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Management of cerebral arteriovenous malformations

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Introduction: Multimodality treatments for cerebral arteriovenous malformations (AVM) offer the best options for the individual patient.
Methods: In a series of 196 cerebral arteriovenous malformations, 107 were treated with surgical excision as part of their management and half of these patients had pre-operative embolisation. The Spetzler Martin Grading system[1] was used to classify the patients.
Results: Sixteen percent were Grade I, 15% Grade II, 36% Grade III, 23% Grade IV and 11% Grade V. Two patients died (Grades II and IV) and 10% were severely disabled (12% Unfavourable outcome)[2] Moderate disability occurred in 10% and 78% made a Good Recovery (88% Favourable outcome). The majority of the patients with disability were Spetzler Grade IV and V lesions with only 1 Grade V patient making a Good Recovery and 4 being Moderately disabled (56% Favourable outcome for Grade V lesions).
Conclusions: This series confirms the usefulness of the Spetzler and Martin Grading System in predicting the outcome from surgical intervention for cerebral arteriovenous malformations.

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The ACE I allele is associated with increased risk for ruptured intracranial aneurysms

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Objective: To assess the association of the angiotensin converting enzyme(ACE) gene locus with the pathogenesis of ruptured intracranial aneurysms.
Background: Genetic and environmental factors play roles in the aetiology of ruptured intracranial aneurysms. Hypertension has been reported as a risk factor for intracranial aneurysm haemorrhage. We have examined whether genotypes at the (ACE) gene locus are associated with ruptured intracranial aneurysms.
Design and subjects: The insertion/deletion polymorphism in the ACE gene was genotyped in 258 subjects presenting in East Anglia with ruptured intracranial aneurysms (confirmed at surgery or angiographically) and 299 controls from the same region.
Results: ACE allele frequencies were significantly different in the cases and the controls (alleles $\chi^2_{1-4.67}$, p = 0.03). The I allele was associated with aneurysm risk [odds ratio for I allele versus D allele = 1.3 (95% CI = 1.02–1.65); odds ratio for II versus DD genotype = 1.67 (95% CI = 1.04–2.66)]. The I allele at the ACE locus is over represented in subjects with ruptured intracranial aneurysms.
Conclusions: These data are supported by non-significant trends in the same direction in two smaller studies. Thus, this allele may be associated with risk for ruptured intracranial aneurysms.

Preliminary experience with 3-dimensional rotational digital subtraction angiography in the assessment of cerebral aneurysms for endovascular or surgical treatment

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Objective: To evaluate the role of 3-dimensional (3D) rotational digital subtraction angiography (DSA) compared to conventional 2D angiography in the management of cerebral aneurysms.
Design: Retrospective study comparing standard 2D DSA to 3D DSA images of cerebral aneurysms performed between May and July 2000.
Subjects: There were 31 patients in whom 54 aneurysms were detected. Of these 23 aneurysms had ruptured.
Methods: Following a standard 2D DSA, all patients underwent a 3D rotational DSA. The images were reconstructed on the *Siemens 3D Virtuoso CT/MR Workstation Version VA30 (Siemens-Forchhiem, Germany)* and compared with the 2D DSA films by two neuroradiologists and a neurosurgeon.
Outcome measures: The information was categorized as follows: (a) resulted in a change in treatment, (b) added extra information, which aided the subsequent management and (c) added no extra information.
Results: 3D DSA led to a change in planned treatment in eight patients (26%) — in three patients (9.6%) aneurysms were demonstrated (all middle cerebral artery aneurysms) that were not detected by 2D DSA. Their presence was confirmed at surgery. In 12 patients (39%), it contributed significantly to management by showing the anatomy of the neck and surrounding vessels in greater detail. In the remaining 11 patients (35%), it did not provide any extra information. In one patient, 2D DSA showed two lesions, which were shown to be artefacts on 3D DSA.
Conclusions: 3D DSA contributed to the management of cerebral aneurysms in 20 patients (65%). The ability to visualize the detailed anatomy of cerebral vessels and aneurysms improved our detection rate and aided decision making during treatment planning.

Spontaneous obliteration of pial arteriovenous malformations — case review

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Introduction Brain arteriovenous malformations occur in approximately 0.14% of the population. The most common presentations are haemorrhage (50%) and seizures (25%). Although they are congenital abnormalities, their angioarchitecture may vary over time. A rare, but well-recognized phenomenon of AVMs is that of spontaneous obliteration. The purpose of our study was

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to determine whether spontaneous thrombosis of AVMs can be predicted by their angioarchitecture and whether there is any risk of recurrence once obliteration has occurred.
Methods: We retrospectively reviewed the angiographic and cross-sectional imaging data amassed over an 18-year period, including follow-up imaging studies, and mail surveys of referring and family physicians. A control group was obtained from contemporaneous AVMs of a similar size.
Results: We identified 28 cases of spontaneous obliteration in a series of 2162 patients. The mean time between initial diagnostic angiography and angiographic obliteration was 10 months, during which time there was no intervention and no history of repeat haemorrhage; nor had haemorrhage recurred during the follow-up period (mean 53 months). Most of the AVMs were deep (22/27), with only one draining vein (21/27), and few feeding arteries. In more than half the cases (15/27), drainage was exclusively into the superficial venous system.
Conclusions: Spontaneous obliteration is rare (1.3%). Common features include haemorrhagic presentation and few arterial feeding vessels. Although we found no instance of repeat haemorrhage during the follow-up period, AVMs can recanalize, and follow-up is therefore recommended.

Management of unruptured cerebral aneurysms

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Objective: The recommendations for treatment of unruptured intracranial aneurysms are unclear following recent studies.[1,2] The aim of this study is to analyse the treatment decisions and outcome for patients with unruptured cerebral aneurysms in a single centre.
Design: A retrospective case note review of patients treated between 1989 and 1999. Group 1 patients were defined as those with no previous history of subarachnoid haemorrhage (SAH). Group 2 represented patients with previous SAH. Outcome was measured using the Glasgow Outcome Scale.
Population: There were 186 patients with 253 unruptured aneurysms. Mean follow-up was 16 months (range 0–136 months).
Results: Overall eight out of 70 patients (11%) treated conservatively had a proven subsequent SAH. There were 95 patients in Group 1 (no SAH) with 130 aneurysms. Six out of 41 (15%) patients treated conservatively bled. In those operated upon, favourable outcome was 87% and unfavourable 13%. In Group 2 (previous SAH) there were 91 patients with 123 aneurysms. Two out of 29 (7%) patients treated conservatively bled. In those operated upon favourable outcome was 90% and unfavourable 10%.
Conclusions: The risk of SAH from an unruptured aneurysm is high even in Group 1 patients. Surgical outcome was similar to that reported elsewhere[1].

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An evaluation of persistent neurological symptoms and personality changes following angiographically negative subarachnoid haemorrhage

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Objective: To assess the prevalence of delayed persistent symptoms and personality change in patients with angiographically negative subarachnoid haemorrhage (ANSAH) and their impact on return to normal functioning.
Design: Formal postal questionnaire interrogating cognitive, personality and behavioural effects, and their impact on return to normality of those affected by ANSAH. The questionnaire included visual symptom severity score (VSSS) scales in addition to a personality profile assessment before and after the ictus.
Subjects: Sixty patients with ANSAH were retrospectively obtained from our neurovascular database and invited to respond to the questionnaire. There was a 55% response rate. The mean age of the respondents was 52 years and of these 14 were male and 19 were female. The mean time from the ictus was 2.6 years (range from 1.3 to 5 years)
Results: Most respondents reported persistent symptoms; 69% (23/33) reported experiencing persistent headaches with VSSS of 6.3/10, 93% (31/33) had persistent sleepiness and tiredness with mean VSSS of 6.8/10, 30% (10/33) experienced insomnia with VSSS of 8/10 and 78% (26/33) had 'difficulties with memory' with mean VSSS of 5.6/10. Personality profile analysis showed the majority of patients noticed significant change after the ictus. While most of the patients previously working continued at the same level, a significant proportion (27%–9/33) noted a negative impact of their post ictal problems on work and five of these left work because of 'reduced desire/ability to work'. Similarly the majority of respondents reported no effect on their families, but a group of 5/33 noted a negative effect.
Conclusions: While ANSAH is traditionally thought of as having a good outcome, we have noted that a group of patients continue to have difficulties in adjusting back to their previous life. While accepting the possibility of a questionnaire response bias we think that ANSAH has significant cognitive and behavioural sequelae that need to be more fully evaluated in regular follow up.

A 20-year review of intractable epilepsy in cortical dysplasia

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Introduction: Cortical dysplasia is a relatively frequent cause of epilepsy. Diagnosis can be extremely difficult and as medical management may prove unsatisfactory, surgical approaches may be sought. The treatment and outcome of 44 surgically managed patients with focal cortical dysplasia is reviewed.
Method: A prospectively collected database of epilepsy surgery patients was used to identify all those with biopsy proved cortical dysplasia who underwent surgical treatment. Results of investigations were examined and seizure outcome assessed. Histology was reviewed.
Results: Forty-four patients (23 male) were treated over a 20-year period with a median follow-up of 52 months; age range 0–48 years; 27 patients were under 16 years old; 68% had preoperative intracranial recordings. Resective surgery in the frontal or temporal lobes was associated with a good outcome (seizure-free) in 50%. Two out of three patients who underwent hemispherectomy were

seizure free. Those requiring parietal, occipital or multilobar resection or undergoing multiple subpial transections for cortical dysplasia in eloquent regions had a less favourable outcome (10 out of 19 patients not improved). Paediatric patients were less likely to improve with surgery. Surgical morbidity was modest.
Conclusions: This is one of the largest series of patients with cortical dysplasia. Diagnosis remains extremely difficult and the preoperative assessment often requires intracranial recording in this highly selected group of patients.

Result of highly selective amygdahippocampectomy (AHE) in epilepsy of temporal lobe origin in medial temporal sclerosis (MTS)
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Objective: It has been suggested that success in seizure reduction after surgery for temporal lobe epilepsy (TLE) may depend on the extent of the resection. It is possible, however, that there is a greater risk of cognitive and memory disturbance with more extensive resections, and even the 'selective' Yasargil AHE resects a considerable quantity of medial temporal tissues. We report the series of patients undergoing a highly selective resection, confined almost entirely to the amygdala and hippocampus, with acceptable results.
Methods: Thirty consecutive patients with epilepsy proven to be of temporal lobe origin and MRI evidence of hippocampal sclerosis underwent this procedure. Preoperative work-up included videotelemetry, SPECT and WADA testing. A standard microsurgical pterional transsylvian approach to the temporal horn of the lateral ventricle was followed by ultrasonic aspiration of the hippocampus and amygdala alone. An estimated 50–80% of the hippocampus was removed. Postoperative MRI confirmed the localized nature of the resection.
Results: One patient died of unrelated causes 1 year after surgery and one patient has a mild dyslexia related to surgery. There were no other permanent complications. Twenty-six patients (84%) are fit free at intervals of 6 months to 6 years; two of these have required further surgery for persistent auras. Neuropsychological testing has revealed no disabling memory loss and no significant cognitive disturbance other than transient depression in two patients.
Conclusions: These results compare favourably with series employing more radical resections.

Usefulness of intraoperative ECoG in lesional epilepsy surgery
B. R. Malla & C. E. Polkey (King's College Hospital, London, UK)

Objective: To estimate the significance of residual electrocorticographic abnormalities on seizure control after lesional epilepsy surgery.
Methods: A retrospective study of intra-operative electrocorticograms (ECoGs) for the presence of epileptiform discharges and their correlation with the outcome was performed for 64 patients who underwent resective surgery for epilepsy. In these patients the pathology was either focal cortical dysplasia (FCD) or dysembryoplastic neuroepithelial tumour (DNET).
Results: Between 1976 and 1998, 43 patients (20 males) with FCD and 21 patients (12 males) with DNET underwent lesional epilepsy surgery. The mean follow-up period of patients with FCD is 56.7 months (range = 2–161) and DNET is 44.5 months (range 8–185). Thirty per cent of patients with CD and 38% with DNET achieved Engel's class 1a outcome. Seizure patterns were more common in patients with cortical dysplasia and their abolition on postresection ECoG recordings was associated with a favourable surgical outcome. Persistence of sporadic ECoG spikes did not affect the outcome significantly.
Conclusions: Intraoperative ECoG is useful in prognosticating the outcome in lesional epilepsy surgery.

Stereotactic radiosurgery for mesial temporal sclerosis: a new era in epilepsy surgery or new clothes for the emperor?
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Background: Based on the observations that localization related epilepsy improves after radiosurgery for cerebral arteriovenous malformations, a small number of patients with mesial temporal sclerosis (MTS) were treated in France and elsewhere. We report the UK experience.
Design: Prospective assessments of subjects were carried out both at the referring Centres and in Sheffield.
Subjects: Eight patients with medically intractable complex partial seizures, magnetic resonance imaging (MRI) demonstrated MTS, congruent video-telemetry, semiology and WADA test were included. Gamma knife surgery was carried out to the mesial temporal structures (25 Gy to 50%).
Outcome measures: Seizure types, frequency and severity were recorded. MRI with MR spectroscopy was carried out at 6-monthly intervals.
Outcome: One patient with only 4 months follow-up was excluded from this analysis. The median follow-up is 31 months (range 19–35). One patient underwent amygdalohippocampectomy 26 months after treatment, when his seizure-frequency was 25% of that before treatment, and became fitfree. Three patients became fitfree, with a median lag time 20 months (range 12–30). One was found to have a contralateral new focus on repeat telemetry. The remaining two had reduction in seizure numbers, but found this disappointing. One is being considered for resection elsewhere. Auras were slowest to respond. There was no permanent neurological deficit. Two patients needed a course of dexamethasone for several weeks for headaches, lethargy, and in one case mild dysphasia and memory impairment.
Conclusions: Stereotactic radiosurgery offers a minimally invasive alternative to open surgery in this condition. The delay in desired effect and the transient radiation induced symptoms require careful management. Larger numbers will be needed for meaningful statistical analysis. Titrating the necessary radiation dose may now be possible.

Manchester experience with vagal nerve stimulator implant for intractable epilepsy
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Objective: To determine the efficacy of vagal nerve stimulator (VNS) implant in the management of refractory seizures with respect to seizure suppression and reduction in the use of anti-epileptic drugs (AEDs).
Design and subjects: Eleven children with a mean age of 12.5 years (range = 5–19) who underwent implantation of VNS for intractable epilepsy was retrospectively studied. Age of seizure onset ranged from 0 to 96 months (mean 30) and the duration of seizures before implantation

ranged from 18 to 192 months (mean 102). The pre-implantation seizure frequency ranged from 4 to 27 per day (mean 12). The mean age at VNS implant was 11 years (range 4–18). The mean number of AEDs at the time of implant were 3. Mean follow-up period was 22 months (range 7–42 months).
Outcome measures: Efficacy outcome was percentage reduction in total seizures and reduction in AEDs.
Results: Percentage reduction in seizures after VNS implant ranged from 0 to – 97.66% (mean -44%). The mean number of AEDs after VNS implant was 2. Non-responders include three patients. There was no patient free of AEDs with a VNS implant, but concurrent treatment with anti-epileptic drugs was reduced by 30%.
Conclusions: Our study highlights the efficacy of VNS implant in refractory epilepsy by reducing the severity of seizures and the use of AEDs.

Bilateral pallidal stimulation for spasmodic torticollis

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Objective: To investigate the effects of bilateral medial pallidal stimulation on spasmodic torticollis.
Design: Prospective study using video recording, neurological and neuropsychological assessments of patients with cervical dystonia undergoing bilateral pallidal stimulation.
Subjects: Eight patients (six female), mean age 37 years (range 22–68), with 10 years mean disease duration (range 5–16), and a mean postoperative follow-up of 9 months (range 3–17).
Outcome measures: Pre- and postoperative video recording with blind neurological assessments and TWSTRS ratings. Neuropsychological assessments including pain and generic quality of life measures.
Results: No major complications. Good relief of dystonic posturing and pain persisting up to 17 months, with three patients coming off opoid analgesia and one patient achieving independent employment in the community for the first time.
Conclusions: Bilateral medial pallidal stimulation is a promising non-destructive treatment for spasmodic torticollis, which may have functional advantages when compared with other lesional or denervation procedures.

Are GLIADEL wafers a useful adjunct to first surgery for malignant glioma?

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Objective: To determine the efficacy of GLIADEL® wafers in the management of patients undergoing first resection of malignant glioma
Design: A Phase III randomized, double-blind, placebo-controlled trial was conducted at 38 centres in 14 different countries.
Subjects: A total of 240 eligible men and women between the ages of 18 and 65 were enrolled from January 1997, and randomly assigned to receive either GLIADEL® or placebo wafers. The randomization was blocked by treatment centre. In addition to resection and either GLIADEL® or placebo wafer patients received standard radiotherapy.
Outcome measures: Primary endpoint for the trial was overall survival. Secondary endpoints included measures of neurological outcome and disease progression.
Results: Median survival in patients increased from 11.6 months for patients given placebo wafer to 13.9 months in patients given GLIADEL® wafer ($p < 0.03$). The p-value was determined using the logrank test, stratified by the country in which treatment was administered. At 1 year, 59% patients given GLIADEL® wafer were still alive compared with 48% of those given placebo ($p < 0.01$). The median time to tumour progression occurred over 2 months earlier in the placebo group. After accounting for the effect of re-operation (27% in both placebo and active groups), GLIADEL® wafer prolonged survival by approximately four months compared to placebo ($p < 0.004$). Improvement in neurological symptoms was another statistically significant benefit in the GLIADEL® wafer treatment group. GLIADEL® wafer treatment was well tolerated.
Conclusions: Placement of GLIADEL® wafers in the cavity created after resection of a malignant glioma offers both significant survival and functional benefits.

Transsphenoidal surgery and petrosal sampling in childhood and adolescent cushing's disease

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Background: Cushing's disease in childhood and adolescence is rare. We present our experience in treating 15 cases.
Objective: To analyse the surgical and endocrinological outcome of a series of childhood and adolescent Cushing's disease, including the role of inferior petrosal sinus sampling.
Design: Retrospective analysis of case notes of all patients under the age of 18 undergoing transsphenoidal hypophysectomy for Cushing's disease, between 1983 and 2000.
Subjects: There were 15 patients with Cushing's disease aged 7–17 who underwent transsphenoidal hypophysectomy as their primary treatment between 1983 and 2000. Inferior petrosal sinus sampling was performed in nine cases.
Outcome measures: Correct localization of adenoma by catheter studies was confirmed by operative findings and ultimately cure or remission. Cure and remission were strictly defined. Patients accepted as being cured by demonstration of postoperative serum cortisol levels of <50 nmol/l. A mean post operative cortisol of <300 nmol/l during a 'six sample' day curve indicates clinical remission, but not cure. Cortisol levels >300 nmol/l indicates persisting disease.
Results: Inferior petrosal sinus sampling gave correct localisation in eight patients (89%). Eight patients (53%) had undetectable cortisol levels postoperatively. During a follow-up period of between 6 months and 160 months (mean 90 months), three patients (20%) were found to be in remission and four (27%) had persisting disease. The latter group received radiotherapy following which remission was achieved in all four cases. However, all patients undergoing radiotherapy became growth hormone deficient within 1 year of completing radiotherapy. One patient developed hypopituitarism. Transient diabetes insipidus was common and only one patient required permanent replacement.
Conclusions: This series characterises clinical features, investigations and management of juvenile Cushing's disease. We found that inferior petrosal sinus sampling gave correct localisation of the adenoma in 89% of patients contributing to the successful therapeutic outcome of these patients.

Dysembryoplastic neuroepithelial tumour: clinical features and longitudinal outcome in a series of 47 paediatric cases

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Objective: To analyse the clinical features and outcome of the largest reported paediatric series of surgically treated dysembryoplastic neuroepithelial tumour (DNT), a rare and indolent lesion principally causing intractable epilepsy in the young.
Design: Retrospective data collection and analysis of cases prospectively recorded in the GOS neuro-oncology database.
Subjects: Forty-seven children presenting between 1988 and 2000 and undergoing surgery for DNT at Great Ormond Street between 1990 and 2001.
Outcome measures: Longitudinal seizure and behavioural outcome, reduction in anticonvulsant medication and results of radiological surveillance.
Results: Twenty-five male and 22 female patients presented at a median age of 5.0 years (3 months to 14½ years) with seizures in 46/47 cases, principally complex partial seizures with or without secondary generalization (94%). Neurological deficit was the exception, seen in only two patients, 76% of lesions were temporal, with 49% being in a mesial location. Consistent MRI features were characterized with previously unreported tumour growth seen in four cases preoperatively and in four separate subtotally resected cases postoperatively. Detailed follow up (median 5.4 years) revealed a seizure-free outcome (Engel I) in 87% and improved outcome (Engel II and III) in 13% of the 23 patients who underwent total resection with results of Engel I (40%) and Engel II and III (60%) in the subtotal resection group. Eight patients with recurrent seizures underwent further resective surgery with an Engel I outcome in five, Engel II and III in two and no improvement in one. Improvement in behaviour was seen in 68% of those affected (40%).
Conclusions: DNT may be recognized by characteristic clinical and imaging features, although a minority of lesions demonstrate change over time. Resective surgery may be offered to those with intractable seizures with a high expectation of a seizure-free outcome, and although subtotal resection results in poorer control of seizures, redo surgery may still be worthwhile in the majority in experienced hands. Tumour recurrence is not seen.

Will new cancer referral guidelines reduce delays in the diagnosis of brain tumours

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Objectives: The Government in its white paper 'The New NHS—Modern, Dependable' has targeted provision of cancer care as a priority. In 1995 the Calman/Hine report advised that along with other cancer types guidelines for the referral of patients with a suspected brain tumour should be given to primary care physicians. In October 2000 the standard was set that patients referred to a specialist using these guidelines will be seen within 2 weeks. We undertook this study to examine the preguideline pathway for referral, subsequent diagnosis and treatment of brain tumours.
Design and subjects: All patients presenting with intracranial tumours between May and July 2000 were interviewed and their case notes reviewed. They were subsequently followed through their diagnosis and treatment pathway.
Outcome measures: Time of delay for the six stages we have identified prior to a definitive diagnosis of a brain tumour being made. In addition the time delay in receiving adjuvant therapy was studied.
Results: Fifty-three patients were included in the study, 28 of whom subsequently received adjuvant therapy. The commonest presenting symptom was a progressive neurological deficit (45.3%), however 7.5% of patients presented with mental state change which is not included in the guideline indications for referral. The overall mean time from onset of symptoms to definitive diagnosis was 71.4 weeks (range 2.1–464.6 weeks). The largest proportion of this time was from first consultation with a physician to referral to a specialist at a mean of 23.8 weeks. Following this the mean time to consultation with the specialist was 1.7 weeks (range 0–22.1 weeks). The mean time for referral from a specialist to consultation with a neurosurgeon was 1.7 weeks (range 0–15.7 weeks) and the subsequent mean time to a definitive diagnosis was 2.1 weeks (range 0.3–24.1 weeks). Following diagnosis, the overall wait for adjuvant therapy was a mean time of 47.1 days (range 20–132 days). This was less for malignant tumours (mean 36.7 days) as compared with benign (mean 94.8 days).
Conclusions: There is an unacceptable delay in the diagnosis of brain tumours. The new guidelines may reduce the delay in primary care physicians referring to a specialist but this may be at the cost of increased referrals of patients who ultimately do not have cancer and possibly increasing waiting times for non-cancer patients. The guidelines do not pick up the proportion of patients who present with mental state changes. The introduction of a 2-week standard will probably not significantly reduce overall time to diagnosis. Once diagnosis is made there is further unacceptable delay in receiving adjuvant therapy.

Qualifying the role of bilirubin spectrophotometry in the detection of aneurysmal subarachnoid haemorrhage

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Objectives: To establish the specificity and sensitivity of bilirubin in CSF detected on spectrophotometry in establishing a diagnosis of aneurysmal SAH and to compare spectrophotometry with the 'Three Tube' test (TTtest).
Design: One-hundred consecutive cases with established or suspected SAH were selected. Based on the CT findings patients were placed in three groups—CT positive, CT negative and equivocal CT. Spectrophotometry and the TTtest results were compared in the latter two groups, and Spectrophotometric findings of the angiogram negative and positive cases.
Results: Eighty-nine patients had CT positive SAH, of whom 70 had aneurysmal SAH. Two patients had equivocal CT scans, but had positive angiograms. Spectrophotometry showed the presence of bilirubin in both cases of greater than 0.02 absorption units (au). The TTtest was performed in one patient and was positive. Of the nine patients who had a negative CT scan only one had a positive angiogram and TTtest, but spectrophotometry was not performed. Of the rest, only two had the TTtest, it being negative in both. In five patients CSF spectrophotometry was equivocal. In the other three an LP was performed more than 12 h after the ictus and had, in all cases, a bilirubin peak of less than 0.016 au.
Conclusions: On CSF samples obtained less than 12 h after the ictus the three-tube test, as opposed to spectrophotometry, is probably accurate. A Bilirubin peak of less than 0.016 au is unlikely to result from aneurysmal

bleeding. Bilirubin spectrophotometry of more than 0.02 au is probably the most accurate predictor of SAH more than 12 h after the ictus.

Influence of anomalies of circle of Willis on outcome following surgery in patients with anterior communicating artery aneurysm

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Objectives: To evaluate the influence of anomalies of circle of Willis on the outcome following surgery in patients with anterior communicating artery aneurysms.
Design: The type of circulation in the anterior communicating artery complex has been studied. The amount of blood in the basal cisterns was graded according to Fisher's Grade.
Subjects: One-hundred-and-fifteen patients in Grade I and II at the time of surgery, operated in the last 5 years.
Outcome measures: Outcome graded on the Glasgow Outcome scale.
Results: The CT scan showed 15% of the patients had Fisher's grade I, 38% Grade II, 18% Grade III and 29% Grade IV subarachnoid haemorrhage. Angiographic vasospasm was seen in 64% of the patients, 60 patients had type I and II, and 55 had type III and IV ciruclation. Nine patients died in postoperative period; in eight of these the circulation was type III and IV. Five of these patients had evidence of angiographic vasospasm pre operatively. One patient died from postoperative meningitis.
Conclusions: In patients undergoing surgery for anterior communicating artery aneurysm, anomalies of circle of Willis have an influence on outcome.

Experiences with the surgical treatment of sporadic brain stem cavernous angiomas

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Objectives: Surgery for symptomatic brain stem cavernomas is performed infrequently and the relative safety of treatment has been addressed in few reports.
Design: We reviewed recent experiences with four surgical approaches in five patients. Outcome was early morbidity or mortality.
Subjects: The patients were admitted to the neurosurgical service between August 1996 and December 2000. The demographics, radiology, operative notes, and outcome were reviewed and tabulated. Subtemporal-transtentorial approach, midline transvermian, midline medial suprafacial triangle and lateral suboccipital approaches were utilized.
Results: Age ranged from 30 to 54 years with follow-up of 1–41 months. The cavernoma was completely excised in three patients with a small residual in the remaining two cases. Postoperative complications: severe nystagmus (n = 4), severe truncal ataxia (n = 4), facial and abducens nerve paresis (n = 1), deafness (n = 1), internuclear ophthalmoplegia (n = 1) and hemisensory loss (n = 1). Most resolved to mild residual problems with time. There was no mortality.
Conclusions: Knowledge of the anatomy of the brain stem facilitates the surgical approach and excision of cavernomas. The anatomy of the lesion itself and proximity to the pial surface is an important consideration. Early complications are significant and patients are probably best operated upon at the time of maximum deficits.

Asleep-Awake-Asleep general anaesthetic technique for insertion of spinal cord stimulator

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Objectives: Retrospective review comparing the results of implantation of Spinal Cord Stimulator using the Asleep-Awake-Asleep anaesthetic technique with general anaesthesia throughout the procedure.
Aim: To ascertain which anaesthetic provides better results in paraesthesia coverage for pain relief in spinal cord stimulator (SCS) implantation.
Methods: Retrospective review was carried out on two groups of patients, who had SCS implanted for pain; 43 patients underwent the procedure where general anaesthesia (GA) was administered throughout. Thirty-one patients underwent the procedure, anaesthetized with Propofol infusion and woken up for the positioning of the electrode in order to achieve the best electrode position for paraesthesia to overlap the painful area. Once this was achieved the patients were re-anaesthetized for internalization of the stimulator and wound closure.
Results: Of the 43 patients who underwent SCS implantation with GA throughout, paraesthesia overlapping the pain was achieved in 23 patients. Of the 31 patients who underwent the procedure with Asleep-Awake-Asleep anaesthetic technique, successful paraesthesia was achieved in 28 patients.
Discussion: While this series is retrospective and relatively small, it suggests that better results in SCS implantation are achieved using the Asleep-Awake-Asleep anaesthetic technique. During the Awake period patient cooperation and comfort allows the best positioning of the electrode to be achieved.
Conclusions: Asleep-Awake-Asleep anaesthesia achieves better results for SCS implantation than general anaesthesia throughout the operation.

Is thalamic deep brain stimulation useful for movement disorders in multiple sclerosis?

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Objective: To evaluate the hypothesis that thalamic Deep Brain Stimulation (DBS) is a safe and effective form of treatment for patients with medically refractory movement disorders due to multiple sclerosis (MDMS).
Design: Prospective, same-subject design whereby each subject served as their own control as the Implantable Pulse Generator (IPG) could be turned on and off.
Subjects: Patients with proven MS and uncontrollable upper limb movement disorders
Outcome measures: Primary — change in tremor (Modified Fahn's Tremor Rating Scale, MFTRS), in the targeted upper limb and number of Jebsen Tests of hand function passed 12 months after surgery. Secondary — the morbidity associated with the procedure and changes in Kurtzke Functional systems (KFS) and Expanded Disability Status Scale (EDSS; 11); Barthel Index (BP; 12); Functional Independence Measure (FIM; 13); London Handicap Scale (LHS; 14); Hospital Anxiety and Depression Scale (HAD; 15); Fatigue Severity Scale (FSS; 16) and the Handicap Questionnaire (HQ; 17).
Results: Fifteen patients underwent stereotactic surgery of 37 referred. At 12 months there was a significant reduction in the upper limb tremor (MFTRS, p = 0.02) and significant improvement in the number of tests of hand function passed (p = 0.02), when the patient was assessed with the stimulator on versus off. There were no significant benefits in any of the secondary outcome measures.

Two patients suffered thalamo-capsular haematomas around the DBS electrode (both had better upper limb function postoperatively due to reduction in tremor). There was one late infection around a pulse generator necessitating its removal. There was a significant short term microthalamotomy effect. There were considerable postoperative programming and rehabilitation requirements.
Conclusions: Although thalamic DBS significantly improves tremor and hand function in MDMS the operative morbidity is greater than that of Parkinsonian patients; its functional benefits are limited; and there are considerable postoperative infrastructural requirements.

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Gamma Knife radiosurgery for trigeminal neuralgia

M. W. R. Radatz, A. A. Kemeny, D. M. C. Forster, J. A. Horaczek, D. Bhattacharyya, J. Hoyle (Royal Hallamshire Hospital, Sheffield, UK)

Objectives: To study the outcome and efficiency of gamma knife radiosurgery for drug resistant trigeminal neuralgia.
Design: A preoperative MRI was mandatory. Gamma knife radiation was performed using the RBS 5000 S model with a 4-mm collimator. The radiation dose of 70–90 Gy was given to the root entry zone of the nerve. Only patients with a minimum of 6 months follow-up were included, maximum follow-up 5 years. Patients treated were examined clinically at 6 weeks, 3, 6 and 12 months, and then on a yearly basis after treatment.
Subjects: There were 11 female and nine male patients in the range of 38–97 (mean 54).
Outcome measures: Clinical follow-up by neurosurgeon or GP.
Results: Eleven (55%) patients are completely pain free from trigeminal neuralgia, 6 (30%) much improved, after 6 months to 5 years of follow-up. Only three (15%) patients had no effects and one suffered very mild anaesthesia for 6 months after surgery, which has not yet recovered.
Conclusions: Gamma knife surgery for trigeminal neuralgia is comparable to other surgical techniques in efficacy, it is minimally invasive and carries very low morbidity and no mortality.

Transcranial approach to tumours involving the anterior skull base. Analysis of the long-term outcome and complications rate

J. Osman-Farah, N. Buxton, P. J. Bradley & I. J. Robertson (Queens Medical Centre, Nottingham, UK)

Objective: The transcranial approach to tumours invading the anterior cranial base (ACB) has become the standard approach for this pathology. A combined craniofacial resection is now used on a selective basis. The purpose of this study is to analyse the incidence of early and late post operative complications along with long term outcome.
Methods: Between 1986 and 2000, twenty-nine patients underwent transcranial resection for tumours invading the ACB. Clinical notes, operating notes, imaging, histology results and adjuvant treatment were analysed for all patients. Morbidity, mortality and long-term outcome were compared with the reported results for the classical combined cranio-facial approach.
Results: There were 21 male and eight female patients (age range 20–79 years). Seven patients had been previously treated in other institutions (surgery or radiotherapy). Twenty-five patients underwent bifrontal craniotomy, four patients fronto-temporal craniotomy and orbitotomy. Two patients died (6.8%), there were 10 early complications (34%) and one (3.4%) late complication. CSF leak, infective complications and frontal contusion account for most of the complications.
Conclusions: Our long-term results and morbidity rate are comparable to or better than those reported in the literature employing a combined craniofacial approach. We conclude that the transcranial approach to tumours involving the ACB offers an excellent surgical exposure for macroscopic tumour clearance, allows optimal reconstruction of the ACB and is associated with fewer complications than the 'classical cranio-facial' approach.

Sudden death due to acute hydrocephalus following endoscopic third ventriculostomy

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Objective: To highlight the risk of sudden death from acute hydrocephalus in patients who have had endoscopic third ventriculostomy (ETV).
Design: Report of two cases.
Subjects: Between April 1998 and October 2000, a total of 150 neuroendoscopic procedures have been performed in this unit. We report two cases in which sudden death occurred following initially successful ETV. A 3-year-old boy with posthaemorrhagic hydrocephalus and an 11-year-old boy with aqueduct stenosis underwent successful ETV with no postoperative complications. Three months following surgery both patients were asymptomatic, and MRI confirmed patent third ventriculostomies. However, both patients were found unresponsive in bed 4 months following surgery. One patient died at home, while the other was brought to hospital where insertion of an external ventricular drain revealed very high CSF pressure. Despite CSF drainage the second patient also died. Postmortem examinations were performed in both cases.
Conclusions: Hydrocephalus remains a condition for life that is potentially fatal and false reassurances about 'cure' following third ventriculostomy seem inappropriate.

Large acoustic neuromas: tests, lessons learned, size matters

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Objective: To identify a better surgical approach for large acoustic neuromas (AN).
Design and subjects: Analysis of prospectively collected data in consecutive selected patients.
Outcome measures: Facial nerve function, morbidity, complications, overall outcome (Glasgow Outcome Score) and quality of life (SF36).
Results: Of 433 patients (1988–2000), 73 had a tumour of ≥4 cm. Forty-one were female and their ages ranged from 14 to 81 (mean 44) Forty-nine had a translabyrinthine (TL) procedure, 14 had a retrosigmoid (RS) operation, nine had a combined transpetrous/translabyrinthine (TP) operation and one had a retrosigmoid/transcondylar approach. Twenty-one patients had staged operations of which three were unplanned (TL ± RS). Of the 73 patients facial reanimation was required in 24, five had a CSF leak repair, four developed meningitis, eight had ataxia and four needed a shunt. Overall two patients died. Three patients have residual disease and each had

staged surgery. Staged procedures did not offer any advantage in terms of the outcome measures selected. Our data demonstrate a shift to the TP approach over the last 2–3 years.
Conclusions: The TL approach is our standard procedure. The TP approach is our procedure of choice in a patient with a large AN when access to the tentorial notch is required with reduced risk of incomplete excision. The retrosigmoid approach is more appropriately used for smaller tumours, particularly when hearing preservation is a consideration.

Stereotactic radiosurgery for brain metastases: the Sheffield experience

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Introduction: Spread of systemic malignancy to the brain is a common complication for cancer patients. Untreated patients with brain metastases have a median survival of 1 month.[1] Conventional radiotherapy offers modest palliation with survival of 3–6 months[2] and surgical resection is generally limited to single metastasis in an accessible location. The majority of brain metastases are pseudospherical in shape and occur at the gray-white matter interface, a relatively non-eloquent area.[1] These characteristics make it an ideal lesion to treat with radiosurgery, where higher dose radiation is precisely delivered to the target, sparing surrounding normal brain
Objective: To report our experience in treating brain metastases in comparison with other published series.
Materials and methods: Thirty-seven patients with brain metastases were treated over the last 10 years. Twenty-five had a single metastasis, five had two metastases and seven had three to five metastases. A retrospective analysis of survival in these patients is presented with complete follow-up.
Results: The median survival for the whole series was 9.75 months and those with up to two metastases had a median survival of 13 months. This compares favourably with the median survival (8.0–11.0) reported from other radiosurgery units world-wide.
Conclusions: Our results suggest that stereotactic radiosurgery is associated with longer survival than conventional radiotherapy and is comparable to published results for surgery in patients with brain metastases. With the particular advantage that it can be used in inoperable lesions and multiple metastases, radiosurgery provides an effective alternative method of treating brain metastases with very few complications.

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Neuroendoscopic management of pineal region tumours

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Objective: To determine the role of neuroendoscopy in treatment of pineal region tumours.
Design: Prospective collection of clinical, radiological and histological data.
Subjects: Between April 1998 and October 2000, 15 patients (nine female, six male), aged 8 to 76 years (median 26 years), with pineal region tumours underwent neuroendoscopic procedures. In all patients endoscopic third ventriculostomy (ETV) was performed to relieve obstructive hydrocephalus. In 10 patients biopsy specimens were taken from the tumour for diagnostic purposes.
Outcome measures: Success rate of endoscopic biopsy in obtaining adequate samples for histological diagnosis of the tumour, and relief of hydrocephalus based on clinical and radiological investigations.
Results: Postoperative complications included temporary 6th nerve palsy in two patients, and transient hyponatraemia in one patient. Histological diagnosis was possible in seven of the 10 patients in whom the tumour was biopsied, while three patients required subsequent stereotactic biopsy. Twelve of the 15 patients (80%) have remained shunt-independent during the follow-up period (range 3–33 months, median 14 months).
Conclusions: Neuroendoscopy allows biopsy of pineal tumours in most cases and relief of obstructive hydrocephalus during the same procedure. It therefore helps plan treatment of these tumours, while avoiding craniotomy and VP shunt insertion.

Placement of an Ommaya reservoir at endoscopic third ventriculostomy (ETV): a useful adjunct in the diagnosis and management of ventriculostomy failure

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Objective: To evaluate the usefulness of an Ommaya reservoir in the diagnosis of ETV failure.
Design: A retrospective review of all patients undergoing ETV with Ommaya reservoir insertion over a 4-year period.
Subjects: Eighty-five patients. Mean age 29.9 years (range 3 weeks–75 years). Mean follow-up of 12 months.
Outcome measures: End points for ETV failure were shunt insertion or revision of ETV. The diagnostic and therapeutic use of the reservoir was quantified.
Results: 75.5% of ETV's were successful. Mean time to failure was 5.4 months. The reservoir was used in 32% of patients ($n = 27$). In patients with symptoms but equivocal radiological evidence of recurrent hydrocephalus, it allowed assessment of intracranial pressure (ICP; $n = 19$) and/or a therapeutic trial of CSF aspiration ($n = 5$). Seven of these patients subsequently required revision ETV or shunt insertion (32% of all ETV failures). In the 14 patients who had a normal ICP conservative management was successful. The reservoir also allowed emergency ventricular access in acute recurrent hydrocephalus ($n = 2$) and intrathecal drug administration for postoperative ventriculitis ($n = 4$).
Conclusions: Routine insertion of an Ommaya reservoir at ETV has not been previously described. The technique facilitates diagnosis of ETV failure and enables therapeutic CSF aspiration or intrathecal drug administration.

Outcome of endoscopic third ventriculostomy in the adult population

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Objective: To evaluate efficacy of endoscopic third ventriculostomy (ETV) in adult patients with obstructive hydrocephalus.
Design: Retrospective study from 1995 to 2000.

Subjects: There were 60 patients who underwent 63 ETVs during this period. Age ranged from 18 to 72 years (mean 39). Causes of the hydrocephalus were 19 primary aqueductal stenosis, 14 secondary aqueductal stenosis, 17 tumours, seven intracerebral cysts and three intraventricular haemorrhages. ETV was the primary procedure in 45 patients, 25 patients had prior shunt procedures. Follow-up period was from 4 to 44 months (mean 12 months).
Methods: The notes and radiographs of all patients that underwent ETV during this period were examined. Age, sex, cause of hydrocephalus, duration of follow-up and symptom-free period, and appearance of postoperative imaging were recorded.
Outcome measures: Success — full resolution of clinical symptoms; early failures — recurrence of symptoms within 3 months; late failures — after 3 months; CT/MRI appearances and complications.
Results: There were 41 successful outcomes (65%) and 22 failures (35%) — 17 early (27%) and five late (8%). The late failures occurred between 4 and 9 months. Of the 20 patients with failed procedures, 11 (55%) had undergone previous shunt procedures. This compared with 14 of the 40 patients (35%) with successful outcomes. All the failed procedures showed no improvement in postoperative CT/MRI, whereas 83% of the successful procedures showed resolution of hydrocephalus. Complications were — transient diabetes insipidus in two patients and ventriculitis in two patients. There were four deaths that were unrelated to the procedure.
Conclusions: In our experience, ETV is effective in the adult population with obstructive hydrocephalus. It has a short-term success rate of 73% and medium-term success rate of 65%, i.e. symptom free after 6 months. Full longer-term follow-up is required to assess long-term success rate. Previous shunt procedures are strong negative predictors of successful outcomes. We therefore suggest that ETV should be the first procedure to be done in obstructive hydrocephalus to maximize its effectiveness.

Third ventriculostomy for hydrocephalus: Leeds experience

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Objective: To assess the effectiveness and safety of endoscopic third ventriculostomy.
Design: Retrospective analysis of the indications, technique, the results and complications of third ventriculostomies performed between September 1997 and September 2000.
Subjects: There were 74 patients aged between 7 days and 78 years with hydrocephalus who under went third ventriculostomy. The follow up ranged from 4 months to 3 years.
Outcome measures: Clinical and radiological improvement, head circumference in children, technical failures and the rate of conversion of third ventriculostomy to shunt.
Results: Thirty-nine patients were children below 18 years (16 under the age of 1 year) and 35 were adults. The commonest indication was shunt failure (19 patients) followed by primary aqueductal stenosis (11), posterior fossa tumours (10) and pineal region tumours (nine). Only two cases of NPH were treated by this procedure. Most (69%) presented with symptoms of raised ICP. A rigid scope was used in most cases (63), flexible only in those requiring a biosy of tumour or if the rigid scope failed. The stoma was made using a blunt diathermy probe with a figure of 8 balloon in most cases. There were three technical failures and three required further attempts at the procedure; 26 patients out of 74 (35%) required conversion to a shunt. Of the 71 who had the procedure, 72% showed clinical and 58% radiological improvement (more than half within a week). Radiological improvement was noticed as late as 6 months and nine out of 15 children(60%) with an enlarging head showed reduction in head circumference. Twenty-five per cent had neither clinical nor radiological improvement. Few complications were noticed, the commonest being CSF leak, followed by minor haemorhage from veins, and subdural collections.
Conclusions: Third ventriculostomy for hydrocephalus is a safe procedure with encouraging results. Further attempts at third ventriculostomy need to be considered in failed cases before conversion to a shunt.

Vagus nerve stimulation: a prospective audit of complications

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Background: Intermittent stimulation of the left vagus nerve (VNS) is a useful treatment for medically refractory seizures. Ten-thousand devices have now been implanted worldwide. Five previous studies showed a low incidence of complications which have generally been of a minor nature. The very low incidence of cardiac arrhythmia or pulmonary complications has not suggested a causative association. Typically the device is activated three weeks after insertion to avoid any interaction with the anaesthetic.
Methods: A prospective audit of 120 consecutive vagus nerve stimulators inserted.
Results: The complications encountered included: three cases of pneumonia occurring after device activation, one of which was fatal; one episode of asystole under general anaesthesia related to an electrical test of the lead; one child with nocturnal bradycardias; one fatal seizure; two complaints of hyperaesthesia over the stimulator box; one wound infection, one temporary laryngeal nerve palsy and one wound resuturing. One patient who had previously undergone a laryngectomy and had a tracheostomy developed throat pain when his VNS was activated. This responded to replacement of his metal tracheostomy tube with a plastic one.
Conclusions: The Cyberonics vagus nerve stimulator has a reputation as safe treatment for refractory seizures. The cardiopulmonary complication rate, however, appears higher than was previously appreciated and may be causally associated with alteration in vagus nerve function.

Vagus nerve stimulation for intractable epilepsy: changes in seizure frequency and quality of life

D. Holliman & A. Jenkins (Newcastle General Hospital, UK)

Objective: To review our institutional experience with vagus nerve stimulation (VNS) for intractable epilepsy during the period 1995–2000.
Design: A retrospective analysis of changes in seizure frequency, anti-epileptic drug (AED) use and quality of life since VNS implantation, using postal questionnaires.
Subjects: Questionnaires were sent to 20 patients receiving VNS. Two further patients were implanted but died of epilepsy-related events prior to the audit. Replies were received from 17 (85%), non-responders (n = 3) all being parents of paediatric patients. Mean time to follow-up was 27.8 months (range 8–70).

Outcome measures: Changes in seizure frequency, AED use and subjective assessment of changes in quality of life.
Results: Mean seizure reduction was -42% (median -50%, range -88 to +60). For paediatric patients mean reduction was -44% (median -75%) and in adults -41% (median -50%). Seizure frequency reduction of >75% was reported by 35% of patients. No change in AED use was detected. General alertness was increased in 59% of patients, 53% had improvement in mood and 41% reported improvement in post-ictal drowsiness.
Conclusions: These outcomes are broadly comparable to those obtained at other centres worldwide with respect to seizure frequency reduction and quality of life measures. VNS appears to be a safe and effective treatment for refractory epilepsy with our results suggesting the effects of VNS may be more marked in paediatric patients.

The use of intrathecal baclofen in the management of spasticity in children with cerebral palsy

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Objective: To assess benefit from intrathecal baclofen (ITB) therapy in spastic tetraparetic children with cerebral palsy in the UK. Investigation by the Sheffield aggressive research group (ScHARR) demonstrated benefit for the treatment of spastic tetraparetics with ITB by improving quality of life, avoiding pressure sores and easing nursing care.
Design: Children with spastic tetraparesis due to cerebral palsy underwent a preimplant screening programme of examination under anaesthetic and bolus injection of baclofen via a lumbar intrathecal catheter. Once awake, the patients were re-examined and pump implantation planned if quality of life or ease of nursing care was noted. A subcutaneously placed Medtronic EL10/EL18 programmeable pump drug delivery system was used.
Subjects: Twenty-four cerebral palsy patients with spastic tetraparesis, 15 male and nine female, aged 5 years 4 months to 17 years 9 months.
Outcome measures: Clinical outcome study incorporating Ashworth scoring, quality of life assessment and opinions of patients and carers.
Results: The preimplant screening showed insufficient effect of baclofen in one child, but proved to be predictive of the success of ITB in all other children. All implants have been uneventful at operation, but migration of two catheters has necessitated their repositioning within the lumbar theca. One pressure sore has developed over the pump itself due to tight restraining straps at school. This had to be removed to allow healing before re-implantation. Percutaneous refills of the pump and change in concentration of the reservoir dose are well tolerated.
Conclusions: ITB is very effective in the treatment of the extreme spasticity in the spastic tetraparetic children, where there is great improvement in both quality of life and ease of nursing care. Funding for ITB is recommended, but must be part of a clinical outcome study. The use of ITB in diplegic children to improve gait has no proven benefits.

Spinal tumours in neurofibromatosis type 2—incidence progression and correlation with type of gene mutation

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Objective: To examine the incidence, classification and progression of spinal tumours in NF2 and to correlate this with emerging genetic subgroups.
Design: Retrospective review of serial radiological and genetic records.
Subjects: Sixty-three patients with NF2 under active follow up at a multidisciplinary clinic.
Outcome measures: Radiological incidence and progression of spinal tumours.
Results: Forty-two patients (67%, median age 32.5 years, range 17–66 years) had one or more spinal tumour. The majority had multiple extrinsic Schwannomas of various sizes. Eleven (26%) had intrinsic cord tumours with the appearance of ependymomas and six (14%) had probable meningiomas. Ten patients (24%) had evidence of radiological progression, the majority being of large extrinsic tumours. No patient with multiple small extrinsic tumours exhibited progression, although this did not reach significance ($p = 0.09$, Fisher's exact test). 100% of patients with a protein truncating genotype had spinal tumours,[1] and this was significant when compared with other genotypes as a whole ($p = 0.03$, Fisher's exact test).
Conclusions: Patients with NF2 develop multiple and various spinal tumours, but large extrinsic and intrinsic tumours are the most likely to progress. The discovery of genetic subgroups aids understanding of phenotypic variability.

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Management of odontoid process fractures in the elderly

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Objective: A retrospective review of elderly patients presenting with fractures of the odontoid process. These are mostly fragility fractures due to osteoporosis and the management of such fractures in the elderly is debatable. We evaluate the clinical presentation, management, and clinical and radiological outcome.
Materials and methods: The clinical records of patients with cervical spine fractures were reviewed to identify those with fractures of the odontoid process. We identified 37 cases (from January 1996–December 2000) of which 15 (40.5%) were aged 65 years and above (elderly). The demographics, management and follow-up data of 4 years were reviewed and analysed. Outcome was measured by radiological stability of the fractures, morbidity and mortality.
Results: The age range in this small series was 67–87 (mean age 76). Most sustained injury from a trivial fall and none presented with myelopathy. Neck pain and radiculopathy were the predominant symptoms. Radiology revealed a Type II fracture in 13 cases and Type III in two cases. Six were surgically managed and the remaining patients underwent closed treatment with halo and hard cervical collar for periods ranging from 5–9 months (average 6 months). Old age, patient's refusal and associated medical problems precluded surgical management. One patient died following halo fixation. The remaining patients had a good outcome with no new disability. Follow up radiological investigations (CT and dynamic plain radiographs) showed persistence of the fracture line but satisfactory alignment and stability in all patients.
Conclusions: The physiological age of the patient is a major determinant of method of management. Surgical treatment remains the ideal, but conservative management

can result in stable pseudoarthrosis and good clinical outcome. We conclude that conservative therapy can be 'successful' in the elderly despite radiological non-union at the fracture site.

A review of neurosurgical negligence cases reaching the law courts. Why, when and how much!

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Aims: To assess the type of, and rationale behind, neurosurgical cases reaching the law courts, with analysis of the pitfalls, outcome and damages.
Design: A retrospective review of 11 neurosurgical negligence cases brought into court over a 10-year period (all cases are within the public domain).
Outcome measures: The facts of the case, the claims of negligence, the judgement, the reasoning behind the judgement and the level of damages, if awarded.
Results: Eleven cases were assessed and 5/11 were judged to be negligent. There was a time lag of between 12–48 months from the initiation of proceedings to the conclusion. The legal costs were up to £100 000 per side. The cases which were judged to be negligent were lost on the basis of poor performance, expertise, communication, verbal advice and note keeping. Those cases which were won were upheld on a mirror image of the same facts. The Bolam test was utilized in a significant minority of cases. In some cases damages were up to 1 million pounds.
Discussion: In this culture of litigation and blame, medical negligence cases are becoming more frequent. Those reaching the courts are the tip of the iceberg. With even the Bolam test deserting the medic, and further increasing sub-specialization are we leaving the door open for a torrent of court appearances?

Xenon CT measured cerebral blood flow in patients with angiographic vasospasm

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Objective: To assess the impact of angiographic vasospasm on cerebral blood flow as measured by xenon CT.
Design: The study is a review of angiograms and xenon CT scans comparing vessel calibre with cerebral blood flow. All cerebral angiograms were reviewed independently by a neuroradiologist and graded for vasospasm in five major vessel regions (ICA, ACA, MCA, PCA and basilar artery). From the xenon CT scans, mean CBF was calculated for each of the three major supratentorial vascular distributions (ACA, MCA, and PCA).[1]
Subjects: Sixty-one patients who suffered CT verified subarachnoid haemorrhage (SAH) and underwent four vessel cerebral angiography and xenon CT (within 12 h of angiogram) during hospitalization.
Results: Nineteen of 61 patients had moderate or severe vasospasm by angiography. There was no relationship between vessel calibre on angiogram and the corresponding regional cerebral blood flow as determined by xenon CT (Rank correlation = -0.18). Patients with moderate and/or severe vasospasm, however, did have globally reduced cerebral blood flow and a poorer outcome than patients without angiographic vasospasm.
Conclusions: Moderate or severe angiographic vasospasm of the large, proximal intracranial arteries is not associated with reduced cerebral blood flow in the corresponding vessel's distribution. These findings are consistent with another published study, which demonstrated that proximal angiographic vasospasm is not associated with a significantly decreased blood flow in the distal cerebral circulation.[2]

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Detecting adverse cerebral metabolic events after subarachnoid haemorrhage

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Objective: To investigate whether episodes of ischaemia after SAH can be detected by focal cerebral monitors and to document their relationship with clinical outcome.
Design: An observational study using Neurotrend recorded continuously and microdialysis chemistry analysed hourly.
Subjects: Thirty-five poor grade patients after SAH and five after complex aneurysm surgery
Outcome measures: Glasgow Outcome Score at 3–6 months.
Results: The total duration of monitoring was 174 days (mean 4, range 1–12 days). Mean ± 95% cerebral values were: PO_2 3.1 ± 0.5 kPa, PCO_2 6.6 ± 0.4 kPa, pH 7.11 ± 0.05, glucose 0.8 ± 0.3 mmol/l, lactate 3.1 ± 0.6 mmol/l, lactate/pyruvate ratio (L/P) 27 ± 4, glucose/lactate (G/L) 0.6 ± 0.2 and glutamate 4.7 ± 2.4 μmol/l. Daily subtotals for SAH patients showed that brain PO_2 was lower and lactate higher on days 6–12 (not significant at $p = 0.05$ ANOVA). WFNS grades 4 and 5 had higher lactate, L/P and lower G/L ($p = 0.05$). Patients who died had lower G/L and those with severe disability had higher lactates ($p < 0.05$). Brain PO_2 decreased below 1.1 kPa in 78% of patients for a mean of 18 ± 6% (95% CI) of time monitored. There were a total of 197 episodes in which PO_2 decreased below 1.1 kPa continuously for at least 30 min. Poor outcomes had experienced more of these episodes [8.8 ± 4.4 versus 2.2 ± 1.1 (95% CI) good outcome]. Poor outcome was also associated with an episode of glutamate over 10 μmol/l or a L/P over 40 ($p < 0.05$ Chi squared).
Conclusions: Episodes of ischaemia are detected by Neurotrend and microdialysis, and are associated with poor outcome.

Cavernous malformations of the brain stem. Natural history and treatment options

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Objective: To evaluate the natural history of brain stem cavernomas and to weigh controversial treatment options against the cumulative natural risk.
Design: Prospective analysis of clinical and radiological follow-up of patients harbouring symptomatic brain stem cavernomas.
Subjects: From 1991 to 2000, 11 patients fulfilled established criteria for brain stem cavernomas in a single institution. Three female, eight male. Age ranged from 31 to 60 years (median 42). Patients were evaluated with CT,

MRI and four-vessel angiography. Patients were followed up from 0.5 to 9.3 years (median 4.1) in the outpatients clinics or during re-admissions.
Outcome measures: Clinical presentation and progression over time, familial occurrence in the UK, risk of rebleeding and neurologic disability, outcome of various tratments.
Results: Patients presented with diplopia (91%), limb or facial numbness (82%), headaches (58%), poor balance (48%), limb weakness (36%) and speech problems (36%). Lesions were located in the midbrain (72%), pons (18%) and medulla (10%). All had pathognomonic MRI features and negative angiography. In contrast with North American studies, no case of familial cavernoma was identified and association with MS was found to be low (9%). None of the patients were hypertensive. In the long term, headache was the most persisting symptom (42%), whilst diplopia resolved in most (84%). There was no mortality. Three patients rebled (27%), two early (<2 months), one late (>7 years). One of them was operated on, but developed hemiparesis. Eight were treated conservatively and showed gradually resolving symptoms with no rebleed on serial imaging. Two underwent stereotactic radiosurgery but had no neurological improvement.
Conclusions: Patients with gradually improving symptoms can be safely followed up. Rebleeding is rarely massive, but increases the incidence of persistent neurological deficit. Rebleeding has unpredictable outcome and is not per se an indication for surgery. The role of stereotactic radiosurgery appears to be limited. Lesions causing acute neurological deterioration should be excised if they extend to pial surface.

Cranioplasty — why throw the bone flap out?

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Introduction: With the recent resurgence in the use of decompressive craniectomy, many patients subsequently require cranioplasty. Cranioplasty agents, including titanium and acrylic resins have been used to fill the defect. Despite difficulties in sterilisation and storage, the best long-term results are achieved by using the patients' own bone.[1] Flaps replaced at a delayed interval have a high incidence of failure. Placement of the flap in a subcutaneous pouch in the abdominal wall and subsequent use has been reported in children.
Design: The authors describe an observational study of patients who underwent decompressive craniectomy for increased intracranial pressure. Flaps were placed in a subcutaneous pocket in the anterior abdominal wall. Patients were observed for signs of wound infection. Follow-up of replaced flaps is ongoing.
Results: Fourteen patients underwent decompressive craniectomy with abdominal placement of the bone flap. Two patients have died and seven have had their bone flap replaced. Wound healing and cosmetic appearance have been good in all patients. We have experienced no wound infections.
Discussion: Use of an abdominal subcutaneous pocket provides a convenient method for storing a patient's own bone flap. It provides a sterile environment maintaining viability of the bone flap, which cannot be lost. Additional surgical time is minimal and subsequent cranioplasty easy.

References

1 Hayward RD. Cranioplasty: don't forget the patient's own bone is cheaper than titanium. *Br J Neurosurg* 1999; 13(5):490–1.

Evaluation of an antimicrobial impregnated shunt system.

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Objective: To determine whether the VP shunt infection rate could be reduced with the use of an antimicrobial impregnated shunt (AIS).
Design: Single blind, prospective, controlled and randomized study.
Subjects: Final cohort of 110 hydrocephalic patients in whom the cause of hydrocephalus was defined as non-infected.
Outcome measures: Development of infection in the shunt, the overlying wound, the CSF or the distal drainage site related to the VP shunt.
Results: The study demonstrated a significant reduction in shunt infections with the use of AIS ($p = 0.038$; 80% power and 5% level of confidence). *Staphylococus aureus* was the commonest organism found. Children <1 year old, demonstrated a trend towards being susceptible to shunt infections.
Conclusions: AIS was found to be a useful tool to reduce shunt infections.

The joint management of combined injuries of the cranium and the face

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Objective: To provide a rationale for the case selection and timing of surgery in the combined management of craniofacial trauma.
Design: A retrospective analysis of the clinical records of a consecutive series of patients, according to our protocol, requiring combined neurosurgical and maxillofacial surgical intervention for combined craniofacial injuries.
Subjects: There were 100 patients with a mean age of 27.5 years treated between 1988 and 1999.
Outcome measures: To assess the risk related to the timing of surgery we have assessed: neurological outcome, requirement for secondary surgery, CSF leakage following craniofacial repair, late infective sequelae and mortality. For the indications for combined repair we have related our clinical and radiological criteria for combined repair to the presence of dural tears.
Results: Glasgow outcome scores showed 87% with a good recovery with no deaths and none in the vegetative group. Secondary surgery was required in 14%; there were no cases of postoperative CSF leaks and no cases of postoperative meningitis or cerebral abscess. Dural tears were present in 86% of cases that fulfilled our radiographic criteria.
Conclusions: Combined management of craniofacial trauma according to our protocol has proven to be a safe and effective method of care.

The use of ciliary neurotrophic factor (CNTF) to promote recovery after peripheral nerve injury by delivering it at the site of the cell body

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Objective: Neurotrophic factors are important in the development and maintenance of neuronal function. Previous studies have shown no benefit using CNTF as an adjunct to surgical nerve repair when applied to the site of nerve injury. This study was to establish whether nerve

regeneration was improved by the addition of CNTF at the level of the cell body.
Design: Three groups each contained five sheep. Group 1 were unoperated controls. In the other groups, the median nerve was divided and repaired by epineurial suture. In group 2, CNTF was delivered into the subarachnoid space by an implanted osmotic pump at C6. In group 3, the pump contained saline. Electrophysiological and morphometric assessment took place at 6 months
Results: The CNTF group showed significantly better results in: (1) area and amplitude of the muscle action potential ($p = 0.025$ and 0.0007, respectively), (2) tetanic tension ($p = 0.0025$), (3) muscle mass ($p = 0.025$).
Conclusions: CNTF may confer a functional benefit when applied at the level of the cell body. We suggest that this benefit is exerted through earlier reinnervation of muscles and hence less atrophy. The effect of intrathecal CNTF may have to be reassessed, i.e. in motor neuron disease.

The problems of data loss encountered during a prospective infection audit in the neurosurgical setting

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Aims: To attempt to audit the 30-day postoperative infection rate in a general adult neurosurgical practice.
Design: A prospective clinical assessment study of consecutive patients, operated on in the Department of Neurosurgery, Queen's Medical Centre, Nottingham, over a 1-month period. Patients were followed up for 30 days postoperatively, including follow-up in the referred institution or community after discharge.
Outcome measures: Coexistent morbidity, operative data and clinical evidence of infection.
Results: Eighty-one patients were included in the study (39 M, 42 F, age range 17–89), 32 patients had pre existing morbidity predisposing to infection, 11 operations were performed for trauma. There were four cases of preoperative contaminated wounds. There were 89 operative procedures (59 cranial, 30 spinal), 53 were performed by the consultant, 36 by the SpR. Fifty operations were of more than 3 h duration, 39 patients were given prophylactic antibiotics and 10 patients were nursed on the ITU. We encountered four (5%) wound infections, one (1%) bone flap infection and one case of meningitis after pituitary surgery, nine (11%) had urinary tract infections, six (7%) had ventilator-associated pneumonia, one patient had femoral line sepsis and one developed septic arthritis. The predisposing factors seemed to be the type and length of surgery, the patient's premorbid status and admission to the intensive care unit. Grade of surgeon and the use of prophylaxis seemed to have no bearing on the risk of infection.
Discussion: Our infection rates are higher than those documented in the literature. This may be related to preventable factors, which we have tried to identify. The premorbid state of the patient, the type and length of surgery, and the rapid turnover of patients may all contribute to the rate seen. However, we have encountered significant logistic difficulties with data collection. We have documented a stepwise loss of data over the 30-day collection period, with up to a 50% data loss by the end of the study. This may be specific to neurosurgery due to the transfer of patients from the unit to other institutions or into the community. The loss of data seems to be proportional to the length of follow up, the number of patients in the study and discharge destination. It is possible that this data loss has been encountered in published series, so the published infection rates may in reality be higher than those reported. Our figure may be closer to the actual level seen in neurosurgery. This may have implications on practice, consenting procedures and clinical governance.

Serum phenytoin level following craniotomy

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Objective: Phenytoin is often used to prevent postcraniotomy seizures, but is not always effective. We investigate changes in serum phenytoin levels following craniotomy.
Design: Prospective observational study.
Subjects: Patients receiving phenytoin who underwent craniotomy.
Outcome measures: Serum phenytoin was determined preoperatively, immediately and 24 h postoperatively. Patients' age, sex, phenytoin dose, pathology, operative duration and blood loss were analysed.
Results: There were 28 patients with a mean age of 54 years (range 23–79): 17 patients had gliomas, seven meningiomas, two aneurysms, one arteriovenous malformation, and one infected bone flap. The average operative duration was 2.7 h (1–8). Mean blood loss was 321 ml (150–1500) and 12 (43%) patients had a preoperative serum phenytoin level < 10 mg/l, 13 (46%) 10–20 mg/l, and 3 (11%) > 20 mg/l. Twenty-five (89%) patients experienced decreased serum phenytoin immediately postoperatively: pre-, immediate post- and 24 h postoperative mean phenytoin levels were 13.4 mg/l (5.0–30.0), 10.0 mg/l (2.5–27.0), and 12.9 mg/l (5.0–24.0), respectively. Operative duration and blood loss correlated with decreased serum phenytoin immediately postoperatively ($p < 0.05$).
Conclusions: Under half of the patients had therapeutic phenytoin levels (10–20 mg/l) before craniotomy. In most patients, serum phenytoin decreases (mean 3.4 mg/l) after craniotomy, and returns to preoperative level within 24 h. This may contribute to early postoperative seizure development.

The use of CT in the management of hydrocephalus in children under one—are we exposing vulnerable brains to excessive irradiation?

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Objective: To audit the use of CT scanning in children aged less than 1 year at the time of ventriculo-peritoneal shunt insertion for hydrocephalus, because of the known risks of irradiation.
Design: A review of the clinical records and imaging studies that these children underwent at our institution was undertaken.
Results: One-hundred-and-forty-nine patients were identified (90 male and 59 female). Ventriculo-peritoneal shunting was performed at a median age of 93 days (interquartile range 47–161 days). Preoperatively they underwent a median of 1 CT scan (range 0–12, interquartile range 1–2) and postoperatively a median of 1 CT scan (range 0–13, interquartile range 1–2). In total, 92, 47 and 10 children underwent 0–2, 3–5 and >5 CT scans, respectively, under the age of 1 year. Two patients underwent 13 scans each. The average effective dose that these children were exposed to was 1.28 mSv (standard deviation 1.01 mSv).

Conclusions: A single CT scan probably does not constitute a significant risk to the incompletely myelinated child's brain. With time, however, these children are likely to be exposed to significant radiation doses. Careful patient positioning and angling of the gantry, use of radioprotective shields or lowering the milliampere seconds used during CT could reduce radiation exposure. Particular thought needs to be given to those children suffering post-operative complications as it is these individuals who undergo frequent imaging. Ultrasound and MRI should be considered more frequently for imaging and monitoring of postoperative complications.

Intracranial fungal granulomas

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Objective: To study the outcome in patients with intracranial fungal granulomas.
Design: Retrospective study.
Subjects: Thirty patients presenting with symptoms of intracranial pathology and with histologically proven fungal lesions in the last 20 years were included.
Outcome: Follow-up ranged from 3 months to 11 years.
Results: Most of the patients presented with features of multiple cranial nerve palsies and signs of raised intracranial pressure. The age at presentation varied from 6 to 62 years. Investigations revealed involvement of paranasal sinuses in 50% of patients, 11 patients had diabetes and five pulmonary tuberculosis. One patient had renal transplantation. Only one of the nine patients tested for HIV was positive. In 19 patients the lesion was aspergillosis and in five mucormycosis. Cryptococcus and cladosporium were isolated in three patients each. In all the 18 patients where the lesion was subjected to microbiological examination, there was growth of the fungus. Appropriate antifungal treatment was administered post operatively. Six patients died during the postoperative period, and a further 16 in the follow-up period.
Conclusions: Mortality is high with intracranial fungal granulomas. A high degree of suspicion and preoperative anti fungal treatment may reduce operative morbidity and mortality.

The impact of protocol driven intensive care therapy on outcome following severe head injury—evidence for supporting transfer of patients to neurosurgical units

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Objective: Not all patients with severe head injury are transferred to specialized neurosciences units. Recently, it has been recommended that such patients are treated in specialised units regardless of whether they need surgical intervention.[1] The objective was to examine the impact on outcome of treating ventilated head-injured patients in a specialized Neuroscience Critical Care Unit using protocol-driven therapy, including burst-suppression therapy, external ventricular drainage of CSF and surgical treatment of intracranial hypertension.
Design: Retrospective assessment of outcome in two time epochs (before and after protocol driven management in a specialized Neuroscience Critical Care Unit).
Subjects: A total of 285 ventilated patients (age range 18–65 years) with head injury. Patients with bilateral fixed and dilated pupils were excluded.
Outcome measures: Glasgow outcome score (GOS) at 6 months. Favourable outcome was defined as GOS good recovery and moderate disability.
Results: Patients were matched for age, admission Glasgow coma scale (GCS), injury severity score and physiological abnormalities between the two epochs. For all patients there was a non- significant increase in favourable outcome following the introduction of protocol-driven therapy (56.0 versus 66.4%, $p = 0.15$). For patients with initial GCS of 8 or less, there was a significant increase in favourable outcome (40.4 versus 59.6%, $p = 0.03$). For patients with intracranial hypertension, but no mass lesions (Marshall Diffuse Injury III), protocol-driven intensive medical treatment and drainage of CSF resulted in favourable outcomes in 62.5%.
Conclusions: Protocol driven therapy is associated with a significant improvement in outcome for patients with severe head injury. The results support the concept of the management of all patients with severe head injury in specialized neurosciences units.

Reference

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The origin and age of striatal neural precursors influences their potential to facilitate repair of the central nervous system

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Objectives: In order to develop a surgical protocol for use in clinical trials of intracerebral implantation of striatal neuroblasts in patients with Huntington's disease, the preparation and delivery of the embryonic tissue must be carefully evaluated. The aim of this study was to explore the relationship between embryonic dissection and donor age with respect to the morphology, function and physiological integration of the resultant grafts with the host neuropil.
Methods: Tissue derived from embryos of 14 and 16 days gestation was prepared as whole, lateral and medial ganglionic eminence suspensions. The tissue was implanted into the excitotoxically lesioned striatum of host rats. Six months after grafting retrograde tracing of graft projections to the globus pallidus was performed followed by electrical excitation of cortical afferent fibres.
Results: Grafts derived from the lateral ganglionic eminence of younger donors attenuated drug-induced rotational bias. Grafts of medial ganglionic eminence from the younger donor group ameliorated deficits in contralateral paw reaching. Grafts derived from the younger donor tissue contained more striatal tissue than from older donors. Immediate early gene expression in retrogradely labelled striatal neuroblasts following afferent cortical stimulation was identified in grafts derived from younger donors.
Discussion: This study indicates that younger donor tissue that is undergoing striatal neurogenesis is capable of better structural and functional integration into the damaged host neuropil compared with older donor tissue where neurogenesis is almost complete. These results have been incorporated into cell delivery protocols in a Phase 1 clinical trial of cell replacement therapy in patients with Huntington's disease.

Disorganization of the facial nucleus after nerve lesion and regeneration the effects of cell transplants at the site of injury

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Objective: To study the organization of the facial nucleus and nerve regeneration after transplanting Schwann cells, olfactory bulb cells, and S-subtype olfactory ensheathing cells to a complete facial nerve lesion.
Design: We used an animal model of facial nerve lesion and repair, which demonstrates abnormal organization of the facial nucleus after regeneration and reflects the clinical sign of synkinesis. In rats (n = 20), retrograde fluorescence labelling of the distal branches of the facial nerve showed that myotomes are somatotopically represented in the facial nucleus. In another group (n = 18), the proximal facial nerve was cut completely, proximal to the parotid gland, and immediately sutured end-to-end. A period of regeneration was allowed, and confirmed by ipsilateral eye closure. Histology of the brain stem revealed that the somatotopy of the facial nucleus was no longer preserved. To determine whether the organization of the facial nucleus might be improved, the brain stem histology was assessed in further experimental groups after transplanting candidate reparative cells to the lesion. (Schwann cells n = 10 rats; olfactory bulb cells n = 18; S-subtype cells n = 6)
Results: Our model clearly demonstrated the failure of adult facial nerve axons to make correct connections during regeneration and illustrates the clinical problem of synkinesis. The support cells in this study were not able to align regenerating axons, and the facial nucleus remained disorganized.
Conclusions: Synkinesis is mainly due to misguided regenerating axons. Providing supporting ensheathing cells alone is insufficient to control aberrant regeneration.

Glucocorticoids modulate the neurotrophin response to head injury, but do not affect outcome

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Objective: To determine the effects of alterations of the glucocorticoid status on neurotrophin expression in the hippocampus and on outcome after traumatic brain injury (TBI).
Design: Neurotrophin expression in the rat hippocampus is altered by experimental traumatic brain injury and neurotrophins are neuroprotective. Glucocorticoids are regulators of brain neurotrophin levels and are often prescribed following TBI. We used fluid percussion injury (FPI) in adrenal-intact or adrenalectomized (ADX) rats with or without corticosterone replacement.
Outcome measures: *In situ* hybridization was used to assess neurotrophin expression in the hippocampus after FPI. Cognitive outcome in these experimental groups was determined using the T-maze test. Histological outcome was measured by counts of normal, necrotic and apoptotic neurones in the hippocampus on H&E sections. Assessment of the mode of neuronal death was additionally made using cresyl violet sections, the TUNEL technique and immunohistochemistry for markers of apoptosis.
Results: NGF and BDNF mRNA expression were increased in the hippocampus by FPI (ANOVA, $p < 0.05$). Prior ADX obliterated the NGF response to FPI ($p < 0.0001$), but enhanced the BDNF response ($p < 0.05$). NT-3 mRNA expression was decreased by FPI ($p < 0.0001$) and further reduced by ADX ($p = 0.0009$). Neurons in the hippocampal CA3/2 region and the hilus of the dentate gyrus (DG) underwent non-apoptotic cellular death after FPI associated with a significant impairment of T-maze performance ($p = 0.03$). ADX caused apoptotic neuronal loss in the DG, which was not associated with a deficit in T-maze function. Prior ADX did not significantly affect the histological or cognitive outcome after FPI.
Conclusions: Glucocorticoids have a critical, but paradoxical role in the modulation of the neurotrophin responses to TBI. Although ADX altered the trauma-induced neurotrophin response, it did not affect cognitive function or the degree of hippocampal neuronal loss after FPI. These results further question the use of glucocorticoids after head injury.

How should we manage immediate posttraumatic seizures in children following minor head injury?

K. Mandal & C. G. H. West (Hope Hospital, Salford, UK)

Objective: To determine the characteristics of children having seizures following minor head injury and assess the need for intubation and ventilation in such patients.
Design: A retrospective review of records of children admitted with a posttraumatic seizure occurring within 24 h of a minor head injury and a normal CT scan of the brain on admission. Those with previous neurological disorders, especially seizures (excepting febrile convulsions), were excluded.
Subjects: Twenty-six children fulfilling these criteria were admitted to the Neurosurgical Ward at the Royal Manchester Childrens Hospital between 1980 and 2000.
Outcome measures: Recurrent seizures, adverse outcomes attributable to intervention (intubation and ventilation) or non intervention (observation).
Results: Two groups of children were compared: Group A comprised 13 children who were intubated and ventilated, but the 13 children in Group B were not. None of the children in either of the groups had any neurological deficit either at discharge or at follow up.
Conclusions: Children with immediate posttraumatic seizures following a *minor* head injury, whose CT scan shows no major intracranial abnormalities and who have no prior history of neurological disease are at low risk of developing recurrent seizures[1] or neurological complications and can be safely managed without recourse to intubation and ventilation.

Reference

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