minimum interference in the region of the internal auditory meatus. The facial nerve is usually found on the front of the tumour capsule when the excavated lower pole of the tumour is lifted upwards, though in occasional cases it lies behind the tumour. Nothing short of a very thorough intracapsular removal of the tumour is likely to relieve the symptoms of raised intracranial pressure in most cases, and hence it is not surprising that many of our attempts to conserve facial nerve function have ended in failure.

As more neurosurgical centres are opened in this country it is unlikely that any one surgeon will deal with a sufficient number of acoustic tumours to become practised in the way possible with other set procedures such as those for trigeminal neuralgia, pituitary tumours, and other types of brain tumour. Each case should thus be regarded as an opportunity for perfecting our technique, and to the young surgeon we would say that an operation for acoustic tumour is a good day's work: it is generally a mistake to operate against the clock.

In treating brain tumours it is usually possible for the young neurosurgeon to proceed cautiously without endangering his patient: for example, the large and vascular meningioma of the cerebral hemisphere can be dealt with in two or more stages. In acoustic tumours, on the other hand, the two-stage operation is of little or no use. It is essential at the first operation, in most cases, to remove sufficient tumour to re-establish the flow of cerebrospinal fluid through the tentorial opening, and to free the pons and medulla from pressure; and that requires at the least a very thorough intracapsular removal of the tumour, and pulling away of the tumour capsule from the tentorial opening and the side of the pons. Nothing less, in most cases, will render the patient capable of returning to active life. On the other hand, radical and complete removal of acoustic tumours has in the past carried a high operative mortality, even in the hands of the most expert and experienced neurosurgeons; and it is easy for the young surgeon of radical intent to lose two or three successive cases of acoustic tumour, with the result that he tends to treat the next case with an inadequate intracapsular operation. There is danger in doing so much as to damage fatally the adjacent vital centres; there is danger in doing too little to relieve the patient's symptoms.

The outlook, however, is far from gloomy. In 1917 Dr. Cushing qualified his doubt about the feasibility of complete removal of acoustic tumour by saying "unless some more perfected method is devised". The introduction of electrosurgery 10 years later was a great technical advance, and more recently the adoption of the sitting position has provided another improvement. In addition, the prophylactic use of penicillin has almost eliminated the risk of meningitis; which formerly was high in these operations, for some reason not wholly explained. There is thus every prospect that with bold design and gentle manipulative technique, the next decade will show considerable improvement in the treatment of acoustic tumours.

REFERENCES

ACOUSTIC NEURINOMA

BY

D. W. C. NORTHFIELD

London

My personal experience of operation for acoustic neurofibroma comprises 47 patients, on whom 57 operations were performed, with 18 deaths. The following is a brief analysis of these operations:

Total enucleation
(in one stage) : 25 patients 6 deaths; mortality 24%
Total enucleation
(multiple stages) : 8 patients 5 deaths; mortality 63%
(total mortality for enucleation : 33\%)
Partial removal : 14 patients 3 died; mortality 20%
(further operation necessary : 5 patients 3 died, and one died subsequently of the tumour.
(ultimate mortality for partial removal 50%)\n
* This report includes cases up to October, 1949.

Suboccipital decompression alone : 2 patients 2 died
Emergency ventricular tap : 1 patient 1 died
Totals : case mortality 38\%. Operation mortality 32\%.

The operation of choice in the earlier years was a partial (intracapsular) removal, but largely as a result of the experience of Horrax, I decided to attempt primary total extirpation more frequently, and this has been my endeavour since about 1942.

This series of cases is too small for reliance to be placed upon percentages, although the mortality figures for one-stage partial and one-stage complete removals are not dissimilar. The figures are to some extent misleading, in that there has been evident selection of cases for radical operation.
either by choice or by force of circumstances. Thus, in five patients a decompression was first performed as a planned step before total removal; two died of this operation, and two died at a subsequent total extirpation. In another case, an attempted total removal had to be abandoned owing to the poor state of the patient, and following a second attempt the patient died. The more useful method of comparing the respective merits of partial and of total removal is an analysis of the subsequent histories of those patients who survived an initial partial, and an initial total, removal.

Partial Removal (14 Cases).—Eleven patients recovered from this initial operation; five needed a further operation (within a maximum period of four years), and three died. Of the eight survivors, two have failed to report, one has died of the tumour, one is bed-ridden, and only three patients can carry out their duties (as housewives) but they have moderate disability.

One-Stage Total Removal (25 Cases).—Nineteen patients survived this operation: 11 are earning their living in employment the same as or similar to that before operation, although one is blind; seven are housewives who have made good recoveries and are fully active in their domestic duties. Only one patient is moderately disabled by ataxia and poor vision after four years.

From this analysis of results, there seems to me little doubt that the operation of choice is total enucleation, and with increasing experience the mortality rate will be reduced. In very large tumours where a palliative first stage is considered advisable, immediate or ultimate total enucleation may carry a high mortality rate, but the alternative is likely to be progressive invalidism. Of seven patients in whom the tumour was totally removed after a palliative first stage, five died; one of the survivors is moderately, and the other severely disabled by ataxia.

The approach for total enucleation has been either a Horrax unilateral suboccipital flap, or a unilateral suboccipital craniectomy through a straight or slightly curved skin incision. The former provides greater access, and I have found it preferable when I have anticipated a difficult operation, by reason of the size of the tumour, or of long-standing and high intracranial pressure. A catheter has been left in the lateral ventricle for several days after operation and this seems to make the post-operative course much smoother. The facial nerve has been spared in only one case. For me the removal of the tumour with minimum damage to the pons is of itself a sufficiently difficult procedure, and any addition to this difficulty or to the surgeon's anxieties by endeavours to preserve the nerve is likely to raise the mortality rate. Moreover, in avoiding damage to the facial nerve there is in many cases a real risk of leaving viable fragments of tumour in the internal acoustic meatus, with a consequent probability of recurrence. The majority of patients—including women—willingly chose facial paralysis in order to be certain of total removal. Facio-hypoglossal anastomosis has been carried out in most of the patients, with considerable improvement in appearance, provided emotional expression is kept subdued.

Cause of Death.—A post-mortem examination was obtained in 16 cases. In seven cases damage to the pons was noted either as "bruising" or "softening", and in the light of Atkinson's researches, these were probably all examples of infarction and constitute the chief cause of death. In three cases the tumour was bilateral as part of a diffuse neurofibromatosis; operation was carried out in the vain hope of palliation. No case of multiple neurofibromata has survived operation, and it is doubtful if operation should be entertained in such cases. One patient died of pulmonary infection, and one of wound infection (in addition to pontine damage); another died of uraemia; one had a fatal haemorrhage from a chronic duodenal ulcer. In three patients the post-mortem examination did not reveal the precise cause of death.

DISCUSSION

Professor Sir GEOFFREY JEFFERSON (Manchester) remarked that the reason why the acoustic neuromas proved so difficult technically was that they were relatively rare tumours. There were often considerable gaps between cases so that they were, in their way, new experiences each time. It took considerable time, therefore, for anyone to become expert with these tumours and that had been particularly true of the older neurosurgeons who had had to find the way. His own material now amounted to 153 cases of which 11 had not been operated upon, usually because the patient was blind or in extremis. A blind person with a cerebellar deficit, such as all had for a considerable period post-operatively, was in a sad situation. He had perhaps rejected some which others might
have accepted but that happens in all branches of surgery.

The overall mortality had been higher than he could have wished, for 37 of the 142 died (26-0%). The outstanding cause of death had been injury to the brain-stem (73% of deaths); infection 13-5%; pneumonia 8%; varia 5-5%.

Sir Geoffrey proceeded to give his figures for total extirpations which he considered to be the operation of choice. In the five-year period 1943-48 the mortality had fallen to 11-7% (four deaths in 34 cases), the last three-year mortality was 6%. In 34 total extirpations the mortality was 8-8%. He thought that these were highly encouraging figures. He attributed the improvement largely to the use of the sitting posture of de Martel and to improvements in general anaesthesia ($N_2O + O_2 +$ trilene). A vertical unilateral exposure had been in use for five years and great care was taken not to interfere with any vessels except those that ramified on the tumour itself. He had found no recognizable ill effects from the careful use of diathermy which he preferred here as elsewhere to silver or tantalum clips. All thermo-coagulation was done on the tumour itself with weak currents allowing its effects to travel slowly and controllably.

Mr. G. K. Tutton later gave an account of the results of facio-hypoglossal anastomosis which he showed to be much superior to spinofacial. Re-innervation was the rule and the cosmetic effect good.

Mr. A. Dickson Wright (London) said that the surgery of acoustic tumours was given a great impetus when Dandy recommended the unilateral approach; this in one stroke reduced the mortality greatly and also the disability rate in the recoveries. He felt that the cerebellar lobe should never be resected for exposure; first it reduces the cerebellar tissue serving the intact vestibule on the other side, and secondly by robbing the cerebellum of its pia membrane, it increases the operative contusion to the cerebellar hemisphere. The mortality rate would be still further reduced by operating upon these patients in the sitting position with the head suspended by calipers, stitches, or hooks through the scalp or in the case of women by the hair itself. This position with all the cervical structures on the stretch gives just a little more working space and the cerebral decongestion could not be improved upon. The laxity obtained is remarkable and all fluids drain away from the operation field without help of suction. In addition, the mastoid process is removed with a burr at the start of the operation and the mastoid cells freely opened up so as to obtain the maximum lateral approach to the tumour. There was no need to respect these cells as the ear was deaf and septic complications did not occur with chemotherapeutic precautions.

Mr. Dickson Wright said that by these measures the mortality rate could be considerably reduced because of the improved visualization of the region and because gravity was on the surgeon's side instead of being an adversary.
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D. W. C. Northfield

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