CEREBELLAR ABSCESS
TREATMENT BY EXCISION WITH THE AID OF ANTIBIOTICS

BY
JOE PENNYBACKER

From the Nuffield Department of Surgery, Radcliffe Infirmary, Oxford
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In a series of one hundred brain abscesses treated in the Nuffield Department of Surgery, Oxford, in the past nine years there were eighteen cerebellar abscesses. With one probable exception they were all due to mastoid infection, and were rather less frequent than temporal-lobe abscess due to the same cause, of which there were twenty-two cases. Of the first nine cases of cerebellar abscess, only two survived, whereas of the last nine, eight have recovered and it is this encouraging experience which we wish to record. The division of the material into two groups of nine cases each is significant because none of the first group was treated with penicillin, whereas all of the second group had the advantage of that preparation. Previous reports deal chiefly with single cases or small series emphasizing the gravity of cerebellar abscesses: thus Sachs (1946) reported eleven cases of which five recovered. Most neurosurgeons and otologists agree that these are among the most dangerous of intracranial abscesses.

During the whole of this period we have attempted to deal with brain abscesses in such a way that they could ultimately be excised. In the case of cerebral abscess this usually entailed repeated aspiration, sometimes combined with a decompression as advocated by Vincent and others (1937), the instillation of thorotrast for radiographic control (Kahn, 1939), and, latterly, instillation of penicillin into the abscess in an attempt to sterilize it. When it was reckoned that the abscess was sufficiently encapsulated to allow dissection, an osteoplastic flap was reflected, and the abscess was extirpated much as a solid tumour. These principles are now in common use and there is abundant evidence that they comprise an effective method of dealing with cerebral abscesses. But applying the same principles to the treatment of cerebellar abscesses we met with repeated disappointments, and, as noted, only two of the first nine cases recovered, one with decompression and repeated aspiration, and the other with decompression and aspiration followed by excision. The following cases demonstrate many of the problems involved.

Cases Treated without Penicillin

Case I.—A 16-year-old girl was admitted on April 17, 1940, complaining of severe paroxysmal headache. She was said to have had a discharge from the right ear at the age of 4 years, ascribed to the retention of a piece of cotton wool in the ear. The discharge ceased when the wool was removed, but throughout her childhood she was prone to bilateral earache when she had a cold. Apart from this she was in good health until Feb. 18, 1940, when she complained of right-sided earache. This lasted for two or three days and subsided with local treatment, but a severe recurrence ten days later led to her admission to another hospital where a myringotomy was performed. Four days later, on March 8, a right-sided mastoid operation was done. The operation note described "a cellular infected mastoid. Lateral sinus and dura and middle fossa appeared to be normal."

For the first week after the mastoid operation she vomited frequently and complained of a good deal of headache. These symptoms subsided in the second week, and she started getting up and about. During the third week the headache and vomiting recurred, and a lumbar puncture on March 24 showed 20 lymphocytes and 50 mg. of protein in the cerebrospinal fluid. On this day some nystagmus was noted for the first time. The headache got steadily worse until on the day before admission she was screaming with it.

On examination on April 17, she was drowsy but could be roused to co-operate adequately. She complained of severe headache, and held her head rigidly bent forward and to the left, resenting any attempt to move it. There was a moderate slurring dysarthria, but no aphasia. The positive neurological abnormalities amounted to bilateral papilloedema (3 dioptres), slow coarse nystagmus on looking to the right, rapid and finer nystagmus on looking to the left, and gross ataxia of the right arm and to a much less extent of the right leg. The right mastoid incision had healed with the exception of a small pellicle in the centre of the wound. These signs pointed clearly to an expanding lesion in the right cerebellar lobe and there seemed to be no reasonable doubt that it was an abscess.
On the following day, under general anaesthesia the posterior fossa was explored and a right cerebellar abscess aspirated. The mastoid scar was used as the right limit of an inverted U-shaped incision and the muscle was reflected from the right two-thirds of the posterior fossa. The exposed bone was removed, including the posterior margin of the foramen magnum. Through the unopened dura, an exploring needle encountered the wall of the abscess at a depth of 1 cm., and 20 c.c.m. of pus were aspirated (from this pneumococcus type I was cultured), and 2 c.c.m. of thorotrust was instilled. This slackened the dura considerably and the wound was closed without drainage.

There was immediate improvement. The headache was relieved, the patient became quite alert and cheerful, and the cerebellar signs were much less marked although still present. Radiographs showed the abscess outlined by thorotrust in the right cerebellar lobe (Fig. 1). The patient was given sulphonamides by mouth from the time of operation, and this treatment was continued until May 7. Improvement was maintained until April 24 (six days after aspiration of the abscess), when she suddenly complained of severe headache which made her scream, the pulse rate increased from 70 to 140 per minute, her neck was very stiff, and she had a positive Kernig’s sign. The cerebellar signs were more marked, but the general picture suggested meningitis, made more likely by the fact that a routine lumbar puncture two days earlier had shown that there were 1,800 cells per c.mm. in the spinal fluid although at that time there were no clinical signs of meningitis. A further x-ray examination, however, showed that there had been a considerable increase in the size of the abscess (Fig. 2), whereas a lumbar puncture showed that the fluid was now clear and there were only 20 cells per c.mm. It was thus clear that the recurrence of symptoms was due to increase in size of the abscess rather than to meningitis. It was accordingly aspirated through a sharp needle, 20 c.c.m. of pus being removed.

From this time there was steady improvement. The headache ceased, and the neurological abnormalities became much less marked. Radiographs taken at regular intervals showed that the abscess was steadily diminishing in size, until ultimately it became a small crescented mass (Fig. 3). The patient started getting up on May 7, and was discharged from hospital on May 28, 1940, at which time she was free from symptoms, the papilledema had subsided, and no neurological abnormalities could be demonstrated. She has remained well, reporting last in July, 1947, that she was married and expecting a baby shortly.

COMMENT.—In this case, it was not necessary to remove the abscess, as from the clinical and radiological evidence it resolved after a bony decompression and two aspirations.

The next case is typical of the disappointments which were so common in the first group: three weeks after excision of a cerebellar abscess, the patient died from pneumococcal meningitis.

Case 2.—A girl aged 12 years was admitted on June 13, 1939, complaining of severe headache and vomiting. She had been in good health until three months before admission, when she had bilateral earache and some purulent discharge from the right ear for four days. The discharge eased the pain, and she seemed to be quite well until a fortnight later, that is, about ten weeks before admission, when she came home from school complaining of severe headache. At first it was generalized, but as time went on it seemed to settle chiefly in the back of the head and neck, and she vomited frequently. At times, there were paroxysms of headache which made her scream. For one week before admission she had been confined to bed: the headache seemed to be somewhat easier, but she became drowsy and apathetic and the vomiting continued. There had been no recurrence of the earache and aural discharge.

On admission to hospital she was conscious and cooperative, but during the first examination she vomited suddenly and complained of severe pain in the back of the neck. Her speech was punctuated by hiccoughs but there was no dysarthria or aphasia. The temperature was 98° F., pulse rate 110 per minute, respirations 24 per minute. She held her neck rigidly and resisted any attempt to move it. Both ears were dry and there was no deafness, but she complained of some tenderness on pressure over the right suboccipital and mastoid regions.

The neurological abnormalities amounted to bilateral papilledema (4 dipters), a slight right external rectus weakness, nystagmus which was slow and coarse on looking to the right and rapid and finer on looking to the left, slight right facial weakness, profound hypotonia, and ataxy and dysdiadochokinesis of the right limbs, the arm being more affected than the leg. Radiographs of the skull showed early separation of the sutures.

The clinical features suggested an expanding lesion in the right cerebellar lobe and the relation to aural infection made an abscess the most likely diagnosis. The patient was clearly on the brink of disaster and she was operated on ten hours after admission. Lumbar puncture immediately before operation showed the pressure to be 420 mm.; the fluid contained 40 mg. protein per 100 c.c.m. and 15 white cells per c.mm., 80 per cent. of which were lymphocytes.

The operation was done under local anaesthesia. Both ventricles were tapped and were found to be capacious. An ordinary cerebellar exploration was then made. The folia of the right cerebellar lobe were broad and pale and an exploring cannula met resistance at a depth of 1 cm. This proved to be the capsule of the abscess, and it was so tough that it could not be pierced with a cannula but required a sharp needle, through which 10 c.c.m. of thick yellow pus were aspirated. A circular area of cerebellar cortex (3 cm. in diameter) was excised to expose the capsule of the abscess, and traction sutures were inserted. The abscess was then dissected from the surrounding white matter, and no great difficulty was encountered until its site of attachment to the petrous bone was reached. It was then found that the tough capsule gave way to a layer of friable granulation tissue adherent to the petrous bone, and in scraping this free the abscess ruptured and some pus escaped into the field. The
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Cerebellar abscess was then lifted out. The site of attachment was scraped clean and the obviously infected field treated with pledgets of wool soaked in azochloramide in tracetin. When these were removed and all bleeding points stopped the wound was closed in the usual manner without drainage. The pus from the abscess was sterile on culture and no organisms were seen in films.

There was some improvement for about forty-eight hours after operation, notably in relief of headache and vomiting, lessening of ataxy, and improvement of ocular movements. On the third post-operative day the patient had a good deal of discomfort in the wound, and it was found to be inflamed, especially at the right end of the incision; two or three days later it began to discharge a little thin, serous pus from which pneumococcus was grown. The wound continued to discharge from that time, and in addition to the pneumococcus a staphylococcus aureus was often cultured.

She was given sulphonamides by mouth from the time of operation and parenterally from the fourth to the sixteenth day after operation. Daily lumbar punctures were done, and by the eighth post-operative day the fluid was clear and colourless and contained 20 mg. of protein per 100 c.cm. and 8 cells per c.mm. Thereafter, the protein and cell content increased slightly, until on the sixteenth post-operative day there were 110 mg. protein and 191 cells, 74 per cent. of which were polymorphs. No organisms had been seen in the cerebrospinal fluid, and cultures were sterile. Nevertheless the wound was still discharging, and the patient was obviously more ill: she had more headache, vomiting recurred, and the cerebellar signs which had been very slight a week after operation were becoming much more marked. Our supply of sulphonamide for intramuscular injection was exhausted on the sixteenth day, and two days later for the first time pneumococci were cultured from the cerebrospinal fluid. A further supply for intramuscular injection was obtained, but despite this and increased dosage by mouth the patient gradually lost strength and developed profound cerebellar signs, and the spinal fluid became purulent with a free growth of pneumococci. She died on July 7, twenty-three days after operation. Necropsy showed a diffuse purulent meningitis, especially marked in the basal cisterns and cisterna magna.

It is worth recounting briefly the fate of the remaining seven cases in this first group. The methods of treatment employed are set out in Table 1.

Of the two fatal cases treated by decompression and aspiration, one died from meningitis which developed before operation. This patient was critically ill when she first came under observation, as much from meningitis as from the direct effects of the abscess, and as it was a streptococcal infection it might have responded to penicillin had that preparation been available. The other case died from increased intracranial pressure due to an undetected loculus; one large loculus had been aspirated and outlined by thorotrust, but aspiration of it was not sufficient to deal with the problem of increased pressure in the posterior fossa. In retrospect we can infer from the deformity and displacement of the throrotrust shadow in the pyograms, that there was another loculus, but we did not know this at the time.

Two cases were treated by cerebellar decompression alone. One was a chronic thick-walled abscess (Fig. 4) which had been causing intermittent symptoms of increased intracranial pressure for five years. Although there was no papilloedema and the spinal fluid was normal as to pressure and content, the correct diagnosis was made before operation on the grounds of a chronic infection of the left mastoid and a slight but definite left cerebellar deficit. It is worth noting that this patient tended to keep his head bent forward as in Case 1. A cerebellar decompression was done, and at a depth of 4 cm. the exploring cannula met a tough resistance which could not be pierced for aspiration. We hoped that the decompression would relieve the pressure symptoms and allow the abscess to enlarge posteriorly and thus make it more accessible for removal at a later stage. He did very well for twelve days after operation and then died suddenly. At necropsy there was no evidence of meningitis, but there was pronounced herniation of the cerebellar tonsils and upward herniation of the cerebellar vermis into the incisura tentorii (Fig. 5) due to a chronic left cerebellar abscess. This patient thus died from increased intracranial pressure rather than from infection.

The other patient treated by decompression had meningitis and pyæmia by the time of operation and died from a generalized infection. On admission he was moribund, but as the infection was staphylococcal it might have responded to penicillin.

In the two cases treated by the open or fungus

<table>
<thead>
<tr>
<th>Table 1</th>
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<tr>
<td><strong>PRE-PENICILLIN GROUP</strong></td>
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<table>
<thead>
<tr>
<th>Method</th>
<th>No. of Cases</th>
<th>Recovered</th>
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<tbody>
<tr>
<td>1. Primary excision</td>
<td>1</td>
<td>0 (Case 2)</td>
</tr>
<tr>
<td>2. Decompression + aspiration + excision</td>
<td>3</td>
<td>1 (Case 1)</td>
</tr>
<tr>
<td>3. Decompression + aspiration + excision</td>
<td>1</td>
<td>1*</td>
</tr>
<tr>
<td>4. Decompression</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5. Fungus method</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>2</td>
</tr>
</tbody>
</table>

* This was a fluid tuberculous abscess attached to the posterior aspect of the petrous bone having the clinical and radiological features of an otogenic abscess, but there was no history of aural infection nor any clinical or radiological evidence of such an infection. The pathology was not known until the abscess was excised, and further search failed to reveal a primary tuberculous lesion. This patient died from pulmonary tuberculosis three years after operation. It is thus probable that the abscess was a haematogenous one; if so, it is the only one in this series not clearly due to mastoid infection.
method the chain of events was similar. In each, the cerebellar abscess was initially aspirated through a mastoid wound; subsequently a cerebellar decompression and further aspirations were done. Signs of increased intracranial pressure and increase of the cerebellar dysfunction called for further aspirations, which were ineffective, so the wound was opened, the cerebellum overlying the abscess was excised, and the abscess was uncapped and allowed to drain on to the surface, the scalp and muscle being left open. In each case there were multiple loculi by the time this was done but subsequent necropsy showed that they had all been dealt with. Both patients died from subacute meningitis, one three and a half months after the original aspiration and two months after the creation of the fungus; the other two and a half months after the first aspiration and one month after the wound was left open. In one the infection was due to a gram-negative bacillus which was not sensitive to sulphonamides and might have resisted antibiotics; in the other, the responsible organism was a streptococcus, and although it did not yield to sulphonamide it might have responded to penicillin.

Thus, of the seven fatal cases it seemed that five died as the direct sequence of infection and two from increased intracranial pressure without any evidence of dissemination of the infection.

Cases Treated with the Aid of Penicillin

The introduction of penicillin has put an entirely new light on the problems set out above, as will be seen from the improved results in the second group (Table II). The methods of administering penicillin are described in a subsequent section.

TABLE II

<table>
<thead>
<tr>
<th>PENICILLIN GROUP: NINE CASES OF CEREBELLAR ABSCESS (WITH PENICILLIN)</th>
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<tbody>
<tr>
<td>Method</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>1. Decompression + aspiration</td>
</tr>
<tr>
<td>2. Decompression + aspiration + excision</td>
</tr>
<tr>
<td>3. Primary Excision</td>
</tr>
</tbody>
</table>

Of the two cases treated by decompression and aspiration one was almost identical with Case 1 above: two aspirations were required, and on each occasion penicillin was instilled into the cavity. There was a complete disappearance of symptoms and signs, and the pyograms showed that the abscess had shrivelled to a small mass stuck on to the posterior aspect of the petrous bone, as in Case 1 (Fig. 3). This patient has remained well for the twelve months which have elapsed since his treatment.

In the other case the patient died three days after operation from a combination of acute pulmonary infection and a post-operative clot. Intracranial infection seemed to play no part in his death, which we regarded largely as due to faulty operative technique.

Five cases were treated by excision after a preliminary decompression and aspiration, with instillation of thorotrast and penicillin at the time of aspiration. They were given systemic penicillin therapy as all of them had mastoid infections which had just been operated on or were thought likely to require operation. All these were so-called "acute" cases, like Case 1, with one exception, and this was a patient who had had a cerebellar abscess drained through a mastoid wound, with the subsequent formation of a fungus, in virtue of which he is included in the category of having had a decompression and aspiration. The fungus was granulating but bulging (Fig. 6, p. 6), and he was not acutely ill at any time before operation. After removal of the chronic abscess he developed acute meningitis due to Ps. pyocyanea, doubtless due to contamination from the fungus, but this responded to intrathecal administration of streptomycin.

In all except two of this group, the general condition of the patient improved so much after the initial decompression, aspiration, and instillation of penicillin that the operation for removal of the abscess could be undertaken as a deliberate procedure. One patient required a further aspiration before his condition improved to the point where the abscess could be left to our convenience. The other did not respond to a second aspiration, and the abscess had to be removed as an emergency measure. In this case the abscess ruptured and the field was grossly contaminated with streptococcal pus. There was slight post-operative meningitis which was controlled with penicillin and sulphadiazine, and the patient was discharged with the wound healed and the spinal fluid normal two and a half months after operation. He has remained well for the three years since operation.

On the whole the management of this group was so straightforward that we thought it worth trying primary excision, that is, at the first operation, rather than doing the preliminary decompression and aspiration. We were encouraged by the fact that in every case in which we had aspirated a cerebellar abscess there had been a perceptible capsule, that is, they were usually moderately chronic by the time they demanded treatment. Thus in Case 1, although
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Fig. 1 A-B.—Case 1. Initial postoperative pyograms. The dotted lines outline the abscess.

Fig. 2 A-B.—Case 1. Pyograms five days later, showing increase in size of abscess.

Fig. 3 A-B.—Case 1. Pyograms three months after operation, showing the small thorotrast-encrusted mass adherent to the posterior surface of the petrous bone.
Fig. 4.—Chronic left cerebellar abscess which had been causing symptoms for five years.

Fig. 5.—Superior surface of cerebellum showing upward herniation of vermis and left cerebellar lobe along margin of midbrain caused by the abscess seen in Fig. 4.

Fig. 6.—Granulation tissue in a case of cerebellar abscess. (From the case described in Fig. 4.)
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Fig. 7—Operation sketches of excision of cerebellar abscess.
the patient was so acutely ill, the abscess was probably five or six weeks old by the time it was aspirated, and its capsule offered definite resistance to the exploring cannula. We have not seen a cerebellar abscess in the acute non-encapsulated stage, either at necropsy or operation and in this respect cerebellar abscesses seem to differ from other brain abscesses, which may cause urgent symptoms or death in the acute stage. It is the more remarkable because it would be expected that an acute infective focus in the small confines of the posterior fossa would have much more serious effects than a similar lesion above the tentorium. In the following case the abscess was removed within six days of the first manifest symptoms, although at operation it proved to have quite a tough capsule.

Case 3.—A man aged 31 years was admitted to the Ear, Nose, and Throat Department on Aug. 1, 1946. He had had bilateral discharging ears since the age of seven years, which had been treated intermittently with local applications. On June 12, 1946, he first came under observation in the E.N.T. Department. At this time he was complaining of a good deal of pain in and behind the right ear and there was an inflammatory swelling above and behind the ear. On the following day a radical mastoidectomy was performed, extensive disease being found in the mastoid. Convalescence was uneventful and he was discharged free from symptoms two weeks later, with instructions to report for outpatient dressings. He remained well until July 25, when he complained of feeling a “weakness” which manifested itself as unsteadiness in walking. On the following day his relatives noticed that his speech was a little slurred. He was due to report for a dressing on July 27, but was so unsteady on his feet that he could not leave his room. On the next day he complained of double vision and it was noticed that he had a squint. He vomited several times, but denied any headache or discomfort in his neck, complaining chiefly of the “weakness.”

On admission to the E.N.T. Department, he was alert and seemed to be in no pain. The mastoid wound had healed and there was very little discharge from the meatus. There was pronounced slurring dysarthria, but no dysphagia. There was no stiffness of the neck nor any abnormality of posture. The optic fundi were normal. There was incomplete right external rectus paralysis, with slow, coarse nystagmus on looking to the right, rapid and fine on looking to the left. The right side of the face showed a slight weakness of the peripheral type. The right limbs were hypotonic and there was considerable ataxy and dysdiadokinesis, much more marked in the arm than in the leg. The spinal fluid pressure was 110 mm. and the fluid contained 150 mg. protein per 100 c.cm. and 150 white cells per c.mm., 72 per cent. of which were lymphocytes.

There seemed no doubt that he had a right cerebellar abscess, despite the absence of headache and of objective evidence of increased intracranial pressure. We have always regarded dysarthria as an ominous symptom in posterior fossa lesions, and partly because of this and partly because the other symptoms had come on so acutely we decided to operate at once. The cerebellum was exposed by the type of incision which we use for acoustic tumours. The folia of the right lobe were broad and pale, and a blunt needle encountered a resistance at a depth of 2-5 cm. A portion of the overlying cerebellum was resected to expose the capsule of the abscess, which proved to be up to 0-5 cm. thick, and it was dissected from the surrounding white matter. As in other cases, the dissection was made easier by aspirating the abscess, and stitching over the site of the puncture to prevent leakage and to provide traction strings. The abscess had a broad and firm attachment to the posterior surface of the petrous bone, and while this was being dissected the capsule burst and the residue of pus escaped into the field. This was sucked out, 10,000 units of penicillin solution (2,000 units per c.cm.) were left in the operative cavity, and the whole wound was dusted with penicillin sulphamezathine powder before closure.

Convalescence was uneventful. The wound healed by primary union and there was no evidence of meningitis. The patient was discharged three-and-a-half weeks after operation, at which time the nystagmus and external rectus palsy had cleared up, but there was still ataxy of the right arm and a little unsteadiness in walking. These symptoms improved slowly and were still noticeable one year after operation, although he had been able to resume his former work as an unskilled labourer.

Comment.—The operative treatment of this case was almost identical with that of the only case of primary excision in the pre-penicillin group referred to above (Case 2). In both of them the field was grossly contaminated in detaching the abscess from the petrous bone. In the one this led to a fatal meningitis, and in the other, treated with penicillin, convalescence was uneventful.

Case 4.—A woman aged 40 was admitted to the Radcliffe Infirmary on March 29, 1947. She had an acute mastoiditis on the left side in 1941 which had been dealt with by a radical mastoidectomy, after which she was deaf in the left ear but at no time subsequently had she ever had any earache or aural discharge. Five months before admission she had a child after a normal pregnancy. The puerperium was uneventful except that she could not feed the baby.

Four weeks before admission she began to complain of severe occipital headache, especially on the left side. Within a week this was followed by frequent vomiting and double vision. She was sent to another hospital, where, apart from deafness of the left ear, no neurological abnormalities were found. Two lumbar punctures were done: at each the pressure was normal or low (75 mm.), the fluid contained 40 mg. protein per 100 c.cm. and on one occasion 60 lymphocytes and on the other 30 lymphocytes per c.mm. While under observation she had agonizing headache, vomited repeatedly, and complained of giddiness if she moved her head; if she tried to sit up in bed she fell to the left side. These signs suggested a rapidly expanding lesion and she was
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accordingly transferred to the Nuffield Department of Surgery on March 29, 1947.

On admission, she was alert but complained of severe headache and resented any attempt to move her head. There was a slight slurring of dysarthria but no dysphagia. The optic discs were normal. No ocular palsy could be demonstrated but there was slow coarse nystagmus on looking to the left, rapid and finer on looking to the right. The cranial nerve functions otherwise were normal. In the limbs, there was very slight hypotonia and ataxia; on the left arm, only demonstrable in careful tests, and no definite abnormalities in the lower limbs. Radiographs of the skull revealed only the operative defect in the left mastoid region, with no evidence of recent infection.

Although the neurological signs were so slight, there seemed little doubt that she had a left cerebellar abscess. At operation on the following day the abscess was excised, the same technique being employed as in Case 3. The right ventricle was tapped before the dura was opened, and 12,000 units of penicillin were instilled. When the abscess was dissected off the petrous bone it was found that the dura also had been removed from an area about 1 cm. in diameter. The bare bone looked sclerotic but no pus was seen, and the field was not obviously contaminated at any time during the operation. Penicillin solution (10,000 units) was left in the operative cavity and the wound dusted with penicillin-sulphamethazine powder before closure.

Convalescence was uneventful. The headache was relieved at once, and the neurological abnormalities had completely disappeared by April 17, when the patient was sent to a convalescent home. She reported on May 14, six weeks after operation, free from any symptoms or signs, and she had returned to her normal activities.

COMMENT.—Of particular interest in this case was the genesis of a cerebellar abscess six years after a successful mastoid operation. It is possible that the intracranial infection occurred at the time of the mastoid operation and remained dormant for many years to flare up during a period of debility, such as might be expected after a pregnancy during a period of dietetic austerity.

Discussion

Cerebellar abscesses are treacherous, not only because they are infective but also because they behave in a less predictable way than other expanding lesions such as neoplasms in the posterior fossa. Thus in most of the cases described above there was little or no papilloedema, and the spinal fluid pressure was normal despite critical pressure relationships in the posterior fossa. Again, there was the experience of sudden death twelve days after a decompression operation without any symptoms or signs to suggest that this catastrophe was impending. For these reasons we only feel confident about a cerebellar abscess when it has been removed. There are exceptions, as in Case 1 and in one case in the second group, in which decompression and repeated aspiration brought about a complete recovery as shown by freedom from symptoms and signs. Schreiber (1941) has reported a series of eight cases in children treated successfully by a single aspiration. Even so we would not have been content to leave these abscesses had it not been that the pyograms showed that they had shrivelled up. In passing it should be said that the finding and removal of a small cerebellar abscess adherent to the petrous bone may be a matter of considerable technical difficulty, as we found in the case mentioned above which had been drained through a mastoid wound and subsequently developed a fungus. In this case we found it expedient to isolate the fibrous track at the base of the fungus and to follow it medially to the abscess.

Operative Technique.—We have employed the same operative approach in each case because we have found a remarkable constancy in the situation of these abscesses (Figs. 1-4, pp. 5 and 6). They are adherent to the posterior aspect of the petrous bone above and medial to the internal acoustic meatus. They expand posteriorly, and come to occupy the antero-superior part of the lateral lobe of the cerebellum. We have encountered only one departure from this situation, and this was an abscess in the superior vermis. In this case there was an infective thrombosis of the lateral sinus and torcular, and the cerebellar abscess seemed to result from a retrograde venous infection rather than by direct extension through the petrous bone as is usually the case.

The operation is thus similar to that which we employ for acoustic tumours; and, as with these tumours, it is usually necessary to excise a portion of the lateral cerebellar lobe to expose the capsule. How much and what part of the lateral lobe should be excised to afford the optimum exposure can be determined by a study of the pre-operative pyograms, if they have been made, or by feeling the capsule with a blunt brain needle to see where it most nearly approaches the surface. Generally excision of the upper and lateral portion of the cerebellar hemisphere affords adequate exposure (Fig. 7, a, c, d). It is important not to carry the excision too far medially because of the risk of damaging the dentate nucleus: such a lesion produces a severe cerebellar disability which may be permanent.

Dissection is made easier by packing off the field; aspirating the abscess, and then stitching up the hole, using the sutures as traction strings (Fig. 7, e). This is analogous to getting an acoustic tumour and it facilitates the deepest and most difficult part of the dissection, which is the detachment of the abscess from the dura over the petrous bone. The additional
room afforded by aspiration may also disclose other loculi and lessen the risks of rupturing them during the dissection.

The attachment to the dura over the petrous bone may be such that it can be scraped off by blunt dissection, or it may be so tough that it has to be cut off. In one case (Case 4) the dura was removed at the site of attachment, exposing a bare area of bone. This area was covered with a stamp of fibrin foam and no trouble ensued, although generally we would prefer to leave the dura intact. The fifth, seventh, and eighth cranial nerves are generally not seen, as the dural attachment of the abscess commonly lies lateral to the fifth nerve and above and medial to the internal acoustic meatus. No damage has been inflicted on cranial nerves in any of these cases.

As to the use of chemotherapy and antibiotics, we employ sulphadiazine and systemic penicillin before operation, and subsequently as dictated by the bacteriology of the abscess. Table III summarizes the bacteriological data in our series.

### TABLE III

**BACTERIOLOGY OF SIXTEEN CASES OF CEREBELLAR ABSCESS (No Data in Two Cases)**

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<tr>
<th></th>
<th>No. of Cases</th>
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<tr>
<td>Pneumococcus</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Anaerobic Streptococcus</td>
<td>3</td>
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<tr>
<td>Beta haemolytic Streptococcus</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Staphylococcus Aureus</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ps. Pyocyanea + Staph. Aureus</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Gram-negative bacteria</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Gram-positive cocci</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>M. Tuberculosis</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sterile</td>
<td>1</td>
<td>0</td>
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</tbody>
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At the time of operation it is usually necessary to tap the lateral ventricle before opening the dura, and 10,000 units of penicillin are instilled. If the abscess is aspirated, 20,000 units in 1 c.c.m. saline are instilled into the cavity whether it is being removed in one stage or left for subsequent removal. When the abscess is removed a further 10,000 units are left in the operative cavity, and the whole wound is dusted with penicillin-sulphadiazine powder. Any evidence of meningitis before or after operation may call for the intrathecal administration of penicillin if a sensitive organism is found to be responsible. If no organisms are found we rely on the parenteral administration of sulphanamides.

In one case post-operative meningitis due to *Ps. pyocyanea* was controlled by streptomycin. This was the case with the fungus mentioned above (Fig. 6), and there was clear evidence of meningitis five days after operation, although the organism was not recovered from cultures until the twelfth day. Lumbar punctures were very difficult in this case, so we punctured the loculation in the posterior fossa and instilled the streptomycin by this route. Forty thousand units were used on the first occasion, and as there was no ill effect 80,000 units were instilled daily for seven days. The fluid was sterile after the first injection and remained so subsequently. The protein content diminished from 300 mg. at the beginning of the infection to 60 mg. at the end of the streptomycin treatment and the cell count dropped from a maximum of 3,500 per c.m.m. to 0.

In none of our cases were there any fits or other untoward results of the use of antibiotics.

As these abscesses are usually due to mastoid infection, the question of treatment of the mastoid often arises. In some cases a patient with an untreated mastoid infection first comes under observation when he develops a cerebellar abscess, and the problem of priority of treatment has to be decided between the aural surgeon and the neurological surgeon. We have not found the decision to be a particularly difficult one in the majority of cases: the lesion which is the more immediate danger to life should be dealt with first. In three of our cases this meant an urgent cerebellar decompression and aspiration or removal of the abscess, depending on the patient’s general condition. The mastoid infection should then be dealt with as soon as possible. As the retro-auricular incision commonly employed in mastoid operations is usually just in front of the lateral limb of the cerebellar operation, our otological colleagues, Mr. R. G. Macbeth and Mr. G. Livingstone, have usually employed the permeatal route with satisfactory results.

It is more common for the cerebellar abscess to require treatment sometime after a mastoid operation. If the classical route has been used the mastoid scar may be incorporated in the lateral limb of the scalp incision if it has healed soundly. If it has not healed, whether clean or suppuring, we prefer to stay away from it, and open the posterior fossa by a middle line incision. This approach can be used for decompression and aspiration to tide over a crisis, but would probably be inadequate
CEREBELLAR ABSCESS

FIG. 8.—Types of incision:
(a) if there is no mastoid wound; (b) if the mastoid wound has not healed.

for removal of the abscess. In the one case in which we employed this method, the decompression and aspiration relieved symptoms for three weeks, by which time the mastoid wound had healed soundly. The vertical middle line incision was then joined to the mastoid one to make an inverted U-shaped flap suitable for a unilateral cerebellar operation (Fig. 8).

Functional Results.—Of the ten patients who have recovered, seven have been left with no demonstrable neurological deficit, and they professed complete freedom from symptoms. They have all returned to full work, or in the case of children are proceeding normally with their education.

In three of the cases treated by excision there were residual disabilities of the ipsilateral limbs. In one unsteadiness of gait and profound ataxy of the right arm prevented the patient from returning to his work as a farm labourer, but he supports himself by working as a tea-boy for a construction company. In another, there was very slight unsteadiness of gait and ataxy of the right arm which did not impair the patient's efficiency as an unskilled labourer. In the third there is a gross residual ataxy of the left arm and leg, but it is too early to assess his potentialities as he was only discharged four months ago and is still having re-educative exercises. In each of them there were technical difficulties at operation and probably more trauma was inflicted than is necessary in most cases: two were multilocular abscesses adherent to the side of the brain stem, and one was the fungus case mentioned above. Nevertheless, two of them were cases which were obviously not going to respond to decompression and aspiration and there seemed to be no alternative to excision.

Diagnosis.—In conclusion we should like to add a short note about diagnosis. The nearly constant location of these abscesses means that the neurological picture is usually very similar, the differences being in degree. Headache, often severe, was almost constant with the notable exception of Case 3. It may be generalized or referred to the occipital region on both sides, or chiefly on the side of the lesion as in Case 4. Vomiting and giddiness are common, and in association with headache during a mastoid infection should always raise the question of an intracranial abscess. Few of the patients complained of subjective visual disturbances, and as most of them were confined to bed they were not aware of any ataxy of their limbs.

Objectively, we were struck by the frequency with which these patients tend to keep their heads bent forward, almost as though they were trying to pull the cerebellum tonsils out of the foramen magnum. This is just as ominous a posture as the more common opisthotonic one seen in cases of intracranial tumours, and it is remarkable that it can occur without papilledema or any increase in the spinal fluid pressure, as in several of the cases mentioned above.

The invariable abnormality was nystagmus, as with acoustic tumours. It is slow and coarse on looking to the side of the lesion, rapid and finer on looking to the other side. It was often associated with weakness of conjugate ocular movement on looking to the side of the lesion, as pointed out by Symonds (1927).

Trigeminal impairment and facial weakness were rare. The degree of deafness was usually determined by the nature of the mastoid infection and operative intervention, but sometimes it is greatly increased and bilateral as a result of pressure of the abscess on both auditory nerves.

Dysarthria was common in the acute stages and seemed to be more a factor of inco-ordination than palatal or pharyngeal paralysis. We regard it as an ominous symptom in abscesses and tumours, and in abscesses in particular it is usually an indication for urgent treatment.

In the locomotor system, the most frequent findings were ataxy of the limbs on the side of the lesion and this was usually much more marked in the arm than in the leg. In some cases it was gross and could not be missed; in other cases it was very slight and could only be demonstrated by formal tests.

In the vast majority of cases there were abnormalities in the cerebrospinal fluid, either an increase
in the protein or a pleocytosis or both. Lumbar puncture may be a dangerous procedure in acute cases and we have usually refrained from doing it until immediately before operation.

Radiographs of the skull have been of no particular help in diagnosis other than showing evidence of the mastoid infection if that was not already known.

In only three of the eighteen cases was the diagnosis in sufficient doubt to make ventriculography necessary. In each of these there was moderate dilatation of the lateral and third ventricles indicating a lesion in the posterior fossa. In one the aqueduct and fourth ventricle could be seen to be displaced to the side opposite the lesion.

We think it important to emphasize the clinical features of cerebellar abscess, because any of the symptoms or signs mentioned above, or any combination of them, in a patient suffering from mastoiditis calls for urgent neurological diagnosis. We believe that the management of the abscess should be the responsibility of the neurological surgeon, and that he should see the patient as soon as possible when intracranial complications are suspected. We consider that exploratory aspiration of the cerebellum through a mastoid wound is generally inadvisable, and that it is preferable to approach the abscess through a clean field as described above. Drainage of an abscess through a mastoid wound is also undesirable because more often than not it will be ineffective, and if a temporary improvement does occur it is usually at the expense of the formation of a fungus which adds considerably to the difficulties and dangers of dealing with the residual abscess.

Summary
1. The diagnosis and treatment of eighteen cases of cerebellar abscess are described.
2. Of the first nine cases treated by various surgical procedures without penicillin, two recovered.
3. Of the second nine cases treated by similar surgical procedures with penicillin, eight recovered.
4. In the majority of the successful cases the abscess was excised, although in two cases recovery followed decompression and repeated aspiration of the abscess.
5. It is suggested that, with the aid of antibiotics, excision of cerebellar abscess is a reasonably safe procedure and is the treatment of choice.

References