PROGRESSIVE KYPHOSIS WITH CORD COMPRESSION IN THE RHEUMATOID CERVICAL SPINE
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In a series of about 160 rheumatoid cervical spines seen over 20 years 70 were treated conservatively, of which five eventually needed operation, and 88 were operated on in a variety of ways. Among the whole group were six cases with a severe and progressive kyphosis affecting the length of the cervical spine from C2-C7. A compensatory lordotic deformity at the cranio-cervical articulation was present. Cervical cord compression was the indication for operation. The main anatomical and pathological features were involvement of the discs anteriorly and extensive destruction of the apophyseal joint spinous processes, laminae, and ligamentous structures posteriorly. These changes, particularly the posterior ones, allowed toppling of the cervical spine in an anterior direction. The deformity at the atlantoaxial articulation seemed to be compensatory. Surgical treatment has proved difficult. Posterior stabilisation is unsatisfactory. Limited success has been obtained by the use of an anterior fibula graft combined with cancellous bone. This seems more likely to succeed than multiple interbody fusions.

STEREOTAXIC TARGET SELECTION FOR THALAMOTOMY FOR MOVEMENT DISORDERS
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Stereotaxic thalamotomy is a regularly, if infrequently performed procedure for movement disorders such as Parkinson's disease, dystonia muscularum deformans, intention tremor from trauma and multiple sclerosis, and benign essential tremor. Although a resurgence of interest in the use of posteroventral pallidotomy, as first practised by Leksell, has been reported by Lahtinen et al, various targets, related to various fixed points has been used. These are based on the foramen of Monro, the anterior commissure, and the posterior commissure. Some surgeons relate target coordinates to the foramen of Monro, some to the anterior commissure, and some to the midpoint of the intercommisural line. Lahtinen et al obtained their preferred radiological target from 14 different stereotaxic surgeons, related to the midpoint of the intercommisural line. With this map, the favoured target after stimulation for physiological localisation was demonstrated in a series of over 100 thalamotomies.


INVESTIGATION OF POSTOPERATIVE RECURRENT SCIA'TICA
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During recent years the radiological investigation of recurrent sciatica after lumbar discectomy has evolved from myelography through enhanced CT to the current gold standard of multiplanar, multiple sequence, gadolinium enhanced MRI. To define the minimum imaging required to confidently distinguish between recurrent disc and epidural scarring, a blind retrospective analysis was undertaken with 20 such cases inspected in January 1991. Multidimodality analysis showed that symptomatic disc recurrence was characterised by an anterior or antero-laterally placed extradural mass at the level of the disc space or pedicle, occupying more than one third of the spinal canal width and elevating the dural tube. In contrast, postoperative scarring was confined to the level of the disc space, extended laterally around the canal drawing the dural tube towards it and when anteriorly placed occupied less than one quarter of the canal width. Assessing the contribution of each sequence to the final diagnosis, precontrast T1 weighted or proton density scans were sufficient to enable confident clinical management of the patient. Additional T2 weighted and gadolinium enhanced T1 weighted scans allowed more precise radiological distinction of scar from disc but did not alter eventual management.

If the morphology of symptomatic postoperative extradural masses are taken into consideration, single sequence MRI is sufficient in most cases to differentiate recurrent lumbar disc herniation from epidural scarring. Multiple time and money consuming investigations may be reserved for those few cases where doubt remains.

REPORT OF A NATIONAL NEUROSURGICAL TELERADIOLOGY SYSTEM BASED ON OPTICAL SCANNING TECHNOLOGY
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In a previous report to this society, it was shown that optical scanning technology was a promising technique for capturing high resolution CT images for teleradiological transmission. We have further developed this technology and have designed and installed a national neurosurgical teleradiology system in Ireland based on optical scanning.

With Telematic grant funding, dedicated x ray scanners were developed to digitise hard copies of CT and MRI scans. These scanners use charge coupled devices to convert the light transmitted through the radiographs to an analogue voltage, which is then digitised. This digital data is read into a transmitting computer that transfers the electronic image to the remote computer in the receiving neurosurgical unit. Here the image can be viewed and manipulated. The system is PC based running under Microsoft Windows. Data transmission is over leased data lines at 128 Kbps per second.

The system has been installed in four remote sites draining into the two neurosurgical centres in Ireland. The system is in full clinical use with over 400 emergency CT scans successfully transmitted to date. The system is simple to use, has gained widespread acceptance, and delivers an image quality superior to many commercially available systems.

EMERGENCY MEDICAL IMAGE TRANSMISSION
BY FAX
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The benefits of image transfer are well known to neurosurgeons and radiologists. Unfortunately, cost is a major constraint, particularly if systems are to be made widely available at reasonable cost or indeed in developing countries.

A novel method is described for emergency medical image transmission, which relies largely on available technology. The technique involves the reproduction of a CT, MRI, or x ray film with a new direct print photographic paper that produces an image of photographic quality in 90 seconds. This is then transmitted by a 64 grey scale fax machine.

To evaluate the efficacy and image quality of this system, a consecutive series of 10 scans sent to the neurosurgery unit at the Royal London Hospital from peripheral units for urgent neurosurgical opinion, were then faxed to neurosurgery registrars and consultant neuroradiologists at five neurosurgical centres. Their opinions were then compared with that of a neurosurgeon and a neuroradiologist who viewed the original image. Examples of the image quality and results were discussed.
ELECTRICAL MAPPING OF THE SPINAL CORD
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The dermatomal pattern of sensory innervation of the skin has been established for many years, but despite this, methods of stimulation of the spinal cord during neurostimulation procedures for pain, to determine those areas most closely associated with the sensory innervation of "difficult" regions to treat, such as the lumbar spine and the perineum.

Stimulation at D1 produced evoked responses over the chest and abdomen the pain of angina (also improving left ventricular function). Stimulation at D8 most consistently produced evoked responses in the lower back. The perineum (bladder, vagina, and rectum) was mostly affected by stimulation at D9/10. As the electrode moved caudally at this region, the evoked responses moved cranially and "deeper" into the perineum.

Chronic pain in the lower back and perineum are notoriously difficult to treat with neurostimulation. By inserting the electrodes under local anaesthesia and identifying the evoked responses in the appropriate region with the starting points indicated gives the best chance of success.

CEREBRAL RESPONSES TO TRIGEMINAL NEURALGIA PAIN MEASURED BY POSTERION EMISSION TOMOGRAPHY (PET)
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Although trigeminal neuralgia is clinically well defined little is known about the central representation of the pain experience.

Eight patients with right sided trigeminal neuralgia each underwent two PET studies with the opiate analogue ligand 11C-diprenorphine; the first before RF-thermoablation, the second after successful treatment (mean visual analogue score changing from 45 ("pain") to 0 ("completely pain free")). Tergotrel doses were unchanged between scans. For each subject the two PET studies were coregistered and subtracted on a pixel to pixel basis to obtain precisely the focal brain changes in 11C-diprenorphine binding. These changes were then averaged across the five subjects.

Elevated binding in all patients with global increases in binding after treatment. Significant focal increases (p < 0.01) were found in the prefrontal and anterior cingulate cortex of the patients. Interestingly, these changes were bilateral but more prominent on the right and did not correlate with changes in regional cerebral blood flow, which were widespread and non-specific. Increased binding of 11C-diprenorphine when pain-free suggests that endogenous opiates are no longer filling receptor sites and indicates that the opiate modulated medial pain system is important in the central response to trigeminal neuralgia pain.

NEUROSTIMULATION FOR PAIN RELIEF: THE ROYAL LONDON HOSPITAL EXPERIENCE
JK Harris, JC Sutcliffe, TH Koeze, S Mooney. Department of Neurosurgery, Royal London Hospital, London, UK

Neurostimulation is an accepted treatment for the relief of chronic pain. The equipment is expensive and the treatment requires a dedicated, specialised follow up and maintenance service. The results of neurostimulation for pain are reported in 80 patients who required 90 stimulator systems.

The mean duration of symptoms before neurostimulation was 11.5 (range 1–31) years, with a mean follow up period of 4.1 (range 0.3–14.5) years. Sixty seven per cent of patients reported to clinicians that they experienced at least 50% relief of their pain, 19% reported no relief. Twenty one patients experienced complete or near complete resolution of their pain at some time during treatment. The outcome reported to clinicians was compared to that documented by a disinterested third party investigator. Complications of the procedure included a wound infection rate of 9.5% and surgical repositioning of the electrode in 17%. An assessment was made of the results according to clinical diagnosis and stimulation type, site, and operative variables.

THE SHEFFIELD EXPERIENCE IN THE TREATMENT OF ACOSTIC NEUROMA BY STEREOTACTIC RADIOSURGERY: THE LEARNING CURVE
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Fifty five acoustic neuromas have been treated by radiosurgery in Sheffield. Of these 29 tumours in 27 patients have been followed up for more than four years. Most patients had central neurofibromatosis, with some considered unsuitable for microsurgery and some who refused to consider it. Tumours were bilateral in 18 and unilat- eral in nine. The radiation dose chosen was similar to that used for AVMs and the growth of 11 out of 17 tumours was controlled (seven decreased in size) but five patients developed facial weakness and three a sensory deficit and only three of the nine with useful hearing were able to maintain it afterwards. Therefore the dose to the periphery of the lesion was reduced from 2500 to 1750 GY. In the subsequent 12 tumours 11 have been controlled (six decreased) with one facial weakness and one sensory loss with preservation of hearing in four out of the six with useful hearing. Four of the seven failures were over 3 cm in diameter. Not surprisingly smaller tumours can be treated better and more safely. The reasons for failure were discussed. Without careful selection and radiation dosage, influenced by the need to preserve hearing, radiosurgery makes a valuable alternative to microsurgery.

INTRACRANIAL REPAIR OF THE FACIAL NERVE WITH FREEZE-THAWED SKELETAL MUSCLE GRAFT
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Facial nerve injury occurs not infrequently during surgery in the cerebellopontine angle (CPA). A novel method of facial nerve repair in the CPA with freeze-thawed skeletal muscle was inserted and secured with fibrin glue. After nine months graft function was assessed by electrophysiological and anatomical methods. Successful graft function was obtained in all animals.

Hence, freeze-thawed skeletal muscle autografts are a convenient method of repairing the facial nerve in the CPA in sheep.


VISUAL OUTCOME AFTER TRANSPHENOIDAL SURGERY IN ELDERLY PATIENTS
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Pituitary adenoma is uncommon in elderly patients. Overt endocrinological symptomatology is rare and the diagnosis is often only apparent once symptoms of mass effect supervene. Visual outcome after transphenoideal hypophysectomy in 22 elderly patients is reported.

Patients of 65 years and over who had undergone transphenoideal hypophysectomy for pituitary tumours with suprasellar exten- sion were reviewed retrospectively. Clinical records, preoperative imaging, and preoper- ative and postoperative ophthalmic assess- ments (including Goldmann perimetry) were examined in all cases. A technique of instillation of saline into the CSF via a lum- bar catheter was used in most cases to aid tumour descent and facilitate removal.

Twenty two patients aged 65 and over (range 67–83 years) were reviewed. Of these cases visual impairment was the primary presenting feature. The duration of symp- toms varied from two weeks to 20 years. CT and/or MRI confirmed suprasellar extension in all cases.

A visual field defect (of one quadrant or more) was present in 20 patients. After surgery improved (seven of these to normal), seven were unchanged, and one patient’s vision was worse. Visual acuity was reduced in 18 cases at presentation. An improvement to 6/12 or better after surgery was seen in 11 cases (four to normal), five were unchanged, and two were worse. The degree of ophthalmalic deficit was a better predictor of outcome than the duration of symptoms. There was no mortality.

Complications comprised CSF leak (two cases), pneumonia (one case), and transient diabetes insipidus (two cases). Six patients required long term endocrine replacement therapy. The most common pathological diagnosis was chromophobe adenoma (17 cases).

In conclusion, transphenoideal hypophy- sectomy may safely afford significant improvement in visual function in elderly patients with suprasellar extension in all cases. Neither age nor duration of symptoms
A retrospective study was carried out of complex cases of hydrocephalus in whom 24 hour intracranial pressure (ICP) monitoring with the Camino system was used either as an aid to the diagnosis of 28 patients of the investigation of complex sympotms occurring in previously shunted patients.

Three seventen patients are reported, 17 of whom were being assessed for the presence of ICP sufficiently high to justify the insertion of a shunt system. Of these seven showed a significant increase in ICP where as the pressures were normal in nine. The remaining 20 patients already had a shunt system in situ and were being investigated for symptoms that could have been due to intermittent shunt blockage, over drainage of CSF, or conditions unrelated to either hydrocephalus or the shunt system. Of these, 14 proved to have overdrainage as demonstrated by a dramatic fall in ICP when the patient was moved from the horizonal to the vertical position. There was no significant morbidity associated with the procedure.

In conclusion clinical and radiological criteria alone may afford sufficient information in both the initial evaluation of hydrocephalus and the subsequent management of the shunted child. ICP monitoring has been a safe means of investigating such cases and has provided valuable information on which to base surgical management.

LONG TERM PROGNOSIS FOR CHILDREN WITH TREATED HYDROCEPHALUS: A 10 YEAR FOLLOW UP
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The short term complication rate of shunt insertion in hydrocephalic children is widely reported: however, there is a paucity of information on their long term future.

The aims of this study were to determine the long term morbidity and functional outcome of a cohort of shunted hydrocephalic patients.

The case records of a cohort of 155 shunted hydrocephalic patients from 1975-83 were analysed thus ensuring a 10 year follow up period. Criteria for admission to the study included a hospital record describing aetiology, treatment, complications, and final outcome at 10 years. Statistical analysis was performed by $t^2$ tests with p < 0.05 regarded as significant.

One hundred and fifty five patients (90 male, 65 female), with an age range of 1-164 months (median 4.1 months) at the time of first shunt insertion, were analysed. Aetiologies were recorded as congenital 32%, intraventricular haemorrhage 21%, aqueduct stenosis 14%, infection 12%, neoplasms 11%, and other miscellaneous causes; 53% of patients attend normal school and 36% require specialist schooling; 19% are severely handicapped; and 44% of patients have required no revisions. A total of 225 revisions (1.45 per patient) were performed over the 10 year period. These were mainly attributable to blockage 49%, infection 19%, or disconnection 13%. The 30 day infection rate was 5.2% for first insertion and 4.9% for revisions; 92% of revisions for infection occurred within three months of insertion.

The risk of blockage was more than three times greater for revisionary surgery compared with first insertions (NS). Those children requiring multiple revisions did not have a poorer intellectual outcome, nor did the aetiology of hydrocephalus affect outcome.

This study provides much needed long term prognostic information for counselling of parents whose children are about to undergo shunt placement.

AUDIT OF THE MEDOS PROGRAMMABLE SHUNT: A PRELIMINARY ANALYSIS
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A nationwide audit of MEDOS programmable valves placed in 138 patients (mean age 44.8, range two days to 84 years) thought to be at higher risk of complications from shunt surgery, has been conducted to evaluate the complications rate in MEDOS shunted patients in addition to clinical outcome and resource consumption (Snowley, RD, Southamptom, Wakefield, Belfast, Sheffield, Royal London, Newcasle, St Bartholomew's, Coventry, Plymouth and Dublin contributed patients).

Of the 149 valves inserted, 22 were removed: 18 due to infection (overall rate 12.1%) and four due to shunt malfunction.
There were 13 shunt revisions. Programming failure occurred in four shunts. On average there were 1-7 (range 1-9) setting changes overall with 0-9 (range 1-6) in the first postoperative month; 33% of settings were changed at the first insertion. Subdural collections occurred in 24 (16.1%) patients after shunting. On average, patients underwent 4-6 (range 1-25) CT scans and 1-20 (range 1-400) computerised tomographic investigations postoperatively. The mean duration of inpatient stay was 25-6 days; for infected cases 46 days, and for non-infected cases 22 days. Twenty two patients were discharged to residential care.

COMPUTERISED LUMBAR INFUSION TEST: MULTICENTRE EXPERIENCE IN CLINICAL STUDIES IN HYDROCEPHALUS
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The computerised lumbar infusion test was designed to compensate for the disadvantages of Katzen’s lumbar infusion method: poor accuracy of estimation of the resistance to CSF outflow (rCSF) and poor predictive value in NPH. Accuracy is improved by computer intracerebral pressure (ICP) signal processing and model analysis for measurement of cerebrospinal compensatory variables including rCSF, brain compliance, pressure-volume index, estimated sagittal sinus pressure, CSF formation rate and other variables. The computerised test has been used for a five year multicentre study in 350 hydrocephalic patients of various ages, aetiology, and states of cerebrospinal compensation. The test measures rCSF as accurately as the reference lumboventricular perfusion study (correlation r = 0.98; n = 32).

The results provide an indication of poor outcome after shunting if the major variables are in the normal range—that is, rCSF less than 13 mm Hg/ml/min, PVI above 13 ml, and resting ICP below 15 mm Hg. In ventricular dilation in children the test is helpful to differentiate between CSF circulation disorders of various origins. The test permits reliable assessment of shunt malfunction: a functioning shunt shows a specific pattern dependent on shunt type. The computerised test is a reliable method for the assessment of disturbances of the CSF circulation.

ANATOMY OF NEUROVASCULAR COMPRESSION OF THE LOWER CEREBRAL NERVES
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For trigeminal neuralgia and hemifacial spasm alone probably more than 50 000 neurovascular decompression operations have been performed worldwide. The incidence with which significant vessels have been found, however, has varied dramatically between authors in both anatomical work on previously unaffected cadavers as well as in the reports of operative findings in afflicted patients. A new method of in vitro perfusion has been established allowing accurate delineation of anatomy in control cadavers and it demonstrated a lower incidence of compressive vessels than in a matched population of patients with trigeminal neuralgia. The significance of this has not yet been tested in the present study.

Meta-analysis of the literature shows a significantly higher incidence of neuralgia on the right side, in females rather than males, in increasing age. Hemifacial spasm is more common in females but does not affect one side more than another and has a less linear relation with age. The present work contains the results of 137 decompressive operations. The epidemiology of trigeminal neuralgia and to a lesser degree hemifacial spasm, was followed by the proximity of these vessels to nerves. The statistical significance of these results and their implication was discussed.
Wada testing has been used routinely for 30 years to lateralise hemisphere dominance, and to identify people at risk of a severe amnesic syndrome after temporal lobe surgery for epilepsy. Using the Montreal memory function assessment, tests recall recognition of items presented for memorisation during the test, it's use has been evaluated in lateralising seizure focus compared with neurophysiological methods. Patients whose memory function performed equally well bilaterally or whose dominant hemisphere performed better on testing were lateralised as having a non-dominant focus, and those with better function in the non-dominant hemisphere as having a dominant hemisphere focus.

Twenty three Wada tests have been evaluated in this unit. Overall, Montreal testing correctly lateralised the focus in 18 cases (sensitivity 78%), and incorrectly lateralised in five (22%). There was no significant difference between dominant and non-dominant foci. A good postoperative outcome (Engel grades 1 and 2) was achieved in 74% overall and this was not significantly affected by concurrence or non-occurrence of Wada and neurophysiological testing. It is concluded that preoperative Wada memory testing provides useful confirmatory evidence of seizure focus lateralisation.

EVERYDAY SPATIAL MEMORY AND ORIENTATION AFTER SURGERY FOR TEMPORAL LOBE EPILEPSY

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The role of temporal neocortex and mesial temporal lobe structures in humans in the formation and storage of internal spatial representations of an everyday real life environment was examined in 20 patients who had undergone unilateral temporal lobe epilepsy or neocortectomy (11 left, nine right) for the relief of intractable epilepsy. Patients and 10 matched controls were exposed to video presentations of routes through a novel urban area. Learning and memory were then assessed across several variables.

Analyses showed deficits after both left and right temporal lobe surgery. Both patient groups required significantly more exposures to the video before a criterion level of learning was reached (p < 0.01), both were impaired on tests of route planning and execution (p < 0.01), and in sketch map representations of the stimulus area (p < 0.001). Analysis of error types in recognition memory during learning, however, showed that the left temporal group made significantly more omission errors (p < 0.01), whereas the right temporal group made significantly more inclusion errors (p < 0.05).

Furthermore, patients with right temporal lesions were also significantly impaired relative to controls and the left temporal group, on tests of landmark selection (p < 0.01), proximity (p < 0.05), and distance (p < 0.01) judgements.

Findings argue a role of both left and right temporal lobe structures in different aspects of spatial representation.

FUNCTIONAL ASPECTS OF CALLOSAL SURGERY

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Callosal section is an empirical treatment for epilepsy that can appreciably relieve atonic (drop) attacks and episodes of status epilepticus. Twenty four partial callosal sections are reviewed, including seven patients with gross unilateral hemisphere disease. Preoperative carotid amytal tests have been used to assess bilateral secondary synchrony and intraoperative electrocorticography to indicate the effectiveness of the callosal section during the procedure. The benefit of each of these techniques has been evaluated.

The 24 patients comprised 14 males and 10 females, eight of the 24 patients were aged 15 or less. There was follow up of more than one year for 22 patients. Overall 12 of these 22 patients gained benefit in terms of fit reduction from the surgery. Three of the patients with unilateral hemisphere disease benefited. The other four patients subsequently underwent major resection. Eighteen patients had preoperative amytal investigation. In eight of these the test suggested that one hemisphere was driving the other. Four of these patients obtained fit reduction including two with unilateral hemisphere disease.

Intraoperative electrocorticography was attempted on 23 patients, but useful data were obtained in only 13 patients. Among these 13 there was a good correlation between EEG desynchronisation and eventual outcome in eight patients.

DYSEMMYOPLECTIC NEUROEPITHELIAL TUMOURS

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Present classification of brain tumours, such as that of the World Health Organisation, are inadequate for the characterisation of certain paediatric tumours. Recognising this problem Daumas-Duport retrospectively analysed a group of neuroepithelial tumours from her institution and identified a group of 20 patients with uniform pathological and clinical features. She coined the term dysemmyoplectic neuroepithelial tumour to describe this abnormality.

We have critically reviewed the clinical, neurophysiological, pathological, pathological, and radiological studies in a series of 10 patients (6 male, 4 female), mean age 5-2 years (seven months to 11 years) in an attempt to further characterise this recently described condition. All patients presented with medically refractory epilepsy, complex (eight) or simple partial seizures (two) with generalisation of seizures in two patients. One patient had headache and a temporal bone swelling. The EEG was abnormal in all the cases, free of seizures, with slowing in activity and interictal spikes. The EEG abnormalities were more extensive in three patients than the observed lesion. Intermittent changes were seen in two patients.

Magnetic resonance imaging was the investigation of choice although the lesion was visualised on CT. The lesion was predominantly intercorical with occasional involvement of the the temporal lobe typically in close proximity to mesial temporal structures. Features of MRI included circumscribed hypointensity on long TE/TR images, hypointensity on short TR images, and cyst formation.

Surgical follow up ranged from eight to 46 (mean 19-7) months. Nine patients are currently seizure free (Engel I). One patient is experiencing a reduced number of seizures (Engel III). There were no serious surgical complications.

Identification of this group of tumours is advantageous as it spares these patients the deleterious effects of radiotherapy, chemotherapy, and unnecessarily aggressive surgery.

LIPOPROTEIN (a) CONCENTRATIONS IN CEREBROVASCULAR SACULAR ANEURYSMAL DISEASE

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Lipoprotein (a) (Lp(a)) is a serum lipoprotein. Raised serum concentrations of Lp(a) are a known independent risk factor for atherosclerosis. Serum Lp(a) concentrations are strongly genetically determined. Cerebrovascular aneurysmal disease (CAD) is a common condition, but its aetiology remains controversial. It remains unclear to what extent, if any, CAD and atherosclerosis are related. Serum Lp(a) concentrations have been measured in 50 patients with angiographically established saccular aneurysmal disease. These were compared with a group of age and sex matched normal healthy controls.

Mean age (SD) of cases was 50 (13-9) years and 46 (12-9) years for controls. Cases and controls were free of clinically significant atheromatous disease as judged by history, examination, ECG, and carotid angiography in the cases. The mean serum Lp(a) concentration in cases was 32.9 (SD 29.6) µg/dl compared with 17-8 (19-2) µg/dl. This corresponds to log normalised values of -2.3 (1-1) for controls and 3.0 (1.1) for cases (z = 3.015, p < 0.003). If only subjects younger than 50 years were considered the difference remained significant (z = 2.351, p < 0.02, n = 21 controls, n = 24 cases). These results indicate that either cerebrovascular aneurysmal disease and subclinical atherosclerosis are related, as evidenced by raised serum Lp(a) concentrations or that Lp(a) is a risk factor for vasculopathies other than atheroma.

COMPARISON OF THE EFFECT ON SURVIVAL OF SURGICAL RESECTION OF A SINGLE BRAIN METASTASES FROM LUNG & NON-LUNG PRIMARY TUMOURS

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Surgical excision followed by radiation therapy (RT) has been advocated as the
treatment of choice in patients with an accessible single brain metastasis and a good performance score. We assessed the survival from onset of neurological symptoms in adult patients with lung or non-lung primary tumours treated by either combined surgical and medical treatment (RT and/or chemotherapy (C)) or medical treatment alone.

Data was obtained from retrospective analysis of the South East of Scotland Brain Tumour Register for incident cases during 1989/90. A single metastasis was present in 54 patients with primary lung tumour and 33 with non-lung primary tumours (breast (35%), bowel (30-5%), and others (39%)). Only 29 patients with lung tumour and 21 patients with non-lung tumours were suitable for active treatment. The median survivals were similar for small cell lung tumours and adeno/squamous cell lung tumours. The results are presented in the table.

In conclusion the role for excision of single metastasis from lung tumours should be reassessed.

AUDITING OUTCOME IN NEUROSURGICAL PATIENTS

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Audit is a growing and important aspect of clinical practice and measuring outcome is an essential part of that process. To achieve this a seven point audit scale (AMH score) was devised to measure disability and outcome in neurosurgical patients. This was shown to be reliable when tested for observers' and patients' sensitivity. Our detailed computer database the input of which is the discharge summary allows collection of admission and discharge AMH and Glasgow coma scores on all patients. Additionally it has been used to follow up AMH scores obtained by outpatient or telephone interview at three months, to assess outcome. An internal control of 50 patients showed no significant difference between scoring the same patients by outpatient or telephone review. From 2323 neurosurgical admissions between June 1992 and May 1993, there were 131 patients who were lost to follow up (6%).

INDICES OF ICP WAVEFORM SHAPE CORRELATE WITH CEREBRAL PERFUSION PRESSURE BUT FAIL TO PREDICT EFFICACY OF MANINTOL THERAPY FOR RAISED ICP

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It is known that the intracranial pressure (ICP) waveform shape changes with cerebral perfusion pressure (CPP), although it is less clear which components of the waveform correlate with CPP and whether these changes provide useful information for managing patients with raised ICP.

In a prospective study carried out over two years, ICP, blood pressure and CPP waveform data were collected from 20 head injured patients using on line minute by minute derivation of 12 indices of the ICP waveform shape. Physiological data including heart rate, core temperature, arterial and jugular venous oxygen saturation (SaO2, Svo2), and end tidal CO2 were also collected.

From data from 20 mannitol treatments were obtained from 12 patients (eight focal and four diffuse brain injuries). There was no significant difference in physiological or ICP waveform variables when either the pretreatment or post-treatment data were classified by type of head injury (focal/diffuse) or by presence of hyperaemia. To determine if ICP waveform variables can predict the efficacy of mannitol therapy, pretreatment data was categorized by either treatment success or failure where success is defined as treatment that either reduces ICP below 20 or increases CPP above 50 mm Hg. With the exception of ICP pulse amplitude (p = 0.00074), which reflects the lower pretreatment CPP found in the treatment success group, there were no significant differences between treatment success/failure data for any pretreatment ICP waveform indices. When waveform indices pretreatment and post-treatment were compared four variables changed significantly (p < 0.01): ICP pulse amplitude, ICP distortion factor k, the best lower pretreatment CPP found in the treatment success group, there were no significant differences between treatment success/failure data for any pretreatment ICP waveform indices. When waveform indices pretreatment and post-treatment were compared four variables changed significantly (p < 0.01): ICP pulse amplitude, ICP distortion factor k, the amplitude transfer function (XPS/M) of the fundamental harmonic. No waveform indices were based solely on high frequency components were found to change significantly with CPP. Further analysis of those waveform variables found to change significantly with mannitol is continuing for other forms of treatment particularly those likely to have a more uniform "vascular" effect.

DETERMINATION OF CEREBRAL PERFUSION PRESSURE THRESHOLDS IN HEAD INJURED PATIENTS

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The management of cerebral perfusion pressure (CPP) in head injured patients remains controversial. Invasive monitoring of CPP, intracranial pressure (ICP), and other physiological variables. Transcranial Doppler (TCD) monitoring can also be useful in the management of such patients. The main aim of this paper was to determine the CPP thresholds in individual patients below which treatment might be required.

Head injured patients who were ventilated in the intensive care unit were studied and had multiple physiological variables monitored. Simultaneous samples of blood pressure, ICP, and TCD signals were obtained and their derived indices based solely on the waveform analysis displayed on a personal computer in real time.

Ten patients were studied during spontaneous and treatment induced periods of changing CPP. A total of 16 recording episodes were carried out and this generated about 2700 data points. With a sequential analysis of variance, a breakpoint near 70 mm Hg of CPP was shown for the group of data when the pulsatility index of the middle cerebral artery waveform was plotted against CPP. There was good correlation between the pulsatility index and the fundamental transfer function (from blood pressure to ICP) data in 11 out of the 16 recording episodes, when plotted against CPP.

The CPP breakpoint values could, however, differ by at least 10 mm Hg between and within patients on different days.

In conclusion, an on line computerised monitoring system of blood pressure, ICP, and TCD waveforms can determine the CPP threshold values, which could differ between individual patients. This breakpoint may be determined by other variables besides the pulsatility index of the middle cerebral artery Doppler waveform.
THE EARLY MANAGEMENT AND USE OF THE INJURY SEVERITY SCORE IN SEVERE HEAD INJURY
RS Cooke, BP McNicholl, DP Byrnes.
Royal Victoria Hospital, Belfast, UK

A 12 month prospective study of the early management of severe head injury (SHI) in Northern Ireland was performed. Glasgow coma scale (GCS) and injury severity score (ISS) criteria were used to define SHI, GCS, ISS, and TRISS scores were related to outcome at one year, with the rank correlation coefficient.

Glasgow coma score defined 78 patients, and ISS a further 53 as having SHI (n = 131), 27% were hypoxic and 18% were hypotensive on admission to the primary hospital. Endotracheal intubation was performed in 92% of comatose patients, and adequate resuscitation was performed in 87% of those transferred; 61% were moved to the neurosurgical unit (with a mean time until transfer of over three hours); 60% were hypotensive with shock (n = 131). 27% were hypoxic and 18% were hypotensive on admission to the primary hospital. Endotracheal intubation was performed in 92% of comatose patients, and adequate resuscitation was performed in 87% of those transferred; 61% were moved to the neurosurgical unit (with a mean time until transfer of over three hours); 60% were hypotensive with shock (n = 131). 27% were hypoxic and 18% were hypotensive on admission to the primary hospital.

Injury severity score identified patients with severe intracranial pathology who required neurosurgical intervention and with poor outcomes that the GCS based definition of SHI did not. TRISS and GCS correlated similarly with one year outcome, but on both Glasgow outcome score and mortality.

It is concluded that the early management of SHI is reasonable with high rates of intubation, but that there are problems with prehospital oxygenation and transfer. We suggest that ISS and TRISS could be used in local audit, and for inter-regional and historical comparison of head injury management.

DEPRESSED SKULL FRACTURES: CONSERVATIVE OR SURGICAL MANAGEMENT?
KS O'Neill, WAS Taylor, JA Wellings, BA Bell.
Atkinson Morley's Hospital, London, UK

There is continuing debate on the correct management of depressed skull fractures, in part due to the variation in severity of injury. It is usually recommended that depressed fragments are raised to restore normal anatomy and allow debridement of damaged tissues. We reviewed 120 patients with depressed fractures admitted between 1986 and 1993. Details of mode and severity of injury were assessed and outcome with an average follow up of 23.8 months measured in terms of complication rate and the Glasgow outcome score. There were 96 (80%) compound fractures and 24 (20%) closed fractures. Forty eight patients (40%) were considered to be continuous and were treated with surgical elevation and debidement. Most compound fractures with underlying brain injury were treated surgically (80%). Of the 63 compound fractures with without brain injury, 32 (51%) were treated with surgical elevation and 31 (49%) conservatively. There was no significant difference in outcome scores between the two groups; 96% of both having a good outcome. The surgical group, however, had four patients (12-5%) with complications, epilepsy (one), focal deficit (one), and cosmetic deformity (two). The conservative group had one complication (3-2%), a patient with a cosmetic deformity and the groups were otherwise comparable. Average depths of depressed fragments were different between the groups, but all the patients with complications had depressions >10 mm in depth. We conclude that some patients with no underlying brain injury can be safely managed with conservative wound toilet and closure, without bony fragment elevation, which may be associated with increased morbidity and be an unnecessary intervention.

COMBINED SINGLE STAGE REPAIR IN CRANIOFACIAL TRAUMA
J Martin, M Danford, DA Lang, BTE Evans, G Neil-Dwyer. Wessex Neurological Centre and Maxillo-facial Department, Southampton General Hospital, Southampton, UK

Management of craniofacial trauma has traditionally been neurosurgically led. The definitive repair was delayed because of concern that early surgery would incur an increased morbidity and mortality. In the United States there has been a trend towards early single stage repair of craniofacial trauma. From August 1988 until December 1993, 59 patients with craniofacial trauma were admitted to the Wessex Neurological Centre. In this retrospective analysis the aim was to determine the effects of earlier surgery not only on morbidity and mortality but also on function and cosmesis.

Of the 59 patients 55 were male and the mean age was 27 years. Twelve were unsuitable for repair due to the severity of their injuries. These patients subsequently died. The remaining 47 underwent combined craniofacial repair. There were no deaths in this group. Twenty seven patients were operated on within 48 hours of injury, 21 (22%) between 48 hours and one week, 11 (23%) between eight and 14 days, five (11%) between 15 and 21 days, 10 (21%) between 21 and 54 days, and one patient at 11 months. At six months 11 were classified as severely disabled whilst the remaining 36 were either moderately disabled or had made a good recovery. The outcomes were as expected from consideration of the Glasgow coma score after resuscitation.

Early reconstructive surgery is technically easier. This approach has been adopted at many centres in the United States, but not in the United Kingdom. With careful patient selection, we have shown that early craniofacial repair is not associated with any increased morbidity or mortality, and produces satisfactory functional and cosmetic results. The changing role of neurosurgery in the management of craniofacial trauma was emphasised as well as the importance of a multidisciplinary team in the patient selection process.


CLINICOPATHOLOGICAL OBSERVATIONS IN 100 CONSECUTIVE FATAL HEAD INJURIES ADMITTED TO A NEUROSURGICAL UNIT
DP O'Brien, M Bennett, JP Phillips, MA Farrell. Departments of Neurosurgery and Neuropathology, Beaumont Hospital, Dublin, Eire

Trauma is the leading cause of death between 20 and 40 years of age and cerebral injuries are the most common cause of trauma related deaths. A retrospective clinical and neuropathological study of 100 consecutive fatal head injuries admitted to a neurosurgical unit was carried out to determine the incidence of primary diffuse axonal injury (DAI) and of secondary ischaemic encephalopathy (HIE). The clinical, necropsy, and coroner’s records of 100 fatal head injury cases admitted to the neurosurgical unit were examined. The mode and location of injury, interhospital transfer, contributing factors, and hospital course were recorded. All cases had a full neuropathological assessment including brain maps, photographs, and histological slides. Standard pathological criteria for the assessment of DAI and HIE were used. A full system of necropsy was performed in each case. The male to female ratio was 3:1 (age range 2-88, mean 40 years). Accidents occurred most commonly on the streets (66%) and at home (21%). Motor vehicle accidents (53%) and falls (36%) accounted for most injuries. Alcohol consumption was the most frequent contributory factor in adults (31%). Neuropathological examinations showed focal mass lesions in 68% of cases, acute subdural haematoma being the commonest (45/68; 66%). Neuropathological evidence of HIE, DAI, and raised intracranial pressure were recorded in 74%, 42%, and 89% respectively. Nineteen patients showed evidence of both DAI and HIE. Fifty two per cent of cases had significant extracranial injuries of whom it was considered that seven died from these injuries.

The results from this study show a high incidence of potentially avoidable cerebral damage (HIE) in fatal head injuries. Although a time lapse between certification of brain death and discontinuation of life support systems may have contributed to the high incidence of HIE, the results still indicate scope for improvement in terms of the prevention of secondary cerebral injury and also indicate a need to increase awareness of potentially life threatening extracerebral injuries as a cause of coma.

ASSESSMENT OF CEREBRAL HYPOPXIA USING NEAR INFRARED SPECTROSCOPY DURING CAROTID ENDARTERECTOMY
PJ Whittaker, P Smith, P Wellings, PC Whitefield, M Czosnyka, JD Pickard. University Department of Neurosurgery, Addenbrooke’s Hospital, Cambridge, UK

Near infrared spectroscopy (Hamamatsu NIRS 1000) was used to monitor the oxygen state of the brain during carotid endarterectomy in 13 patients. During surgery a continuous measurement of deoxymaoglobin (HbO2), oxygenated haemoglobin (Hb), deoxyhaemoglobin (Hb), oxytocytome (CytoO), and the total haemoglobin content (HbT) was obtained. Changes in these signals were compared with variations in middle cerebral artery flow velocity
obtained using transcranial Doppler. Cross-clamping and later reperfusion of the external carotid artery did not affect any variable measured. After application of the internal carotid cross clamp, eight patients showed a fall in middle cerebral artery flow velocity. Of these, seven demonstrated a rapid and correlated fall in HbO2 signal, and a reciprocal rise in Hb. The CytoO2 and tHb remained unchanged. Recovery of the HbO2 and Hb concentrations towards preclamp baseline values occurred in three of these patients during the period of internal carotid cross clamping. The use of an intraoperative shunt (n = 3) was also accompanied by a recovery of middle cerebral artery flow velocity, HbO2, and Hb, although preclamp baseline concentrations were not achieved during shunting. In those patients in whom complete spontaneous recovery had not occurred, release of the internal carotid cross clamp resulted in a rapid increase in HbO2 and decrease in Hb signal towards the respective baseline values. A hyperaemia evolved with significant increases in middle cerebral artery flow velocity and HbO2 to above baseline values (p < 0.05). tHb was also increased during the hyperaemic hypoxic phase (p < 0.08). The potential use of near infrared spectroscopy in adults for monitoring cerebral hypoxic stress was discussed.

THE ROLE OF NITRIC OXIDE IN VASOSPASM AFTER SUBARACHNOID HAEMORRHAGE
LD Watkins, TP Opremendovitch, L Symon. Department of Neurological Surgery, Institute of Neurology, London, UK

Evidence is accumulating that a basal production of the endothelium derived relaxing factor, nitric oxide (NO), plays a part in maintaining normal cerebrovascular tone.1 The purpose of this study was to examine whether subarachnoid haemorrhage, an event associated with cerebral vasospasm and neurological deficit, alters basal NO production. Cross-clamping of the common carotid arteries and injection of 2% formalin into the anterior communicating artery in adult male rabbits also demonstrated a reduction in NO production.2

MINIMALLY INVASIVE ANEURYSM SURGERY: IS IT SAFE?
RW Gullan, SP Harland, A Hussein. Neurosurgical Unit, Brood General Hospital, London, UK

A prospective study comparing conventional perional craniotomy with extended burr hole exposure for anterior circulation aneurysms is presented. Each group comprised consecutive cases. Only those with posterior circulation aneurysms or those requiring an interhemispheric approach were excluded. Perional craniotomy was performed on 25 patients (age range 22-72, mean 48 years, 10 men, 15 women) for 28 aneurysms (single 20, multiple five). Extended burr hole was performed on 34 patients (age range 23-70, average 48 years, 17 men, 17 women) for 37 aneurysms (single 27, multiple seven). Preoperative WFNS grading was similar in both groups as was the average number of days from ictus to surgery (perional craniotomy average 11-0, range 6-16; burr hole average 11-6, range 1-39 days). Temporary clips were used in seven of the perional craniotomy burr hole and three of the cases. Intraoperative rupture occurred and was controlled in three perional craniotomy and five burr hole cases. Extension of the craniectomy to improve exposure was required in only two of the 34 burr hole operations. The overall quality of survival was seen in both groups (table). There were no intraoperative or early postoperative deaths (<one month) in either group. Likewise morbidity directly related to surgery was exceedingly low. One patient in the perional craniotomy group deteriorated, however, to a persistent vegetative state (Glasgow outcome score 2) because of intense vasospasm. In the burr hole group a patient whose aneurysm could only be wrapped died from a massive rebleed at six weeks. Mild hemiparesis was seen at follow up in two patients from each series. Permanent weakness of the frontalis muscle occurred in three patients after perional craniotomy and in one after burr hole. It is concluded from this series that it is safe to continue this technique. Details of the procedure were openly discussed.

GLASSHOPE OUTCOME SCORE

<table>
<thead>
<tr>
<th>Operation</th>
<th>Directly home %</th>
<th>Average stay post-op (days)</th>
<th>Average follow up (months)</th>
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<tr>
<td>Standard</td>
<td>52-0</td>
<td>9-7</td>
<td>10</td>
</tr>
<tr>
<td>Burr hole</td>
<td>61-8</td>
<td>8-2</td>
<td>5</td>
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</tbody>
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Glasgow outcome score

MINDLESSLY INVASIVE ANEURYSM SURGERY: IS IT SAFE?
RW Gullan, SP Harland, A Hussein. Neurosurgical Unit, Brood General Hospital, London, UK

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3

EFFECTS OF EARLIER TRANSFER, FLUID RESUSCITATION, AND SURGERY ON THE OUTCOME OF PATIENTS WITH ANEURYSMAL SUBARACHNOID HAEMORRHAGE
PC Whittington, PJ Kirkpatrick, H Moss, D O'Hare. Department of Neurosurgery, Addenbrooke's Hospital, Cambridge, UK

The outcome in 214 consecutive patients presenting with subarachnoid haemorrhage to a regional neurological unit was audited. During the study period a change in management protocol was introduced to encourage earlier admission and active fluid resuscitation. All patients received nimodipine. The timing of surgical intervention was assessed and the morbidity and mortality compared between different surgical groups. One hundred and thirty three (62%) patients underwent aneurysm surgery. The mean day of surgery was reduced from day 16-9 in the first 75 patients to day 7-5 in the subsequent 58 patients. Seventy eight per cent of surgical patients had a good outcome (Glasgow outcome score 1) two months postoperatively. In 100 operative patients presenting with grade 1 or 2 subarachnoid haemorrhage, a Glasgow outcome score of 1 was achieved in 82% and was independent of the timing of surgery. In those with grades 3-5, a Glasgow outcome score of 1 was achieved in 67% and was also independent of the timing of surgery. The overall operative mortality was 5%. Of the 81 nonoperated cases, 26 patients re-bled (median day 8-3), leading to death in 23 (88%); 39 (18%) cases had negative angiography.

With earlier transfer and resuscitation,
The use of drains for siringomyelia has an immediate appeal and has been practised widely since the report of Abbe and Coley over 100 years ago. Good short term results have been claimed but long term outcome is largely unknown. An experience in Birmingham, United Kingdom, is reviewed. Eighty two patients who had some form of syrinx drainage procedure had 59 syringopleural and 15 syringobasilarachnoid shunts. Ten years after their operation only 54% and 46-6% of the patients respectively remained stable. A 7% complication rate was recorded, including fatal haemorrhage and drain displacement. At least 5% of shunts were blocked at second operation or necrosis. These data indicate that drainage procedures are not the answer to siringomyelia. The effect of other tubeless drainage procedures such as siringotomy and terminal ventriculostomy was also analysed and found not to offer a long term benefit. It is suggested that rather than attempt to drain the syrinx cavity by shunting its contents to a low pressure site, it is best to disable the filling mechanism of the syrinx. Most forms of siringomyelia had a blockage at the foramen magnum or in the subarachnoid space of the spine. Measures to reconstruct the continuity of the subarachnoid space at the blockage site are strongly recommend.

In conclusion, grade of surgeon does not influence outcome from subarachnoid haemorrhage.


CRITICAL APPRAISAL OF DRAINAGE IN SYRINGOMYELIA
S Sguoero, B Williams. Midland Centre for Neurosurgery and Neurology, Smedwick, UK

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