OTOGENIC BRAIN ABSCESS

A STUDY OF EIGHTY CASES

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ALTHOUGH otogenic brain abscess is uncommon, its presence constitutes a threat to life. As opportunities of encountering and managing this type of case are less than formerly, a general review has been made of such patients admitted to the Regional Neurosurgical Unit at Killearn Hospital, near Glasgow, during the 10 years 1953-62.

Statistics

The basic statistics are shown in Table I, and within themselves there is nothing atypical in the figures. Three of the temporal lobe abscesses and one cerebellar abscess were not demonstrated until post mortem.

TABLE I.

BASIC STATISTICS OF PATIENTS UNDER REVIEW.

Site of Abscess	No.	Sex		Underlying otitis		Side		Mortality	
		M.	F.	ASOM	CSOM	R.	L.	No.	%
Temporal	52	41	11	2	50	29	23	12	23
Cerebellar	25	20	5	—	25	9	16	9	36
Subdural	3	2	1	—	3	3	—	1	33
Total	80	63	17	2	78	41	39	22	27·5

The distribution and mortality by age group of the temporal and cerebellar abscesses are shown in Fig. 1. The youngest patient was 7 years, and the oldest 68. Two of the subdural abscesses were in the fifth decade, and one in the fourth.

There has been no appreciable diminution in the number of annual admissions, 40 patients being admitted in the first 5 years (with 12 deaths) and 40 in the second 5 years (ten deaths).

* This investigation was carried out while the author was on the staff of the Department of Otolaryngology, Western Infirmary, Glasgow.

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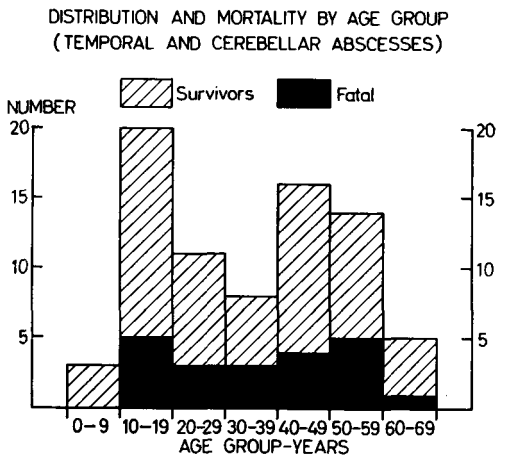


FIG. 1.
Distribution and mortality by age group (temporal and cerebellar abscesses).

Clinical Features

The duration of symptoms prior to the diagnosis of abscess ranged from 5 days to 4 months with an average of 20 days in temporal and 17 days in cerebellar abscesses. In all three subdural abscesses prior symptomatology was less than a week.

The main features at admission are shown in Table II. In 33 (41 per cent. of total) the ear condition was an acute exacerbation of chronic suppurative otitis media.

TABLE II.

OTOGENIC BRAIN ABSCESS—FEATURES AT ADMISSION.

	Temporal	Cerebellar	Subdural
Total	.. 52 (100%)	25 (100%)	3 (100%)
Headache	.. 43 (83%)	22 (88%)	3 (100%)
Diminished consciousness	.. 42 (81%)	17 (68%)	3 (100%)
Pyrexia	.. 28 (54%)	12 (48%)	3 (100%)
Neck stiffness	.. 30 (58%)	16 (64%)	3 (100%)
Papillœdema	.. 22 (42%)	9 (36%)	2 (67%)
Localizing signs	.. 43 (83%)	21 (84%)	3 (100%)

Ten patients were unconscious at admission, but all had previously complained of headache. Headache is thus the outstanding symptom, being present in 97·5 per cent. of the total. (It is not reported in two patients with temporal lobe abscess.) Vomiting occurred in 37 (46 per cent.) of cases.

The prognostic significance of the state of consciousness at the time of admission is illustrated in Table III.

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TABLE III.

RELATIONSHIP OF THE CONSCIOUSNESS LEVEL AT ADMISSION AND THE MORTALITY RATE

Cerebration	Number	Fatal
Normal	18	2 (11%)
Diminished ..	52	15 (29%)
Unconscious ..	10	5 (50%)

Neck stiffness was present in 16 (73 per cent.) of fatal cases, as opposed to 33 (57 per cent.) of survivors. Papillœdema was also relatively more common among the fatal cases (12 or 55 per cent.), than among the survivors (21 or 36 per cent.).

As regards localizing features, contralateral motor defects were present in 31 (60 per cent.) of temporal abscesses, homonymous field defects in 57 per cent., and nominal aphasia in 65 per cent. of left-sided lesions. Among cerebellar abscesses, nystagmus was present in 18 (72 per cent.), consistently to the affected side, and hypotonia or inco-ordination was elicited in 16 (64 per cent.).

The subdural abscesses all had contralateral hemiplegia, which was preceded by fits in one, and all had nominal aphasia; visual field defects were present in two. Occasionally subdural abscess causes ipsilateral hemiplegia due to the brain stem being forced against the opposite side of the tentorium with the interruption of the contralateral pyramidal impulses at mid-brain level.

In eight patients (six temporal and two cerebellar abscesses) frank meningitis was present before the brain abscess was demonstrated. In each case ventriculography performed during the meningitis, and at least 6 days prior to the subsequent demonstration of brain abscess, was normal. Seven of those eight patients survived.

The prognosis appears much less favourable when meningitis develops in the presence of a brain abscess, and it is then likely to be the result of leakage of the abscess into the ventricular system or into the subarachnoid space. The exact number with secondary meningitis cannot be stated as lumbar puncture was not routinely performed when the presence of abscess seemed likely, and neck stiffness may also be induced by tentorial or cerebellar coning. However, meningitis was proved by lumbar puncture in seven with temporal lobe abscess, and demonstrated at post mortem in two others, and six of those nine patients died. Similarly, three out of five patients with cerebellar abscess and meningitis died.

As regards the remaining findings obtained at lumbar puncture, fluid of normal pressure and constituency was present in one patient with a small cerebellar abscess, but in all others the pressure, the protein level and the cell content were raised. (The highest cell count was 315/mm.^{3}

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and the highest protein level was 130 mg. per cent., while the lymphocyte content ranged from 48-94 per cent.) On the other hand the cerebrospinal fluid obtained at ventriculography was frequently of normal constituency.

Diagnostic Procedures

Ventriculography was performed in 28 patients with temporal lobe abscess, with positive findings in 24. Carotid angiography was positive in a further six. Electroencephalography was performed on eight of the remaining 18, with positive localizing features in five and diffuse abnormalities in three. Ten temporal lobe abscesses were aspirated on the basis of clinical examination only.

Ventriculography was performed on 20 cerebellar abscesses with positive findings in 18; five were aspirated on the basis of clinical examination only.

Ventriculography was positive in one subdural abscess, carotid angiography was positive in one, and the third subdural abscess was found at burr-hole exploration.

Straight antero-posterior skull X-ray is always taken and may demonstrate pineal shift.

Opinions vary as to the value of electroencephalography in the localization of supra-tentorial abscess, and it has not been a routine procedure in this series. Schwab and Carter (1942) obtained abnormal readings in 100 per cent. of supra-tentorial abscesses and found it of value in localization in 50 per cent. of those, and Tutton (1953) recommends its use. High voltage slow delta-wave activity in the vicinity of the abscess is the commonest localizing feature.

As regards the patients on whom normal ventriculograms were obtained, in three of the temporal lobe cases small abscesses were demonstrated *post mortem* several days later, and in the fourth, who survived, 20 c.c. of pus were aspirated 4 days after ventriculography. One of the cerebellar cases presented by coning which may have been precipitated by ventriculography performed several hours previously; despite decompression the patient died and a small cerebellar abscess was demonstrated at post mortem. The other cerebellar case coned 5 days after normal ventriculography and decompression was life-saving.

As ventriculography carries the danger of upsetting intracranial pressure relationships and inducing coning, carotid angiography is the procedure of choice in some clinics when temporal lobe abscess is suspected. However, ventriculography is more likely to demonstrate a small abscess situated more posteriorly in the temporal lobe. It must always be remembered that normal findings on contrast radiography do not necessarily exclude the presence of an abscess.

The most easily available diagnostic method will obviously be employed

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when the situation is urgent. For various reasons electroencephalography and carotid angiography have not always been available in cases of suspected temporal lobe abscess; hence the predominance of ventriculography in this series.

Bacteriology

Culture of the abscess pus yielded Gram-positive organisms only in ten cases, and mixed Gram-positive and Gram-negative organisms in 16. Gram-negative organisms only were cultured in 37 cases.

TABLE IV

BACTERIOLOGICAL CULTURE IN BRAIN ABSCESSES

		%
Total cultured ..	76	100
Staph. pyogenes ..	9	12
Strep. pyogenes ..	13	17
Pneumococcus ..	7	9
B. coli	13	17
B. proteus	29	38
P. pyocyaneus	3	4
Sterile	13	17

Treatment

Therapy is generally commenced with systemic penicillin and sulphonamides; practically all cases also received broad spectrum antibiotics as a result of sensitivity tests on the abscess pus.

(*a*) *Treatment of the abscess*

Treatment of the abscess is carried out by the neurosurgeon employing a burr-hole approach through the temporal or occipital bone.

In temporal and cerebellar abscesses the method of primary aspiration with antibiotic instillation has been employed, with secondary excision reserved for selected cases. The instillation of thorium dioxide (Thorotrast) into the abscess cavity enables its extent and progress to be demonstrated by contrast radiography; there is also evidence that thorium dioxide stimulates early capsule formation (Falconer *et al.*, 1943). Repeat aspiration is undertaken where the patient's general and neurological conditions do not improve, or if shrinkage is not demonstrated radiologically, and aspiration may be initially required at daily or alternate daily intervals.

Excision has been reserved for those cases where there is thick capsule formation with pronounced physical signs, and for those in whom there has been a failure of shrinkage after repeated aspiration, a state of affairs which is generally the result of infection in the capsule, or the presence of loculation or associated communicating abscess. Of the 49 temporal lobe abscesses that received treatment, 16 (33 per cent.)

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required excision, and, similarly six (25 per cent.) of cerebellar abscesses were excised. Excision has not been a routine procedure because it inflicts additional brain damage and may induce further neurological defects, and it also carries a small mortality (about 5 per cent.). In some clinics, however, routine primary excision is undertaken, irrespective of the degree of capsule formation, and in an appraisal of this method, Kerr *et al.* (1958) state that it provides prompt internal decompression, the possibility of recurrence due to overlooked daughter abscesses is reduced, and also hospitalization is shortened.

One superficial temporal lobe abscess was treated by drainage through a temporal burr-hole. The subdural abscesses were treated by tube drainage via a burr-hole approach, with the instillation of antibiotics through the tubes.

In the early part of the series three patients required re-admission after apparent cure as a loculus or a small associated abscess had been overlooked. Consequently, it is now the practice to obtain a normal ventriculogram on each patient before discharge.

Where the patient is faced with a long journey to a neurosurgical unit, high intracranial pressure may be lowered by the intravenous administration of 50 ml. of 50 per cent. sucrose or glucose, or by intravenous urea (1 g./kg. as a 30 per cent. solution in 10 per cent. invert sugar). Should a definite improvement in consciousness not manifest within 20 minutes of administration, Pennybacker (1961) advises that a burr-hole should be made in the squamous temporal bone above the ear (or, in cerebellar cases, just below the transverse sinus midway between the mastoid process and the external occipital protuberance), and aspiration attempted through a brain cannula.

(*b*) *Treatment of the primary focus*

As regards the primary focus, antibacterial therapy was curative in both patients with acute otitis media. Mastoidectomy was indicated in the remaining cases in view of the presence of chronic otitis media of the unsafe type.

Generally speaking the mastoid was dealt with once the abscess was under control, but early mastoidectomy was undertaken where an acute exacerbation of chronic otitis media did not subside on antibacterial therapy, and also where an acute (non-capsulated) abscess was not responding to treatment. The time of operation varied from 4 days to 3 months after the treatment of the abscess was commenced. (Formerly, in those instances where early mastoidectomy was not undertaken, the patients were returned for mastoid operation to the hospital that originally referred them, but in order to avoid any delay which might lead to further intracranial infection from the primary focus it is now policy to carry out mastoidectomy before the patient leaves the neurosurgery department

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and as soon as the patient is considered fit to receive a general anæsthetic.)

The extent of the pathology usually warranted radical mastoidectomy, and in one instance Hinsberg labyrinthine drainage was undertaken. Routine exposure of middle and posterior fossa dura enables any unsuspected extradural abscess to be dealt with and also the state of the lateral sinus may be assessed.

Brain Abscess Diagnosed after Aural Surgery

It is inadvisable to undertake aural surgery in the presence of any features suggestive of brain abscess until the likelihood of abscess has been excluded by complete neurological examination. Normal electroencephalographic findings are strong evidence against temporal lobe abscess, but if doubt still exists ventriculography is indicated. When an abscess is demonstrated it requires priority of treatment as it is the potentially killing lesion, and also the administration of a general anæsthetic for the purpose of aural surgery may initiate tentorial or cerebellar coning by further raising intracranial pressure.

In the present series 20 patients (25 per cent. of total) were referred from elsewhere by otologists for the treatment of brain abscess in the period following aural surgery. The patients comprised 13 temporal lobe and seven cerebellar abscesses, and the abscesses were demonstrated between the first and the 85th post-operative day (average 23rd day). The operations included one aural polypectomy and two Hinsberg labyrinthine drainage operations. the remainder being either modified radical or radical mastoidectomies.

Although headache was reported in 19 (95 per cent.) cases, it appears that a neurosurgical opinion was not usually sought until focal signs were present or a diminution in consciousness had occurred. In three instances unconsciousness supervened suddenly, and two others did not recover completely after the general anæsthesia for the purpose of mastoidectomy.

It cannot, of course, be definitely stated that abscess was present in each case at the time of aural surgery as some may have originated in the post-operative period. However, it has been estimated by Grant (1932) and others that it takes about 4 weeks for firm capsule formation to occur, and in 14 cases capsulated abscesses were demonstrated within this period. Three (23 per cent.) of the temporal lobe abscesses manifesting in the post-operative period were fatal, and similarly three (43 per cent.) of the cerebellar abscesses died, as opposed to six (17 per cent.) temporal and five (29 per cent.) cerebellar abscesses where mastoidectomy was performed once the abscess was controlled. As the fatal cases all died within 4 weeks of aural surgery, and well-formed abscess capsules were demonstrated in each, it seems likely that those abscesses were present at the time of the ear operation. Those patients with abscesses demon-

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strated for the first time after the fourth post-operative week all survived, and as some of these abscesses probably originated in the post-operative period, the mortality rates where aural surgery had been performed in the presence of brain abscess may be higher than stated.

Cody *et al.* (1964) have recently written at length on this problem of brain abscess manifesting after aural surgery. They reported vertigo (not a prominent feature of the present series) and headache as the commonest pre-operative symptoms.

Pathology

The aural findings, established at operation or autopsy, are shown in Table V. (Details are not available in two fatal temporal lobe cases who died without operation or autopsy.)

TABLE V

THE PRIMARY FOCUS IN OTOGENIC BRAIN ABSCESS

	Lateral sinus thrombosis	Tegmen eroded or necrotic	Extradural abscess	Purulent labyrinthitis
Temporal	2 (4%)	38 (76%)	4 (8%)	2 (4%)
Cerebellar	9 (36%)	2 (8%)	3 (12%)	2 (8%)
Subdural	—	1 (33%)	—	—

Cholesteatoma was stated to be present in 61 (78 per cent.) cases.

Multiple temporal lobe abscesses were present in five (9·6 per cent. of temporal lobe cases) while a sixth patient developed a contralateral occipital abscess. Multiple cerebellar abscesses were present in five (20 per cent.) cerebellar cases, while a sixth developed an ipsilateral temporal lobe abscess.

All 12 fatal cases with temporal lobe abscesses were males with chronic otitis media, and autopsy was performed in nine, revealing associated pathological lesions in seven (leptomeningitis in five, extradural abscess in two, contralateral occipital abscess in one, numerous temporal abscesses in one). One of the three who died without autopsy had meningitis; thus it can be established that multiple intracranial lesions were present in eight out of ten (80 per cent.) fatal cases. Since the exact number of surviving cases that had meningitis is not known, the percentage of survivors that had multiple intracranial lesions cannot be stated; however, it certainly appears to be much less than 80 per cent. Pressure cone formation was the mechanism of death in eight cases and rupture into the lateral ventricle occurred in the remaining four.

All nine fatal cerebellar cases had chronic otitis media; seven were males. Autopsy was performed in seven, revealing associated pathological lesions in four (leptomeningitis in three, extradural abscess in two,

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numerous cerebellar abscesses in two, lateral sinus thrombosis in one, purulent labyrinthitis in one). One of the two who died without autopsy developed a temporal lobe abscess, and the other was found at mastoidectomy to have lateral sinus thrombosis. Thus multiple intracranial lesions were demonstrated in six out of the nine fatal cases. The presence of lateral sinus thrombosis in seven of the survivors means about half the survivors had multiple intracranial lesions; also lateral sinus thrombosis does not appear to adversely influence the prognosis in cerebellar abscess. Coning was the mechanism of death in six cases, while general toxæmia appeared to be the cause of death in the remaining three.

The fatal subdural abscess case died of myocardial infarct. Empyæma was present and the patient also had unilateral hydronephrosis with renal calculi.

As regards brain abscesses in general, it has been suggested by Levy (1963) that the use of antibacterial drugs and also improvements in the standards of living have been associated with an increase in the proportion of cases of multiple abscess formation of poor prognosis. As far as otogenic brain abscesses are concerned, the findings in the present series show that the mortality rate of cases of multiple abscess formation is certainly greater than that of cases with single abscess; however, the incidence of multiple abscess formation, 12 cases or 15·4 per cent., is not dissimilar from the 11·9 per cent. recorded in the pre-sulphonamide era by Mygind (1921).

Comments

The large number of otogenic brain abscesses treated at Killearn Hospital results from the extensive area served by this unit and also the high incidence of chronic otitis media within certain parts of this area. Thus Lee (1957) reported that the rejection rate due to chronic otitis media among National Service recruits from the Glasgow area was more than double comparable figures from the South of England.

It is of interest that 44 per cent. of patients with temporal or cerebellar abscesses in the present series were under 30 years of age as opposed to the 69 per cent. recorded in an extensive statistical review by Courville and Nielsen (1934). This diminished incidence in the younger age groups is probably a reflection of the efficacy of antibacterial therapy in childhood acute otitis media—not so much by a reduction in the number of abscesses resulting directly from acute otitis media, but by a reduction in the numbers who progress to chronic otitis media and subsequently develop brain abscess. Acute otitis media has never been a common cause of brain abscess, being responsible for less than 20 per cent. of Courville and Neilsen's (1934) series. (Acute otitis media was and still is more liable to give rise to leptomeningitis than to brain abscess.) The fact, however, that there has been no appreciable reduction in the number of annual

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admissions in the present series suggests that the optimum effect of the antibacterial drugs in otitis media may now have been reached. It is noteworthy that Jeanes (1962) likewise recorded no diminution in the incidence of otogenic intracranial suppuration in recent years.

The prognostic significance of the state of consciousness at the time of admission to the neurosurgical unit and also the frequency with which multiple intracranial lesions are demonstrated post mortem, emphasize the importance of the early recognition of otogenic intracranial infection. This can only be ensured by constant vigilance in the management of otitis media; the importance of headache is emphasized, and this symptom always requires full investigation when associated with middle-ear infection.

Two of the fatal cases died shortly after their transfer from Infectious Diseases Hospitals whence they had been initially admitted because of pronounced meningeal signs. The outcome might have been different had they been referred originally to the Neurosurgery Unit for investigation and treatment. An early neurosurgical opinion should be obtained in all cases of suspected or manifest otogenic intracranial infection in order that any abscess formation may be precisely located and the appropriate treatment commenced as soon as possible. The nature of the primary focus will usually demand mastoid exploration, and this should always be undertaken without delay as soon as the patient is considered fit for general anæsthesia.

Summary

Eighty cases of otogenic brain abscess are reviewed. The presenting features, diagnosis, management and pathology are discussed.

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