

Objective: We report a rare case of spontaneous thrombosis of a dissecting aneurysm of a left middle cerebral artery branch in a 27-year-old man who presented with a recent onset of seizures. The pathogenesis and management of spontaneous thrombosis of unruptured dissecting aneurysms is discussed.

Subjects: A 27-year-old caucasian male presented with a recent onset of four seizures over a ten-week period. A CT and MRI scan of the brain demonstrated a well-defined $1.6 \times 1.2 \times 2.2$ cm lesion lying deep within the sylvian fissure posteriorly. He underwent a bilateral carotid angiogram which showed a solitary dissecting fusiform aneurysm arising from an ascending branch of the left middle cerebral artery with the sac lying in the region of the left sylvian fissure.

Results: He underwent a carotid angiogram with a view to performing coil occlusion of this branch of the left MCA. During the procedure, the ascending branch of the left MCA failed to opacify with radiological findings consistent with a spontaneous thrombotic occlusion of the ascending branch of the left MCA with obliteration of its associated dissecting aneurysm. The patient remained neurologically intact. After two years' surveillance the patient remains asymptomatic having discontinued antiepileptic medication and CT angiogram has shown continued occlusion of the branch of the MCA with obliteration of the dissecting aneurysm.

Conclusion: One needs to consider a number of options in the management of dissecting intracerebral aneurysms. In our case the patient had a rare symptomatic dissecting aneurysm which required active management. We recommend endovascular

occlusion as an option in the management of this type of aneurysm where the aneurysm is in a location which is difficult to access surgically and where a good collateral circulation has developed. We also recommend regular follow up with CT angiogram.

V2: The role of CT perfusion in the management of cerebral vasospasm after aneurysmal subarachnoid haemorrhage: A retrospective review

M. J. Asha, C. K. Jadun, A. Kraus & P. S. Dias (North Staffordshire Royal Infirmary, UK)

Objective: 17.2–22.2% of patients receiving interventional treatment for aneurysmal-subarachnoid haemorrhage (SAH) develop symptomatic cerebral vasospasm.[1] Vasospasm is usually diagnosed clinically. Computed tomography perfusion scan (CTP) has emerged, recently, as a non-invasive modality to study cerebral blood flow (CBF). It provides qualitative and quantitative assessment of CBF with a comparable accuracy to the standard digital subtraction angiography (DSA) in diagnosing vasospasm.[2] This study was conducted to examine the role of CTP in the management of SAH-associated vasospasm.

Design and subjects: 148 patients, treated for aneurysmal SAH in our unit between 2005–2006, were retrospectively reviewed. Thirty-two patients had perfusion scanning for clinically-suspected vasospasm.

Outcome measures: The outcome was analysed in correlation with the timing of CTP and the reported degree of hypoperfusion. Improvement was measured, retrospectively, according to the Extended Glasgow Outcome Scale.

Results: On basis of CTP timing from the onset of neurological symptoms, three different categories were identified: 0–8 hours (47%), 8–24 hours (28%), and 48 hours or more (25%). CTP showed evidence of hypoperfusion in 80%, 67%, and 75% respectively. All of the patients with hypoperfusion were started on Triple-H Therapy (THT) subsequently. The observed improvement rate after THT was 85%, 83%, and 33% in the three groups respectively. Patients fell into four groups, according to the degree of hypoperfusion, being 'no evidence of hypoperfusion' 25%, 'oligaemia' 41%, 'Ischaemia' 25%, and 'established infarct' 9%. None of the patients with no evidence of hypoperfusion received THT. 88% of these patients improved with expectant management. For the other groups, 77%, 63%, and 33%, respectively, showed improvement with THT.

Conclusion: Early CTP scanning for SAH patients with suspected vasospasm is recommended. CTP can complement the clinical management and guide the decision to provide active treatment for selected patients. A randomised controlled trial with sizable population will be required to support this conclusion.

References

1 Charpentier C, Audibert G, Guillemin F, Civit T, Ducrocq X, Bracard S, Hepner H, Picard L, Laxenaire MC. Multivariate analysis of predictors of cerebral vasopasm occurrence after aneurysmal subarachnoid haemorrhage. *Stroke* 1999;30: 1402–8.

2 Moftakhar R, Rowley HA, Turk A, Niemann DB, Kienitz BA, Van Gomple J, Baskaya MK. Utility of computed tomography in detection of cerebral vasospasm in patients with subarachnoid hemorrhage. *Neurosurg Focus* 2006;21(3):E61–65.

V3: Inhibition of T-type calcium channels protects neurons from delayed ischaemia-induced damage

M. Bancila, I. Nikonenko, D. Muller & P. Bijlenga (Geneva University Hospital, Switzerland)

The earliest neuronal alteration induced by ischaemia is a small increase in basal intracellular calcium concentration. We tested the assumption that reducing the initial calcium rise by inhibiting T-type Cav might increase neuronal tolerance to ischaemia. The study compaired pharmacological T-type Cav inhibition versus placebo, using an *in vitro* model of cerebral ischaemia and measuring delayed neuronal death. Observations were confirmed with a double blinded randomised T-type Cav inhibitior versus placebo study using a global cerebral ischaemia model in rats and measuring animal death within the first three days after insult and number of neurons in the CA1 at Day 3 post insult. The inhibition of T-type Cav during OGD reduced delayed neuronal death (48 h) in a dose dependent manner correlating with current inhibition (10 M mibefradil: $13 \pm 5.5\%$ placebo PI fluorescence, $p < 0.002$). T-type Cav also reduced delayed neuronal death if applied up to three hours after the insult (10 M mibefradil: $53 \pm 10\%$ placebo PI fluorescence, $p < 0.03$). The intratechal injection of mibefradil prior to transient global brain ischaemia in rats, showed a significant reduction of delayed neuronal loss (45% versus 60% surviving neurons $p < 0.05$, $n = 30$) but no significant impact on animal survival. The results suggest that inhibition of T-type calcium channels during or even up to three hours after induction of ischaemia prevents ischaemia-delayed neuronal death.

V4: Physiological changes of ruptured aneurysms during coiling and clipping

H. W. Chan, N. A. Farooqi, S. Coley, T. J. Hodgson & U. J. Patel (Royal Hallamshire Hospital, Sheffield, UK)

Objective: There has been no report on physiological changes of aneurysm rupture during coiling and clipping. It has been suggested that the rise in ICP after aneurysm rupture tamponades aneurysm bleeding. However, in the majority of patients there is no

loss of consciousness, suggesting that haemorrhage is not stopped by perfusion arrest alone. We aim to study the physiological changes, including blood pressure and pulse, the outcomes and the presence of EVD in ruptured aneurysms during coiling and clipping.
Design: Retrospective analysis of the notes of six patients who had aneurysm rupture during coiling and clipping.
Subjects: Age: 34 – 67 years Gender: three males, three females WFNS grade: 0 – 4 Aneurysm sites: ACom a., PCom a., PICA, terminal ICA.
Outcome measures: Physiological parameters during endovascular and surgical procedures, and clinical outcome measured using modified Rankin score (MRS).
Results: All the cases had intraoperative aneurysm rupture. Transient hypertension lasting five minutes was noted in all cases immediately after aneurysm rupture intra-procedurally. Transient tachycardia for 15 minutes and persistent tachycardia throughout the procedure were noted in one surgical and one endovascular cases, respectively. Of the endovascular cases, one had EVD, two did not have EVD and one had LP post-procedure. Three patients had MRS 0 (one endovascular and two operative cases), two had MRS 3 at four and nine weeks (both endovascular) and one (endovascular) died on the table.
Discussion: It is noted that all the cases that survived had an escape route for haemorrhagic blood, two endovascular cases, one with EVD and one had LP post-procedure, and two surgical cases. One endovascular case with no EVD died on the table. It is also noted that in one endovascular case with persistent tachycardia, there was 500 ml of blood emerged from the EVD over 10 minutes suggesting that EVD was lifesaving. In addition, all the cases demonstrated a transient hypertension and tachycardia immediately after aneurysm rupture, indicating that there would be a sharp rise in ICP from the haemorrhage unless the blood is allowed to escape.
Conclusions: Transient hypertension and tachycardia can occur immediately after aneurysm rupture. EVD allowing prompt reduction in intracranial pressure can lead to a better outcome during endovascular procedures.

V5: What is the definition of 'competence' in intracranial aneurysm surgery?

D. J. Chang (Davis Medical Center, University of California, USA)

Introduction: ISAT required a minimum of 30 aneurysm coilings for an interventional neuroradiologist to participate in the trial without specific experiential criteria for trial neurosurgeons. Can 'competence' in aneurysm surgery be defined?

Methods: A retrospective review of an initial 30 surgical aneurysm series for a cerebrovascular/skull base fellowship-trained neurosurgeon in the time period 2000–2001 is presented.
Results: 26.7% were unruptured aneurysms and 73.3% were ruptured aneurysms. 40% were in the AComm location. 13.3% were large or giant (21 mm, 26 mm, 26 mm, 30 mm). 93% had a Glasgow Outcome Score of 4–5 (80% GOS of 5). There was no statistically significant difference between the clinical grade of the first 15 cases compared to the second 15 cases ($p = 0.8$). Experience did affect complication rate when comparing the first 15 cases to the second 15 cases ($p = 0.03$). A decreasing incidence of complications defined as 'experience-related' over time was observed (all occurred in the first 15 cases). There was no difference in mortality rate of patients with complications defined as possibly experience-related ($p = 0.39$). A proposed sequential algorithm for developing competence in aneurysm surgery is described.
Conclusions: 'Acceptable' levels of 'competence' in aneurysm surgery is nebulous and rests on dynamic definitions of 'good' technical expertise, sufficient cognitive background, and to a significant extent, on internecine ego clashes among neurosurgeons. Thus, although the complexity of a given case can always increase as time in neurosurgical clinical practice increases, the bedrock of fundamental skills and knowledge critical for successful consistent aneurysm surgery is still based in neurosurgery residency/fellowship training and in certain innate tendencies of the individual. Further active discussion regarding issues of 'competence' merits the continued sincere attention of neurosurgical educators. Issues of 'competence' have important implications for outlining local/regional/national patient care recommendations and for organising potential coil/clip clinical trials.

V6: Mirror image pericallosal aneurysms, the marriage of coiling and clipping

J. Ekanayake & A. Saxena (University Hospital of Coventry and Warwickshire, Coventry, UK)

Introduction: Mirror image aneurysms of the anterior cerebral artery, and in particular its distal branches represent an unusual and rare pathological entity in the neurovascular field. It provides particular challenges in terms of management and treatment.
Case: We describe the case of a 46-year-old gentleman who presented with a subarachnoid haemorrhage of a WFNS (World Federation of Neurosurgeons Society) grade IV. CT demonstrated interhemispheric blood and a left frontal haematoma. Cerebral angiography revealed the presence of two mirror image aneurysms of the left and right

pericallosal arteries arising at identical but adjacent sites. An interhemispheric approach was used to identify and clip the ruptured left pericallosal aneurysm. Despite careful dissection of adhesions, the right pericallosal aneurysm could not be found. A postoperative angiogram confirmed the presence of the right pericallosal aneurysm. This aneurysm was successfully coiled at a neighbouring unit specialising in endovascular treatment.

Follow up: The patient made a successful recovery, returning to full-time work. Check angiography after both procedures demonstrated definitively treated aneurysms.

Discussion: This case illustrates the useful combination of two techniques in the treatment of a neurovascular oddity. Surgery potentially allows control of both aneurysms, which is important when the two aneurysms are intimately related, in view of the potential risk of premature rupture. There are difficulties which must be surmounted including adhesions and the narrow working space provided by the interhemispheric fissure. Endovascular treatment has evolved significantly, allowing the tailored treatment of these distally located twin aneurysms.

V7: Extracranial-intracranial bypass using the thoracodorsal axis graft: A novel technique

J. T. Laban, A. Jain, M. Patel, N. Kirkpatrick, J. Nanchahal & K. O'Neill (Charing Cross Hospital, London, UK)

Extracranial-intracranial (EC-IC) bypass grafting is an effective surgical treatment for the management of select cases of intracranial aneurysmal disease not amenable to surgical clipping or endovascular occlusion. The need to bypass the cerebral circulation bilaterally, however, is uncommon. Traditionally, a low flow superficial temporal artery to middle cerebral artery bypass is performed in unilateral disease. However, high flow EC-IC bypass, using a saphenous vein or radial artery graft connecting the external carotid to the cerebral circulation, can be used in cases of bilateral disease. These end-to-side anastomoses are technically difficult as the recipient vessels are of smaller diameter and the extracranial vessels have a much thicker wall than intracranial vessels. We report a case of bilateral anterior cerebral artery EC-IC bypass performed using the thoracodorsal axis graft to allow occlusion of the proximal anterior cerebral artery circulation to both hemispheres. The natural bifurcation of the thoracodorsal axis allows both the latissimus dorsi and serratus branches to be used to bypass both anterior hemispheres, while a long intramuscular dissection achieves appropriate small vessel size, giving advantages to previously described techniques. The bypass demonstrated

patent anastomosis and good flow post operatively. To our knowledge, this technique has not previously been described.

V8: Transcranial dopplers: Is there an absolute correlation with the clinical picture

N. Mukerji, S. Gupta & F. P. Nath (James Cook University Hospital, Middlesbrough, UK)

Background: Transcranial doppler is an investigation that is often utilised to monitor the progress of patients with subarachnoid haemorrhage. There have been conflicting reports on the value of this investigation and its correlation with the clinical state of the patient. It has substantial resource implications as it requires an experienced radiographer/radiologist to perform this investigation. We undertook this study to examine the correlation of transcranial doppler values with the clinical state of patients with suspected vasospasm.
Methods: This was a retrospective study. The details of all patients with subarachnoid haemorrhage who had undergone transcranial doppler studies in the past two years were obtained. Their clinical records were traced and the values of the transcranial doppler examinations and the clinical state at that time were recorded along with demographic details and the presenting WFNS and Fisher grade. The data was analysed using SPSS in a multivariate model.
Results: A study of 36 records analysed in a multivariate model controlling for age and the velocities in the internal carotid arteries (which was within normal range in all cases) revealed a significant negative correlation of the left MCA flow velocity with the GCS ($p = 0.019$). Focal deficits did not have clinically viable statistical correlation with the transcranial doppler velocities.
Conclusions: Our results are in keeping with previous studies which suggest that the MCA flow velocities correlate best with the clinical state. Although transcranial dopplers are a good non-invasive means for monitoring vasospasm, they require significant resources to perform and have many drawbacks. They should be used judiciously in a clinical scenario.

V9: Acutely raised cardiac output predisposes to rupture of intracranial aneurysms but does not influence outcome of subarachnoid haemorrhage

S. Muquit, Y. Sergides & C. Tolias (King's College Hospital, London, UK)

Objectives: (1) To determine whether states of increased cardiac output (CO) predispose to rupture of intracranial aneurysms (for instance by increasing the blood load). (2) To assess the affect of high CO

during rupture of intracranial aneurysms on outcome.
Design: Retrospective analysis from case notes documenting activity on rupture, GCS on admission, Fisher grade on CT scan and Glasgow outcome score (GOS) at 6 months.
Subjects: 234 consecutive patients with aneurysmal subarachnoid haemorrhage (SAH) admitted to a regional neurosurgical centre from June 2004 to December 2005
Outcome measures: GOS at six months.
Results: There were 234 patients, 101 male and 133 female, age range 12 to 84. 41 of the 234 patients (17.5%) suffered SAH whilst their CO was high. The mean GOS in patients who had a high CO at ictus was 4.1, and for those who were at relative rest the mean GOS was 3.8. There was no statistical difference between these two groups.
Conclusions: Around one in six patients who suffered SAH were enduring a high CO suggesting this may facilitate the rupture of an intracranial aneurysm. However the activity of the patient at the time of rupture does not appear to influence outcome.

V10: Follow up of endovascular treatment of ruptured intracranial aneurysm

A. J. Pandian, F. Robertson, S. Brew, J. P. Grieve & N. D. Kitchen (National Hospital for Neurology and Neurosurgery, London, UK)

Objective: To assess the role of catheter angiography in the follow up management of solitary aneurysms presenting with subarachnoid haemorrhage and treated with endovascular coil embolisation.
Methodology: Patients presenting with aneurysmal subarachnoid haemorrhage during the period Jan 2000-March 2005 were evaluated retrospectively from the database. Only patients with single ruptured aneurysms and had follow up angiograms at six months and 24 months were included. Multiple aneurysms, associated AV malformation, died, re-treated within six months, that had follow up MRA or no follow up were excluded. Angiograms following coil embolisation were reviewed by a neuroradiologist, and the degree of exclusion graded—Raymond's grade—1 (complete occlusion), 2 (neck remnants) and 3 (subtotal occlusion).
Results: During this period 41 patients had embolisation for the single aneurysm. There were 28 females and 13 males. Age range—19–73 (mean 52 years). The size of aneurysms - 2 to 18 mm (average 6 mm). The site of the aneurysms was anterior circulation (21) and posterior circulation (20). On the immediate angiogram, post embolisation, 30 patients were of grade 1 (73%), 10 grade 2 (24%) and 1 grade 3 (2.4%). All patients were followed up with six months angiogram and a two year angiogram (Average 27 months). 30/41 (73%) remained stable and did not need any intervention during the follow

up period. They were Grade 1 (16); Grade 2 (12) and grade 3 (2) which remained the same in six months and two year follow up. Three patients showed change in grading (1, 2+ and 3 which were observed with angio/MR. Eight patients were re-treated (seven neck remnants and one subtotal occlusion). All the patients were treated after 12 months except one with an 18 mm aneurysm who had treatment twice (at seven and 12 months).
Conclusions: Most aneurysms with total occlusions and neck remnants remain stable for one year. Re-treatment of neck remnants can be done following the one year angiogram.

V11: How much can be concluded from the International Subarachnoid Aneurysm Trial (ISAT)?

M. J. Tait, G. R. Critchley & J. S. Norris (Hurstwood Park Neurosciences Centre, UK)

Recently published data from the International Subarachnoid Aneurysm Trial (ISAT) shows that for patients enrolled in the trial there is a 7.4% reduction in the incidence of death or dependency at one year if they undergo coiling rather than clipping. Furthermore, extrapolation of longer term follow up data for patient mortality appears to suggest that this advantage will be maintained in the longer term. Based on a reassessment of the published data the authors note: (1) The incidence of re-bleeding following treatment is approximately three times higher in the coiled group. (2) The need for aneurysm re-treatment is likely to be higher in the coiled group. (3) Trends in longer term mortality data are not a reliable basis for predicting future outcomes of the trial. (4) Trends in longer term morbidity data are more reliable; they suggest that the advantage of coiling diminishes with time. (5) The absence of up to date published rates of aneurysm re-treatment and of longer term rates of death or dependence makes ISAT extremely hard to interpret. It is far from clear that the early advantage of coiling will be maintained in the future and hence longer follow up is required. Treatment of aneurysms is a continually evolving field and there is currently no other major source of information concerning management of aneurysms. For these reasons the authors recommend the instigation of a national aneurysm registry to prospectively collect data.

V12: Angiographic recurrence of cerebral aneurysms treated by coil embolisation

S. S. Wahab, N. U. O Owase, F. Robertson, A. J. Pandian, N. Kitchen & J. Grieve (The National Hospital for Neurology and Neurosurgery, London, UK)

Objective: The endovascular approach in the treatment of both ruptured and unruptured intracranial

aneurysms has witnessed an exponential increase over the past 15 years. The purpose of our study was to assess the radiographic outcome of intracranial aneurysms treated with coil embolisation and recommend appropriate intervals for post-procedure angiograms.
Method: A retrospective analysis was conducted of 165 patients with intracranial aneurysms treated with coil embolisation at our institution from January 2000 until October 2004. Patients undergoing angiographic follow up at our institution had their initial and follow up angiograms reviewed by a single interventional neuroradiologists. Morphological outcomes were scored.
Results: Of 165 patients undergoing coil embolisation for intracranial aneurysm, 58 of these patients underwent a minimum of two angiographic follow up imaging at our institution. Of the remaining 107, 18 had one angiographic follow up followed by MRA, 11 underwent MRA follow up only, 53 were lost to follow up and 25 died. We present out results on aneurysm recurrences post embolisation. The time of recurrence, the morphology and the requirement for further treatment is expounded upon.
Conclusion: Treatment with coil embolisation is effective. Close follow up is essential. We discuss the case of appropriate timing for follow up angiography after coil embolisation for intracranial aneurysms and the management of radiographic recurrences.

ONCOLOGY

O1: Postoperative hypofractionated cyberknife radiosurgery for brain metastasis

W. F. Beringer, A. R. Stroink, E. M. Nardone & K. A. Kattner (Central Illinois Neuroscience Foundation, USA)

Objective: While there have been several studies demonstrating the efficacy of postoperative whole brain radiotherapy (WBRT), WBRT with stereotactic radiosurgery (SRS) boost and SRS alone for brain metastasis, little has been published on postoperative hypofractionated stereotactic radiotherapy (HSRT). The radiobiology of hypofraction for brain metastasis and the convenient, highly conformal delivery of radiotherapy via cyberknife may provide similar local control at the site of resection for postoperative brain metastases with fewer radiation induced side effects.
Design: Retrospective chart review of fifteen consecutive patients receiving 25 Gy HSRT divided over five fractions to the postoperative metastasis resection cavity was performed after Institutional Review Board approval. Patients with three or fewer additional unoperated metastases were treated with single fraction Cyberknife SRS. New metastases found during follow up were also treated with single fraction SRS. All patients had to have a Karnofsky Performance Score of at least 50 at the time HSRT was started.

Subjects: Fifteen patients with recently operated brain metastases aged 48 to 74 years. Ten patients had pathology proven non-small cell lung carcinoma while the remaining five had a variety of other tumour types. Eleven patients had a Karnofsky Performance Score of at least 70.
Outcome measures: Survival, local control, recurrence of distant metastases.
Results: Survival ranged from two to 24 months with a median survival of six months. One patient had local recurrence of non-small cell lung carcinoma in the resection bed requiring repeat craniotomy five months after HSRT. Three patients required SRS for distant metastases three to six months after HSRT.
Conclusions: (1) Postoperative HSRT for brain metastasis provides similar recurrence rates and survival outcomes when compared to SRS alone or with WBRT. (2) Postoperative HSRT in the form of 25 Gy divided into five fractions may provide more radiobiological efficacy than conventional SRS or WBRT for brain metastasis. (3) Cyberknife HSRT divided into five fractions is a painless, effective outpatient procedure to reduce local recurrence in postoperative brain metastases patients.

O2: Slip elastography: A method for measuring adherence of tumour to brain

J. C. Bamber & N. D. Dorward (Royal Free Hospital, London, UK)

Objective: The brain tumour interface is a very important concept in the context of tumour neurosurgery. Tumours that are adherent to brain provide a greater surgical challenge and complete macroscopic resection may be more difficult to achieve. There is currently no objective measure of the adherence of tumour to brain in clinical use. Slip elastography is an ultrasound-based technique that has been developed at the host institution for imaging the anatomical location of a slip boundary and quantitatively measuring adherence between the two tissues. The development of this technique from its theoretical basis and its application *in vitro* using gelatine phantoms are described. Following this, slip elastography was applied intraoperatively to identify the properties of the brain tumour interface prior to brain tumour resection following craniotomy.
Design: The theory, development of the system and *in vitro* experiments performed prior to *in vivo* testing are described. The technique was then applied intraoperatively during brain tumour resection.
Subjects: 22 patients undergoing craniotomy for brain tumour resection were recruited into this study. Both intrinsic and extrinsic tumours were included.
Outcome measures: Surgical evaluation of adherence of tumour to brain was compared to slip

elastogram findings. Absolute values of force required to produce slip were obtained.
Results: Slip elastography was successful in identifying the anatomical position of slip boundaries *in vitro* using gelatine phantoms. *In vivo* results demonstrate that 20 of the 21 patients had good correlation between surgical findings and the quantitative values of force required to produce slip using slip elastography. One patient had a biopsy only so comparison was not possible.
Conclusions: The results show that slip elastography can reliably and quantitatively image the anatomical location of the brain tumour interface and measure adherence at this interface. This technique may assist in planning safer tumour resection.

O3: Surgical intervention and outcome in adult patients with high grade thalamic tumours

N. Douglas, M. Foroughi & R. Nannapaneni
(University Hospital of Wales Cardiff, UK)

Objective: Does surgical intervention significantly influence outcome in patients with high grade thalamic tumours?
Design: Retrospective case series.
Subjects: 28 adult patients with thalamic tumours treated between January 2000 and February 2006.
Outcome measures: The factors analysed included age, presenting features, histology, and treatment (biopsy/surgical excision and CSF diversion).
Results: The group consisted of 12 males and 16 females, with an average age at presentation of 49 years (range 22–73 years). Twenty-seven underwent surgical biopsy, 17 stereotactically, three ultrasound guided, two endoscopic and the remaining five during tumour excision. The histological diagnosis was glioblastoma multiforme (GBM) in 13 patients (46%), Grade III astrocytoma in six (21%), Grade II astrocytoma in four (14%), one haemangioblastoma, a Grade II oligodendroglioma and two metastatic adenocarcinomas. All patients with high grade gliomas received radiotherapy. Five patients with high grade (GBM) tumours underwent a craniotomy and excision with a median survival time of 9.5 months (range 1.4–32.1 months). A total of 14 patients with high grade tumours (8 GBM and 6 Grade III) had a biopsy only with median survival time of 4.6 months (range 2.3–28.2 months). Five patients with high grade tumours underwent a CSF diversion procedure for hydrocephalus, with a median survival time of 7.2 months (range 2.3–28.2 months). A total of eight high grade tumour patients had no treatment for their hydrocephalus with a median survival time of 3.2 months (range 1.4–25.4 months).
Conclusions: Surgical excision and CSF diversion for hydrocephalus appears to significantly improve survival time in patients with high grade thalamic tumours.

O4: Diversity in clinical presentation and symptoms in twins with NF-2 and identical spinal cord tumours

A. Papadias, A. Ng & G. Solanki (Birmingham Children's Hospital, Birmingham, UK)

Introduction: The close association of neurofibromatosis type 2 (NF-2) and intracranial and spinal lesions has been extensively reported in the literature. Dermatological and opthalmological signs and symptoms usually prompt further investigations to be undertaken in children suspected to have NF-2.
Aim: We review the association of spinal cord tumours and NF-2 and present an example of nearly identical tumours in twins.
Subjects: We report the case of two identical eight-year-old twin brothers, presenting with cutaneous, opthalmological signs of NF-2. MR imaging revealed intramedullary cervical cord lesions. Of great interest is the fact that despite clinical and radiological similarities, only one of the two children progressed clinically to tetraparesis from involvement of the cervical spinal cord. Despite receiving radiotherapy, he continued to deteriorate. Cervical cord open biopsy revealed an ependymoma. Subsequent genetic chromosomal analysis revealed a specific mutation involving the NF-2 gene. Adjuvant chemotherapy was offered.
Discussion: We report a rare occurrence of nearly identical tumours in twins with NF-2. This should be borne in mind when one twin becomes symptomatic. Consideration for screening the other twin should be given.

O5: Sensitivity and specificity of per-operative smear biopsies for assessment of tumour excision margins

V. Petrik, P. Wilkins, A. King, A. Loosemore & H. Marsh (St George's Hospital, London, UK)

Objective: We assessed the accuracy of per-operative smear biopsies to detect clear tumour excision margins suggesting total tumour resection.
Design: Per-operative biopsies were taken prospectively from the walls of tumour resection cavities. All biopsies were cut in half. One part was used for immediate per-operative smear biopsy and results were reported to the operating surgeon. The second half was used for conventional haematoxyline-eosine (HE) paraffin sections. The paraffin sections were allocated random numeral codes and were read by an independent blinded observer.
Subjects: Altogether 134 tumour biopsies were taken at the end of radical excisions of seven low grade gliomas (four astrocytomas WHO grade II, two oligodendrogliomas and one oligoastrocytoma).
Outcome measures: The results from HE paraffin sections were matched with appropriate smear reports and sensitivity and specificity of smear results were calculated.

Results: 57 HE sections revealed tumour but only 15 of them were detected in smears, which gives a sensitivity of 26.3%. 23 HE sections were reported as normal. Corresponding smears reported 22 tumour negative and one tumour positive sample, which gives a specificity of 95.6%. Forty-eight HE sections were reported as inconclusive but all corresponded to tumour negative per-operative smears. Six HE sections were inadequate for assessment.
Conclusion: Poor sensitivity of smears makes this method unsuitable for per-operative assessment of clear margins after radical brain tumour resection.

O6: Outcome prediction and control chart development in intradural spinal lesions

S. J. Smith & B. D. White (Queen's Medical Centre, Nottingham, UK)

It is increasingly important to calculate surgical risks accurately to enable properly informed consent, to maintain an ongoing audit of surgical results and monitor outcomes. We present the results of 178 intradural operations in 175 patients for spinal space-occupying lesions, performed over a ten-year period by a single surgeon. We examine the outcome predictors for this surgery, finding significant associations between outcome and age ($p = 0.001$ linear regression analysis), intra/extramedullary location of tumour ($p = < 0.0001$ Mann-Whitney) and tumour type (schwannoma and meningioma doing significantly better than ependymoma, Mann Whitney). Overall, 91.5% of extramedullary tumours remained the same or improved on the Cooper-Epstein scale and 69.6% of intramedullary tumours remained unchanged or improved. Using this outcome data, we demonstrate the use of a control chart to evaluate the results of a further year's patient cohort. A positive or negative score can be assigned to each case, e.g. in the intramedullary population an unchanged or improved patient would score $+30$, whilst someone worsened by surgery would score -70, and can be further refined to examine each cord modality. A graphical representation (control chart) of ongoing results can be created using this scoring system. Drift from the historical mean (for better or worse) can be easily perceived and promptly investigated, with great potential as a continuous, ongoing, audit and clinical governance tool.

O7: Survival after surgery for glioblastoma: Analysis of 625 cases

M. J. Tait, V. Petrik, A. Loosemore, B. A. Bell & M. C. Papadopoulos (Atkinson Morley Wing, St George's Hospital, London, UK)

Introduction: Glioblastoma is the most commonly encountered intracranial tumour in general

neurosurgical practice. Despite this, little accurate survival data are available, particularly from European centres. The aim of this study was to determine longevity post surgery and to look for trends in survival over a 12-year period. Prognostic factors were identified and a new prognostic score proposed.
Method: Survival data were collected retrospectively for 625 patients who had surgery for histologically-confirmed glioblastoma between 1993–2004 in a single centre. Data including age, sex, pre-operative Karnofsky performance score, tumour site, date of surgery, and type of surgical and adjuvant treatment were collected. Kaplan Meier survival curves were plotted and compared using the log-rank, and Wilcoxon signed rank tests. Multivariate analysis was done with the Cox proportional hazards model.
Results: Overall median survival was 189 days; there was no significant change in survival over the 12 years studied. Multivariate analysis identified the following independent positive prognostic factors: age <60 years ($p < 0.0005$); Karnofsky score >70 ($p < 0.0001$); tumour debulking rather than biopsy ($p < 0.001$); right-sided lesion ($p < 0.05$); unilateral tumour ($p < 0.05$) and radiotherapy ($p < 0.0001$). The following factors made no significant difference to survival: patient sex, extent of resection, season, and chemotherapy. We designed a novel six-point prognostic score by allocating one point for each of the independent prognostic factors and found a strong correlation between the prognostic score and median survival: median survival was 45, 94, 111, 252, 302, and 447 days for patients scoring 1, 2, 3, 4, 5, or 6 points, respectively.
Conclusions: Despite neurosurgical advances, the survival of patients with glioblastoma has not changed for 12 years. Although glioblastoma is commonly perceived to have a short survival, our data show that patient survival is heterogeneous. The six-point prognostic score stratifies survival and may therefore be useful when counselling patients and families.

O8: Accuracy of surgeon's identification of sellar margins during endoscopic pituitary surgery: Quantifying perception using a neuro-navigational tool

W. A. Thiryayi, R. Raguramaswami, T. Kearney, J. Leggate & K. Gnanalingham (Greater Manchester Neuroscience Institute, Manchester, UK)

Objective: To assess the surgeon's accuracy during the intraoperative identification of sellar margins during endoscope guided pituitary surgery, using the BrainLAB^{TM} computer-assisted navigation system.
Design: Prospective observational study.
Subjects: Between August 2005 and October 2006, 46 patients (25 female and 21 male) with a median age of 52.5 (range 22 to 75) years underwent endoscopic endonasal transphenoidal surgery

assisted by the BrainLAB VectorVision neuronavigation system.

Outcome measures: During the procedure, the surgeon estimated the initial trajectory to the floor of the pituitary fossa and later the margins of the pituitary fossa. The difference between the margins identified by the surgeon and those boundaries identified by the BrainLAB system were noted.

Results: Of the 46 patients, there were 43 pituitary adenomas, two craniopharyngiomas and one dermoid cyst (four re-operations). The neuronavigational system could not be used in four patients due to technical errors. The intraoperative target-localising accuracy of the system was 1.02 ± 0.141 mm (mean $\pm$ SD). The initial trajectory to the floor of the pituitary fossa was estimated by the surgeon cranial to its actual position in 15 cases by a mean value of 7.88 mm (0.3 – 17.6) and caudally in 24 cases by 7.13 mm (1.4 – 20.2). The superior margin of the pituitary fossa was identified cranial to its actual position in six cases by a mean of 3.18 mm (1.8 – 4.2) and caudally in 25 cases by 4.94 mm (0.1 – 16.7). The inferior margin of the pituitary fossa was estimated cranial to its actual position in 16 cases by a mean of 3.87 mm (1.2 – 8.4) and caudally in 14 cases by 2.53 mm (0.5 – 5.6). The lateral border of the pituitary fossa was identified medial to their actual position in all cases by a mean of 6.76 mm on the right (2 – 11) and 4.98 mm (0 – 13.1) on the left.

Conclusion: MRI based neuronavigation is a useful tool in endoscopic pituitary surgery, especially to determine the initial trajectory and later the lateral margins of the pituitary fossa. It is particularly useful for re-operations and for extended transphenoidal procedures, where it may help to avoid straying off the midline.

SKULL BASE

SB1: The no-drill technique of anterior clinoidectomy: A skull base approach tailored to pathology

D. J. Chang (Davis Medical Center, University of California, USA)

Introduction: Published articles describe a power drilling technique for anterior clinoidectomy. The entire 'shaft' of the power drill is exposed in the operative field; thus all neurovascular structures in proximity to the full length of the rotating drill bit are at risk of direct mechanical and thermal injury. Ultrasonic bone removal has been recently developed to mitigate these risks. However, ultrasound-related cranial neuropathies are recognised complications of its use, in addition to the increased cost related to the devices.

Methods: A retrospective review of the author's 40 consecutive cases of anterior clinoidectomy utilising

the 'no-drill' technique is presented. Clinical indications include: ophthalmic segment aneurysms, tuberculum sellae meningiomas, clinoidal meningiomas, selected ICA-PComm and ICA bifurcation aneurysms, other large/giant/complex anterior circulation aneurysms, basilar bifurcation aneurysms, cavernous sinus lesions, pituitary macroadenomas, suprasellar tumours, other peri-chiasmal lesions (sarcoid), and fibrous dysplasia.

Results: A bony opening is made in the mid-to-posterior orbital roof during the process of the initial craniotomy. Periorbita is dissected from inside the orbital compartment. Subsequent piecemeal resection of the medial sphenoid wing, anterior clinoid process, and optic canal roof is performed with various bone-biting instruments. No power drilling was employed in this series. Optimal microsurgical exposure was obtained in all cases. There were no cases of direct injury to surrounding neurovascular structures. Illustrative cases and detailed surgical technique are presented.

Conclusions: Power drilling is generally not necessary for anterior clinoidectomy. Rigorous study of the preoperative CT, MRI, and angiogram is essential to identify important anatomic relationships between the anterior clinoid and neighbouring neurovascular structures. The 'no-drill' technique eliminates the risks of direct power drilling mechanical/thermal injury and the risk of ultrasound-associated cranial neuropathies. This technique achieves efficient and directly effective microsurgical exposure of the parasellar and paraclinoid region for a variety of clinical situations.

SB2: The management of midline transcranial nasal dermoid sinus cysts

L. Morgan, B. Dhamija, M. Hanikeri, N. Waterhouse, N. Kirkpatrick & D. Peterson (Charing Cross Hospital and Chelsea and Westminster Hospital, London, UK)

The most common congenital midline nasal masses are nasal dermoid sinus cysts (NDSC). They are clinically important because of a potential connection with the intracranial compartment. All patients with a NDSC require imaging with high resolution MR and fine cut CT scan to reveal the anatomical extent of the tract and its relationship to the anterior cranial fossa.

Subjects: We present five patients referred to our unit with nasal dermoid with intracranial extension. A one-stage craniofacial approach to resection of midline NDSC extending to the anterior cranial base was effective in each case. The cyst and tract are accessed through a combination of nasal and transcranial approaches. The tract is dissected and visualised with from above with a small incision on the nasal dorsum to include the cutaneous punctum. Dural involvement was identified at operation and confirmed on histopathology. The only significant

complication resulted from an early postoperative infection, requiring re-operation.
Results: There were no recurrences and acceptable aesthetic outcomes have been observed in all cases.
Conclusions: Intracranial extension is an unusual association of NDSC. It is important to recognise dural involvement preoperatively with appropriate imaging techniques. Satisfactory outcomes are obtained with transcranial procedures which minimise facial scarring.

SPINE

S1: Total thoracic vertebrectomy with anterior and posterior column reconstruction via single posterior approach

M. J. N. Crocker, N. W. T. Thomas & B. P. Chitnavis (King's College Hospital, Department of Neurosurgery, UK)

Objective: To report a range of patients managed with three-column resection and stabilisation of the thoracolumbar spine via total posterior approach surgery.
Design: Retrospective review.
Subjects: Eight patients with neurological compression and/or deformity undergoing three-column resection with stabilisation using and *in situ* expandable cage with pedicle screw and rod fixation.
Outcome measures: Follow up to date; neurological improvement and postoperative radiology.
Results and conclusions: Eight patients were treated. Four had a primary tumour, three with neurological compression and one with instability. Two patients had metastatic disease with neurological compression. One patient had progressive deformity after trauma and one patient had tuberculous disease of the spine with neurological compression. The level ranged from T5 to L3. All patients underwent circumferential decompression through midline posterior approach with expandable cage and pedicle screw placement. Two patients underwent a two above/two below fixation; others were one above/one below. There were no unexpected neurological deficits and all patients with preoperative deficits improved markedly to postoperative ambulation. There were no instances of instrumentation failure or revision. One primary tumour re-presented with local recurrence managed with repeat decompression.
Conclusion: We conclude that a posterior approach total vertebrectomy with expandable cage placement is a mechanically sound operation in the thoracolumar spine to minimise operative complications whilst providing good neurological decompression and stabilisation in a variety of conditions.

S2: Five years of broken backs: A review of spinal trauma referrals to a single metropolitan centre

K. Deniz, G. M. Spink, K. O'Neill & D. Peterson (Charing Cross Hospital, London, UK)

Objective: To review all spinal trauma referrals to a single metropolitan unit over a five-year period, assessing patterns of injury; management; and workload implications.
Design: A retrospective analysis of a computerised referral database. Analysis was performed over a five-year period from 2001 to 2006.
Subjects: 335 patients fulfilled the criteria for a spinal injury over the five-year period. The average age was 49.6 years (range 16 – 105). 64% were male. 12% were referrals from other neurosurgical regions. 44% were ASIA D or worse at the time of referral. 17% of patients were polytrauma victims.
Outcome measures: The primary end point was the decision regarding transfer (no transfer; neurosurgical bed required; spinal injuries unit required). Other outcomes assessed were the use of methylprednisolone and the need for surgical intervention.
Results: 156 patients (47%) required transfer to a neurosurgical bed. This represents a neurosurgical bed occupancy of three new spinal injured patient per month. Only 41 patients (12%) were referred directly to a specialist spinal injuries unit. Methylprednisolone was only recommended in 4% of patients with a spinal injury - the majority were ASIA A. No patient has been recommended methylprednisolone since April 2004. Of the patients that were transferred to a neurosurgical bed ($n = 156$), 60% required surgical intervention (mainly posterior instrumented fusion or halo/jacket orthosis).
Conclusions: As orthopaedic services move away from managing spinal patients, spinal trauma represents an increasing portion of emergency neurosurgical workload. This five-year review reveals that a typical metropolitan unit can expect to admit three new spinal trauma patients each month. Given the often complex nature of their management and the prolonged hospitalisation, units should ensure they have the necessary skill mix and resources to deal with these patients.

S3: Neuronavigation-guided transoral odontoidectomy in children: Initial experience

S. M. Joshi & D. Thompson (Department of Neurosurgery, Great Ormond Street Hospital for Children, London, UK)

Objective: Transoral approach provides excellent exposure to the anterior craniocervical junction. However in paediatric practice, access may be compromised by the size of the oropharynx and, whether the aetiology is congenital or acquired, anatomical landmarks are commonly distorted.

We have used image-guidance as an adjunct to transoral surgery. The aim is to describe this preliminary experience of image-guidance in paediatric transoral surgery.
Methods: We reviewed all consecutive children who had undergone neuronavigation-assisted transoral surgery.
Results: Prior immobilisation of the craniocervical junction by means of halo-body jacket or occipitocervical fixation permitted the use of intraoperative neuronavigation. At surgery, registration was performed using a combination of anatomical landmarks and fixed points on the halo-ring. Three boys and three girls with age ranging from 6.5 – 13 (SD $\pm$ 9.67) years were identified. Four presented with progressive myelopathy and two with neck pain. Three children had torticollis. Two had prior occipitocervical fixation procedures, four required pre-operative placement of a halo-body jacket. Fiducials were not required. Fluoroscopy was not used. Follow up ranged from 14 – 22 (17.67 mean) months. All cases had pre- and postoperative CT scan (bone algorithm) to allow assessment of the bony removal. One child had a transient worsening of pre-existing deficits. There was no infection and no CSF leak.
Conclusion: Intraoperative neuronavigation represents an excellent, safe aid in reducing the problem of negotiating complex anatomy during transoral surgery in children. We believe that a more predictable decompression can be achieved with reduced morbidity.

INFECTION

I1: The impact of a superbug in a neurosurgical unit

B. Dhamija, A. Ghosh & J. R. Van Dellen (Charing Cross Hospital, London, UK)

Objective: Much has been reported on methicillin resistant *Staphylococcus aureus* (MRSA) infection and its effects on surgical units. However, little data exists on the less well known, often multidrug resistant organism, *Acinetobacter*. To investigate the effect of this organism and its significance the authors surveyed a sample of *Acinetobacter* colonisation and infection in their neurosurgical unit.
Design: A retrospective study of a random selection of patients colonised or infected with *Acinetobacter*, who had been treated in the unit between July 2005 and November 2006.
Subjects: Patient names were identified from a computer database. Laboratory records from case notes were reviewed ($n = 20$). Age range 20 to 74 years, M:F (3:1).
Outcome measures: Length of hospital stay; ICU admission; surgical procedure; origin of body fluid isolate of *Acinetobacter*; method of treatment.

Results: All patients were admitted as emergencies. Ten (50%) had inpatient stay of less than 30 days, five (25%) had a stay greater than 40 days.16 (80%) had spent some time in ICU, 10 patients in this group were present in ICU less than 20 days. *Acinetobacter* was isolated from sputum (11), urine (4), blood (one), CSF (one), femoral line tip (two), central line tip (one). Procedures carried out in this group, craniotomy (nine), ICP bolt insertion (three), reduction of cervical fracture dislocation (one), VP shunt (one) and EVD insertion (three), three patients had no procedure. Most isolates were sensitive to colistin, sometimes given in combination with vancomycin and meropenem.
Conclusions: *Acinetobacter* is most commonly a nosocomial infection increasing in incidence in the neurosurgical population. Colonisation with this organism appears to be more common than actual infection. However it is responsible for longer inpatients admission. There is a clear association between carriage of *Acinetobacter* and ICU stay, $p < 0.05$ (binomial distribution).

I2: HIV related spinal epidural abscess in the West Midlands: Management of a case of *Streptococcus pneumoniae* spinal abscess

J. Ekanayake, G. Walters, G. Solanki & T. Elliot (Queen Elizabeth Hospital and University Hospitals Birmingham, Edgbaston, UK)

Introduction: Spinal epidural abscess is an unusual, but potentially disabling condition. Incidence is 1 – 2/ 10 000 admissions. Despite antibiotic therapy and vaccinations, patients with underlying chronic disease and immunosupression remain susceptible. 70% are *Staphylococcus aureus* but one emerging organism is *Streptococcus pneumoniae* (SP) accounting for 1.6%. Human immunodeficiency virus (HIV) is now the commonest risk factor for extrapulmonary pneumococcal disease.
Aim: The role of medical and surgical management is presented. The emergence of *Streptococcus pneumoniae* in HIV-related spinal epidural abscess is highlighted by a rare case requiring surgical drainage.
Patients and methods: A 36-year old male with HIV developed rapid leg weakness and incontinence following four weeks of non-traumatic low back pain. The patient was apyrexial, had a T4 sensory level with paraplegia. MRI scan demonstrated an enhancing epidural compressive spinal cord lesion from D4-D8 vertebrae. IV antibiotic therapy (cefotaxime + vancomycin) with surgical drainage of epidural pus and removal of granulation tissue was performed.
Results: Sustained neurological improvement was seen postoperatively. At six months he stood with crutches, improved sensations and recovered bladder and bowel continence.

Conclusion: HIV is a high risk factor for extrapulmonary pneumococcal disease which should be considered in the diagnosis of spinal infections. The importance of pneumococcal vaccination in HIV is emphasised. The prevalence of HIV-related spinal abscess in the Midlands remains small (0.15%) but is associated with significant morbidity. Targeted medical antibiotic therapy alone or with urgent surgical decompression, in the presence of neurological compromise remain the mainstay of therapy.

PAEDIATRIC

P1: The childhood operative burden of patients with myelomeningocoele

Y. C. Gan, A. Williams, D. Cochrane, P. Steinbok, A. Singhal & B. Irwin (Department of Paediatric Neurosurgery, Birmingham Children's Hospital, Birmingham, UK, and Department of Paediatric Neurosurgery, British Columbia's Children's Hospital, Vancouver, Canada)

Introduction: Throughout childhood, numerous operative procedures and therapeutic interventions are required to optimise the functional abilities of children with myelomeningocoele. A previous study determined that families sought normal ambulation, continence and cerebral function from intrauterine interventions. Similar goals guide recommendations for treatment and parental consent for post natal management.

Objective: To describe the number and type of surgical interventions performed on a cohort of patients with myelomeningocoele during the first 19 years of life to optimise nervous system function, continence and ambulation.

Subjects and method: 172 patients with myelomeningocoele born between 1965 and 1990 were reviewed to determine the number and sequence of operative procedures performed during the first 18 years of life. Level of the myelomeningocoele was L3-5 in 102 patients, T4-L2 in 55 patients and S1-2 in 15 patients.

Outcome measures: Operative interventions were categorised on the basis of the intent of the procedure to maintain function as follows: (1) cerebral function (shunt procedures, craniocervical decompression etc.), (2) Sitting (scoliosis etc.), (3) ambulation (spinal neural and orthopaedic procedures, (4) urinary, (5) faecal continence (urological and general surgical procedures)and (6) other procedures.

Results: Total operations were 2189 with mean of 12.65 operations per patient over 19 years. Operations to maintain ambulation were most common with mean of 4.61, followed by operations to maintain cerebral function (mean = 4.23), urinary continence (1.61), sitting (0.86) and faecal continence (0.25). The majority of the operations to optimise cerebral function and ambulation occurred

at the first year of life and at year 4 – 12 years. Whereas majority of the operations to optimise sitting and urinary continence occurred between year 4 – 12 years and for faecal continence between 13 – 18 years old. Patients with myelomeningocoele at T4-L2 required more operations to maintain function (mean = 14.71), L3 – 5 (mean = 12.45) and S1-2 (mean = 7.27). Thirty-seven patients (21.5%) required a second operation to untether the spinal cord and this group of patients required more operations to maintain function (mean = 14.65) compared to those that did not require another untethering (mean = 12.10). However the difference was not statistically significant ($p = 0.436$).

Conclusions: This group of patients required a significant number of operations to optimise function, i.e. one operation every 1.5 years with surgery to optimise cerebral function and ambulation being the commonest procedures needed. Patients with high level myelomeningocoele or who require a second untethering surgery needed more operations to maintain function. While further analyses are necessary to determine the efficacy of these procedures, this basic data is useful for counselling families on the impact of management directed to achieve optimal functional ability

P2: *In situ* autologous split bone cranioplasty for reconstruction of skull defect: A technical note

A. Papadias, Y. C. Gan & A. Singhal (Department of Paediatric Neurosurgery, Birmingham Children's Hospital, Birmingham, UK, and Department of Paediatric Neurosurgery, British Columbia's Children's Hospital, Vancouver, Canada)

Background: Skull defects are commonly created in neurosurgery either as part of the treatment process, such as removal of skull tumours or decompressive craniectomy, or as a complication of surgery when the bone graft becomes infected and needs to be removed. Procedures to close the bone defect have included cadaveric bone grafts, synthetic materials, or split calvarial bone grafts.

Objective: A simple and effect method of cranioplasty, using the lateral edges of the bone defect, is presented.

Methods: A case report is presented, with accompanying operative photographs, demonstrating the principles involved in harvesting, *in situ*, split thickness bone grafts.

Results: A 12-year-old female presented with progressive scalp swelling. Clinical examination and CT demonstrated a 6.1 × 6.7 cm right parietal bone mass. After performing a craniectomy, including resecting a margin of bone around the mass, the patient had a 7 × 7 cm skull defect. Strips of split thickness bone measuring 2 cm were then harvested

from the free edge of the surrounding bone by using a curved osteotome in the bone diploic spaces, taking care to not fracture the bone. The bone strips were then laid parallel to each other over the defect with care taken to match the curvature of the skull. The strips of bone are then secured firmly to the surrounding skull with thick Vicryl sutures. The wound was then closed in the standard fashion. The patient suffered no complications, and the pathology in this instance was fibrous dysplasia. At one year follow up, the bone was well fused, with excellent cosmetic result.

Conclusions: *In situ* autologous split thickness bone grafts are less invasive than craniotomy for bone graft harvest, are inexpensive alternatives to synthetic materials, and can result in good fusion and cosmesis.

MISCELLANEOUS

M1: Pre-operative clotting studies: Are they really necessary?

A. Harries, H. Nishikawa, S. Dover, A. Kay, S. Sgouros, R. Walsh & G. Solanki (Birmingham Children's Hospital, Birmingham, UK)

Objective: To determine why pre-operative clotting studies are requested and usefulness in predicting surgical bleeding risk.

Design: Retrospective study analysed 100 consecutive neurosurgical procedures.

Patients and methods: The medical records, haematology screen, clotting profile, operation and anaesthetic notes of 39 girls and 61 boys aged between one day to 16 years were reviewed. 26% of activity was emergency. Abnormal clotting cases were further studied. Need for re-testing or pre-operative correction, surgery delay or cancellation, and transfusion requirements and operative or transfusion adverse events were analysed.

Outcome measures: Impact of abnormal clotting profile on surgical risk.

Results: Of the 100 cases, 78 cases had a clotting profile performed. Eleven cases were abnormal (14%). 35% (7/20) of these were emergency cases and just under 7% (4/58) were elective. This difference was a statistically significant one at $p < 0.0034$. one in three of the abnormal cases had associated co-morbidity. Most abnormalities required no pre-operative correction. Retesting was performed in four cases (36%) leading to surgical delays. In this series there was no surgical cancellation, and none had an adverse outcome. In particular excess bleeding was not associated with pre-op abnormal clotting. A routine clotting study costs £5.

Conclusions: We conclude that a pre-operative clotting study is a poor indicator of which patients will experience adverse bleeding intraoperatively but

in 36% delayed surgery was the outcome. A thorough history would identify at risk patients which require a clotting study, and rationalise testing.

M2: Internet neurosurgery: Five-year experience

G. Narenthiran (Department of Neurosurgery, Wessex Neurosciences Centre, Southampton General Hospital, UK)

Aim: The aim of the project was to utilise the Internet to create avenues for communication, collaboration, sharing of knowledge and expertise among neurosurgeons.
Method: We created a virtual community of neurosurgeons by setting up an electronic mailing. This was followed up by founding an electronic peer-reviewed journal. Continuing medical education of the members of the mailing lists were facilitated by running of an on-line self-assessment web-site ('Quiz'). Electronic neurosurgery conferences on the Internet were annually organised for presenting the research findings of the members.
Results: Currently there are 217 members. Thirteen papers and articles have been published on the journal which receives 50,000 web-hits annually. Four editions of on-line quiz have been published. International Neurosurgery Conference has now been held in 2005 and 2006 with twenty presentations.
Conclusion: Internet provides a useful media for sharing of knowledge and transfer of expertise among national and international neurosurgeons. Its role in this regard is likely to increase in future.

HYDROCEPHALUS

H1: Benign intracranial hypertension: Experience from a single centre

A. Tarnaris, J. M. Barber & L. D. Watkins (National Hospital for Neurology and Neurosurgery, London, UK)

Objective: To assess the outcomes following shunting in patients suffering from benign intracranial hypertension (BIH).
Design: Retrospective review of medical records of 20 patients.
Study period: 2001–2005. Patient demographics, neurological status and opthalmological examination at presentation and last follow up, initial CSF dynamics, preoperative medication, as well as operative records were examined to document initial shunt placement and following revisions.
Subjects: There were 17 female and three male. Mean age: 37 years. Twenty patients underwent 45 shunt placements in total (35 lumboperitoneal and 10 ventriculoperitoneal shunts). Mean preoperative symptom duration: 17 months. Only one patient

had optic nerve sheath fenestration previously. Mean CSF opening pressure on initial LP was 33 mm Hg. 90% of the patients experienced symptom improvement post-LP. In two out of three of the patients headache was the initial symptom. Headache was present in all subjects whereas visual disturbances were present in 90% of the patients. 85% of patients had papilloedema on presentation. 80% of patients were obese. 80% had additional pharmacological treatment prior to operation.

Outcome measures: Rate of shunt revision, headache and visual outcomes as documented in follow up clinics.

Results: The revision rate was 60%. In 58% of the revision cases there was a site change. Two patients had both a VP and LP shunt *in situ* for control of symptoms. Mean time for first shunt revision was 15 months. Number of revisions ranged from one to five in mean follow up period of 15.8 months. Headaches improved in 80% of cases. Visual function improved in 50% of cases.

Conclusions: Headaches improve more often when compared with visual disturbances in patients suffering from BIH. Patients undergo frequent shunt revisions which often require change of site insertion or occasionally an additional shunt component.

H2: An audit of programmable vs. non-programmable VP shunts in children with hydrocephalus

M. K. Teo, S. M. R. Kabir, H. Zaki & P. J. McMullan (Sheffield Children Hospital, Sheffield, UK)

Objective: The aim of this audit is to investigate the revision and complication rate of programmable versus non-programmable shunts in children with hydrocephalus, and to compare the data with that published by UK National Shunt Registry.

Design/subject: A retrospective study of VP shunts implanted from Jan 2000 - Jan 2006 in our institution was performed. Patients were analysed for demographic data, implantation diagnosis, valve type, opening pressure adjustments, and incidence of shunt complications. The end point of the study was a surgical shunt revision.

Results: In 70 patients, 37 had non-programmable and 33 had programmable shunts implanted. The one-year revision rate was 27% for non-programmable and 24% for programmable shunts. Both results were comparable to the national one-year revision rate of 28%. 49% (18/37) of non-programmable shunts compared to 30% (10/33) of programmable shunts subsequently required revision during the study period. The reasons for revision of non-programmable shunts were infection (6/37), overdrainage (6/37), disconnection (3/37), underdrainage (2/37), and wound breakdown (1/37). For programmable shunts, the reasons for revision were

underdrainage (5/33), overdrainage (3/33), infection (2/33) and disconnection (1/33).

Conclusions: The one year revision rate was almost similar for both programmable and non programmable VP shunts, and this is in keeping with UK National Shunt Registry data. However, there was a noticeably higher overall revision rate in non-programmable shunts during the whole study period.

Abstracts from the British Neurosurgical Research Group Meeting presented at the SBNS meeting

Utility of 2D phase-contrast magnetic resonance imaging in the assessment of carotid arterial compliance and comparison with ultrasound

S. P. S. Howarth[1,2], T. Tang[1], S. Wallace[1], M. J. Graves[1], I. Wilkinson[3], P. J. Kirkpatrick[2] & J. H. Gillard[1] ([1]University Department of Radiology, Addenbrooke's Hospital NHS Foundation Trust, University of Cambridge, UK, [2]Academic Department of Neurosurgery, Addenbrooke's Hospital NHS Foundation Trust, University of Cambridge, UK, and [3]Clinical Pharmacology, Addenbrooke's Hospital NHS Foundation Trust, University of Cambridge, UK)

Background: There is increasing evidence to show that overall vascular compliance is related to cardiovascular morbidity, with less compliant vasculatures being at greater risk from the ischaemic sequelae of atherosclerosis. A number of methodologies have been utilised in the measurement of carotid compliance of which the most reported is ultrasound-based wall-tracking coupled with non-invasive blood pressure monitoring. This technique is highly operator dependent and can only assess the artery at a suitable point of insonation. We have developed an MR-based assessment of carotid compliance based on beat-to-beat non-invasive blood pressure monitoring and 2D phase-contrast imaging.

Methods: 12 asymptomatic individuals with carotid atheroma (stenosis $>50\%$ on conventional MRA) were imaged at 1.5T using a dedicated four-channel phased-array neck surface coil and a multi-sequence protocol including black blood vessel wall imaging and time-resolved 2D phase-contrast acquisition 1cm below the bifurcation. Non-invasive blood pressures were acquired during phase-contrast imaging. A custom designed software wall tracker was used to determine change of cross-sectional area over time per unit force applied and hence compliance. Vessel compliance was also determined using an ultrasound-based wall tracking method following the MR examination.

Results: Statistical analysis revealed an excellent correlation between ultrasound-based measures of

compliance and the MR method ($r = 0.69$) Blood pressures during MR imaging were statistically higher than those taken during ultrasound examination ($p < 0.05$) Individuals that were found to have a lower compliance in the common carotid artery, tended to have a larger atheromatous burden distal to that segment of artery.

Conclusion: Magnetic resonance measures of carotid compliance agree with traditional ultrasound measures and may be useful in the comprehensive MR-based individualised risk assessment of patients with carotid atheroma. The next phase of the study will compare a symptomatic cohort of patient with carotid atheroma with an age-matched asymptomatic cohort

N-Terminal pro B Type natriuretic peptide is associated with decreased cerebral blood flow after acute subarachnoid haemorrhage

S. Pushpananthan[1], G. Fellows[1], D. Gaze[2], V. Petrik[1] & B. A. Bell[1] ([1]Academic Neurosurgery Unit, St George's, University of London, and [2]Chemical Pathology Department, St George's Hospital, London, UK)

Introduction: There has been increasing speculation that B type natriuretic peptide (BNP) is responsible for natriuresis after aneurysmal subarachnoid haemorrhage (SAH) and may be linked to the development of secondary cerebral ischaemia. The N -Terminal peptide (NT-proBNP) of BNP is more stable and provides a robust measure of BNP serum concentration. We investigated the relationship between NT-proBNP serum concentrations and outcome after SAH. We present early results of a work in progress.

Methods: NT-proBNP serum concentrations were measured (using ECLIA) at four different time periods (1 – 3, 4 – 6, 7 – 9 and 10 – 12 days post ictus) in 48 patients referred with spontaneous SAH. NT-proBNP serum levels were compared with initial clinical grade and clinical outcome at six months. Serum NT-proBNP was compared with cerebral blood flow (CBF) measurements in 20 patients using stable Xenon CT.

Results: There were 48 subjects (28 female) with a mean age of 55 years. Initial NT-proBNP levels were elevated in those that were left dependant versus independent at six months on the Glasgow Outcome Score (310 v 105 pg/ml; $p = 0.02$ t-test) and modified Rankin Scale (304 v 78.7 pg/ml; $p = 0.01$). Initial NT-proBNP levels were elevated in aneurysmal SAH patients compared with non-aneurysmal SAH and non-SAH patients (mean 219.3 v 98.1 v 17.9 pg/ml). In five of 20 patients with decreased cerebral blood flow the NT-proBNP levels remained elevated 7 – 9 days post ictus (190 v 46 pg/ml; $p = 0.06$).

Conclusions: Our early results show that NT-proBNP serum levels are elevated shortly after SAH, and stay elevated in patients with decreased CBF. These early findings suggest that secretion of BNP after aneurysmal SAH may contribute to cerebral ischaemia.

From homunculi to consciousness: Painful revelations from deep brain stimulation

E. A. C. Pereira[1], A. L. Green[1], N. de Pennington[1,2], S. Wang[2], S. L. F. Owen[2], M. L. Kringelbach[2], J. F. Stein[2], D. Nandi[1] & T. Z. Aziz[1,2] ([1]Oxford Functional Neurosurgery, Department of Neurological Surgery, The West Wing, Oxford Radcliffe Hospitals, Oxford, UK, and [2]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, UK)

Analgesic efficacy was the first property of deep brain stimulation (DBS) demonstrated in patients half a century ago. DBS as a therapy for medically refractory chronic pain has been regularly performed for over three decades, two popular targets being the ventral posterolateral and ventral posteromedial nuclei of the sensory thalamus (VPL/VPM) and the midbrain periaqueductal and periventricular grey matter (PAG/PVG). Nearly 1300 patients have been treated by DBS for chronic pain worldwide, but the procedure's current status as 'experimental' in the USA leaves only a handful of centres worldwide able to perform it. DBS provides unique opportunity to invasively record directly from neuronal ensembles within the human brain and the possibility to modulate neuronal function by altering stimulation parameters.

Local field potentials (LFPs) were recorded from indwelling electrodes in human subjects in several paradigms. Firstly, the midbrain PAG/PVG region was mapped by measuring deep brain somatosensory evoked potentials from different DBS contacts during electrical stimulation of different body regions and anatomical assessment of DBS contact position using CT, MRI and brain atlas information. A craniocaudally inverted somaesthetic homunculus was found. Secondly, LFP recording of event-related potentials was performed to reveal interactions between VPL/VPM and PAG/PVG and show that sensory processing between the two nuclei is likely to be bottom-up rather than top-down. Thirdly, the effects of endogenous opioids upon PAG/PVG neuronal responses were investigated by naloxone infusion studies. Finally, LFP analysis of patients with varying levels of pain revealed relationships between degree of pain and characteristic low frequency spindles that suggest a neural signature for pain correlating with the conscious perception of pain.

Alongside the fundamental neuroscientific insights gained, the advances presented here have several applications. They potentially improve the procedure

of DBS for pain by enhancing targeting, patient selection, therapeutic efficacy and further technological developments like demand-driven DBS. Future research avenues will utilise complementary imaging technologies like diffusion tensor imaging (DTI) and magnetoencephalography (MEG).