TABLE IV—Survey of selected series with large numbers of cases to assess incidence of chromosomal abnormalities in fetuses with and without an increased risk of abnormality

	Without increased risk of chromosome abnormalities		With increased risk of chromosome abnormalities	
	No of pregnancies	No (%) of abnormalities	No of pregnancies	No (%) of abnormalities
European Collaborative Study ³	711	12 (1.7)	4788	135 (2.8)
Canadian Medical Research Council ¹	191	2 (1.1)	829	21 (2.5)
German Medical Research Council ²	843	3 (+ ?) (0.4)	2547	68 (2.6)
Ferguson-Smith and Ferguson-Smith ⁷	497	3 (0.6)	433	12 (2.7)
Present series	359	5 (1.4)	739	9 (1.3)
Total	2601	25 (0.96)	9336	245 (2.6)

was 2.1%, which corresponded to the spontaneous abortion rate in women not having amniocentesis.

We are therefore left with the fact that we found the same proportion of abnormalities in a group of fetuses with a low risk as in a group with a high risk. These findings raise several questions. Firstly, is it justified to screen all pregnant women, considering that a high proportion of the fetal abnormalities found will not be severe? Secondly, is it justified not to screen the whole population of fetuses, considering that there is a and that amniocentesis is a fairly safe procedure?⁸ Thirdly, is 1% risk of chromosomal abnormalities in fetuses with a low risk it justified to abort fetuses with chromosome abnormalities that do not cause very severe congenital malformations or mental retardation?

Our present definition of risk groups may not be correct. But larger series must be investigated, and further discussion and explanation of the problems are needed before decisions are made to enlarge the prophylactic programmes for preventing chromosomal diseases.

This paper was supported in part by the Danish Medical Research Council.

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(Accepted 24 August 1977)

Primary excision of brain abscess

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British Medical Journal, 1977, **2**, 1119-1121

Summary

Sixteen consecutive patients with brain abscess, including two with multilocular and two with infratentorial abscesses, were treated by primary total excision of the abscess. The patients were followed for six months to three years. Only one patient died and there were no recurrences.

Immediate primary excision is therefore the treatment of choice in brain abscess.

Introduction

In 1928 Sargent¹ was the first to advocate total extirpation of brain abscesses without drainage. In 1946 Sachs² reviewed a series of 142 cases of brain abscess and concluded that "excision without drainage is the ideal procedure." Then and later total excision has been recommended by several workers,³⁻⁸ and

the feasibility of primary surgical removal, with an attendant reduction in both mortality and morbidity, has been clearly shown.⁵⁻¹⁰ It is now clear that the mortality of brain abscess relates to its space-occupying effect,^{6, 8, 11} which is caused by both the lesion and its surrounding brain oedema. The extent of the oedema is often disproportionate to the size of the abscess and oedema may be great when the abscess is small. This, we believe, explains the inadequacy of aspiration in preventing death from acute compression of the brain stem. Furthermore, repeated aspiration often does not bring about improvement before excision, especially with an acute lesion, and aspiration or drainage may miss some loculi in multilocular abscesses. Many patients treated by aspiration will improve clinically, although the abscess continues to expand.¹² Because the oedema is partly inflammatory, a direct and more radical approach is necessary, not only to avert immediate disaster but also as the most effective way of eliminating recurrences.

Although primary excision of brain abscess has been shown to be an improvement over other methods, it does not yet enjoy wide acceptance, and hence this communication reports our favourable experiences of primary excision of brain abscesses in 16 consecutive patients.

Patients and methods

Since the implementation of primary excision of brain abscess by the senior author (JCT) in this unit, 16 patients, including two with

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multilocular abscesses, have been admitted and treated under his care over the past three years. All were operated upon by JCT or ARC. There were 11 males and five females with a mean age of 43 years, the youngest being nine and the oldest 66. The patients' level of consciousness, the site of their abscesses, and the neuroradiological studies for localisation are shown in tables I-III. In all except two patients the brain abscess was diagnosed before operation. In two cases neoplasm was diagnosed before operation and the true nature of the lesion discovered only at craniotomy.

In the earlier cases the abscess was aspirated once through a burr-hole and the pus replaced with Steripaque and antibiotic. After skull radiographs had been taken to show the abscess, craniotomy was performed within 24 hours and the abscess capsule totally excised. Since the EMI scanner has been available it has been our policy to omit the burrhole aspiration and proceed directly with craniotomy and total excision as a matter of urgency. After initial evacuation of pus to collapse the abscess, we have always found it possible to dissect out the capsule completely, even when complex and multilocular. Separation from surrounding brain tissue was not difficult. The capsule was thick and well-formed in all patients presenting seven days or longer after the onset of symptoms. In only two patients was the capsule ill defined or absent, and both of these came to surgery within three days of the onset of symptoms. Both did well with primary excision of the abscess including surrounding necrotic brain. When the responsible organisms and their sensitivities were known the appropriate antibiotic was used. When they were not known penicillin in large doses was used parentally and also instilled directly into the cavity. The craniotomy (craniectomy for abscesses of the posterior fossa) was closed and no drainage of any kind was used. Antibiotic treatment was continued for three weeks. It was changed, if necessary, when the results of bacteriological study were obtained (table IV).

TABLE I—Clinical status according to level of consciousness in 16 patients with brain abscesses

Clinical status	Level of consciousness	No of patients
Grade 1	Alert and rational	2*
Grade 2	Responds to verbal commands but may be confused	7
Grade 3	Responds to pain but not to voice; response may be purposeful or decerebrate	6
Grade 4	Unresponsive to pain	1

*Abscess was found at time of craniotomy for presumed neoplasm in both cases.

TABLE II—Source and site of 16 brain abscesses

Source of infection	Site	No of patients
Middle ear	Temporal lobe	5
	Cerebellum	2
Paranasal sinuses	Frontal lobe	4
	Parietal lobe	1
Trauma	Temporal lobe	1
Unknown	Frontal lobe	2
	Parietal lobe	1

TABLE III—Neuroradiological studies in 16 brain abscesses

Investigation	Isotope scan	Arteriogram	Pyrogram	Ventriculogram	EMI scan
No of abscesses	16*	6	6	1	2

*One cerebellar abscess was operated on after isotope scan alone.

TABLE IV—Results of bacteriological study of 16 brain abscesses

Organism	No of abscesses
Anaerobic streptococci	4
α -haemolytic streptococci	2
Non-haemolytic streptococci	1
Microaerophilic streptococci	1
<i>Staphylococcus aureus</i> (coagulase-positive)	2
Non-haemolytic streptococci and <i>Proteus mirabilis</i>	1
Anaerobic streptococci and <i>Bacteroides</i> spp	2
No growth	3

In cases of mixed infections, appropriate combinations of drugs were administered, and the antibiotics were given in double the usual doses for gas-containing abscesses. The intrathecal route was used only in cases complicated by severe ventriculitis and meningitis.

Treatment of the site of the primary infection—for example, mastoid or sinus—was carried out as soon as the patient was out of danger, unless it had already been treated.

One patient, a girl of 16, developed a second abscess after excision of a right frontal abscess. The second abscess was in the right parietal lobe and was quite discrete from the first. This was also excised satisfactorily only to be followed by a further illness three weeks later, which was shown to be caused by a communicating hydrocephalus. After insertion of a ventriculoatrial shunt she made a complete recovery and remained well two years later.

Results

All the survivors were followed for six months to three years. The results of the operation were assessed clinically by considering the patient's capacity to work and the residual disability. Patients were described as having good to excellent results only if they returned to their previous employment with minimal or no neurological deficit and were leading a normal family life. This was achieved in 11 of the 13 survivors. Fair results were achieved in two patients who, although they returned to work, worked with some restriction because of parietic disability in one and ataxia from a cerebellar abscess in the other. There were no poor results.

Mortality—One patient (6%) died soon after surgery in circumstances that were somewhat unusual and directly related to the original condition. He was a 33-year-old man who was in grade 1 before operation—alert and rational. The abscess, which was left post-frontal, parasagittal, presumably blood born, but from a source never detected, was not diagnosed preoperatively but only at craniotomy. There were difficulties with organism culture and identification and it was seven days before it was established that *Bacteroides* spp were principally responsible and the sensitivity known. On the fourth day after operation the patient's condition deteriorated and he died two days later. Necropsy showed tentorial and cerebellar pressure cones associated with the development of two other abscesses adjacent to the site of the previous one. There was thus a complete lack of control of infection because of delayed culture and identification of the *Bacteroides* and consequent inappropriate antibiotic treatment. There were two late deaths. Necropsy confirmed that they were unrelated to the abscess or its excision. One was due to myocardial infarction and occurred six weeks after operation and the other was caused by a ruptured abdominal aortic aneurysm four months later.

Morbidity—Postoperative disorders were few, and all were a direct sequel of the preoperative state. One patient who was initially hemiplegic remained hemiparetic; one patient with a cerebellar abscess remained ataxic; and of three patients who presented with epilepsy all have been controlled since. So far there has been only one case of epilepsy in the group. All other patients recovered fully from their neurological deficits. There was no late case of abscess recurrence.

Discussion

Although recognised as a surgically curable form of intracranial suppurative disease since Macewen's¹³ initial report in 1893, brain abscess persists as a serious diagnostic problem and therapeutic challenge. Despite the introduction of antibiotic treatment,^{4 7 12 14-16} the mortality rate has continued to range between 30 and 60%.^{6 7 10 11 15 17 18} This distressingly high mortality, despite recent advances in diagnostic and neurosurgical techniques, has consistently taxed the judgment and the technical skill of clinicians managing this disease.

The mortality of brain abscess now relates to its space-occupying effect^{6 11 19 20} rather than to the spread of infection by contamination from the abscess to adjacent brain. The introduction of antibiotics prevents such contamination and allows this lesion to be approached as an expanding, space-occupying, intracranial lesion. Thus, the expanding lesion should be curable by excision. The evolution of surgical treatment has been well reviewed by King and Turney,²¹ who came to the conclusion in 1954 that "the choice of operative attack upon most brain abscesses by most neurosurgeons is that of complete removal." With the

aid of antibiotics, radical removal of the abscess has become reasonably safe and is now the treatment of choice.^{1-8 19 20 22}

In 1969 Garfield,¹⁵ in reviewing 200 cases over 20 years, stated that the mortality rate of 40% was due to continuing inaccurate localisation of the abscess and inadequate use of antibiotics. He believed, also, that the results of assiduously repeated aspiration compared favourably with those of late excision. Localisation is no longer a problem because of the advances in neuroradiological techniques. Adequate antibiotic treatment is, of course, essential to control spread of contamination from the abscess. But we do not agree that the results of assiduously repeated aspiration compare favourably with those of later excision. Time and again it has been observed that aspiration does not always lead to improvement before excision, especially in acute cases. In chronic cases also sudden deterioration may occur after aspiration or ill-advised spinal tap, and the patient may be saved only by immediate excision.²⁰

It is generally believed that there is a close relation between mortality and depth of unconsciousness. In our group, the only death occurred in a patient who was alert (grade 1) on clinical presentation.

The incidence of epilepsy cannot be accurately estimated in this series because of the limited follow-up since epilepsy may develop several years after operation.¹² It was a presenting feature in three cases, and only one of the patients followed up has so far developed epilepsy; this constitutes 10% of the survivors with supratentorial abscesses—a very low incidence compared with that in other series.^{9 12 16} No relation was found between the severity of the neurological deficit and the development of epilepsy, and the patient who developed epilepsy was not taking prophylactic anticonvulsant medication. This type of treatment may be a factor and aspiration may be associated with higher incidence of seizures.²³

It has often been argued that total excision before encapsulation would lead to more severe neurological deficit than would repeated aspiration combined with massive antibiotic treatment and delayed excision if required.^{16 23} Our experience, like that of Ballantine and Shealy,⁶ has been that primary excision causes little or no postoperative deficit. Ballantine and Shealy⁶ found that eight out of nine patients had no postoperative deficit after primary excision of the brain abscess and the other improved over his preoperative status. Out of nine patients who had excision secondary to aspiration or evacuation, eight, although improved, had residual deficits and one patient was essentially unimproved neurologically. None of our patients became totally disabled because of paralysis. Neurological deficit when present

disappeared completely in all except two patients, who were left with hemiparesis in one case and cerebellar ataxia in the other. Visual field defects and speech disturbance also cleared up post-operatively.

In our hands primary excision has produced results so clearly superior to those from burrhole aspiration that we urge this method be adopted as the treatment of choice. It provides prompt internal decompression, permits careful inspection of the abscess cavity for daughter abscesses and allows their removal, and greatly shortens the length of the illness and need for hospital treatment. Most important, it greatly reduces both mortality and morbidity.

We thank Miss Barbara Tustin Smith for her help in preparing and typing the manuscript.

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(Accepted 24 August 1977)

Noxythiolin-resistant organisms in a district general hospital

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British Medical Journal, 1977, **2**, 1121-1122

Summary

Twelve strains of *Pseudomonas aeruginosa*, three strains of *Klebsiella aerogenes*, and two strains of *Escherichia coli* were found to be resistant to noxythiolin. Some of the pseudomonads were isolated from patients in the same ward, not all of whom were on noxythiolin treat-

ment. The strains from these patients were indistinguishable from each other on phage typing, which suggested cross-contamination. No Gram-positive organism was found to be resistant to noxythiolin.

Noxythiolin should not be used before a disc diffusion sensitivity test has been performed to determine whether the organisms are sensitive to it. This is particularly important when pseudomonads are the offending organisms.

Introduction

Noxythiolin (N-hydroxymethyl-N-methylthioarea) decomposes in solution and works by liberating formaldehyde.¹ It has a

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