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Radical mastoidectomy: its place in otitic intracranial complications

BHARATH SINGH, M. MED. (OTOL), TEJPRAKASH JUGPERSHAD MAHARAJ, F.C.S. (OTOL), (DURBAN, SOUTH AFRICA)

Abstract

Standard recommended treatment for patients with intracranial complications from otitis media, has been radical mastoidectomy, whether cholesteatoma is present or not. This was established in the pre-antibiotic era to improve survival. Over a six-year period, from January 1985 to December 1990, 268 patients were admitted with intracranial and extracranial complications of otitis media. The prospective treatment consisted of antibiotics and surgery. Surgery entailed mastoidectomy and drainage of intracranial collections of pus in all patients.

However, prospectively in these patients the ear pathology and not the complication dictated the type of mastoidectomy performed. Cortical mastoidectomy was performed in non-cholesteatomatous ears and radical mastoidectomy in cholesteatomatous ears.

Recurrence of intracranial complications occurred in only four patients (two per cent), a temporal lobe cerebritis in the non-cholesteatomatous ear group, and, a temporal lobe abscess, posterior fossa abscess and subdural empyema in the cholesteatomatous ear group. The temporal lobe cerebritis settled on intravenous antibiotics whilst the temporal lobe abscess, posterior fossa abscess and subdural empyema required redrainage. In none of these was the ear surgery revised.

There were 15 deaths (eight per cent), all occurring in patients with intracranial complications, 12 associated with brain abscess, two with subdural empyema and one with meningitis. Eight were from the non-cholesteatomatous group and seven from the cholesteatomatous group. The mortality was directly related to the patients consciousness level on admission and not to the type of ear pathology.

It can therefore be concluded that radical mastoidectomy is unwarranted in the non-cholesteatomatous ear, even with an otogenic intracranial complication.

Key words: Otitis media, suppurative, complications; Cholesteatoma; Facial paralysis; Meningitis; Brain abscess; Surgery, mastoidectomy

Introduction

According to Wright and Grimaldi (1973), Browning (1984) and also authors of leading textbooks, for example, Scott Brown's Otolaryngology (Ludman, 1987) and *Diseases of the Ear* (Mawson and Ludman, 1979), the standard recommended treatment for otogenic intracranial complications is radical mastoidectomy, whether cholesteatoma is present or not. Without doubt, this was the best form of treatment in the pre-antibiotic era, when mortality from intracranial complications was around 80 per cent. With the advent of antibiotics, especially penicillin and metronidazole, it appears to us that this form of treatment was unnecessarily severe for a non-cholesteatomatous infected ear, bearing in mind that the majority of patients with otogenic intracranial complications are children in whom normal binaural hearing is preferable for learning skills.

The purpose of this study was to determine prospectively whether or not radical mastoidectomy was warranted in patients with non-cholesteatomatous infected ears.

Materials and methods

Over a six-year period from January, 1985 to December, 1990, 268 patients were admitted to King Edward VIII and Wentworth Hospitals, with complications of otitis media. There were 170 males and 98 females. Their ages ranged from 6 months to 72 years, as shown in Figures 1, 2 and 3.

Eighty-seven patients (32 per cent) had extracranial complications, 150 (56 per cent) intracranial complications and 31 (12 per cent) combined intra- and extracranial complications. The various types of intracranial, extracranial, and combined intra- and extracranial complications are displayed in Figures 4 and 5, and Table I respectively.

The symptomatology in patients with intracranial complications (and combined intracranial and extracranial

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TABLE I
COMBINED INTRA- AND EXTRACRANIAL COMPLICATIONS

Extracranial complications	Intracranial complications							Cholesteatomatous ears
	MEN	MFA	PFA	SDE	EDE	LST	Total	
Postauricular abscess	1	3	4		7	13	28	17
Facial palsy		1	1				2	
Labyrinthitis						1	1	1
Total							31	18

MEN = meningitis; MFA = middle fossa abscess; PFA = posterior fossa abscess; SDE = subdural empyema; EDE = extradural empyema; LST = lateral sinus thrombosis.

complications) ranged from pyrexia to meningism, hemiparesis, cranial nerve palsies and alteration in level of consciousness. One hundred and seventeen were admitted fully conscious, 28 drowsy, 33 stuporous and three were comatosed.

The initial treatment consisted of intravenous ampicillin 30 mg/kg/day and metronidazole 20 mg/kg/day in patients with extracranial complications and penicillin 30 mg/kg/day, chloramphenicol 30 mg/kg/day and metronidazole 20 mg/kg/day in patients with intracranial complications and combined intra- and extracranial complications.

Exploratory mastoidectomy was performed on all patients within 24 hours of admission, although in the majority it was performed within 12 hours. In the cholesteatomatous ear, 143 (53 per cent), a modified radical mastoidectomy was performed and in the non-cholesteatomatous ear, 125 (47 per cent), a cortical mastoidectomy was performed.

The intracranial collection of pus in patients with brain abscess (84) and subdural empyema (27) were evacuated by the neurosurgical service within 12 hours of admission. In *all* patients with intracranial complications the ear surgery and the neurosurgical procedure were performed under the same anaesthesia, the neurosurgical procedure always preceding the ear surgery.

Extracranial complications

Postauricular abscess

There were 65 patients (75 per cent) out of 87 patients in the extracranial complication group with postauricular abscess, 32 (49 per cent) having cholesteatomatous ears and 33 (51 per cent) non-cholesteatomatous ears.

Surprisingly in the intracranial complication group (150 patients) only 28 patients (15 per cent) had postauricular abscess, implying that, in a large percentage of patients, otitis media as a source of the intracranial sepsis can be missed if the ears are not examined.

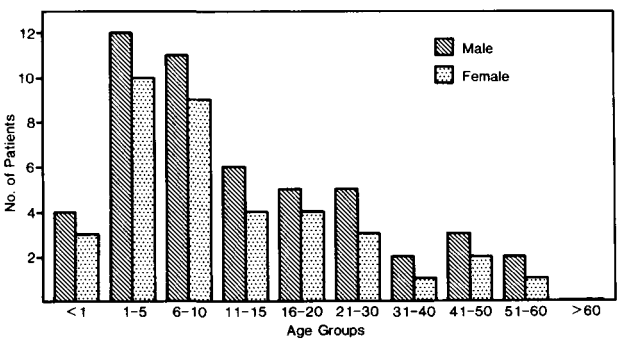

FIG. 1
Extracranial complications: age and sex distribution.

Facial palsy

There were 15 patients (six per cent) with facial palsy, 13 in the extracranial complication group (87 patients) and two in the combined intra- and extracranial complication group (31 patients).

Cholesteatoma was found in two patients and leukaemic deposits in one; all three belonged to the extracranial complication group. The nerve was exposed by the disease process in two patients. In none was the nerve formally explored nor decompressed. Complete recovery occurred in all patients.

Petrous apicitis

There were two patients (0.7 per cent) with petrous apicitis in the extracranial complication group (87 patients). Both were associated with non-cholesteatomatous ears. Complete recovery occurred with intravenous antibiotics and cortical mastoidectomy.

Bezold's abscess

There were five patients (two per cent) with Bezold's abscess in the extracranial complication group. All were associated with non-cholesteatomatous ears. Uneventful recovery occurred with intravenous antibiotics, cortical mastoidectomy and incision and drainage of the neck abscess.

Intracranial complications

There were 181 patients with intracranial complica-

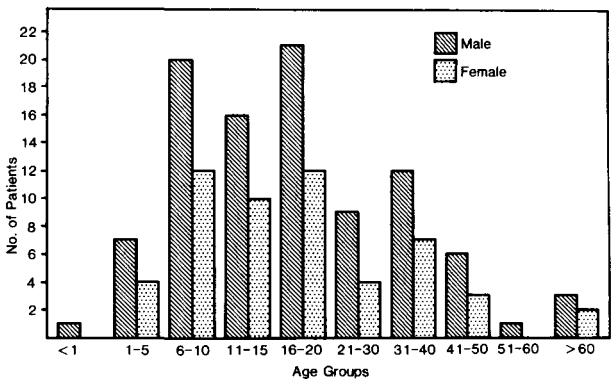

FIG. 2
Intracranial complications: age and sex distribution.

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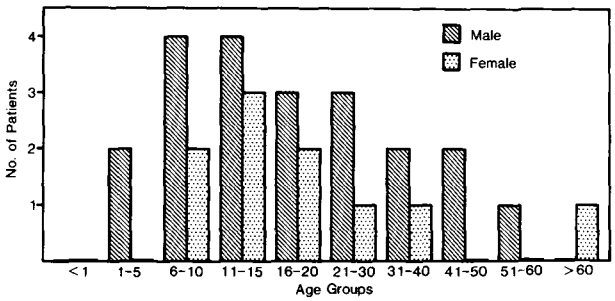

FIG. 3

Combined intra- and extracranial complications: age and sex distribution.

tions, when the 150 patients in the intracranial and the 31 patients in the intra–extracranial group are combined.

Meningitis

There were 22 patients (12 per cent) with meningitis. In two it was associated with extradural empyema, in one with lateral sinus thrombosis, and one with postauricular abscess. Cholesteatoma was found in nine (41 per cent). There was one (4.5 per cent) death.

Brain abscess

There were 93 patients (51 per cent) with brain abscess. Temporal lobe abscesses were found in 46 (49.5 per cent), posterior fossa in 44 (47.3 per cent) and both temporal and posterior fossa in three (3.2 per cent). Cholesteatoma was found in 54 (64 per cent).

There were 12 (13 per cent) deaths, seven with temporal abscess and five with posterior fossa abscess.

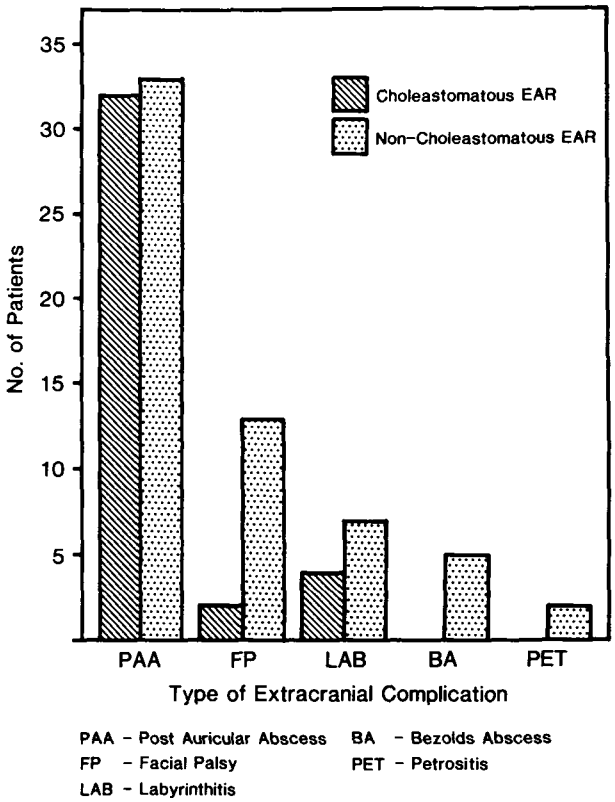

FIG. 4

Extracranial complications.

Subdural empyema

There were 36 patients (20 per cent) with subdural empyema, nine were associated with brain abscess, two with extradural empyema and one with lateral sinus thrombosis. Cholesteatoma was found in 25 (69 per cent). There were two (5.5 per cent) deaths, both belonging to the intracranial complications group.

Extradural empyema

There were 19 patients (10 per cent) with extradural empyema. It was associated with meningitis in two, brain abscess in three, subdural empyema in two, lateral sinus thrombosis in five, and postauricular abscess in seven. All were diagnosed intraoperatively. Cholesteatoma was found in 11 (58 per cent).

Lateral sinus thrombosis

There were 36 patients (20 per cent) with lateral sinus thrombosis proven at surgery.

Thrombosis was found in 18, thrombosis with associated abscess formation in 11 and actual erosion of the sinus in seven. In one patient it was associated with meningitis, one with subdural empyema, three with brain abscess, five with extradural empyema, and five with cavernous sinus thrombosis (diagnosed clinically). Choles-

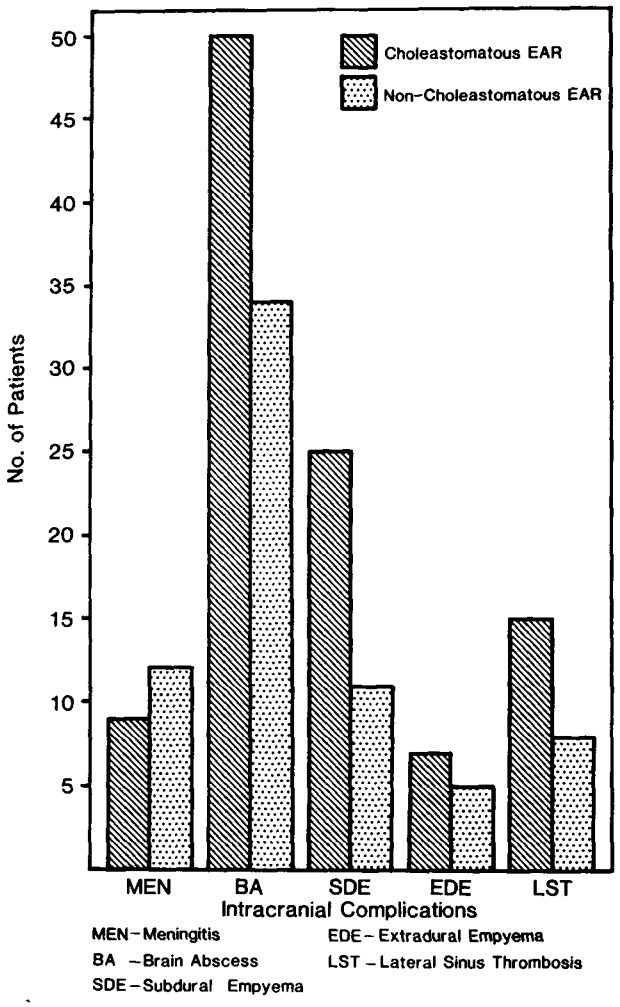

FIG. 5

Intracranial complications.

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TABLE II
MORTALITY

Intracranial complications	Deaths (percentage)	Cholesteatomatous ears	Non-cholesteatomatous ears
Brain abscess	12 (13)	6	6
MFA 7			
PFA 5			
SDE	2 (5.5)	1	2
Meningitis	1 (4.5)		
Total	15 (8)	7	8

MFA = Middle fossa abscess; PFA = posterior fossa abscess; SDE = subdural empyema.

teatoma was found in 19 (53 per cent). Recovery occurred in all with mastoidectomy and combination of antibiotics, ampicillin, metronidazole, chloramphenicol and amikacin.

Ear pathology

In the extracranial complications group, there were 36 patients (41 per cent) with cholesteatomatous ears and 51 (59 per cent) with non-cholesteatomatous ears, in the intracranial complications group there were 89 (59 per cent) with cholesteatomatous ears and 61 (41 per cent) with non-cholesteatomatous ears, and in the combined intra- and extracranial complications group, there were 18 (58 per cent) with cholesteatomatous ears and 13 (42 per cent) with non-cholesteatomatous ears. In all there were 143 patients (53 per cent) with cholesteatomatous ears and 125 (47 per cent) with non-cholesteatomatous ears.

Mortality and morbidity

There were 15 (eight per cent) deaths, all occurring in patients with intracranial complications (Table II). As expected mortality and morbidity were directly related to the level of consciousness on admssion (Table III).

Recurrence

Intracranial recurrences occurred in four patients (two per cent) (Table IV). All occurred within a month of admission. One occurred in a patient with a non-cholesteatomatous ear and three in patients with cholesteatomatous ears.

The patient with temporal lobe cerebritis settled on intravenous antibiotics, whilst those with temporal lobe abscess, posterior fossa abscess and subdural empyema required redrainage procedures. In none was the ear surgery revised.

Over a follow-up period ranging from 23 months to seven years and ten months, there have been no further recurrences of intracranial complications.

TABLE III
MORTALITY AND MORBIDITY IN RELATION TO CONSCIOUSNESS LEVEL

Consciousness level on admission	No. of patients	Deaths (percentage)	Hemiparesis (percentage)
Fully conscious	117	1 (0.9)	
Drowsy	28	2 (7)	1 (3.5)
Stuporous	33	10 (30)	2 (6)
Comatose	3	2 (67)	1 (33)
Total	181	15	4

Discussion

Otitis media can be a very serious disease because of the life-threatening intracranial complications which can be associated with it. In the pre-antibiotic ear, the mortality from such complications was around 80 per cent (Ballantine and White, 1953; Proctor, 1966) and therefore various aggressive treatment modalities, including radical ear surgery with removal of the tegmen tympani and irrigation of the wound with normal saline (Layton *et al.*, 1935) and also removal of tegmen tympani right up to the eustachian tube (Ruttin, 1934), were undertaken to improve survival, but without success. With the advent of antibiotics, survival improved. Initially with sulphonamides the survival rate improved to 50 per cent and later, with penicillin, it increased to 80 per cent. House (1946) reported an improved survival rate from 10.6 per cent to 85.7 per cent in patients with associated meningitis. In a similar group of patients Watson (1948) and Blohmke and Link (1951) reported an 85 and 88 per cent survival rate, respectively. It would therefore appear that antibiotics and not radical surgery has been the main determinant of improving results. The question then remains – why are we still performing radical mastoidectomy in non-cholesteatomatous ears with intracranial complications? The purpose of this study was to prospectively address the problem and also to evaluate the effect of modern medicine on a disease in a population with an incidence of otogenic intracranial complications, similar to that in the pre-antibiotic era.

The worldwide incidence of otogenic intracranial complications has decreased with only a few isolated case reports in the literature. In South Africa, and more especially in the rural regions of the province of Natal where otitis media is often neglected because of inadequate primary medical services, these complications are very prevalent, as noted in the present series and also by Samuel *et al.* (1986) from the same service.

For unknown reasons, otogenic intracranial complications predominantly occur in males (Kaplan, 1976; Samuel *et al.*, 1986; Habib *et al.*, 1988) and peak in the first and second decades (Samuel *et al.*, 1986; Habib *et al.*, 1988; Mathews and Marus, 1988). This was noted in the present series as well (Figure 2).

As the first and second decades of the child's life are

TABLE IV
INTRACRANIAL RECURRENCES

Type of recurrence	Interval between primary treatment and recurrence	Ear pathology	Treatment of intracranial recurrence
Temporal lobe cerebritis	2 weeks	Non-cholesteatomatous	Intravenous antibiotics
Temporal lobe abscess	3 weeks	Cholesteatomatous	Redrainage and antibiotics
Posterior fossa abscess	2 weeks	Cholesteatomatous	Redrainage and antibiotics
Subdural empyema	2 weeks	Cholesteatomatous	Redrainage and antibiotics

vital in terms of learning, it is essential that hearing preservation surgery be performed, implying that radical mastoidectomy must be avoided at all cost. For this reason a prospective policy was evaluated, *viz.* modified radical mastoidectomy for cholesteatomatous ear and cortical mastoidectomy for non-cholesteatomatous ear.

Meningitis is the most commonly reported otogenic intracranial complication (Kaplan, 1976; Gower *et al.*, 1983; Samuel *et al.*, 1986; Habib *et al.*, 1988; Yaniv and Pocock, 1988). In the present series this was not the case as there was only a 12 per cent incidence. Surprisingly, of the 22 patients with meningitis, only one had any external evidence of ear disease (postauricular abscess) to alert the examiner that otitis media was the source of the intracranial sepsis.

The mortality from meningitis decreased dramatically from 80 per cent in the pre-antibiotic ear (Ballantine and White, 1953) to between 12 and 15 per cent (House, 1946; Watson, 1948; Blohmke and Link, 1951) in the immediate post-antibiotic era. A figure of eight per cent was reported for our service in the period between 1978 and 1983 (Samuel *et al.*, 1986). The 4.5 per cent mortality rate reported in the present series is very low compared to that previously and probably reflects modern antibiotic management.

Otogenic brain abscesses almost always develop in the temporal lobe or the cerebellum, usually in a ratio of 2:1 (Pennybacker, 1961; Bradley *et al.*, 1984). This figure differs from the present series in which there was a 1:1 ratio.

The incidence of brain abscess in the present series was 51 per cent (93), similar to that of Mathews and Marus (1988) i.e. 51 per cent (30) but much higher than that reported previously from this service by Samuel *et al.* (1986) i.e. 23.6 per cent (53).

The mortality from otogenic brain abscess decreased sequentially from 80 per cent in the pre-antibiotic era (1936–1940) to 34 per cent in the immediate post-antibiotic era (1946–1950) (Ballantine and White, 1953), to 25 per cent between 1965 and 1971 (Wolfowitz, 1972), 36 per cent between 1978 and 1983 (Samuel *et al.*, 1986) and finally to 12 per cent between 1980 and 1984 (Mathews and Marus, 1988). The 13 per cent reported in the present series therefore compares favourably with the most recent report by Mathews and Marus (1988).

South Africa seems to have the highest reported incidence of otogenic brain abscess in the world as over the last decade most reports have been from South Africa: Samuel *et al.* (1986) reported 53, Mathews and Marus (1988) 27, and Yaniv and Pocock (1988) four. In the present series once again a very high incidence (93 patients) was noted.

The decrease in mortality in our institution, from 36 per cent as reported by Samuel *et al.* (1986) in the period 1978–1983, to 13 per cent in the present series is due largely to the change in neurological treatment policy. Importantly ear surgery is no longer delayed but routinely carried out immediately after the neurosurgical procedure under the same anaesthesia, and as soon as possible (all within 12 hours). The addition of metronidazole to the antibiotic treatment regimen and earlier referral to the hospital has also been important. The latter is due to the fact that doctors working at the peripheral hospitals have now been trained to recognize the seriousness of this condition, probably, as a result of our intensive continuing medical education rural teaching programmes, and refer the patients earlier to either the ENT or neurosurgical departments.

Subdural empyema is a very rare complication of otitis media. Proctor (1966) reported on three cases in the pre-antibiotic ear but none were described in the early post-antibiotic period. Of the recent reports, six (10 per cent) were reported by Mathews and Marus (1988), and four (14 per cent) by Yaniv and Pocock (1988). The 20 per cent incidence in the present series is slightly higher than these figures.

Subdural empyema is still associated with a significant mortality. Of the three patients reported by Proctor (1966) in the pre-antibiotic era, there was one death (33.3 per cent). Wright and Grimaldi (1973), in the period between 1961 and 1971, reported two cases with one death (50 per cent). More recently Mathews and Marus (1988) reported six cases with one death (16.6 per cent). In the present series, although there was a relatively high incidence of subdural empyema, the mortality rate was very low (5.5 per cent).

Extradural empyema is another rare complication of otitis media and there have been only a few reported cases. Proctor (1966), in the pre-antibiotic period, 1934–1943, reported 17 cases with a mortality of 29 per cent, in the post-antibiotic era, 1953–1962, only one case was reported. Since then, all reported cases, except for the four reported by Habib *et al.* (1988), have been from South Africa. Wolfowitz (1972) reported 11 cases (39 per cent) with one death (nine per cent), Samuel *et al.* (1986) reported 49 (22 per cent) with four per cent mortality and Yaniv and Pocock (1988) reported two (seven per cent), with no deaths. In the present series there were 19 patients (10 per cent), with no deaths.

In South Africa lateral sinus thrombosis is also a very common complication. The majority of the cases reported in the literature in the last decade have been from South Africa. Samuel *et al.* (1986) reported on 39 cases (17.4 per cent), Mathews, (1988) 22 cases (37 per cent), and Yaniv and Pocock (1988) six cases (21 per cent). The 36 patients (20 per cent), reported in the present series, are similar to those reported by Samuel *et al.* (1986) and Yaniv and Pocock (1988). Lateral sinus thrombosis is a very serious complication of otitis media as there have been reports of deaths in all large series. Rosenwasser (1945) reviewed 100 cases and reported a mortality of 27 per cent. Similarly Seid and Sellars (1973) reported a mortality of 23 per cent; Wolfowitz (1972) 18 per cent, Teichgraeber *et al.* (1982) 17.6 per cent; Samuel *et al.* (1986) 10 per cent and Mathews and Marus (1988) nine per cent. In the present series there were no deaths.

The overall mortality from intracranial complications was eight per cent. This is significantly lower than that reported by Samuel *et al.* (1986) 14 per cent, Habib *et al.* (1988) 17 per cent and Mathews and Marus (1988) 13.5 per cent.

Although mortality is highest in patients with brain abscess, the prognosis is ultimately dependent on the level of consciousness of the patients on admission. The highest mortality occurred in stuporous and comatose patients (Table III), as observed in the present series, and also by Wolfowitz (1972) and Bradley *et al.* (1984). The main reasons for the decrease in mortality in our hospital from 14 per cent, as reported by Samuel *et al.* (1986) in the period 1978–1983, to eight per cent as reported here is due

to the change in management policy and earlier referral to hospital. The change in treatment policy with regard to ear surgery in our service from radical mastoidectomy for all patients with otogenic intracranial complications (Samuel *et al.*, 1986) to cortical mastoidectomy for non-cholesteatomatous ears and modified radical mastoidectomy for cholesteatomatous ears, as undertaken in the present study, has not, in any way, increased the mortality. In fact, if anything, it has resulted in lowered mortality, when compared with the Samuel *et al.* (1986) series and another recently published large series by Mathews and Marus (1988).

Intracranial complication recurrences have not been reported in the literature. In the present large series, there were only four recurrences, all occurring in the immediate post-operative period. One occurred in a patient with a non-cholesteatomatous ear and settled on intravenous antibiotics. The others were found in patients with cholesteatomatous ears, all of which settled on redrainage of the intracranial collection of pus and antibiotic therapy. In none of the patients was the ear surgery revised, implying either that incomplete excision of ear disease is not the cause of recurrence, or that if the residual ear disease is the cause, it can be completely eradicated by prolonged intravenous antibiotics and there is no need for revision surgery. Since there was only one intracranial recurrence in the non-cholesteatomatous ear group, which settled on intravenous antibiotics only, it can be concluded that radical mastoidectomy is unwarranted in the non-cholesteatomatous ear with otogenic intracranial complication.

Conclusions

The mortality from otogenic intracranial complications has decreased markedly from the pre-antibiotic era to the present time. This is due mainly to early detection and intervention with appropriate antibiotics and appropriate neurosurgical and otological surgical procedures.

Therefore to perform radical mastoidectomy in all patients with otogenic intracranial complications to improve survival is totally unnecessary, bearing in mind that the majority of patients are children in the first and second decades, to whom normal hearing is absolutely necessary for their learning skills. The ear surgery pathology must be dealt with on its own merit, radical mastoidectomy for cholesteatomatous ears and cortical mastoidectomy for non-cholesteatomatous ears.

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Address for correspondence:
B. Singh,
Department of Otorhinolaryngology,
Faculty of Medicine,
University of Natal,
PO Box 17039,
Congella 4013,
South Africa.