

BRAIN ABSCESS: ASPIRATION, DRAINAGE, OR EXCISION?

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In treating brain abscess we have three primary concerns: saving life, preserving or restoring function, and preventing sequels such as epilepsy and recurrence of infection. Our success with the first of these is accurately expressed by the immediate mortality rate, but information about the last two can only be obtained by long-term follow-up studies. And for statistical assessment larger figures are required than any one clinic can supply. Furthermore, the methods of treatment tend to differ in different clinics. In Oxford, for instance, we have records of about 120 cases of brain abscess treated since 1938, but most of these have been dealt with by excision after successful aspiration, and we have little useful information about aspiration or other forms of drainage as the sole procedure. Accordingly we approached Professors Norman Dott and Sir Geoffrey Jefferson who kindly placed at our disposal the records of their cases treated in Edinburgh and Manchester over the last 25 years or so. From the three centres there were altogether 295 cases. Of these patients, 118 died soon after operation (40%). The remaining 177 patients survived for periods up to 26 years, and of these it has been possible to obtain adequate follow-up information in 173 cases. As we were particularly interested in the long-term results, we have not included any cases treated within the last 12 months.

We found that in general three methods of treatment had been used (Table I): aspiration (with or without a decompression); continuous drainage by a tube, or by marsupializing the abscess; and excision (with or without previous aspiration and/or decompression).

No clinic had applied any of these methods to the exclusion of others, but there was a strong preference for excision in one clinic, and for continuous drainage in another. In the third clinic there was less rigidity and the various methods all had a fair trial.

TABLE I
METHODS OF TREATMENT

Method	No. of Cases	Died	Mortality (%)
I. Aspiration (with or without decompression)	95	58	61
II. Drainage (by tube, fungus, or marsupialization)	89	45	50
III. Excision (with or without previous aspiration and/or decompression)	111	15	13
Total	295	118	40

Mortality

The mortality rates of the different methods (Table I) are not comparable, for in many of the cases finally treated by excision the abscess had already been tided over to the chronic stage by repeated aspirations; at the time of the excision an apparent cure had already been effected and the patient was often free from symptoms, although papilloedema or other signs persisted. In addition, many of the cases treated by aspiration alone were desperate ones, and the aspiration was done when the patient was *in extremis*.

Another factor which must be considered is the introduction of penicillin, which is given systemically, injected directly into the abscess cavity, and also into the cerebrospinal fluid pathways if there is risk of meningitis. There is no doubt that all of us have much more confidence in the treatment of brain abscess now than at any time in the past, and we are inclined to ascribe this largely to penicillin. From our survey this would appear to be the case, for if the material is divided into pre- and post-penicillin groups, the mortality rate in the former

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was 53% and in the latter 27% (Table II). Improved results from the use of penicillin were especially striking in the cerebellar abscesses and in the bronchogenic abscesses of the cerebral hemisphere. In one centre, among 21 cases of cerebellar abscess, 10 were operated on without penicillin, and there were seven deaths (70%), whereas in 11 cases operated on with the aid of penicillin there was only one death (9%). In the same centre the mortality from bronchogenic abscesses was 100% before and 32% after the introduction of penicillin. On the other hand, in the common type of abscess of the cerebral hemisphere, penicillin did not produce much change in the results: of 100 cases of abscess of the cerebral hemisphere, 44 were treated without penicillin and there were 16 deaths (36%), while 56 were treated with penicillin with 17 deaths (30%).

We next sought to see what effect penicillin had had on the various methods of treatment. The figures (Table III) show that penicillin has produced considerable improvement in the results of all methods of treatment. The two determining factors in the use of antibiotics are the sensitivity of the organism to the antibiotic, and the possibility of treating the whole of the infected area with it. As to the former, of 100 cases of cerebral abscess in Oxford, organisms were found in smears or on culture in 75, and in 12 of these the organisms were of a type insensitive to penicillin. In the whole series streptomycin was only rarely used; some of the penicillin-resistant organisms may prove sensitive to this and other antibiotics in the future.

The second point about the access of penicillin to the infected area is concerned with the character of the abscess, i.e. whether it is a single cavity or has multiple loculi, or whether there are multiple discrete abscesses. In this connexion it will be seen later that the abscess is strictly unilocular in rather less than half the cases, and in the remainder it is possible that the penicillin is getting to only one of the loculi.

Preservation and Restoration of Function

In general it would appear that the chances of improving a neurological disturbance are rather better with aspiration than with excision. This is well seen in the case of the visual field defect in temporal lobe abscess: after aspiration it is by no means uncommon for the hemianopia to clear up completely, whereas with excision the upper quadrant defect may be rendered permanent, and in some cases a pre-operative upper quadrant defect has been converted into a complete and permanent hemianopia. On the other hand, we have not seen a case in which aphasia has been

TABLE II
INFLUENCE OF PENICILLIN ON TREATMENT OF BRAIN ABSCESS

	No. of Cases	Died	Mortality (%)
Without penicillin	145	77	53
With penicillin ..	150	41	27

TABLE III
METHODS OF TREATMENT

	No. of Cases	Died	Mortality (%)
Aspiration :			
Without penicillin ..	50	37	74
With penicillin ..	45	21	47
Drainage :			
Without penicillin ..	57	32	56
With penicillin ..	32	14	41
Excision :			
Without penicillin ..	38	8	21
With penicillin ..	73	7	9
Total	295	118	

made any worse by excision of a left temporal abscess, and in most cases it has cleared up completely. With excision the risks of damage are less in the chronic than in the acute stage before encapsulation.

Whichever method of treatment is used, the result will depend largely on how much of the disability is due to destruction by the abscess and how much is due to local pressure effects. Of 175 patients in this series who recovered from a brain abscess and were followed up, 8% were disabled by profound motor, sensory, or visual defects; another 8% had slight defects but were able to maintain themselves in gainful occupations; the remainder had no significant neurological disturbance.

Late Complications

The sequels with which we have been particularly concerned are recurrence of the infection and epilepsy.

Recurrence of Infection.—Among the 96 survivors of excision in this series there was no case in which an abscess recurred at the same site once it had been excised. We are, however, informed that Professor Cairns and Mr. Falconer had a case at the Military Hospital for Head Injuries, Oxford, in which a temporal abscess recurred several months after it was removed. Recurrence in this case was

thought to be due to a fresh infection from the mastoid which had not been adequately treated.

With aspiration or drainage the risk of recurrence is greater. Of the 88 patients treated by these methods who left hospital alive, seven subsequently developed recurrent infection at the same site, at intervals varying from three months to 13 years, and all of these died. Expressed statistically the risks are thus not very great (8%), but should be borne in mind. The efficacy of any aspiration or drainage procedure depends largely on the character of the abscess, that is, whether it is a single or multilocular cavity. In 91 cases of which we have surgical or necropsy material at Oxford, the abscess was multilocular (Table IV) in 39 (43%). It may be that penicillin instilled into one locus permeates adjacent loculi to some extent, but in two cases of multilocular abscess removed at operation only the locus treated with instillation of penicillin had been sterilized.

Epilepsy.—The practical functional result after abscess of the cerebral hemisphere is often determined by the presence or absence of epilepsy. Epilepsy is a frequent feature of the development of an abscess, occurring before operation in 27% of the 264 cases of abscess of the cerebral hemisphere in this series. The incidence corresponds fairly closely to that in cases of neoplasm.* After treatment of the abscess epilepsy was manifest in 72 cases among the 152 survivors who have been followed up: that is to say, 47% of the survivors of abscess of the cerebral hemisphere subsequently had fits. McKenzie (1948) reported an incidence of 30.5% in 47 survivors out of 105 cases. Our figures of post-operative epilepsy approximate to the incidence of post-traumatic epilepsy in cases of penetrating missile wounds of the brain reported by Ascroft (1941), 45%, and by Russell (1951), 43%.

The incidence of post-operative epilepsy relative to the method of treatment is seen in Table V, from which it would appear that there is little difference whether the abscess capsule is left in the brain or is primarily or secondarily excised. However, when the different parts of the cerebral hemisphere are considered separately (Table VI), although the figures are small, it is seen that epilepsy following treatment of frontal abscess is considerably more common after aspiration or drainage than after excision.

The following additional factors in the incidence of epilepsy have been considered.

* Hoefler, Schlesinger, and Pennes (1947) reported epilepsy in 36% of 476 cases of intracranial tumour, and Penfield and Erickson (1941) in 37% of 703 cases.

TABLE IV
RELATIVE INCIDENCE OF UNILOCCULAR, MULTILOCCULAR, AND MULTIPLE BRAIN ABSCESES

Nature of Abscess	Site of Lesion		No. of Cases	%
	Cerebral	Cerebellar		
Unilocular ..	35	9	44	48
Multilocular ..	34	5	39	43
Multiple ..	8	—	8	9
Total ..	77	14	91	

TABLE V
POST-OPERATIVE EPILEPSY IN VARIOUS METHODS OF TREATMENT

Method	No. of Cases Followed Up	Epilepsy	%
Aspiration	31	15	48
Drainage	38	21	55
Excision :			
(a) Without previous aspiration or decompression	18	10	55
(b) With previous aspiration or decompression	65	26	40

Age.—Table VII shows that there was no significant difference in the incidence of epilepsy in any particular age group; children seem to be no more or less liable to post-operative epilepsy than adults.

Time of Onset of Epilepsy after Treatment.—Fits frequently occurred within a few weeks of operation but in one case the interval was 14 years. In 63% of the cases of post-operative epilepsy the first fit came on within 12 months of operation. However, after frontal abscess the onset of epilepsy was delayed: only 10 of the 27 patients had their first fit within the first year. With abscesses of other sites 70 to 100% of those having post-operative fits had them within a year of operation.

Influence of Penicillin.—Table VIII shows that the incidence of epilepsy was 57% among cases treated without penicillin and 40% among cases treated with penicillin. These figures must be viewed with caution since the incidence of epilepsy after missile wounds in Ascroft's series (45%), none of which had penicillin, did not differ from the incidence in Russell's series (43%), most of which were treated with penicillin.

TABLE VI
INCIDENCE OF POST-OPERATIVE EPILEPSY IN RELATION TO SITE OF ABSCESS

Site of Abscess	Mode of Treatment	No. of Cases	Incidence of Post-operative Fits	%
Frontal lobes	Aspiration or drainage	18	13	72
	Excision	32	14	44
Temporal lobes	Aspiration or drainage	30	12	40
	Excision	26	7	27
Parietal lobes	Aspiration or drainage	5	2	—
	Excision	11	6	—
Occipital lobes	Aspiration or drainage	5	2	—
	Excision	5	3	—
Multilobular and multiple abscesses ..	Aspiration or drainage	11	7	—
	Excision	9	6	—
Total		152	72	—

TABLE VII
INFLUENCE OF AGE ON INCIDENCE OF EPILEPSY AFTER OPERATION FOR BRAIN ABSCESS

Age Group	No. of Cases	Incidence of Fits	%
A. (1-10 years) ..	28	12	43
B. (11-20 years) ..	34	15	44
C. (21-30 years) ..	46	25	54
D. (31-40 years) ..	15	8	53
E. (40 and over) ..	29	12	41
Total	152	72	

TABLE VIII
INFLUENCE OF PENICILLIN ON INCIDENCE OF EPILEPSY

Cases Treated	No.	Incidence of Fits	%
Without penicillin	61	35	57
With penicillin	91	37	40
Total	152	72	

The Use of Thorotrast.—It is believed by some that the use of thorotrast for pyrography during the treatment of brain abscess increases the risk of epilepsy. We have not two comparable series, but in one centre there were 50 patients in whom thorotrast was used, and of these 23 subsequently had fits, and 27 had no fits. That is to say, the incidence of epilepsy was no higher in this thorotrast group than in the whole post-operative series.

The Use of Anticonvulsants.—There is abundant evidence that patients with cerebral abscess, however treated, should remain on an anticonvulsant régime for several years, if not permanently. We have on many occasions seen patients whose fits have been controlled by phenobarbitone for two or three years, to the point where they felt justified in discontinuing the drug, and this has been followed immediately by a recurrence of seizures, which were controlled again by resuming the drug. There is no evidence that phenobarbitone in ordinary therapeutic dosages exerts any harmful effects on the patient's well-being or general health, and although we realize that in advising it for all patients some will be having it unnecessarily, there is no way of selecting the patients except by waiting to see whether or not they have a fit. Some authorities (Russell, 1950) prefer not to give phenobarbitone until fits develop, but in one case in this series the first manifestation of post-operative epilepsy was status epilepticus which proved fatal, and this patient had had no prophylactic anti-convulsant treatment.

Whatever method of treatment is employed, post-operative epilepsy remains a hazard in brain abscess, and it has accounted for death in status epilepticus in five of the 152 survivors in this series whose subsequent fate is known. These were all cases of frontal abscess, two of which had been treated by excision, two by tube drainage, and one by aspiration. This corresponds with the findings of Whitty (1951) that it is with frontal lesions in particular that status epilepticus is apt to arise.

In four of the 72 patients with post-operative epilepsy the attacks were so frequent, despite treatment, that the patient was virtually disabled

by them. On the other hand, in 61 cases the fits were so mild and infrequent as not to constitute a serious disability, although the fact of epilepsy sometimes demanded a change in occupation. In only 12 cases (16% of the total with post-operative epilepsy) was it considered necessary to supplement phenobarbitone with other anticonvulsants. As the patients are followed over a period of years, the frequency and severity of the attacks tend to diminish. When this does not happen, and epilepsy constitutes a disability, the possibility of surgical excision of an epileptogenic focus should be considered. In cases of epilepsy associated with hemiplegia and disorders of behaviour the question of hemispherectomy should be reviewed in the light of Krynauw's recent work (1950).

Discussion

As regards death rate, our results do not differ significantly from those published in a collective review by Webster and Gurdjian (1950) who found that the average mortality for aspiration was 50% ; for tube drainage procedures, 50% ; and for excision, 12%. Even apart from the mortality rate, we interpret our figures for post-operative epilepsy and recurrence of abscess as indicating that of the methods which have been tried, excision is by a slight margin the most reliable. The risks of relying on aspiration derive from the fact that many abscesses are multilocular, and it may not be possible to deal with all of the loculi by aspiration. The same risk is incurred in tube drainage. It is a fact that many patients treated by aspiration will improve clinically, although the abscess continues to expand, as is shown in serial pyograms, which we regard as an essential part in the management of these cases. There is also the risk, albeit slight, of a late recurrence of the infection in the capsule of an abscess left in the brain when treatment has been by aspiration or tube drainage. This risk is particularly marked in chronic brain abscess after a penetrating missile wound.

The addition of penicillin instillation to aspiration or other drainage techniques is an improvement, but there remain the infections due to insensitive organisms, and the difficulty of sterilizing a multilocular abscess.

We have found no significant difference in the incidence of epilepsy whether the abscess be excised or treated by aspiration, though in abscesses of the frontal lobe the results suggest that the risk of epilepsy is greater if the abscess is not removed. The advantages of aspiration are its simplicity, and the fact that it carries slightly less risk of adding to a neurological deficit than does excision. These are important considerations, especially in the Rolandic

region or in the speech area, and doubtless more cases will be treated by aspiration as time goes on. If so, we would urge that a strict test of cure be applied before the patient is discharged : that he should be free from symptoms and signs of increased intracranial pressure ; that the cerebrospinal fluid should have reverted to normal ; that the thorocast-encrusted abscess should have shrivelled up, as seen in serial pyograms ; and that if there is any doubt at all, a ventriculogram should have shown that there are no residual loculi.

In conclusion, it must be emphasized that no hard and fast rules can be laid down in advance. Each case must be treated on its merits. In some cases with high intracranial pressure, operative decompression is necessary to save life, and in these it is usually advisable at a later stage, or even at the time of the first operation, to excise the abscess. In other cases, where the abscess is situated in an eloquent area of the brain and the abscess is unilocular, repeated aspiration is the better method of treatment. But in these regions, as in other parts, an abscess is occasionally encountered which does not collapse after repeated aspiration, and must be excised to obtain a cure.

Summary

A group of 295 cases of brain abscess from Edinburgh, Manchester, and Oxford has been reviewed. Of the 177 survivors, 173 have been followed for periods of one to 26 years.

In general, three methods of treatment were followed : aspiration (95 cases, with mortality of 61%) ; tube drainage (89 cases, with mortality of 50%) ; and excision (111 cases with mortality of 13%). The overall mortality was 40%.

The mortality rate without penicillin was 53%, and with penicillin 27%.

The risk of adding to certain neurological deficits, for example, visual field defects, was less with aspiration than with excision.

The recurrence rate after aspiration or drainage was 8%. After excision there was no recurrence among 96 survivors.

Post-operative epilepsy was manifest in 72 cases among 152 survivors of abscess of the cerebral hemisphere. Of these, five (all of them frontal lobe cases) died in status epilepticus. In 63% of patients with post-operative fits the first fit occurred within 12 months of operation.

The incidence of post-operative epilepsy in frontal lobe abscess was considerably higher after aspiration or drainage than after excision.

The findings in this series are slightly in favour of excision as the best method of treatment but each case must be treated on its merits.

The value of regular and indefinitely prolonged anticonvulsant therapy after operation for brain abscess is stressed.

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