Proceedings of the Society of British Neurological Surgeons: 68th meeting

The 68th meeting of the Society was held in London from 27 to 29 June 1963 as a combined meeting with the Neurosurgical Society of America. Meetings were held at the National Hospital, Queen Square, and the Royal Society of Medicine. The Presidents, Mr. G. F. Rowbotham (Society of British Neurological Surgeons) and Dr. Claude Bertrand (Neurosurgical Society of America) occupied the Chair in rotation.

ELECTROPHYSIOLOGICAL STUDIES OF THE HUMAN THALAMUS AND ADJOINING STRUCTURES

C. Bertrand, S. N. Martinez, and Jules Hardy (Montreal) reported electrophysiological observations made on a recent series of 150 patients. They stated that increased experience and the use of micro-electrode recording had provided new data and confirmed observations made in a previous series as to the functions of the area in the region of the nucleus ventralis posterior lateralis and the underlying cortico-spinal tract.

In an area 18 mm. behind and 16 mm. below the foramen of Monro (21 mm. behind the anterior commissure and 11 mm. below the intercommissural line) and 13 to 14 mm. from the midline an antero-posterior pattern of motor responses was found with face to arm to leg. The arm-leg response was obtained 18 mm. behind and 16 mm. below the foramen of Monro (21 mm. behind the anterior commissure and 11 mm. below the intercommissural line) at a distance of 13 to 14 mm. from the midline. This could be changed to an arm or leg response if the electrode was moved 2 mm. anteriorly or posteriorly respectively.

Arrest of speech by stimulation and alterations of speech mechanism by section could not be produced within the ventro-lateral thalamus and probably not within any part of the thalamus.

With stimulation at 60 c/s sensations of tingling and electric shock were more constant in the nucleus ventralis posterior medialis and lateralis than in the underlying lemniscus and also demonstrated some antero-posterior face-arm-leg distribution but with more overlap.

Of four cases with persistent hypoaesthesia, one had a moderate amount of thalamic pain which seemed to result from a lesion underlying the thalamus. There was increasing evidence that thalamic pain did not result from a lesion involving the thalamus. A persistent bitter taste was experienced by this patient (and two others) and taste discrimination was altered on the contralateral portion of the tongue.

At 16 mm. behind the foramen of Monro (19 mm. behind the anterior commissure) introduction of a 1.5 mm. electrode produced cessation of tremor in two patients out of three and the arm-leg response was obtained.

Using auditory amplification this effect occurred 2 to 3 mm. after the intense firing of the nucleus ventralis posterior lateralis and the whining sound of the zone grillage had stopped and the electrode was in the sub-thalamus. Occasionally a rhythmic 5 c/s discharge was obtained which stopped with the tremor, being apparently evoked rather than autonomous. In other cases opening the fine wire of the leucotome could achieve temporary suppression of tremor.

Contrary to their previous impression that the optimum point for producing hypotonia was slightly more anterior and closer to the nucleus ventro-lateralis a lesion of the above-mentioned region produced marked hypotonia.

Alertness and mental processes did not seem to be impaired by ventro-lateral thalamic lesions so that contralateral lesions could be made later with impunity.

CRYOGENIC SURGERY

Irving S. Cooper (New York) presented a report of a complete system for cooling or freezing biological tissue and his experience with the use of intense cold as a physiological and surgical tool. He noted that during the past century there had been several reports of investigations into the use of extreme cold as an agent of physiological inhibition or surgical destruction of tissue within the nervous system.

He noted that five mechanisms had so far been described through which extreme cold produced chemical and morphological change in tissues. They were dehydration and toxic concentration of electrolytes, crystallization and rupture of cell membranes, denaturation of lipid-protein molecules within the cell membrane, thermal shock, and vascular stasis.

The cryogenic system which he used would cool temporarily or freeze and destroy a predictable volume of tissue in a sharply delimited fashion. The refrigerant was liquid nitrogen, the temperature of which was −196°C. This cooled a vacuum insulated cannula, only the tip of which was not insulated, so that cooling or freezing occurred only in the tissue surrounding the cannula tip. Temperature was monitored by thermocouple in the cannula and controlled automatically by a servo-mechanism.

This system provided an ideal method for basilar ganglion surgery for Parkinsonism and other disorders of
involuntary movement. Initial cooling of the cannula tip provided a temporary block or reversible lesion, whilst freezing at -60 to -70°C, produced a sharply circumscribed lesion of sufficient size to provide lasting relief of symptoms. The frozen lesion was generally tolerated without producing any morbidity. For this reason, in some cases of torticollis or dystonia, he had been able to perform bilateral thalamectomy simultaneously without ill effect and with very satisfactory therapeutic results.

The system had also been applied to brain tumour surgery either to freeze a tumour solid in order to dissect it out en bloc or to produce freezing necrosis of tumour in situ. Freezing necrosis of tumours in other parts of the body had confirmed the usefulness of this technique as an ancillary approach to the surgery of neoplasms.

He concluded that intense cold as a surgical tool within biological tissue was anaesthetic, haemostatic, physiologically reversible, controllable, and tolerated without insult to the remainder of the organism.

FURTHER OBSERVATIONS ON THE STEREOTACTIC ISOLATION OF AREA 13

GEOFFREY KNIGHT (London) said that in a series of 500 cases of restricted orbital undercutting evidence indicated that the maximum benefit was derived from the posterior 2 cm. of an incision 1-8 cm. wide lying 1 cm. from the middle line and 1 cm. above the orbital roof extending to a distance of 6 cm. from the frontal pols. This incision was in the substantia innominata which lay below the caudate nucleus and overlay area 13 of the cortex and contained fibres descending from the frontal cortex, converging towards the hypothalamus, where they could be divided at a point below and behind the ascending thalamo-frontal radiation. The area also contained fibres of the amygdaloid complex and an important projection from area 13 to the ventro-mesial hypothalamic nuclei.

In relation to bone landmarks, the posterior extremity of the incision lay 1 cm. above the anterior clinoids and the inner border lay 1 cm. from the middle line over the inner third of the sphenoid wing.

Two rows of four seeds of radioactive Ytrium (Y. 90) were inserted bilaterally within a plane 1-8 cm. wide, 2 cm. long, lying 1 cm. above the orbital roof 1 cm. from the middle line and extending to a point 1 cm. above the anterior clinoid process; these seeds were inserted from in front and not from above in order to avoid damage to the caudate nucleus, which might well alter the effect.

Thirty-two out of 35 patients had responded well.

Cases of depression, anxiety states, and obsession did best. Patients of poor personality, such as hysterics and schizophrenics, failed to reach the highest grades. Of the first 25 patients, eight were completely relieved in grade 1; 10 were to all intents and purposes completely relieved and required no treatment; four were improved and still required drugs, and three were unchanged.

These results had been achieved without mortality in patients of advancing years and poor physical condition. Four patients over the age of 79, three with depressive symptoms of more than 15 years' duration, and four others above the ages of 59, some with illnesses of 10 to 20 years' duration, reached grade I. Nine patients between the ages of 60 to 70, five with illnesses of 10 to 20 years' duration reached the second grade. Two patients with previous failed leucotomies had been improved.

These results were obviously significant and indicated that relief could be extended with little risk to geriatric patients. There was no flattening of normal emotion, the operation being in essence a selective fronto-hypothalamic tractotomy.

DIENCEPHALIC PROJECTIONS OF TRIGEMINAL SUBNUCLEUS CAUDALIS

ROBERT B. KING (Syracuse) said that anatomical and evoked potential studies had shown a wide distribution of relays from the trigeminal subnucleus caudalis to the diencephalon. Only the evoked potential in the region of the centre median and adjacent interlaminar nuclei was totally dependent on a relay at the subnucleus caudalis.

Cats could be rendered over-reactive to tactile facial stimulation by the local application of strychnine to the subnucleus caudalis. Thereafter stimulation of the whiskers or trigeminal nerve initiated marked over-reaction and an increase in the amplitude and duration of the trigeminal dorsal root reflex. The overreaction disappeared (the dorsal root reflex remaining unaltered) after intercollicular decerebration, which suggested that altered diencephalic potentials might occur in cats with overreaction to tactile facial stimulation. Particular attention had been directed to features of the evoked responses in the mid-brain reticular formation, the centre median, and the arcuate nuclei. These thalamic projections were discussed as representing neural pathways which related to mechanisms of pain.

TRIGEMINAL NEURALGIA TREATED WITH G.32883

JULIEN C. TAYLOR (Derby) reported a series of cases of trigeminal neuralgia treated with a new drug, Geigy 32883. A series of 52 patients was treated over a period of 13 months. Their ages ranged from 35 to 90 years, the majority being in the fifth, sixth, and seventh decades, and the length of history varied from three months to 20 years. The follow-up period was more than six months in 49 and less than two months in three cases.

He stated that the drug had been developed as an anticonvulsant and was an iminodibenzyl derivative. There was no relationship with the hydantoins but there was a chemical resemblance to the tranquillizer Imipramine or Tofranil.

The drug was found to be very effective in controlling pain but produced several side-effects. For this reason he advised starting with a small dose and increasing gradually by weekly increments until control was achieved. The dosage required had varied from 200 to 1,600 mg. daily. Treatment had been effective in 44 cases. Relief from pain was experienced in some cases within an hour of starting treatment and always within 48 hours. In 10 cases all symptoms were abolished, and pain recommenced within three days of stopping treatment (in five within 24 hours). The remainder experienced occasional sensations in the face of pricking or 'jumps' but these were slight. Thirty-five patients experienced side-effects...
of drowsiness, nausea, dry mouth, headache, and unsteadiness of gait. These were usually mild and subsided within one or two weeks. If the dose was increased too quickly or too far these might recur. In four cases a generalized erythematous scaly, itchy skin rash appeared at periods from six weeks to five months after continuous treatment. This subsided on stopping the drug and reappeared within a few hours of starting again. In two patients persistent diarrhoea occurred after six and eight months of treatment. Apart from those with skin rashes there had been four patients in whom the treatment had failed. One failed to get any relief and three others, after a period of successful treatment varying from five to 12 months the drug, quite suddenly, ceased to be effective.

He concluded that treatment was effective in 85% of cases. Though individual dose was variable the average was 600 mg. daily and might have to be adjusted at different times in relation to infections, accidents, or injuries when the dose might have to be increased. A trial group of 10 patients, six with post-herpetic neuralgia and four with migrainous neuralgia, did not derive any benefit from the drug.

ACUTE MANIFESTATIONS OF PITUITARY TUMOURS

J. M. SMALL (Birmingham) reported a series of 100 consecutive cases of pituitary tumour, of which 27 had acute onset, 11 presented in the acute episode, nine presented during investigation, two post-operatively in extrasellar extensions, and four with a recurrence of tumour. Six of the 11 presenting in the acute episode had evidence of severe meningeal irritation, varying field defects, and ocular paresis. Two of these had bacterial infection of the intrasellar tumour and one of them an associated bacterial meningitis; the others, meningeal irritation due to infarction of the pituitary tumour exhibiting either severe polymorpho-nuclear response or looking like subarachnoid haemorrhage depending on whether or not the infarct was white or red. Only one of these patients died, one with associated bacterial meningitis.

In four of the 11 cases presenting in the acute episode, there was definite evidence that infarction having occurred the tumour completely disappeared. No example of infarction from irradiation appeared in this series.

HYPOPHYSEAL STALK EXCISION IN THE TREATMENT OF DIABETIC RETINOPATHY

CHARLES A. FAGER (Boston) said that pituitary ablation had been known to arrest the course of diabetic retinopathy favourably in some cases, but hypophysectomy had not been universally accepted as a method of treatment. Aside from the inherent surgical risk, other factors militated against total pituitary removal in the unstable juvenile type of diabetic, and a number of subsequent deaths after surgery had been directly attributed to hypoglycaemia. Section of the pituitary stalk alone produced inconsistent results until Field and his associates offered convincing evidence of its effectiveness.

In 25 severe diabetic patients, a compromise procedure had been employed; this involved a difference in technique whereby, after low section of the stalk, its hypophyseal end was dissected and excised with a portion of the pituitary gland. The operation ensured a moderate degree of pituitary insufficiency but did not produce crippling hypofunction. The anatomical rationale was indicated and two post-mortem specimens were presented to show a comparative difference in the degree of pituitary necrosis between stalk section and excision.

Follow-up periods ranged from two and a half years to six months. There had been one operative death and one subsequent death from myocardial infarction three months after surgery. Both cases presented useful object lessons. In 15 patients progressive visual loss had been completely arrested; most of these had had no further retinal haemorrhage and many had shown improvement in vision. Eight surviving patients who had not been helped by operation were discussed, and certain conclusions reached regarding the proper timing and selection of patients.

BULK FORMATION AND ABSORPTION OF CEREBROSPINAL FLUID IN THE CEREBRAL VENTRICLE

EDGAR A. BERG, JR. (Boston) reported a modification of the method developed by Pappenheimer et al. to measure the formation and absorption of cerebrospinal fluid by perfusing the ventricular system with large lipophilic insoluble molecules, designed to study the physiology of cerebrospinal fluid in hydrocephalus. Results showed that there were both intra- and extra-ventricular formation of cerebrospinal fluid in the normal state. The intracerebral formation rate was essentially unchanged as hydrocephalus developed, but there were marked changes in the absorptive capacity of the ventricular system. As hydrocephalus developed this absorptive capacity was increased over the normal ventricle so that formation of cerebrospinal fluid did not produce a pressure gradient between the ventricular cerebrospinal fluid and the brain. This was considered as additional evidence that the blockade to the flow of cerebrospinal fluid was not the forced causing ventricular enlargement. Resistance to flow was, however, too great to respond to the sudden pressure changes produced by the choroid plexus pulsation.

Experiments had been carried out to measure changes in the intraventricular pore size using inert molecules of various sizes.

SECRETION OF CEREBROSPINAL FLUID BY THE CHOROID PLEXUS OF THE RABBIT

KEASLEY WELCH (Denver, Col.) reported a method of estimating the secretion of cerebrospinal fluid by the choroid plexus in the rabbit. This was based on the fact that the rate of loss of blood volume during transit, the difference between arterial and venous flows, was the rate of production of cerebrospinal fluid. The venous blood flow was measured by analysis of cine records of the passage of a contrasting interface introduced into the main choroidal vein by puncture. The venous haematocrit
was measured on blood obtained by puncture of the main choroidal vein and this was compared with the haemato-
crit of blood obtained from the aorta.

The following results were obtained:
1. The mean arterial blood flow was 2.86 ± 0.41
   μl/mg.min. (M ± S.E.M., 16 animals).
2. The mean rate of secretion of fluid was 0.37 ± 0.07
   μl/mg.min. (M ± S.E.M., 16 animals).
3. Thirty minutes after giving 100 mg/kg. acetazol-
amide the fraction of blood lost as cerebrospinal fluid
   was reduced from control value of 0.142 ±0.02 to
   0.02 ±0.02 (10 animals).
4. Acetazolamide, 10⁻⁴ and 10⁻³M and ouabain 10⁻⁴
   and 10⁻³M were effective in inhibiting the formation of
   fluid when they were applied topically to the plexus.
5. Analysis of CO₂ in arterial blood and venous blood
   of the choroid plexus showed that there was insufficient
   additional CO₂ in the venous blood to meet the demands
   of the ion exchange hypothesis for secretion.

**PRIMARY SPONTANEOUS**

**CEREBROSPINAL FLUID RHINORRHOEA**

J. E. A. O’CONNELL (London) said that cases of spontaneous

cerebrospinal fluid rhinorrhea could be separated into
two groups: (1) Secondary, in which the leak resulted
from a gross lesion producing erosion of the cranial floor,
for example, an osteoma of a nasal sinus, an intracranial
neoplasm, or internal hydrocephalus; (2) primary, in
which no cause could be found for it.

Exploration in two cases of primary spontaneous
cerebrospinal fluid rhinorrhea had revealed abnormality
which permitted large prolongations of the subarachnoid
space access to the lamina cribosa of the ethmoid. Study
of the anatomy of this region demonstrated that the
tissue barrier between the prolongations of the sub-
arachnoid space around the olfactory nerves and the
nasal cavity might measure only a fraction of a millimetre.
Normally the cribriform plate was closely and entirely
covered by the olfactory bulb and overlying frontal lobe.
When this protective covering was defective and a wide
subarachnoid channel gained access to the cribriform plate
the arachnoid sheaths of the olfactory nerves could
become distended with cerebrospinal fluid. It was
suggested that the normal cerebrospinal fluid pulse gave
rise to progressive enlargement of one or more of these
channels with the eventual development of primary
spontaneous cerebrospinal fluid rhinorrhea.

**FACTORS UNDERLYING INACCURATE LOCALIZATION OF**

**TEMPORAL LESIONS**

R. C. SCHNEIDER and E. C. CROSBY (Ann Arbor, Mich.)
presented a group of six cases in which symptoms
strongly indicated the involvement of a specific cortical area
but the lesion was located in some other cortical field.
All the patients had verified lesions, E.E.G. studies and,
in some instances post-mortem material in which the
anatomical pathways involved had been studied.

Only two patients were described in detail; the first had
a frontal lesion irritating the uncinate fasciculus and the
other a lesion pressing on the cingulum. Both had
temporal lobe symptoms and E.E.G. foci which regressed
with excision of the lesion.

All six patients in the series were thought to be
psychotic or confused and insufficient attention had been
paid to the history of the illness. All presented the clinical
picture usually associated with symptoms suggesting
involvement in one brain region which had actually
resulted from irritative lesions at distant cortical sites.
This clinical picture was modified by some signs and
symptoms characteristic of the involvement of the actual
site of the lesion. The E.E.G. evidence in all the cases
where it was obtainable supported the thesis that there
was firing from the site of the lesion to the region which
gave rise to the accompanying clinical signs, the primary
focus being at the site of the lesion and secondary foci in
the area or areas to which the primary site fired.

Anatomically speaking, such firing to secondary areas
implied an interconnexion of the areas over association
bundes. Major association bundles inter-relating frontal,
temporal, and occipital regions were the uncinate fasciculus,
the inferior and superior longitudinal fasciculi, and the superior frontal-occipital (or occipital-
frontal) fasciculi.

Cingulate areas were related with the more temporally
situated portion of the limbic lobe and, through it, with
various temporal regions over components of the
cingulum. All of these bundles consisted in part of
multisynaptic and in part of longer fibres.

They said that these cases also indicated that in cortical
and subcortical lesions cortical functioning, like the
functioning of all parts of the nervous system, depended
on the interrelation and the activation of neuron arcs and
was not an expression of the activity of isolated cortical or
subcortical regions.

**A CASE OF EPILEPSY ARISING IN THE MINOR HEMISPHERE**

**WITH Ictal SPEECH AUTOMATISMS**

**REPRODUCED BY VARIOUS ACTIVATION TECHNIQUES**

M. A. DRIVER, M. A. FALCONER, and E. A. SERAFETINIDES

(London) discussed the problem of ictal speech automatisms
from epilepsy arising in the minor hemisphere.
They defined the condition as the utterance of recognizable
and linguistically correct words or phrases during a
seizure, the patient being subsequently amnesic.
They then described in detail the case of a 38-year-old
male whose adult epilepsy started at the age of 26 years.
A possible attack at 11 was mentioned. During his attacks
he repeated the phrase ‘I beg your pardon’ in English
though this was only his fifth language and only recently
acquired. Hospital investigation disclosed a slight
enlargement of the right lateral ventricle, including the
temporal horn, and a right anterior temporal E.E.G.
focus of irregular slow and sharp activity. Following an
induced seizure there was a left homonymous hemianopia.
Right temporal craniotomy was carried out under a local
anaesthetic and numerous cortical stimulations failed to
produce an attack but a typical attack with speech
automatism was produced by stimulation in the area of the
amygdaloid nucleus. The anterior 6 cm. of the
temporal lobe, together with the uncus, amygdala,
and part of the hippocampus, was removed. Follow-up for
10 months showed no return of attacks and the E.E.G., which included pentothal splenothaloid leads, showed no evidence of epilepsy.

They concluded that the occurrence of paroxysmal dysphasia in seizures was strong evidence that the attack began in the dominant hemisphere whereas ictal speech automatism might occur in seizures beginning in either hemisphere, though more often in the minor one.

BEHAVIOUR AFTER TEMPORAL LOBECTOMY

AYUB K. OMMAYA (Bethesda) presented an analysis of 180 cases of so-called temporal lobe epilepsy coming to operative treatment. Emphasis was placed on the interictal behaviour of such patients as well as on the characteristic ictal disturbances. A one- to 10-year post-operative follow-up period was scrutinized from the clinical, psychological, and social aspects. A preliminary group of 106 such patients who had undergone standard anterior temporal lobectomy was compared from these three aspects with a group of 25 cases serving as controls consisting of cases coming to operation with the same criteria as the lobectomized cases, but at craniotomy no excision of cerebral tissue was done because of the repeated electrocorticographic finding of diffuse dysrhythmia as opposed to focal activity seen pre-operatively. Thus two groups of temporal lobe epilepsy considered good candidates for focal excision were compared. The results in the lobectomized cases were as follows: Excellent 7.3% (no fits or aura); good 55.2% (very few fits or aura); poor 37.5% (little change or worsening of seizure). The results in the control group undergoing craniotomy were as follows: Excellent 0, good 59.1%, poor 40.9%. Thus the improvement in the lobectomized cases (62.5%) was only 3.4% greater than in the cases not undergoing temporal lobectomy (59.1%). This difference was not statistically significant. Moreover the quality of improvement in the two groups suggested no real difference, and indeed a comparison of the poor results in the two groups showed a significantly better social adjustment in those patients not undergoing temporal lobectomy.

It is thus suggested that although surgery did reduce the seizure activity of such patients it was not known what the crucial factor in the improvement was. Four possibilities were envisaged if the above results were true. 1 Improvement followed from the effects of the total therapeutic environment at the ward and surgery was irrelevant. 2 Improvement followed from some unknown change occurring in the brain when exposed at craniotomy and electrocorticography. 3 A combination of (1) and (2) above. 4 Lastly, the observed improvement might be part of the natural history of a disease which was primarily a behavioural disorder but was dramatically highlighted by epileptic manifestations. This concept would fit in with other observations on the long-term follow-up of patients with temporal lobe epilepsy, e.g., by Slater and his colleagues. The role of surgery in such a behavioural disorder was then unknown but might be to accelerate or retard the natural progress of the disease.

It was proposed that a controlled trial of temporal lobectomy combined with a minimum of a 10-year follow-up period of observation of such patients was the only way in which these questions could be resolved.

THE USE OF CORTICOSTEROIDS FOR THE CONTROL OF CEREBRAL OEDEMA

L. A. FRENCH and J. H. GALICICH (Minneapolis) reported their experiences with the use of Dexamethasone, a potent synthetic glucocorticosteroid, for the treatment of symptoms attributable to cerebral oedema. They were able to assess the value of this drug in 211 patients. These presented a wide spectrum of lesions including neoplasms, operative oedema, closed head injury, subarachnoid haemorrhage, x-radiation, intracerebral haematoma, and 'pseudo-tumour cerebri'. Specific evidence of reduction in the signs and symptoms attributable to cerebral oedema was obtained in 77%. Most of the patients only received treatment for 8 to 11 days but in a few tumours where therapy was continued for up to a year a 'moon facies' developed. Hypertension was not encountered and serum electrolyte abnormalities were unusual and only occurred in the post-operative phase. The catabolic and antifibrinolytic action of this drug did not appear to interfere with wound healing or increase the incidence of infection. The same was true for acute gastrointestinal ulceration and bleeding.

They felt that the proper time for the use of Dexamethasone was not in the routine craniotomy for a glioma but where it was of value in other cases. The patient with raised intracranial pressure in whom it was reasonable to delay operation a few days in order to improve his general condition; the patient with recurrent tumour and raised pressure from oedema could be benefited over several months; patients with brain swelling during operation could be given intravenous doses followed by intramuscular therapy thereafter and the post-operative course immensely improved. In fact, any patient with a problem of oedema could be benefited, for this drug seemed to relieve symptoms due to oedema, not to the rapid, profound degree observed with urea, but more slowly and over a longer period.

ACUTE HEAD INJURIES IN A BRITISH HOSPITAL REGION

D. G. PHILLIPS and R. G. S. AZARIAH (Bristol) reported a study of the results of treatment for closed head injury with haematoma and severe brain damage during the first week after injury.

Most of the patients were transferred to the neurosurgical centre and operated on within the first 24 hours, many coming from a considerable distance, up to 150 miles.

Carotid angiography was used extensively in diagnosis, though the most urgent cases were taken straight to the theatre. Nearly all patients had a full craniotomy.

Mortality rate for extradural haematoma was low (16% in 95 cases or 19.5% in 114 cases, including those where intradural haematomas were also present).

The term 'intradural' haematoma was used to include cases of acute subdural haematoma, usually (70%) associated with cerebral laceration, and intracerebral haematoma. Mortality in 95 such cases was 52%.
The rehabilitation rate in the survivors was very satisfactory with extradural haematoma, and even with the cases of intradural haematoma three-quarters were able to work. Late epilepsy rate was low (3%) following extradural haematoma and high (30%) following intradural haematoma.

Many patients arrived at the centre with one or both pupils dilated and fixed. Over half such patients with extradural haematoma survived. There were hardly any survivors in the intradural group (there were some in the cases of combined extradural and intradural haematoma).

A third group of patients who had craniotomy for brain swelling with contusion and laceration but without large localized haematoma provided two cases of good survival after bilateral dilatation and fixation of the pupils. Two more cases of survival following bilateral pupillary fixation and dilatation when patients with intradural haemorrhage were first seen at hospital were encountered before and after the six-year period of this survey.

They said that dilatation and fixation of the pupils following injury might be due to vessel spasm and ischaemia associated with brain-stem shift. This could be reversible; severe intrinsic brain damage at the moment of injury was not. The distinction could not be made on clinical examination. Early radical operation was called for in at least a proportion of patients whose condition was grave from the start, even where extradural haematoma could be excluded.

AN EXPERIMENTAL STUDY OF CEREBRAL VASOMOTOR CONTROL

JOHN E. ADAMS (San Francisco) said that an experimental preparation had been developed in the monkey by means of which the degree of vasoconstriction or dilatation of the cerebral resistance vessels could be measured. This preparation involved isolation of the cerebral arterial circulation from the systemic circulation in so far as the effect of changes in systemic blood pressure were concerned. This isolation was accomplished by ligation of the basilar artery through a transclival approach accomplished by ligation of the right common, external, and internal carotid arteries. An extracorporeal bypass was then employed by cannulating the proximal left common carotid artery, pumping the blood through the bypass, returning it into the distal internal carotid artery. The left external carotid artery was ligated. Perfusion or line pressure was monitored by incorporation of a strain gauge into the extracorporeal circuit. Marked changes in systemic arterial pressure produced by the intravenous injection of neo-synephrine did not in any way alter perfusion pressure or thereby the calibre of the intracranial resistance vessels, thus indicating a complete separation of the two circulations in so far as pressure relationships are concerned.

VASOSPASM ACCOMPANYING SUBARACHNOID HAEMORRHAGE DUE TO RUPTURED INTRACRANIAL ANEURYSM

C. D. HAWKES (Memphis, Tenn.) said that spasm might occur in the immediate vicinity of intracranial aneurysms when bleeding was produced by their rupture or it might occur in other portions of the circle of Willis and its branches, producing false localizing signs. Spasm might make it impossible to visualize the aneurysm by arteriography in the initial stages. Symptoms might be produced indicative of a supratentorial lesion when the aneurysm was actually in the posterior circulation. Post-operatively vasospasm might complicate the patient’s recovery and even produce infarction and death when an apparently satisfactory technical procedure had been performed. Most methods of treatment proposed for the condition had proved ineffective but there was some suggestion that profound hypothermia might be effective in management of this problem. Illustrative arteriograms were shown to demonstrate the points raised in this presentation.

EXPERIMENTAL CEREBRAL INFARCTION IN THE DOG AT TWO ATMOSPHERES OF OXYGEN WITH PRELIMINARY CORTICAL FLOW CORRELATIONS USING Kr.65

I. JACOBSON and D. D. LAWSON (Glasgow) said that the possibility that hyperbaric oxygen exerted a degree of cerebral protection was assessed in 32 dogs. Standard infarcts were produced by occlusion of the middle cerebral artery with a clip just distal to the internal carotid artery. A comparison was made of 15 normothermic normobaric dogs with nine hypothermic normobaric and eight normothermic hyperbaric animals. Hypothermia (27°C) afforded complete clinical protection with very small infarcts. No cerebral protection resulted from exposure to two atmospheres of oxygen.

Cortical blood flow was measured with the Kr.65 clearance method. At constant arterial pCO2, a comparison was made between air at one and two atmospheres and oxygen at one and two atmospheres. Central aortic and sagittal sinus samples were used to monitor respiratory gas tensions and to derive the cerebral oxygen consumption. With thiopentone anaesthesia marked cerebral vasoconstriction was noted. There was no significant change with oxygen at one and two atmospheres. Venous PO2 levels did not indicate any significant increase in tissue oxygenation. A 21% decrease in cortical blood flow was, however, found using tricloethylene anaesthesia in a further eight animals. It was concluded that cerebral vasoconstriction induced either by anaesthesia or by oxygen at pressure partially negates the potential advantages of hyperbaric oxygen. Tissue oxygen levels were not sufficiently augmented to prevent infarction at two atmospheres of oxygen.

MULTIPLE ANEURYSMS

ALAN RICHARDSON (London) discussed the natural history of subarachnoid haemorrhage in the presence of multiple aneurysms. He said that in the literature the incidence of multiple aneurysms was 5 to 17% in angiographic studies, and in his series of 1,686 cases 14%, whereas in post-mortem material it was 21 to 33% and 29% in his series.

The age incidence was the same as single aneurysms with the same loading of the older age group with hypertensive females; the incidence of hypertension was the same. The sex incidence showed a higher proportion of females and was similar to that of single posterior
communicating aneurysms. In the series 251 had multiple
aneurysms and it was most common to find two or three;
only a small proportion had more than three. The middle
cerebral artery was the commonest site and bilateral
middle cerebral the commonest combination.

Of 155 cases treated conservatively, 93% in category A
(unconscious at time of admission and likely to die) were
dead within six months whereas in the remainder 54% were
dead. All cases in category B died from recurrent
haemorrhage.
The category B cases were compared with the controlled
trial of surgical and conservative treatment in which all
cases were considered suitable for surgery. The mortalities
in the trial series were 57% for conservative and 48% for
surgical treatment compared with 53% for the non-trial
cases. He concluded from these figures that the mortality
in conservatively treated cases suitable for operation was
similar to those not suitable and that, so far, surgery had
shown no improvement over conservative treatment.

Recurrent haemorrhage occurred earlier in multiple
aneurysms (70% in 48 hours and 90% in one week) than
in single aneurysms where the maximum rebleeding was
in seven to 10 days. He found that untreated multiple
aneurysms had a higher mortality rate than single ones
and this was highest where an anterior communicating
aneurysm was present. This was an odd feature, as it was
found that in all but four cases repeated haemorrhage was
from the same aneurysm as the primary bleed.

DIFFERENTIAL CAROTID LIGATION FOR SUPRACLINOID
ARTERIAL CEREBRAL ANEURYSMS

FRANK P. SMITH (Rochester, N.Y.) said that direct
surgical attack on an intracranial aneurysm offered the
best opportunity for prevention of recurrent haemorrhage.
However, for one reason or another, there were some
cases that lent themselves to carotid ligation.

He then outlined a method for differential ligation of
the carotid artery system so that the pulsatile pressure at
the aneurysm was reduced but there was maintenance of
blood flow through the long cervical segment of the
internal carotid artery to avoid progressive thrombosis.
When the carotid artery bifurcation was exposed surgically, a
needle was inserted into the internal carotid artery and pressure readings were taken to outline the
course in a specific case. Examples of circulatory pressure
changes were presented. The usual technique was ligation
of the external carotid artery above the first branch,
superior thyroid artery, and then placing of a clamp
(Selverstone) around the common carotid artery.
Gradual occlusion of this vessel was accomplished over a
period of days, as tolerated. At the point of complete
clamp closure, a limited collateral circulation remained
between the superior thyroid and internal carotid
arteries to discourage an ascending thrombosis. Clinical
results were discussed regarding the use of this technique.

RADIOLOGICAL CLUES FOR THE IDENTIFICATION OF
THE BLEEDING SITE IN PATIENTS WITH
MULTIPLE ANEURYSMS

ERNEST H. WOOD (London) said that approximately 30%
of patients who had a cerebral aneurysm had more than
one lesion. Frequently it was not clear from the clinical
standpoint which aneurysm had been responsible for a
subarachnoid haemorrhage. Desirable surgical treatment
might be delayed or withheld under such circumstances,
or inappropriate treatment instituted.

The minimum angiography to insure the demonstration of
all treatable aneurysms had been defined. Additional
special techniques and projections were found useful in
selected cases.

Through a radiological-pathological correlative study
an attempt had been made to establish angiographic
criteria for the identification of the aneurysm which had
ruptured. A detailed review had been made of the case
records of a large number of patients who had had the
bleeding sites verified at necropsy, including histological
study of aneurysms. Angiographic findings concerning
the morphology of the aneurysms, physiological and
anatomical alterations in the cerebral vascular arborization,
and other radiological changes had been checked by
pathological means. Objective radiological standards for
identifying the ruptured aneurysm, among multiple
lesions, had been found which were highly reliable when
applied alone. When the angiographic signs were inter-
preted in the light of the total radiological picture and
integrated with clinical findings, it should be possible to
determine the offending lesion in the vast majority of
instances.

VERTEBRAL ARTERY SYNDROMES

LORD BRAIN (London) said that since the vertebral
arteries supplied the basilar artery and the posterior
cerebral arteries and their branches, lesions of the
tral artery, which might be situated anywhere
between the subclavian artery and the basilar, might
produce symptoms resulting from impairment of the
circulation as high as the posterior cerebral artery.
Syndromes of the vertebral artery included (1) symptoms
of lesions within the distribution of the posterior cerebral
artery, (2) symptoms of acute vascular lesions of the
brain-stem or cerebellum, (3) symptoms of chronic
progressive brain-stem ischaemia, and (4) symptoms of
paroxysmal brain-stem ischaemia. Their principal causes
were trauma to the cervical spine, atheroma, cervical
spondylosis, and tumours in the posterior fossa. (1), (2),
and (3) might exist singly or in any combination.

He stressed that the basic anatomy and pathology
should take into account the relation of the vertebral
artery to the intervertebral discs, neurocentral joints, and
apophyseal joints in the cervical spine. Atheroma
rendered the vessels more susceptible to pressure or
displacement. Intervertebral disc narrowing by shortening
the cervical spine tended to produce kinking of the
vertebral arteries. Atheroma of the internal carotid
arteries might interfere with collateral circulation.
Pathological changes in the vertebral artery might lead to
emboli, progressive ischaemia, or intermittent ischaemia.

The commonest symptom of a lesion within the
distribution of the posterior cerebral artery was visual
field defect. A case was cited in which this followed
traction on the cervical spine for spondylosis. Another
case was cited in which it was the result of neck injury in a
young man.
Acute vascular lesions of the brain-stem or cerebellum might also follow manipulation of the neck or be associated with cervical spondylosis. It was suggested that in cases of head injury, particularly to the elderly, injury to the vertebral arteries in the neck might lead to lesions in the brain-stem.

The clinical picture of chronic progressive ischaemia of the brain-stem was not discussed, but it was pointed out that signs of this might provide support for a vascular origin of paroxysmal symptoms and that bilateral extensor planter reflexes in elderly patients might be due either to brain-stem ischaemia was discussed with special reference to head movement. The typical patient was elderly with both cervical spondylosis and atheroma and who complained of one or more of the following symptoms: Vertigo, especially on head-turning or change of posture, drop attacks, and syncopal attacks. In normal people head rotation to one side might temporarily arrest the blood flow through the contralateral vertebral artery where it passed through the transverse process of the atlas (a film illustrating this point was shown). In cervical spondylosis it had been demonstrated that a similar arrest might occur on the ipsilateral side lower in the cervical spine. Thus in the presence of cervical spondylosis and atheroma head rotation might temporarily arrest the blood flow through both vertebral arteries. While the three symptoms mentioned might any of them be due to other causes there was no accumulating evidence that they could be produced by temporary compression of the vertebral arteries in the neck.

In the brachiovertebral syndrome atheromatous narrowing of one subclavian artery before the origin of the vertebral artery might produce characteristic symptoms. The radial pulse on the affected side was diminished, or absent, and exercise of that upper limb caused vertigo or even loss of consciousness. Angiography in such cases showed that owing to the difference in blood pressure between the two brachial arteries blood passed up the vertebral artery on the normal side and down the artery on the affected side thus temporarily reducing or abolishing the blood supply to the brain-stem.

Narrowing of the subclavian artery at this site, however, did not always give rise to symptoms, or it might be associated, as in one case cited, with persistent ischaemic symptoms within the vertebro-basilar distribution.

Study of possible contributing factors in this series of patients suggested that the presence of antecedent oitis, sinusitis, or pharyngitis might be of aetiological importance.

CAUDA EQUINA SYNDROMES
CAUSED BY LUMBAR SPONDYLOSIS

GEORGE EHN (Houston) discussed the role of lumbar spondylosis in cauda equina syndromes and said that, as with cervical spondylosis, the lumbar disease became neurologically manifest in patients whose spinal canals were smaller than average and when some long-standing abnormality lead to stress upon a disc and its associated facets, neural arches, and ligamenta flava. There resulted a mixture of posterior disc protrusion, hypertrophic changes in facets and arches, and hypertrophy and infolding of the ligamentum flavum with exaggeration of the spinal canal encroachment in lordosis. The neural structures were compressed in a pincer which produced a complete, or nearly complete, myelographic block. There gradually accumulated innumerable small movement lesions which eventually produced the recognizable neurological disease. Intermittent claudication due to leg ischaemia was likely to be misdiagnosed and stood in the same relationship to lumbar spondylosis as amytrophic lateral sclerosis did to cervical spondylosis. In lumbar spondylosis there was a liability to acute cauda equina injury analogous to the hyperextension catastrophes to which patients with cervical spondylosis fell victim.

ENTEROGENOUS CYSTS OF THE SPINAL CORD
WITH ASSOCIATED ANOMALIES

C. LANGMAID and R. JONES (Cardiff) described four cases of spinal enterogenous cyst. In three cases intradural cysts exposed and removed were histologically compatible with enterogenous cysts. In one case, a 38-year-old man, the cyst was the only abnormality and had caused spinal cord compression at the mid-thoracic level. In a second case the cyst was associated with a hairy back, scoliosis, and a lumbo-sacral spine bifida with double dural canal. In a third case there was widespread abnormality of the spine and ribs, a bony spur at T8.9 level with split spinal cord. In this case part of a bilocular cyst was embedded in the cord.

In the fourth case, a boy of 7, the spinal lesion had not been verified by operation. He had an anterior spinal defect in the upper dorsal region with a filling defect on myelography. This was associated with a mediastinal mass, thought to be a cyst. At a previous operation a mesenteric cyst had been removed and a jejunal diverticulum found. The only neurological abnormality in this case was some clumsiness of the left hand and of the right foot with increased tone in the right leg.

THE EPENDYMAL RESPONSE TO LONG-TERM INTRAVENTRICULAR PANTOPOAQUE

WILLIAM F. MEACHAM and SIDNEY TOLCHIN (Nashville) reported the results of experiments to discover the ependymal reaction to Pantopaque and also referred to
similar studies on the arachnoid membrane. The experiments were carried out on dogs in which an obstructive hydrocephalus had been induced by the injection of lamp black into the cisterna magna. When hydrocephalus was established the lateral ventricles were filled with Pantopaque and the animals killed at intervals of up to six months. Fifteen animals were used and also a control series of two without hydrocephalus, four without any ventricular injection, and two with air ventricular injection only.

They concluded that Pantopaque within the ventricular system of hydrocephalic dogs did not produce any significant response in the ependyma, choroid plexus, or brain parenchyma. No unfavourable clinical response was noted in any of the animals. The microscopic examination of tissues in such animals did not differ in any respect from the tissues in control animals.

They had confirmed their findings, after spinal subarachnoid injection of Pantopaque, that contact with the arachnoid produced an acute inflammatory reaction, progressing to a chronic granulomatous response with encystment of small oil droplets, ultimately to resolve into a dense local fibrosis of the arachnoid.

They considered that both the ependymal epithelium and the pia mater appeared to be effective protective barriers against harmful inflammatory responses to the adjacent neural parenchyma.

QUALITY OF SURVIVAL IN TREATED GLIOMATA

M. J. BETTY (Sheffield) reported a follow-up study in a series of gliomas. He said that in a nine-year period, 1950 to 1959, 443 adults had presented with supratentorial glioma (excluding the third ventricle). Sixty-one per cent received major surgery, consisting of a lobectomy for frontal, temporal, and occipital tumours, and local excisions for those in the central and parietal areas. Left-sided tumours were treated in exactly the same way as those on the right.

Of those treated, 14% died post-operatively and 18% remained in beds for the chronic sick. Of male patients, 43% stayed at home and 15% returned to work; of female patients, 47% were at home doing partial domestic duties and 10% were either employed or doing full domestic duties.

Seventy-four (53%) of the males and females at home had major neurological defects. In these, 43 tumours were on the left side and 31 on the right side. Thirty-four patients returned to work and in these 17 tumours were on the right side and 16 on the left. It was suggested that patients with left or right hemisphere tumours had an equal chance of returning to work when treated with major surgical resections. Major surgery was capable of returning a small but significant number of patients to work for periods of one to 10 years, depending on the histology of the tumour.

BRAIN SCANNING WITH RADIO-JODINE AND A RECTILINEAR SCANNER

T. P. MORLEY (Toronto) discussed the place of external brain scanning in the practice of one neurosurgical department. A rectilinear scanner had been used with radio-iodinated human serum albumin. Experience had been gained over four years from some 2,000 scans. The value and practicability of the method were indicated by these points. (a) Reasonable cost in original outlay and continuing operation; (b) ready availability of the isotope preparation; (c) efficiency of detection of supratentorial malignant gliomas, meningiomas and, to a somewhat less extent, metastatic tumours. Many other lesions were often but less consistently detected. (d) Ease of examination.

Brain scanning had therefore shown its merit in the following circumstances: the screening of cases (in or out-patients) where an intracranial mass was suspected or had to be disproved; screening for recurrent tumour, particularly meningiomas; pre-operative localization of intracranial masses, in a proportion of which (about 15%) arteriography or pneumoencephalography could be dispensed with altogether. The extent to which this harmless method of investigation could supplant pre-operative angiography and air studies would naturally vary from one surgeon to another and would depend on many factors which differed from case to case.

A MULTI-CHANNELLED COLLIMATED SCANNER FOR VISUALIZATION AND INTERPRETATION OF CEREBROVASCULAR EVENTS

E. SCHLESINGER (New York) said that for 10 years his laboratory had been carrying out preliminary studies with a view to constructing a scanning device capable of simultaneously comparing data from the entire brain. Recent developments in electronic equipment, including analyzers and improved photo-tubes, along with more efficient collimation, had permitted fruition of such a goal. A description of the apparatus, means of detection and recording was presented. In its present form, it was capable of graphic display of the passage of isotope throughout the brain, along with data as to differential uptake in space-occupying lesions. Scanning time for the collection of statistically significant data was two minutes, and all areas might be compared concurrently.

TORSION OF THE CAROTID ARTERY AS AN ALTERNATIVE TO LIGATION

J. R. GIBBS (London) described a method of cervical carotid occlusion, either temporary or permanent, in the treatment of intracranial aneurysms. The instrument shown was a simple means of distorting the long axis of the artery. At the end of the treatment no foreign body was retained in the neck.

EXPLORATION AND DECOMPRESSION OF THE ORBIT

HARVEY JACKSON (London) discussed various methods of exploring the orbit. He mentioned that an approach through the upper or lower lid, or even the conjunctival fornix, could be used for biopsy of tumours or removal of fat. The Kronlein operation, he felt, gave only a meagre approach to the orbit, did not exclude post-operative pulsation and left an unsightly scar, sometimes with adherence of the external rectus muscle. His early operations had been of the Naffziger type but now he restricted the use of this approach to cases in which a
wider exploration of the anterior and middle fossa was required. He recalled that Dr. Walter Dandy had advocated this operation on the grounds that it was impossible to tell pre-operatively whether the tumour was restricted to the orbit or had an intracranial extension. He felt that not only should one be able to come to such a conclusion on clinical grounds alone, as confirmed by radiological examination, but that even a pathological diagnosis should be feasible pre-operatively in the majority of cases of proptosis. The formidable nature of the Naftziger operation and the poor exposure from a lateral approach had led him to devise the 'pawnbroker' type of operation which improved the available field whilst avoiding the use of an osteoplastic craniotomy; the avoidance of an unsightly scar was a matter for further consideration.

A film was then shown illustrating this operation.

TREMOR MONITORING FOR POSTERIOR SUBTHALAMIC PLACEMENT OF LESIONS IN PARKINSONISM

O. J. ANDY (Jackson, Miss.) said that in order to locate the optimum site for the lesion in the subthalamus a technique of continuous tremor evaluation during electrode insertion was used. Tremor was recorded through a transducer (piezoelectric phonograph pick-up) and transmitted to an inkwriter. An electrode, slightly over 1 mm. in diameter, was inserted through a frontal burr hole in increments of 2 to 4 mm. There was a minimum pause of 30 sec. between each increment. Thus, small lesions, slightly over 1 mm. diameter and 2 to 4 mm. in length, were evaluated in terms of their immediate effect on tremor. A marked change in the amplitude, pattern, and persistence of the tremor was invariably noted as the electrode entered from the thalamus into the optimum subthalamic site. With this technique, the chances of finding the optimum site in the posterior subthalamus (a relatively small region containing the zona incerta, field H of Forel, and the prerubral field, just medial to the posterior boundary of the corpus Luysii) were thought to be good because the anatomical variability of its structures was only 2.5 to 3 mm. for one standard deviation. This method of localizing the optimum site was found more profitable than utilizing electrical stimulation and recording.

TWO FACETS IN THE SURGICAL TREATMENT OF CRANIOSTENOSIS

LESTER A. MOUNT (New York) described his method of treating craniostenosis. The treatment was based on two facts: first, that a baby’s brain and skull would continue to grow, and second that a properly placed door of skull would open in a manner to correct the cranial deformity. In the case of premature closure of the metopic suture, the suture and 2 or 3 cm. of bone on each side of it were removed together with 1 or 2 cm. of bone immediately above the orbital rim and posteriorly to the coronal suture. The open coronal suture acted as the hinge for the door. In case of the unilateral closure of the coronal suture, the closed suture together with 2 cm. of bone on each side of it were removed. The craniectomy was then extended forward immediately above the orbital rim to the midline, 1 or 2 cm. of bone being removed. Then 1 or 2 cm. was excised along the midline leaving only a narrow strip of bone which acted as the hinge for the bony door. Growth of the brain opened the door and corrected the deformity.

DIAGNOSTIC APPLICATIONS OF CLOSED-CIRCUIT TELEVISION IN RADIOLOGY

C. B. HOLMAN (Rochester, Minn.) said that following certain modifications closed-circuit television techniques showed great promise as diagnostic aids in radiology. Because of the excellent quality of radiological images now possible through projection of the image of a film on a television monitor it was possible rapidly and easily to perform many of the special 'photographic' techniques which had enhanced diagnostic radiology in the past but which were tedious and cumbersome when accomplished strictly by methods of photographic manipulation. The most valuable of these techniques concerned the use of closed-circuit television in the so-called 'subtraction read-out' technique. Through some minor alteration of the equipment, it was possible conveniently and easily to employ these techniques in any contrast examination in which the subject was not required to move. This was particularly helpful in diagnostic neuroradiology, where it was possible to visualize all of the contrast material without interference due to overlying densities of soft tissue and bone.

Magnification of the radiological image might be quickly and easily accomplished. This added much to the diagnostic value of certain examinations. Another application concerned the reversal of the radiological image. This was quite helpful in the interpretation of positive contrast angiograms and in reversing Polaroid prints. It was anticipated that in the near future closed-circuit television would become an important tool not only from the standpoint of communication and teaching but also from that of radiological diagnosis as well.