Proceedings of the Society of British Neurological Surgeons

The 86th Meeting of the Society of British Neurological Surgeons was held at the National Hospital, Queen Square, and the Hospital for Sick Children, London, on 2 and 3 May 1974.

SURGERY OF SUPRATENTORIAL MENINGOMAS: A MODERN SERIES

VALENTINE LOGUE (London) emphasized that postoperative neurological defects, persistence of preoperative epilepsy, and the appearance of postoperative epilepsy were due to brain retraction and distortion, damage to arteries, or interruption of veins. A series of 350 cases was presented. Essential features of the operative technique were circumferential incision of dura mater close to the tumour, exenteration of the tumour with diathermy loop, sucker, or rongeur, division of vessels between tumour capsule and brain, excision of exposed dura mater, and removal of the bone flap, which was then frozen in antibiotic solution in preparation for replacement at a later date. Where possible, involved sinus was removed.

There were 16 operative deaths, giving a total mortality rate of 4.57%. For convexity tumours the rate was 3.2% and for basal tumours 6.7%. Venous infarction was a more frequent cause of death than arterial. Three patients were admitted in coma.

Of the 350 cases, 287 returned to work, 15 were left dependent, and 48 died before being gainfully employed or settled. Thirty-seven of those who went back to work did so in a higher grade, 220 returned in the same grade, and 30 went back at a lower grade.

Two hundred and nine (60%) of the patients had preoperative epilepsy. Of these 130 were completely free of fits after operation. Postoperative epilepsy occurred in 8 (5.7%) of the 141 patients without preoperative seizures.

Epilepsy was thus relieved in 62.2%. The number of recurrences among 296 survivors to 1971 was 33 (11.1%).

INTRACRANIAL VOLUME/PRESSURE RELATIONSHIPS—CLINICAL AND EXPERIMENTAL ASPECTS

J. D. MILLER, P. J. LEECH, and J. D. PICKARD (Glasgow) pointed out that sudden unpredictable increases in intracranial pressure (ICP) might occur in a variety of conditions such as trauma, tumour, vascular disorders, cerebral hypoxia, and benign intracranial hypertension. Increase in ICP was thought to be due to failure of compensation for the increased volume of intracranial mass lesions. During continuous ICP monitoring it was not possible to measure the amount of compensatory reserve when the ICP was still normal.

Experiments were made with humans and baboons, introducing fluid into a lateral ventricle and measuring the volume/pressure response (VPR). In humans a significant positive correlation was found between resting ICP and VPR induced by a 1 ml increase in ventricular fluid volume. In baboons there was a correlation between VPR and increase in size of an extradural balloon. When ICP approached arterial pressure, cerebral blood flow decreased, and VPR fell. With normal ranges of ICP, changes of arterial pressure did not affect the low VPR. When ICP was increased, VPR rose with arterial hypertension. Mannitol produced 20% reduction in ICP for 30 minutes and 50% reduction in VPR for 45 minutes. Hyperventilation to an arterial Pco2 of 25 mmHg produced a reduction in ICP (30%) which returned to the control level at 45 minutes. The effect on the VPR was similar. Clinical studies on humans with brain injuries demonstrated a closer correlation between angiographic shift and VPR than between resting ICP and VPR.

The value of VPR measurement in patients with mass lesions was less when hydrocephalus is present. In humans mannitol produced a fall in ICP but a greater reduction in VPR over a 45 minute period Beta-methasone (4 mg/6 hourly) reduced ICP by 18% and VPR by 71% over 24 hours.

VPR was a measure of periventricular elasstance which was largely a property of cerebral blood vessels. The aim of treatment was not only to reduce ICP but give the brain the ability to compensate further and this property was measured by VPR.

PREFERRED ROUTE TO THE PITUITARY—TRANSETHMOIDAL SURGERY

HUW GRIFFITH and RASHID AHMAD (Bristol) described their experience of 136 transethmoidal pituitary
operations, and showed a film of the procedure. After packing the nose with gauze soaked in cocaine, adrenaline, and chlorhexidine, the surgeon made a right ethmoidal incision which was deepened as far as the anterior ethmoidal artery, a landmark for the level of the cribriform plate. The operating microscope was brought to bear and the approach continued through the ethmoidal cells, the perpendicular plate of the ethmoid, and the sphenoidal air sinus. A chisel and a 2 mm bite punch were used to enter the sella. The dura mater was opened with diathermy and special bayonet microscissors. When endocrine surgery was being performed the pituitary stalk was divided before removal of the gland. In cases where gland and fossa were large, removal of some of the gland might be necessary before access to the stalk was obtained. Complete removal of chromophobe adenomas was seldom possible. The fossa was sealed with muscle and fascia lata, a gauze pack was led down the right nostril, and the skin was closed in two layers. Results are tabulated below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinoma of breast</td>
<td>100</td>
</tr>
<tr>
<td>Acromegaly</td>
<td>17</td>
</tr>
<tr>
<td>Cushing's syndrome</td>
<td>7</td>
</tr>
<tr>
<td>Nelson's syndrome</td>
<td>1</td>
</tr>
<tr>
<td>Visual pathway compression</td>
<td>11</td>
</tr>
<tr>
<td>Totals</td>
<td>136</td>
</tr>
</tbody>
</table>

One patient had a central scotoma due to a haemorrhage in the retracted eye, one developed a central field defect thought to be due to use of unipolar diathermy near the right optic nerve, one had a 6th nerve palsy which recovered, nine had cerebrospinal fluid leaks (cured by fascial grafts), three had meningitis, and one had a tear in the right internal carotid artery due to the use of too large a bone punch.

This operation was advocated for all cases of pituitary disease requiring surgery.

**VARIABILITY STUDY OF HUMAN BRAIN-STEM STRUCTURES**

F. AFSHAR (London) had investigated the position and variability of the trigeminal nucleus and tract and of related brain-stem structures, including the spinothalamic tract, because of interest in techniques of percutaneous tractotomy. Measurements had been made in 30 hemibrain-stems obtained from necropsies on patients without central neurological disorder.

At the obex level the coordinates of the centre of the trigeminal tract were 6.5 mm from the midline and 4.5 mm from the posterior surface of the brain-stem. The mean measurements and variability were:

<table>
<thead>
<tr>
<th>At obex level—22 mm caudal to fastigium</th>
<th>Mean (mm)</th>
<th>SD ±</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial</td>
<td>5.46</td>
<td>0.64</td>
<td>0.14</td>
</tr>
<tr>
<td>Lateral</td>
<td>6.97</td>
<td>0.72</td>
<td>0.16</td>
</tr>
<tr>
<td>Anterior</td>
<td>5.67</td>
<td>1.11</td>
<td>0.25</td>
</tr>
<tr>
<td>Posterior</td>
<td>3.41</td>
<td>0.92</td>
<td>0.21</td>
</tr>
</tbody>
</table>

At the C1 level in the spinal cord the coordinates were 3.0 mm from the posterior cord surface and 5.25 mm from the midline. The mean measurements and variability were:

<table>
<thead>
<tr>
<th>Level 31 mm caudal to fastigium</th>
<th>Mean (mm)</th>
<th>SD ±</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial</td>
<td>4.28</td>
<td>0.70</td>
<td>0.17</td>
</tr>
<tr>
<td>Lateral</td>
<td>5.46</td>
<td>0.64</td>
<td>0.16</td>
</tr>
<tr>
<td>Anterior</td>
<td>3.93</td>
<td>1.09</td>
<td>0.27</td>
</tr>
<tr>
<td>Posterior</td>
<td>2.03</td>
<td>0.60</td>
<td>0.15</td>
</tr>
</tbody>
</table>

At 5 mm below the fastigial level (approximately the site for tractotomy) the centre of the structure was 6.0 mm from the 4th ventricular floor and 5.75 mm from the midsagittal plane. In view of the closeness of the proximity of important nuclei and tracts here, it was suggested that tractotomy would be better carried out 8 to 9 mm more caudally in the medulla.

**FORAMEN OF MAGENDIE**

GORDON BROCKLEHURST (Hull) read a paper based on his 1973 Sir Hugh Cairns Memorial Fund prize essay. Some primitive animals had no anatomical pathway through the roof of the fourth ventricle, most mammals had laterally placed fourth ventricle foramina, and man, in common with Old World monkeys and anthropoids, had a median foramen. In the 20 mm human embryo, the metapone was in a process of active development. Evidence showed the phylogenetic and physiological independence of the internal and external cerebrospinal fluid compartments. In the treatment of hydrocephalus the limited success of the Torkildsen operation was probably due to obliteration of the ambient cistern, while failure of the Stookey-Scarff procedure might be due to surgical destruction of the chiasmic and interpeduncular cisterns. To overcome these problems the operation of transcallosal third ventriculochiasmatic cisternostomy had been devised. A silastic tube
introduced from above through the lamina terminalis and from the third ventricle was guided into the pre-pontine cistern. Another tube was passed into a lateral ventricle and the two tubes were joined, the junction being hitched up through the corpus callosum to the falk cerebri. Preoperative RIHSA ventriculography had shown ventricular dilatation in all 10 patients treated. Eight had non-communicating hydrocephalus, and two were presumed to have blocks at the foramen magnum. In only one case, with superior caval obstruction, was the postoperative pressure higher than 10 mmHg. Satisfactory clinical arrest of hydrocephalus was obtained in six cases, and hydrocephalus recurred in three. One child, thought to have arrested hydrocephalus, died of hypotalsmic disturbance.

Transcallosal third ventriculochiasmic cisternotomy was feasible and the results were encouraging.

HAEMANGIOBLASTOMA OF THE POSTERIOR FOSSA

R. V. JEFFREYS (Edinburgh) reviewed 67 patients with posterior fossa haemangioblastomas. The association of these tumours with the von Hippel-Lindau complex and with erythrocytosis was emphasized. All patients with this condition should be screened for haemangioblastoma of the retina, renal carcinoma, and phaeochromocytoma. In this series haemangioblastoma of the retina occurred in 6% and the von Hippel-Lindau complex in 10%. There were 74 posterior fossa haemangioblastomas, of which 72% were cystic and 28% were solid. In 60% of the solid tumours the haemoglobin was more than 16 g/100 ml, whereas this association was present in 40% of cases with cystic tumours. The haemoglobin was less than 15-9 g/100 ml in 40%, between 16 and 17-9 g/100 ml in 42%, and over 18 g/100 ml in 18%. As renal erythropoietin (which comes from mesodermal cells) was identical with haemangioblastoma erythropoietin, it was suggested that haemangioblastomas were derived from mesoderm, possibly derived from primordial choroid plexus. The commonest clinical features were headache, occipital pain, imbalance of gait or limb, double vision, papilloedema, ataxia, nystagmus, external ocular palsies, and dementia. Gamma encephalography was always positive provided the tumour was not too far caudal. Vertebral angiography was 100% correct in this series. Solid tumours should be totally removed. Cystic tumours required only fluid drainage and mural nodule removal. Radiotherapy could only slow down tumour growth rate.

In this series there were 10 postoperative deaths (15%), five patients (7%) were incapacitated, and the remainder were alive and well at three month follow-up.

SENSORY FIBRE ARRANGEMENT IN THE POSTERIOR ROOT OF THE TRIGEMINAL NERVE

R. D. ILLINGWORTH (London) pointed out that Dandy in 1929 had maintained that section of the trigeminal sensory root at the side of the pons produced analgesia but not loss of light touch or of the corneal reflex due, it was said, to separation of the fibres for light touch and the corneal reflex in a bundle distinct from the main sensory root. These light touch fascicles were called by Dandy accessory fibres and they were described as lying between the main sensory and the motor roots. These fibres were rediscovered by Janetta and Rand in 1966.

Twelve patients with previously intact trigeminal sensation underwent sufficient division of the main sensory root at the side of the pons to relieve pain. Eleven had trigeminal neuralgia and one had malignant disease of the jaws. All showed marked dissociation of light touch and pain sensation postoperatively. The pain fibres for the lower jaw lie lateral and ventral in the sensory root, those for the forehead are dorsal and medial, and the upper jaw fibres lie in between.

Four patients with two-thirds sections had slight reduction of light touch sensation. Of eight patients with total or subtotal sections, five had almost normal light touch sensation and three had greatly reduced sensation. In the nine patients with well-preserved light touch sensation, the corneal reflex was normal, and some corneal sensation and reflex were present in the remaining three.

It was concluded that the fibres carrying light touch impulses separated from the pain fibres as the trigeminal nerve approached the pons. The light touch fibres did not remain in strict trigeminal divisions.

CRANIoplasty—a review of 31 cases

A. R. PATE (Dublin) had not found tantalum plates satisfactory for skull repair and had reviewed the records of 31 patients treated during the past 22 years. The results of the various operations were as follows:

<table>
<thead>
<tr>
<th>Satisfactory</th>
<th>Unsatisfactory</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tantalum plate</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Acrylic resin</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Rib graft</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Iliac bone graft</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Skull bone graft</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

The unsatisfactory tantalum and acrylic plates were all removed because of sepsis. The bone grafts classed as unsatisfactory had undergone absorption.

In two of the patients treated by rib grafting, the
pleura was opened and atelectasis occurred in another.

Rib grafting was recommended as a simple and effective method of skull repair, although the cosmetic results were inferior to those obtained by use of plates.

**SOME PARTICULAR FEATURES IN THE MANAGEMENT OF EXTRA-INTRACRANIAL ANASTOMOSIS**

J. LECUIRE, R. DEPUTY, J. P. DECHAUME, and PH. BRE'T (Lyons, France) had performed 15 extra-intracranial arterial anastomoses. The extracranial vessel used was the superficial temporal artery in 12 cases, and the occipital artery in three. In 10 cases anastomosis was made with the anterior temporal branch of the middle cerebral artery, and in five cases with the posterior temporal or angular artery. Scoville clamps were placed on the cortical vessel in the early cases but, because these clamps seemed to cause vasospasm, microtourniquets are now preferred.

Postoperative angiograms showed patency in nine cases and obstruction in six. One patient died of cardiovascular disease six months after operation and was found at necropsy to have a patent anastomosis. The six patients with obliterated anastomoses were no worse clinically after operation. Of the nine patients with patent anastomoses, one remained unaltered, two improved neurologically, and six had no more ischaemic attacks.

**STUDIES OF LOCAL BLOOD FLOW AND CORTICAL ACTIVITY IN THE EXPERIMENTAL PRIMATE**

LINDSAY SYMON, NEIL M. BRANSTON, H. ALAN CROCKARD, and JOHAN JUHASZ (London) had employed a technique of hydrogen polarography using multiple platinum electrodes in cortex and deep nuclei to study the distribution of reduced blood flow after middle cerebral artery occlusion in experimental animals. The focal nature of hydrogen recording enabled local blood flow to be related to nervous tissue function.

The study showed no significant differences between CO₂ reactivity obtained from cortex, putamen, or white matter, which were in the region of 2–3.5% per Torr increase in flow, although the data suggested a somewhat greater reactivity for white matter than for grey. Excellent autoregulation to altered perfusion pressure induced either by haemorrhage or by raised intracranial pressure was found, and autoregulatory curves to changes in perfusion pressure obtained by either method seemed identical. Pressure measurements during establishment of an extradural space occupying lesion indicated passive pressure perfusion of the compressed hemisphere first, followed by general autoregulation failure associated with subfalcine herniation.

After middle cerebral artery occlusion, reduction of blood flow was present over the entire lateral aspect of the cerebral hemisphere, being maximal in the frontoparietal and temporal opercula and in the deep nuclei. Reactivity to carbon dioxide was correspondingly reduced and intracerebral steal was found in the most densely ischaemic opercular zone. In no area was tissue blood flow increased. With the establishment of an acute ischaemic lesion failure of a somatosensory evoked response occurred which was critically dependent on a final blood flow after occlusion of <16 ml/100 g (two minutes’ clearance).

**PROXIMAL OCCLUSION OF THE ANTERIOR CEREBRAL ARTERY FOR ANTERIOR COMMUNICATING ANEURYSM**

A. HOCKLEY (Cambridge) reported 10 years’ experience in the treatment of anterior communicating aneurysms in a centre where proximal anterior cerebral artery occlusion had been the operation of choice. Out of a total number of 372 patients with haemorrhage from aneurysms, 124 had anterior communicating aneurysms. When the aneurysm filled mainly from one side, and the cross-flow was adequate, occlusion of the main supplying anterior cerebral artery was the preferred treatment.

In this series 68 patients were treated by anterior cerebral artery occlusion, 15 by direct surgery, one by evacuation of subdural haematoma only, one by decompression, and 39 conservatively. The reasons for this last line of treatment were poor clinical condition, vasospasm, multiplicity of aneurysms, myocardial infarction, pulmonary embolus, and refusal of operation. In the 15 patients undergoing direct surgery, the aneurysm was clipped in six, wrapped with muslin and muscle in six, and both clipped and wrapped in three.

The mortality rates were 10.3% for anterior cerebral artery clipping, 13% for direct surgery, and 69% for conservative management. After proximal occlusion, the causes of death were infarction (five), pulmonary embolus (one), and refusal due to lack of obliteration of the clipped vessel (one). In five deaths from infarction there had been vasospasm in three cases and very poor cross-flow in one. One patient had internal carotid artery thrombosis at postmortem examination. Death after direct surgery was due to infarction and in the conservatively managed group was most commonly caused by recurrent haemorrhage. Of the 61 survivors after proximal anterior cerebral artery occlusion, 51 returned to their usual work and seven to lighter work, two had a major deficit, and one died later of pneumonia in an institution. One patient died seven months and one four years later of haemorrhage, although angiography had demonstrated adequate clip closure.
ANATOMICAL VARIATIONS IN THE ORIGIN OF THE POSTERIOR CEREBRAL ARTERY DEMONSTRATED BY CAROTID ANGIOGRAPHY, AND THEIR SIGNIFICANCE IN THE DIRECT SURGERY TREATMENT OF POSTERIOR COMMUNICATING ANEURYSMS

R. P. SENGUPTA (Newcastle upon Tyne) emphasized the risk of ischaemic complications after treatment of posterior communicating aneurysms either by direct surgery or by carotid ligation. It was suggested that some common basic factor underlay these complications. Thirty patients had been treated by direct clipping of aneurysms and the size of the posterior communicating artery was studied retrospectively on the preoperative angiograms. The postoperative fate of the artery was also examined by angiography. Age of the patient, preoperative status, and time of operation after haemorrhage were all studied. The relation of size of the posterior communicating artery to outcome was as follows:

<table>
<thead>
<tr>
<th>Result</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Died</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large artery</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Small artery</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>18</td>
</tr>
</tbody>
</table>

The fate of the posterior communicating artery is shown below:

<table>
<thead>
<tr>
<th>Artery</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Died</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>4</td>
</tr>
<tr>
<td>Occluded</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>Severe spasm</td>
<td>1</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Not known</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>2</td>
<td>—</td>
</tr>
</tbody>
</table>

The significantly high rate of poor results with large posterior communicating arteries indicated that the size of this artery was an important factor in the production of ischaemic effects. A large posterior communicating artery seen on the angiogram was regarded as the posterior cerebral artery on that side.

PROBLEMS IN THE MANAGEMENT OF MULTIPLE INTRACRANIAL ANEURYSMS

R. A. C. JONES (Salford) thought that multiple aneurysm cases differed from single aneurysm patients because of difficulty in locating the site of haemorrhage and doubts concerning progress after incomplete operations. In a series of 205 aneurysm cases 45 (22%) had more than one aneurysm. Forty-three of these presented with haemorrhage and two with 3rd nerve palsy. The 45 patients had a total of 105 aneurysms, the majority being doublets. Bilateral carotid angiography was carried out in all cases but vertebral angiography was not a routine investigation. Forty-one operations were carried out in 38 patients (operability rate 85%). Seven un-operated cases died (mortality 27%), and there were five deaths in the operated series (mortality 13%). In 15 cases there was doubt about the site of bleeding. The criteria of localization were vessel displacement, local arterial attenuation, and the relative size of the aneurysm.

It was concluded that localization of the site of haemorrhage was usually possible, and that if the aneurysms were suitably situated a curative one-stage or two-stage operation was possible. Three patients had more than one operation and a cure rate of 24% was achieved. The other survivors were being observed and occasionally submitted to angiography for a check on the size of remaining aneurysms.

In the group of 15 patients where there was difficulty in deciding which aneurysm had bled, there were two deaths (one postoperative), and seven radical cures.

In the management of these cases it was recommended that clearly defined ruptured lesions should be made safe, that neighbouring unruptured aneurysms should be operated upon if appropriate, that more than one aneurysm should be excised at a single operation if the site of bleeding were in doubt, that more than one operation might be necessary, and that long term detailed review might be required.

AFFINITY OF CERTAIN STREPTOCOCCI FOR THE CENTRAL NERVOUS SYSTEM

JOHN DE LOUVOIS, PETER GORTVÁI, and ROSALINDE HURLEY (London) pointed out that certain streptococci, notably S. pneumoniae, had an affinity for the central nervous system. Three recent cases of brain abscess had been found to be due to streptococci and in two the organism was S. milleri. In 374 patients with serious streptococcal disease it had been found that the majority of isolates of S. agalactiae were associated with meningitis, and that S. milleri was associated with meningoitis and brain abscess. Streptococci were shown in a series of controlled experiments in mice to differ markedly in virulence according to the site of injection. S. agalactiae inoculated intravenously and intraperitoneally at high dosage killed all animals by 72 hours. When inoculated intracerebrally it killed by 48 hours. S. milleri showed a similar affinity for the central nervous system when inoculated intracerebrally at high dosage. S. mutans was lethal at high doses if it was injected intraperitoneally or intracerebrally. In low dosage S. agalactiae still killed all animals.
within 48 hours after injection into the brain. S. mutans and S. milleri in low dosage killed none. There was therefore a difference both in virulence and in target affinity in these three streptococcal species.

Differentiation of streptococci to group or species level might help the neurosurgeon by enabling predictions of likely response to antibiotics. Further, if the natural history of brain abscess could be established by laboratory studies, the surgeon might be able to hazard an informed guess as to the nature of the infecting microbe before culture.

EFFECTS OF AN EXPERIMENTAL WATER SOLUBLE CONTRAST MEDIUM IN THE POSTERIOR FOSSA OF THE BABOON

I. G. Wylie, F. Afsar, and T. H. Koeze (London) emphasized the need for a radiological technique which would demonstrate clearly the fastigium, the floor of the fourth ventricle, and the dorsal surface of cervical cord and medulla for the purpose of stereotaxic surgery. Myodil, emulsified Pantopaque, and Conray all had disadvantages. Investigations were carried out on four anaesthetized baboons using metrizamide (Amipaque). In each injection the needle lay in line with the foramen of Magendie. The foramen lay vertically below the needle tip, and the viscosity of the medium was at or above a concentration of 300 mg I/ml. Excellent radiographs showing the necessary detail were obtained. During and immediately after injection there were no alterations in EEG, ECG, pulse rate, respiration rate, blood pressure, or rectal temperature. The duration of anaesthetic action was prolonged. EEG abnormalities and grand mal seizures occurred in three animals four to six hours after injection. One of these died, and one had a transient hemiplegia. These baboons had been anaesthetized with Nembutal, Droperidol, and Fentanyl. A fourth animal anaesthetized with halothane and nitrous oxide behaved in exactly the same way as the first three.

It seemed that injections of metrizamide in high concentration into the fourth ventricle might not be feasible clinically, so, in a fifth baboon anaesthetized with halothane, nitrous oxide and intraperitoneal barbiturate, 1 ml of the contrast medium at a concentration of 300 mg I/ml was injected into a lateral ventricle. Good visualization only as far as the foramen of Magendie was obtained. This animal did not have seizures. The investigation was proceeding.

COMPUTERIZED AXIAL TOMOGRAPHY WITH THE EMI SCANNER—EARLY AND FRUITFUL EXPERIENCE IN PAEDIATRIC NEUROSURGERY

Kenneth Till (London) had found computerized axial tomography especially valuable in children because of absence of need for general anaesthesia, short duration (4 to 20 minutes), ease of repetition, no necessity for injections, possibility of outpatient investigation, and very low exposure to irradiation. Examples of cases in which it had been possible to make important decisions with a minimum of disturbance to the child were given. The desirability of avoiding disturbing and hazardous investigation before a decision not to operate was stressed. The following illustrations of EMI scan diagnosis were given:

1. A boy with a left hypotonic hemiparesis and calcification in the left internal capsule and thalamus was diagnosed as having an inoperable pineal teratoma.

2. A girl with a craniopharyngioma was shown to have a very large solid tumour with no ventricular enlargement and it was decided to treat with radiotherapy.

3. The son of parents who suffered from migraine presented with episodes of hemiparesis, and headache. The parents’ opposition to angiography was countered by the demonstration of a frontotemporal mass.

4. Three years after operation and radiotherapy for cerebellar ependymoma a boy developed mild upper limb ataxia. The necessity of reoperation was shown by the demonstration of a cerebellar mass.

5. In two cases cerebellar tumours were so clearly demonstrated that operation was performed without anything other investigations. One child had a cerebellar hemispheric astrocytoma, and the other had a venous medullary blastoma.

6. A boy of 13 who had been treated in infancy for hydrocephalus with a ventriculocardiac shunt developed mild headache. There was no sign of raised intracranial pressure but the scan showed grossly enlarged ventricles, indicating that shunt revision was necessary.

7. Excision of an optic nerve tumour from a girl with an enlarged optic foramen was carried out because the scan showed that the tumour had not extended to the chiasm.

AQUEDUCT STENOSIS IS A RESULT OF HYDROCEPHALUS

Bernard Williams (Birmingham) said that aqueduct stenosis could cause hydrocephalus but it was possible that aqueductal closure or narrowing might occur as a result of hydrocephalus. In some cases in the past aqueduct stenosis might have been wrongly blamed as the cause of hydrocephalus to which it contributed only in the final stages. From the second month of fetal life until birth the aqueduct was compressed from outside by the cerebral hemispheres. If the ventricles were distended, excessive aqueductal narrowing might follow.

The facts about nontumoral stenosis of the aqueduct could be explained on the basis that...
hydrocephalus from any cause distal to the aqueduct acting in early life might cause the lateral ventricles to enlarge and displace the tentorium and the hind-brain downwards. Thereafter, compression of the midbrain between the hemispheres might occur, aggravating the normal tendency of the aqueduct to become narrowed during intrauterine life. If the hydrocephalus was not too severe, and became compensated, so enabling the fetus to live, then subsequent decompensation might occur after birth, in infancy, childhood, or adult life, by blockage which appeared to be at the aqueduct alone.

**BRAIN ANTIGEN RELEASE INTO THE PERIPHERAL BLOOD OF PATIENTS WITH HEAD INJURIES**

D. G. T. THOMAS (Glasgow) considered the difficulty of early prognosis in severe head injuries. In experimentally induced brain injuries, synaptic vesicle antigens had been found in the cerebrospinal fluid, and pulmonary embolism by fragments of brain tissue had been recorded. Brain antigens had been found in the sera of patients with neurological disease. It seemed worthwhile to investigate the possible existence of brain antigens in peripheral blood after head injury. Antisera were produced by injection of grey and white cerebral tissue from craniotomies into mice. Patients' sera were tested for brain antigen using absorbed antisera by Ouchterlony’s double diffusion method.

Brain antigen was found in the serum of 22 of 36 patients (63%) with severe blunt head injuries. It was present in two out of 15 patients (13%) with other brain damage and in none of 24 healthy medical students who formed a control group.

Of the 22 head injured patients with antigen in the serum, 10 died, and only one made a good recovery. Of the 14 patients with no brain antigen in the serum, eight made a good recovery, two were disabled at one month, and four died, but only two of these deaths were directly attributable to brain injury. Application of Fishers’ Exact Test showed significant correlation between presence of brain antigens in serum and death or persisting brain damage.

**EPENDYMOMAS IN CHILDHOOD**

R. A. COULON and NORMAN GRANT (London) reviewed 43 cases of intracranial ependymoma. These represented 6% of the total number of intracranial tumours treated over an 18 year period. Thirteen were supratentorial and 30 in the posterior fossa. The average age for benign lesions was 7 years and for malignant lesions 3-5 years. The duration of the history averaged nine to 10 months in the benign cases and three to four months in the malignant ones. Vomiting and headaches were common. Personality changes were frequent. In the very young, retardation or developmental regression occurred. Unsteadiness of gait was common with posterior fossa lesions. Signs were papilloedema in 67%, increase in head circumference above the 90th percentile in 37%, abnormal skull percussion note in 51%, stiff neck in 23%, ataxia in 35%, hemiparesis in 19%, and marked meningeal signs in one case. Skull radiographs were abnormal (suture diastasis, sellar changes, pathological calcification) in 74%. Tumour cells were found in cerebrospinal fluid from five cases.

Of the 13 supratentorial lesions, three had burr-hole biopsy only, and 10 had craniotomies. One of the burrhole biopsy cases and one craniotomy died in hospital. The surviving craniotomy cases and one biopsy case had radiotherapy.

Of the 30 infratentorial tumours, one died before operation and 29 had attempted maximal removal, the aim being at least to unblock the 4th ventricle. Seven of these children died in hospital, and one shortly after discharge. The 21 survivors had radiotherapy.

Of 13 supratentorial operation cases, two died in hospital (operative mortality 15%). Three year survival was 30% (three out of 10). No child had yet lived five years, but four might do so. Three year survival in the radiotherapy series was 43% (three out of seven).

Of 30 infratentorial tumours, seven were operative deaths (23%). Three year survival was five out of 26 (19%), and five year survival was 12%. Three year survival after radiotherapy was five out of 17 (29%), and five year survival three out of 16 (19%).

No child with a malignant lesion had survived beyond the second year after operation.

**SIR BERNARD KATZ, FRS** (Department of Biophysics, University College, London) gave a lecture on ‘The Molecular Effect of the Neuromuscular Transmitter’.

**CONTINUOUS MEASUREMENT OF DIFFERENTIAL CSF PRESSURES ACROSS THE TENTORIUM**

S. R. SONI (Swansea) described a method for continuous and simultaneous comparison of ventricular fluid pressure and the difference between ventricular and cisterna magna pressure by means of two radiotelemetric transducers. Raised intracranial pressure was likely to be of immediate serious consequence only if differential pressures in various compartments led to brain shifts. There was an impression that coning results if the ventricular pressure exceeded that in the cisterna magna by 100 mm water.

Differential pressure measurements were made on 13 occasions in 12 patients with raised intracranial
pressure. Continuous recordings were made for between two and 18 hours.

Despite large recorded differences between ventricular and cisternal pressure, only one patient had tentorial herniation. High differential pressure could be reduced to zero by ventricular aspiration. Mannitol reduced pressure, especially in the supratentorial compartment. Differential wave forms were seen in some cases.

This investigation was the first in which a differential transducer had been used and showed that a difference of 165 mm water pressure across the tentorium was compatible with life and did not indicate that tentorial herniation had occurred.

Further work was necessary to determine the place of differential measurements in clinical practice.

FRONTAL LOBE LESIONS FOR DEPRESSIVE ILLNESS
RAYMOND NEWCOMBE (London) had found that in depressive illness the lower medial quadrants of the frontal lobes were the usual target areas for leucotomy. These involved the amygdalothalamic-orbital circuits of the limbic systems and regions of convergence of the somatosensory cortical activity on the visceral brain. Experience of orbital undercuts after previous rostral procedures had indicated the beneficial effects of the deeper parts of these lesions. A stereotaxic tractotomy operation was employed. The target position for introduction of yttrium seeds was determined in the lateral radiograph by reference to the plane passing through the orbital roof laterally and the tuberculum sellae, and the plane perpendicular to the latter. Six seeds were inserted on each side. From the average brain outline it was seen that the lesions usually lay anteroventral to the striatum. These conclusions received support from postmortem studies in seven patients who died from intercurrent disease. Small lesions in the ventral part of the head of the caudate nucleus caused temporary confusion or lethargy. It was concluded that small planar lesions of about 1 ml volume anteroventral to the striatum might relieve intractable depression. These lesions need not extensively involve the projection from the dorsomedial nucleus of the thalamus, neither need they extend posteriorly to isolate the agranular orbital cortex or enter the substantia innominata of Reichert.

CLINICAL SIGNIFICANCE OF MESIAL TEMPORAL
(AMMON'S HORN) SCLEROSIS IN EPILEPSY
MURRAY A. FALCONER (London) drew attention to the involvement of the amygdala, hippocampal gyrus, and uncus in Ammon's horn sclerosis. The lesion usually resulted from a severe febrile convulsion in infancy. Surgery for epilepsy gave its best results when mesial temporal sclerosis was found. Suitable patients for operation were those with drug-resistant temporal lobe epilepsy, with exclusion by neuroradiology of space-occupying lesions, and with EEG evidence of focal spike discharges confined to or, if bilateral, predominant on the side chosen for resection. Three hundred patients had undergone operation with two deaths, one in the first case of the series, and one due to pulmonary embolism. Half the patients had mesial temporal sclerosis, a fifth had hamartomas, a tenth had scars and infarcts, and the remainder had no definite neuronal pathology. Fifty to 60% of cases of mesial temporal sclerosis could be rendered fit-free. An olfactory or gustatory aura usually pointed to a diagnosis of tumour or hamartoma. In 30 to 40% of patients with mesial temporal sclerosis a history of a febrile convulsion lasting at least half an hour could be obtained. A family history of epilepsy was also frequent. Almost all the patients had a remembered aura or psychomotor seizures. Some had also had grand mal or absence types of seizure. Dysphasia was of great localizing value, and intracarotid sodium amylobarbitone tests were less and less frequently used.

Radiologically there might be relative smallness of the middle fossa on the affected side, and a collateral eminence might be visible in the temporal horn. Spike discharges on the EEG were usual. Lack of barbiturate induced fast activity usually pointed to mesial temporal sclerosis but sometimes to hamartoma. If depth electrodes in the hippocampus and amygdala showed EEG silence or uncal activity, only, mesial temporal sclerosis was the likely pathology. Injury potentials or spike discharges pointed to other types of lesion.

The importance in prophylaxis of prompt and vigorous treatment of febrile convulsions in infancy was emphasized. In Copenhagen a reduced incidence of habitual epilepsy was believed to be following a determined effort to treat infantile convulsions early and effectively.

CONTROL OF INCONTINENCE DUE TO THE UNINHIBITED BLADDER BY SELECTIVE SACRAL NEURECTOMY
MICHAEL J. TORRENS and HUW B. GRIFFITH (Bristol) studied 304 incontinent patients in 48% of whom there were uninhibited bladder contractions. Physiological assessments of the effects of sacral root blocks and selective sacral root sections on bladder and sphincter functions had been made. Seventeen patients underwent bilateral selective nerve blocks of the S2-S4 roots. After assessment by cystometry, pressure flow analysis, and urethral pressure recording, nine were selected for sacral neurectomy. Blocking the S3 nerve root seemed effective in
increasing bladder capacity and reducing uninhibited activity. S4 blocking resulted in an increase in resting sphincter pressure. Operation consisted of nerve root exposure by means of limited sacral laminectomy. Intraoperative nerve root stimulation produced sustained tonic bladder contraction. The level for neuroectomy was selected by comparing the information from preoperative nerve blocks and intraoperative nerve stimulation. The S3 roots were cut in eight cases and the S4 roots in one. Cystometrogram capacity was increased in six patients. Average volume voided became greater in four cases. Maximum volume voided was significantly increased. Uninhibited bladder activity became less in eight patients. Resting urethral sphincter tone was insignificantly increased. Urinary flow rate rose in most cases. Enuresis was cured in two cases, substantially improved in four, and unchanged in three. Urinary frequency tended to improve.

Urge incontinence was cured in six patients. None of the four male patients had changed sexual potency. There was no significant disturbance of bowel function.

It seemed that the best results followed bilateral sacral neuroectomy at one level, usually S3. Suitable patients for operation were those with urge incontinence, reflex incontinence, or enuresis where conservative treatment had failed. Urodynamic assessment should confirm uninhibited bladder activity, absence of sphincter weakness and outflow obstruction, and show intact sensation. A potential functional capacity of 400 ml should be demonstrated.

OPERATION FOR REINNERVATION OF URINARY SPHINCTERS IN CONGENITAL OR POST-TRAUMATIC PARAPLEGICS

H. A. Maslowski (Manchester) had operated on four infants with paraplegia due to meningomyelocele. S3–S4 nerve roots were detached from the neural plates and joined to nerve roots to the lesion, either directly or by using sacrificed nerve roots to close gaps. It was thought that unilateral operation should be sufficient. The first anastomosis was performed four years ago using silk sutures and sleeves, but the operation was difficult and unsuccessful, so in the other three cases a spot-glue technique using t-ethylcyanoacrylate had been employed. The outcome was expected to be satisfactory in the last two cases.

The operation should be suitable for adults with post-traumatic paraplegia where the lesion was between the midthoracic level and the conus. A hemilaminectomy at one or two levels should be sufficient. One or two sacrificed cauda equina nerve roots could be used to bridge the gaps between the S3–S4 nerve roots (sectioned close to the cord) and roots just above the level of the lesion. Alternatively, freeze dried and irradiated cadaver allografts could be employed in combination with immunosuppressive therapy.

C. A. Carlsson and T. Sudin had had a satisfactory functional result after anastomosing the S1–S2 roots to the T10–T11 roots in a four year old girl with meningomyelocele and paraplegia.

SPASMODIC TORTICOLLIS

L. S. Walsh (London) had treated 25 men and 21 women with spasmodic torticollis over a period of 17 years. Pain was usually due to cervical spondylosis. Three patients developed myelopathy. Only two patients had spontaneous remissions. Thirty-three had torticollis, five had retrocollis, and six had torticollis associated with other involuntary movements. It was thought that the condition was organically determined. In five patients significant head injury had preceded the onset of the disorder, one had a parietal lobe abscess four years previously, one had Sydenham’s chorea in childhood, and one had choreoathetosis 30 years before the onset of torticollis. Another had an influenza-like illness immediately beforehand, and one patient later developed Huntington’s chorea.

Six patients were treated by section of the accessory nerve in the neck, and two of these showed some improvement.

Three underwent bilateral stereotaxic operations. All developed dysarthria, and abnormal movements returned to some extent in one.

Six unilateral thalamotomies were performed. In only one case was there benefit from the procedure.

Thirty-three patients had been treated by cervical rhizotomy, including three who had previously had unsuccessful thalamotomies. The operation consisted of division of the upper four cervical motor roots on the side to which the head moved and of the upper three roots on the other side. On both sides the spinal accessory nerve was cut intrathecally at the C1 level and connections between the nerves and the first cervical roots were divided. On the side of sternomastoid spasm the accessory nerve was cut in the neck, sparing the fibres to the trapezius muscle if possible, whenever the intrathecal operation had not stopped the sternomastoid contractions. In 26 cases the results had been satisfactory. Of the remaining seven, one died of pulmonary embolism, one died of myocardial infarction, one was relieved of torticollis but had a deformed neck due to muscle weakness, one was disabled by Huntington’s chorea while being cured of torticollis, and three had no relief. The 26 patients who were improved had no involuntary movements but had some stiffness of the neck. Ten had some dysphagia. Some had ache in
the neck and a few had difficulty in raising one or both arms at the shoulder.

DORSAL COLUMN STIMULATION:
AN INITIAL EXPERIENCE

G. CORKILL, O. W. ALBRAND, and J. R. YOUNGS (Davis, California) pointed out that chronic benign pain did not always respond to the classical pain operation. The 'gate theory' of pain perception called for modulation in the dorsal horn area of the amount of centrally transmitted pain signals. Inhibition of the transmitter cell by the substantia gelatinosa was the anatomical basis. Alpha and beta fibre activity enhanced the inhibition. Gamma and delta fibre activity decreased the inhibitory effect of the substantia gelatinosa and allowed more pain impulses to reach consciousness after passing through the transmitter (or T) cell gate. Stimulation of the beta fibres in the posterior columns had been employed by several investigators in the management of pain.

Nine patients with intractable pain had undergone 12 operations. A foot plate was implanted on the dorsal columns in the subarachnoid space and connected by a subcutaneous wire to a radio receiver implanted beneath the skin in the right mid-clavicular line. The patient applied a radiofrequency transmitter to the skin over the receiver when necessary.

All the patients were relieved of pain. One developed paraplegia six hours after surgery, and at reoperation was found to have a swollen cord.

It was concluded that all patients needed extensive screening before operation, that the foot plate should not be inserted between the T4 and T8 levels where the canal was narrow, that arachnoiditis contra-indicated operation, that steroids should be employed, that intensive postoperative care was necessary, and that the patient should be flat for three days after operation to minimize the risk of CSF leakage.

Further research into technical improvements was proceeding.

ASSESSING AND RECORDING 'CONSCIOUS LEVEL'

G. M. TEASDALE, R. KNILL-JONES, and W. B. JENNETT (Glasgow) had found little consistency between various systems of describing patients with impaired consciousness. Unstructured observations result in ambiguities and misunderstandings, when it comes to exchanging information about patients. A system based on best motor response, verbal response, and eye opening, was devised.

The best motor response varied for obeying commands (best response possible), through localizing response, flexion responses, and extensor posturing. Verbal responses were graded from orientation down through confused conversation, and inappropriate verbal responses, to incomprehensible sounds. Eye opening was recorded as provoked spontaneously on approach of the observer, in response to speech, or after the application of a painful stimulus.

Observer consistency was investigated and an average rate of disagreement of one in 10 was found in a group of nurses, neurosurgeons, and general surgical trainees.

The need for defining consciousness and coma in absolute terms was avoided. The system had the merit of simplicity, making it appropriate for use by relatively inexperienced staff.

CONGENITAL ATRESIA OF THE FORAMINA OF LUSCHKA AND MAGENDIE, WITH ABSENCE OF THE CEREBELLAR VERMIS AND CORPUS CALLOSUM IN AN ADULT

R. E. RAMIREZ (Haywards Heath) described the case of a 29 year old woman with a short history of headache, nausea, vomiting, and dizziness. Physical signs were bilateral papilloedema, gross horizontal jerk nystagmus, left hypotonia, and slight incoordination of left arm movements. Radiologically there was thinning of the skull vault and of the dorsum sellae. The electroencephalogram was moderately abnormal with dominant beta activity accentuated by hyperventilation. Slow activity was not attenuated by eye opening. A brain scan showed a high position of the torcular. Left carotid angiography revealed evidence of a posterior fossa space occupying lesion with forward displacement of the deep cerebral veins and of the occipital lobes. A vertebral angiogram showed an avascular mass displacing the cerebellum forwards.

Posterior fossa exploration revealed a distended fourth ventricle, and absence of the cerebellar vermis. A ventriculoatrial shunt was established later because of persistently high posterior fossa pressure, but the patient died two months after the first operation.

At necropsy the brain was found to be hydrocephalic, with a cyst between the cerebellar hemispheres and having the floor of the fourth ventricle as its base. The cerebellar vermis, corpus callosum and septum lucidum were absent.

This case was considered to be an example of mal-development of midline structures, with involvement of both cerebrum and cerebellum.

CERVICAL SPINAL INTERBODY FUSION
WITH KIEL BONE

P. S. RAMANI, R. M. KALBAG, and R. P. SENGUPTA (Newcastle upon Tyne) had used iliac crest autografts for spinal fusion by the Cloward technique, but had abandoned the technique in 1968 because of complaints of pain at donor sites, and had turned to processed animal bone from calves for grafts.
Traction had been applied during operation and patients had been discharged to their homes on the fifth postoperative day unless they had required prolonged treatment for paraparesis.

Complications noted were anterior protrusion of graft (17 cases), partial absorption of dowel (four cases), retropharyngeal abscess (one case), partial resorption of vertebral bodies (three cases), fracture of adjacent vertebral bodies (two cases).

Fifty-five cases out of the 65 submitted to surgery showed satisfactory alignment of the spine without abnormal mobility in flexion or extension. In no case could it be said with confidence that bony fusion had occurred. Only six cases were considered to be failures despite the seemingly long list of complications.

OPTIC NERVE COMPRESSION BY THE OPHTHALMIC ARTERIES IN CASES OF PITUITARY ADENOMA

P. R. R. CLARKE (Middlesbrough) described two cases of chromophobe pituitary adenoma with visual failure in which local pressure effects exerted by the ophthalmic arteries had been noted.

A 53 year old man with hypopituitarism and a pituitary tumour presented with recent visual deterioration in the right eye only, a visual acuity on the right of 6/60, a central temporal field defect, and a filling impairment below the right optic nerve as seen on pneumoencephalography. At operation a considerable quantity of the adenoma was removed, and it was noted that the right optic nerve was elevated over the ophthalmic artery which passed under it from the lateral to the medial side. The processus falciformis, which was tightly applied to the upper surface of the nerve, was divided. After operation the visual acuity improved to 6/18.

A 46 year old man, who had multiple sclerosis, developed a chromophobe pituitary adenoma, central temporal visual field defects, and deterioration in vision to 6/36 in each eye. Pneumoencephalography showed that there was a considerable suprasellar extension of tumour. At right frontal craniotomy it was seen that the right ophthalmic artery ran from lateral to medial under the nerve and was splitting the nerve at its centre so that the artery was visible in the middle of the optic nerve. The processus falciformis was divided, and as much as possible of the adenoma was removed. Postoperatively visual acuity did not improve.

It was pointed out that the ophthalmic artery did sometimes run medially beneath the optic nerve before entering the optic canal, and that the processus falciformis might produce pressure on the nerve from above.