

Extracranial and intracranial complications of suppurative otitis media. report of 102 cases

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Abstract

During the eight-year period, 1983–1990, 102 cases of intracranial (IC) and extracranial (EC) complications from 17 144 suppurative otitis media were reviewed. The prevalence of each complication was 0.24 and 0.45 per cent respectively. Facial paralysis, subperiosteal abscess and labyrinthitis were the common complications among the EC group, while meningitis and brain abscess were common in the IC group. Twenty five per cent of the EC group and 44 per cent of the IC group had more than two complications. The reliable warning signs and symptoms for IC complications were fever, headache, earache, vestibular symptoms, meningeal signs and impairment of consciousness. *Proteus spp.*, *Pseudomonas aeruginosa* and *Staphylococcus spp.* were the commonest organisms isolated from both groups. Cholesteatoma and granulation/polyp in the middle ear/mastoid were the major findings in both patient groups. Mortality rate in the IC group was 18.6 per cent. Morbidity rate in each group was 14.3 per cent (EC) and 27.9 per cent (IC) respectively. Epidemiological presentations, clinical features and the result of treatment are discussed.

Key words: Otitis media, suppurative, complications

Introduction

Otitis media is common in Thailand. The advent of antibiotics has clearly changed the management of otitis media. Previously a surgically treated entity, otitis media is now primarily managed medically. Both acute and chronic otitis media are potentially serious diseases because of their complications. In its chronic form, complications are usually caused by progressive and relentless erosion of bone, thus exposing the risk of damage to the facial nerve, the labyrinth and the dura. In the acute form, complications occur earlier, through thrombophlebitis and the anatomically available pathways (Ludman, 1987). Prior to the antibiotic era, intracranial complications occurred in 2.3 per cent of cases (Dawes, 1979). With antibiotics and new surgical techniques, the complications have been greatly reduced to 0.15–0.04 per cent (Janes, 1962; Palva *et al.*, 1985).

Despite an overall decline in the incidence of complications of otitis media severe complications still exist with high mortality. Suggested reasons are decreasing in the physician's experience, changing of virulence and susceptibility of bacteria, and the state of the individual patient (Glasscock and Shambaugh, 1990; Goycoolea and Jung, 1991).

The purpose of this study is to show the prevalence of overall complications of acute and chronic otitis media, warning signs and symptoms, some aspects of causative bacteria and results of treatment.

Materials and methods

From the records of 17 144 suppurative otitis media

patients treated at the Otolaryngology Department of Maharaj Nakorn Chiang Mai Hospital, Thailand, during the eight years from 1983 to 1990, 138 patients were diagnosed as having otitis media with complications. The charts of these patients were reviewed as to their history, clinical findings and investigations; audiological and radiological studies and also culture/sensitivity. Only 102 cases had sufficient data to be included in the study.

Based on popular usage (Goycoolea and Jung, 1991), complications of suppurative otitis media in our study were classified into two major categories; extracranial (EC) and intracranial (IC) complications. EC groups included subperiosteal abscess, labyrinthitis, mastoiditis, facial paralysis, perichondritis. Two patients with pneumonia were also included in this group. Both of them had lateral sinus thrombosis and developed pneumonia during the period of treatment. IC groups included meningitis, peridural abscess, brain abscess, sinus thrombosis and otitic hydrocephalus.

For labyrinthitis, there were two groups of the patients. Acute cases came with otorrhea, hearing loss, vertigo and nystagmus. Chronic cases usually came late with unilateral profused otorrhea and profound hearing loss without any complaint of vertigo.

Results

Prevalence

From 17 144 case records, 102 patients were identified with complications; 77 extracranial (0.45 per cent) and 43

TABLE I
PREVALENCE OF OTITIS MEDIA FROM 1983-1990 (EIGHT YEARS)

	No. of patients	No. of patients with complications
Otitis media cases	17 144 (100%)	102
Acute otitis media	3 196 (18.6%)	10
Chronic otitis media	13 948 (81.4%)	92
EC complications		77* (0.45%)
IC complications		43* (0.24%)

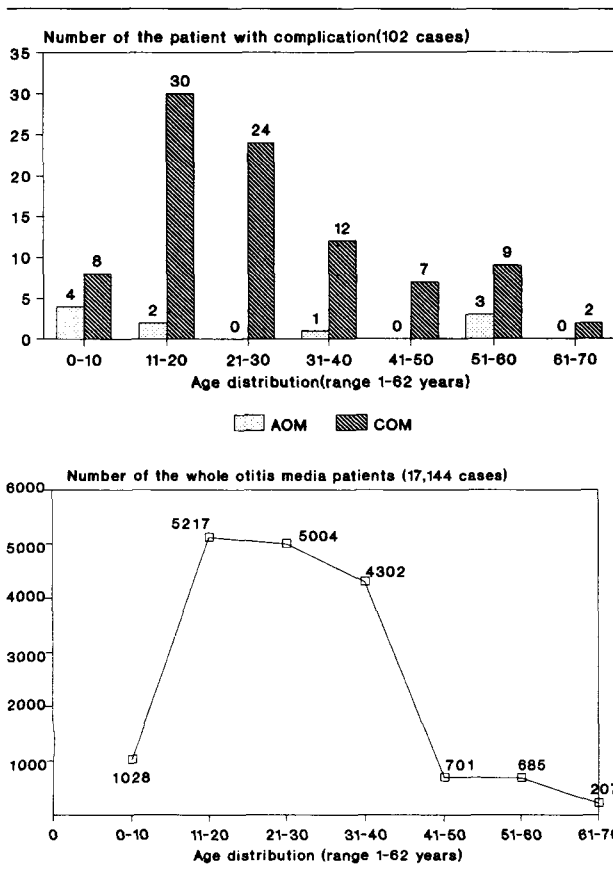
Eighteen patients (0.1 per cent) had both extracranial (EC) and intracranial (IC) complications.

intracranial (0.24 per cent). Acute otitis media (AOM) to chronic otitis media (COM) ratio in the general otitis media group was 1 : 4.5 while it was 1 : 9.2 in the complication groups (Table I). Eighteen out of 102 patients (0.1 per cent) had both extracranial (EC) and intracranial (IC) complications.

The ratio of complications male into female was 3 : 2; it was 2.3 : 2 for all the otological patients. Otitis media with complications and otitis media in general, commonly occurred between the ages of 11 and 20 years. In the complication group the youngest age was 1 year and the oldest 62 years (Table II).

Occupations of the patients included teachers or students (31.4 per cent), agriculturists (33.3 per cent) and others (35.3 per cent). It was found that 75.3 per cent of these patients lived in or close to the city of Chiang Mai.

TABLE II
AGE DISTRIBUTION



Complications

For the EC group (24.7 per cent) and for the IC group (44.2 per cent) had more than one complication (Table III). For the EC group, subperiosteal abscess and fistula were the major co-diseases (32 per cent), while meningitis was the commonest co-disease in the IC group (51 per cent).

Complications found in the 102 cases were: facial paralysis, subperiosteal abscess and labyrinthitis. These were the commonest EC complications with an incidence of 58, 40 and 34 per cent respectively (Table IV). Facial paralysis was complete in 83 per cent of cases and occurred as a result of COM in 91 per cent of cases (AOM 4; COM 41 cases). The majority of them (85 per cent) were related to cholesteatoma.

Meningitis and brain abscess were two commonest complications in the IC group and occurred in 51 and 42 per cent respectively. Of the 18 cases of brain abscess, 10 cases occurred in the temporal lobe and eight cases in the cerebellum. The other complications of the IC group were not uncommon and included lateral sinus thrombosis, extradural abscess and perisinus abscess which occurred in 19, 16 and 12 per cent respectively (Table V).

Clinical signs and symptoms

Duration of otorrhoea (102 cases) was: < 5 years: 40 per cent; 5-10 years: 30 per cent; > 10 years: 30 per cent.

The common clinical signs and symptoms of both groups are demonstrated in Table VI.

Bacterial organisms

Anaerobic bacteria were not included because only five per cent of specimens were specifically cultured.

Of the IC group, culture results from the septic focus were available in 28 out of 42 patients and only 13 cases yielded positive growth on culture. *Proteus spp.* and *Staphylococcus spp.* were the two commonest organisms. Culture of a single organism was more common (86 per cent) than of mixed organisms (Table VII).

Cultures from ear discharge were available in 85 per cent of cases and 91 per cent yielded a positive result. Single bacterial culture was found in 63.5 per cent with *Proteus spp.*, *Pseudomonas spp.*, *Staphylococcus spp.* and *Streptococcus spp.* the four commonest organisms (Table VIII).

Treatment

In all cases treatment was with multiple high dose parenteral antibiotics as follows: penicillin (penicillin G; 10-20 million units/day), aminoglycosides (gentamicin; 4.5 mg/kg/day after a leading dose of about 1.5 mg/kg) and chloramphenicol (100 mg/kg/day) 48-72 hours

TABLE III
NUMBER OF COMPLICATIONS OF THE DISEASE OCCURRING IN EACH PATIENT

No. of disease complications	Extracranial (percentage)	Intracranial (percentage)
1	75.3	55.8
2	22.0	37.2
≥3	2.7	7.0

TABLE IV
EXTRACRANIAL COMPLICATIONS IN 77 PATIENTS (SEVERAL PATIENTS
HAD MORE THAN ONE)

	No. of cases (n = 77)	Percentage
Facial nerve paralysis	45	58
Subperiosteal abscess	31	40
Labyrinthitis	26	34
Post-auricular fistula/scar	14	18
Coalescent mastoiditis	11	14
Pneumonia	2	3
Pinna perichondritis	1	1

before surgical intervention. Metronidazole (400–600 mg; eight-hourly) was reserved for cases of brain abscess because of its penetration into the abscess.

The most common extracranial (EC) complication in our series was facial paralysis (45 cases) found in four AOM and 41 COM cases. Treatment depended upon the cause as follows: (i) In the AOM cases, intravenous ampicillin (0.5–2 g; 4–6 hourly) or the combination of penicillin G and gentamicin as mentioned previously was used in addition to a wide myringotomy, while waiting for culture and sensitivity reports. Serial facial nerve electrical stimulation was also performed. Simple mastoidectomy ($n = 2$) was performed in patients whose local infective process failed to respond after 10 days of medication. We did not decompress the facial nerve when facial nerve paralysis has complicated AOM. (ii) In the COM cases, surgical intervention at the earliest possible moment was carried out. Modified or classic radical mastoidectomy was the procedure of choice in our experience. Urgent facial nerve decompression was carried out in 37 out of 41 cases. Only five per cent of patients in the EC group (two coalescent mastoiditis and one pinna perichondritis) received medication without surgery. The other 95 per cent had radical mastoidectomy, modified radical mastoidectomy or simple mastoidectomy in 65, 10 and 20 per cent respectively.

The pathology in the mastoid cavity and middle ear was cholesteatoma 58 per cent, granulation/polyp 21 per cent and simple perforation of the tympanic membrane with pus 20 per cent.

Treatment in all intracranial complications (IC) included: (a) multiple parenteral antibiotic therapy; (b) intracranial drainage; and (c) treatment of the ear lesion. Multiple intravenous antibiotic therapy was initially given 48–72 hours before intracranial drainage because intracranial infection might take place due to osteothrombo-

TABLE V
INTRACRANIAL COMPLICATIONS IN 43 PATIENTS (SEVERAL PATIENTS
HAD MORE THAN ONE)

	No. of cases (n = 43)	Percentage
Meningitis	22	51
Brain abscess	18	42
Lateral sinus thrombosis	8	19
Extradural/epidural abscess	7	16
Perisinus abscess	5	12
Cerebellitis	2	5
Internal jugular vein thrombosis	2	5
Otic hydrocephalus	2	5
Encephalitis	1	2
Cavernous sinus thrombosis	1	2

phlebitis and extension along a preformed pathway. In this manner the infectious process always spreads widely and is very difficult to control if the temporal bone blood supply is cut by early surgical treatment. Intracranial drainage in temporal lobe and cerebellar abscess was scheduled as soon as the patient's general condition improved to decrease anaesthetic risks (Newland, 1965; Proctor, 1966). The ear surgery, modified or radical mastoidectomy, was performed at the time of IC drainage if the patient's condition permitted it. Generally, it is delayed for about 10–14 days after the IC complication has been controlled.

In the meningitis cases, the most common IC complication, lumbar puncture was repeated carefully several times to reduce IC pressure and to check the state of the infection. Again, multiple parenteral antibiotics were administered before ear surgery until the meningitis was under control (usually 48–72 hours). Modified or radical mastoidectomy was performed in the presence of irreversible pathological changes such as cholesteatoma, granulation and/or polyp. Simple mastoidectomy was performed in the presence of reversible pathological changes such as eardrum perforation, mild to moderate middle ear mucosa swelling, and good aditus drainage. In patients with perisinus abscess and possible lateral sinus thrombosis, aspiration through the sigmoid sinus wall was attempted. If there was no blood, the upper and lower parts of the sigmoid sinus were packed tightly with umbilical tapes before the wall was incised. These tapes were removed on the 4th to 5th day after surgery.

The patients in the IC group were treated surgically by radical mastoidectomy, modified radical mastoidectomy and simple mastoidectomy in 88, 7.2 and 4.8 per cent of cases respectively. The major operative findings in the middle ear and mastoid cavity were cholesteatoma in 73.8 per cent, granulation and/or polyp in 21 per cent and tympanic membrane perforation with pus in 4.8 per cent.

Result of treatment

For the EC group there were two deaths which were not directly related to ear diseases, one from renal failure and

TABLE VI
COMMON CLINICAL SIGNS AND SYMPTOMS IN THE INTRACRANIAL
(IC) AND EXTRACRANIAL (EC) GROUPS

	IC group‡ percentage (n = 43)	EC group‡ percentage (n = 77)
Fever	92	35
Headache	88	30
Meningeal sign	76	17
Diminished consciousness	60	12
Otalgia	44	57
Nausea/vomiting	44	16
Localizing sign	40	3
Post-auricular swelling and/or fistula*	30	56
Papilloedema	24	6
Facial weakness	21	61
Dizziness/vertigo†	16	22
Nystagmus†	12	23

*Subperiosteal abscess and post-auricular fistula.

†The unequal number between dizziness/vertigo/nystagmus and labyrinthitis was explained in **Materials and methods**.

‡Eighteen patients had both EC and IC complications.

TABLE VII
BACTERIAL ORGANISMS ISOLATED FROM THE INTRACRANIAL SPECIMEN IN 13 CASES

Organisms	No. of isolates
<i>Proteus mirabilis</i>	8
<i>Staphylococcus epidimidis</i>	6
<i>Staphylococcus aureus</i>	2
<i>Pseudomonas aeruginosa</i>	4
<i>Gamma-Streptococcus</i>	2
<i>Citrobactor freundii</i>	1

the other from tetanus. Apart from these two patients, there were 11 patients who suffered from the sequelae of the disease, six had complete facial paralysis and five had profound deafness from purulent labyrinthitis. This figure gave a morbidity rate of 14.3 per cent (Table IX). All four facial palsy cases caused by AOM gradually recovered in six to eight weeks after simple mastoidectomy and wide myringotomy were performed. Of the 41 facial palsy cases caused by COM, four died of IC infections (two had lateral sinus thrombosis and two had a brain abscess), five with lateral sinus thrombosis and six with EC complications had permanent facial weakness in spite of facial nerve decompression.

For the IC group, eight patients died; six cases of brain abscess and two of lateral sinus thrombosis, making the mortality rate 18.6 per cent. Morbidity occurred in 12 cases (27.9 per cent). Three out of twelve patients had more than one morbidity (Table IX). Of the 22 meningitis cases only one case caused by AOM had no other IC complications and did not die. The mortality occurred only in COM patients who had meningitis with other IC complications as mentioned in Table IX.

Discussion

In Thailand, the prevalence of suppurative otitis media (AOM and COM) complications was reported from some centres in central and northern parts of the country. In Bangkok, a report from the Ramathibodi Hospital found a prevalence of IC complications of 1.6 per cent (Niphatakosolsuk and Visudhipan, 1974). At the Siriraj Hospital, the total prevalence was 7.6 per cent which 6.6 per cent suffered from EC and 1.0 per cent from IC complications (Siriyanon *et al.*, 1984). In Chiang Mai, Navacharoen *et al.* (1984) reported 1.8 and 0.6 per cent of EC and IC complications respectively. When these are compared with our

TABLE VIII
BACTERIAL ORGANISMS ISOLATED FROM EAR DISCHARGE

Organisms	No. of isolates
<i>Proteus mirabilis</i>	15
<i>Proteus vulgaris</i>	5
<i>Pseudomonas aeruginosa</i>	14
<i>Staphylococcus epidimidis</i>	7
<i>Staphylococcus aureus</i>	5
<i>Streptococcus</i> —beta hemolyticus	4
—gamma sp.	3
—alpha sp.	2
<i>Klebsiella pneumoniae</i>	3
<i>Eschericia coli</i>	3
<i>Providencia stuartii</i>	3
<i>Acenobactor hemolyticus</i>	3
<i>Diphtheroid sp.</i>	2
<i>Enterobactor sp.</i>	1

study which found EC and IC complications of 0.45 and 0.24 per cent, respectively, there has clearly been a decline in the prevalence of these complications.

The decline could be explained in many ways such as an increase in number of otolaryngologists throughout Thailand, and the improvement in the standard of living and quality of life of the people during the past decade. However, when our study is compared with reports from developed countries, the figures are still high. Samuel *et al.* (1986) found 0.13 per cent of EC complications, and Palva *et al.* (1985) found only 0.04 per cent of IC complications.

The age of patients with complications closely paralleled the age distribution of the otitis media patients as a whole. Thus, the common age group of the patients with the complication was between 10 and 20 years as in other reports (Pennybacker *et al.*, 1961; Proctor, 1966).

Facial nerve paralysis was the most common complication (0.26 per cent; 45/174 cases) followed by subperiosteal abscess (0.18 per cent; 31/174 cases). These are lower than for other studies which reported facial paralysis in 0.7–5 per cent (Siriyanon *et al.*, 1984; May, 1986; Savic and Djeric, 1989), and subperiosteal abscess in 2.9–4 per cent (Edison, 1980; Siriyanon *et al.*, 1984). In facial paralysis caused by AOM, the combination of penicillin and gentamicin, serial facial nerve electrical stimulation, wide myringotomy and/or simple mastoidectomy are our treatments of choice. In the facial paralysis caused by COM, urgent radical or modified radical mastoidectomy should be carried out with the facial nerve decompression regardless of whether the paralysis was due to direct extension of cholesteatoma, granulations, or toxic effects upon the nerve itself. Nerve sheath splitting and definitive facial nerve reconstruction such as grafting and anastomosis is postponed until the infection in the mastoid cavity is under control (Ludman, 1987; Goycoolea and Jung, 1991). The recovery rate in our series was 100 per cent (4/4 cases) in AOM, and 70 per cent (26/37 cases) in COM. Compared with the report from Savic and Djeric (1989) who studied 64 patients with facial paralysis, due to COM, treated by facial nerve decompression, the facial

TABLE IX
RESULT OF TREATMENTS

	Mortality rate	Morbidity rate
Extracranial group (77* cases) (facial paralysis 6; profound deafness 5)	—	14.3% (11/77)
Intracranial group (43 cases)	18.6% (8/43)	
Dead	8	
(a) brain abscess	6	
(b) lateral sinus		
(c) thrombosis	2	
Morbidity	12	27.9% (12/43†)
(a) profound deafness	4	
(b) facial paralysis	5	
(c) diplopia	2	
(d) epilepsy	2	
(e) hemiparesis	2	
(f) impaired vision	1	
(g) psychosis	1	

*2/77 cases died of undirected ear disease; 1 renal failure and 1 tetanus.

†3/12 morbidity cases had more than one sequelae.

nerve function recovered completely in 70 per cent. The 4/41 facial paralysis cases caused by COM who died of intracranial infections were not included in this morbidity statistic.

Meningitis was the most frequent intracranial complication (51 per cent). In other studies its incidence varied from 34–77 per cent (Newland, 1965; Andrade and Arroyo, 1977; Jahn and Snell, 1980; Gower and McQuirt, 1983). Neck stiffness was the most important sign of meningitis. The laboratory diagnosis was based on CSF findings and a positive bacterial culture. Due to high occurrence of multiple complications, a CT scan was recommended in every case to exclude other coexisting intracranial complications. We had no mortality in the pure meningitis patients. All eight deaths had multiple intracranial complications (six brain abscess and two lateral sinus thrombosis cases), making meningitis mortality 36 per cent (8/22). Overall meningitis mortality reported in other studies was 10.7 per cent (Bluestone and Klein, 1990).

Brain abscess, the second commonest intracranial complication in our study has a very grave prognosis. Although Stuart *et al.* (1955) reported that it could occur in both AOM and COM, in all of our patients it was caused by COM and cholesteatoma. So a direct extension from the middle ear was considered to be the main mechanism in our patients. Because of our high mortality rate (33 per cent), when compared to other series (20–36 per cent; Stuart *et al.*, 1955; Spires *et al.*, 1985; Samuel *et al.*, 1986), we suggest that extensive investigations and early treatment should be made in every patient who presents with fever, headache and neck stiffness. The priority of neurosurgery and otosurgery is discussed later.

Because multiple complications were high both intracranially (44 per cent) and extracranially (25 per cent), diagnosis may not have been easy. To obtain early diagnosis, the warning signs and symptoms listed in Table VI should be emphasized. Simultaneously, the further investigations such as eye ground examination, careful lumbar puncture, Tobey-Ayer test and CT scan must be made.

Organisms isolated from otorrhea reasonably reflect the aetiological agents of middle ear infection. *Proteus mirabilis*, *Pseudomonas aeruginosa* and *Staphylococcus spp.* were the most recognizable organisms in our study as in other reports (Newland, 1965; Niphatakosolsuk and Visudhipan, 1974; Navacharoen *et al.*, 1984; Mathews and Oliver, 1988; Leelamanit and Kalnouwakul, 1989). However, the increase of *Pseudomonas spp.* and *Staphylococcus spp.* from three to six per cent (Navacharoen *et al.*, 1984) to 17–20 per cent should be stressed since both of them tend to be resistant to common antibiotics and may require different medication.

Multiple parenteral antibiotics as mentioned earlier and hydration therapy for 48–72 hours before any surgical intervention are important to control the infective process and improve the general condition (Glasscock and Shambaugh, 1990; Goycoolea and Jung, 1991). The antibiotic combinations should be prescribed as indicated by the pathological microorganisms listed in Tables VII and VIII. The sophisticated and expensive antibiotics would be dictated by the culture report. Our recommended antibiotics whilst waiting for culture and sensitivity to be carried out are penicillin G (or ampicillin), gentamicin and chloramphenicol as mentioned before.

Simple mastoidectomy or intact canal wall mastoidectomy without tympanoplasty are employed in the presence of reversible pathological changes e.g. mild to moderate middle ear mucosal swelling or granulation, and acute otitis media with good eustachian tube function. Radical or modified radical mastoidectomy should be performed in cases which will prove hard to follow up post-operatively, and also in the presence of suspected irreversible pathological changes e.g. cholesteatoma or severe granulation with poor eustachian tube function.

Our intervals prior to ear surgery during continuing medication were: (A) seven to 10 days after the medical trial failure in the non-life-threatening cases (extracranial complication), and (B) forty-eight to 72 hours in the life-threatening cases (intracranial complication). To reduce surgical time and to avoid anaesthetic risks, intracranial drainage should be done first, and the aural surgery should be scheduled at the earliest safe time during convalescence which is usually several days to several weeks (Myers and Ballantine, 1965). Cholesteatoma and granulation were still our major findings in agreement with other studies reporting 32–96 per cent (Newland, 1965; Andrade and Arroyo, 1977; Navacharoen *et al.*, 1984; Siriyanon *et al.*, 1984). Extensive cholesteatoma, progression of clinical signs and difficulty in obtaining long-term follow-up, led us to perform radical surgery. The decision to expose the sigmoid sinus and dura was made whenever pulsatile pus was draining from a fistula, granulation covered the tegmen tympani, or perisinus disease were found. The details of surgical treatment of the intracranial complications such as, lateral sinus thrombosis, otitic hydrocephalus and brain abscess have been described elsewhere (Glasscock and Shambaugh, 1990; Goycoolea and Jung, 1991).

Mortality in the intracranial complication group decreased from 32.6 per cent (Navacharoen *et al.*, 1984) to 18.6 per cent. This is not a favourable figure when compared to the 14 per cent of Samuel *et al.* (1986) and the 15 per cent of Niphatakosolsuk and Visudhipan (1974) and also current reports from American and European groups (Edison, 1980). The reason for this may be: (i) our series had a higher incidence of brain abscess (42 per cent) than other series (six to 23 per cent) (Gower and McQuirt, 1983; Samuel *et al.*, 1986); (ii) multiple intracranial complications existed in almost 45 per cent (Table III). Our increased intracranial morbidity from 11.6 per cent (Navacharoen *et al.*, 1984) to 27.9 per cent may reflect earlier diagnosis, the availability of various investigations and the improvement in new antibiotics.

Conclusion

Advanced complications of otitis media still occur in spite of the administration of modern antibiotic therapy. Extracranial complications in our series were 1.8 times (77:43) more common than intracranial complications. Many of these patients suffered from multiple complications, and the virulent bacteria that caused these diseases required sophisticated antibiotic therapy. Thus, early diagnosis, based on clinical signs and symptoms, and a series of investigations such as culture and CT scan should be undertaken in every case. In some situations, delay of treatment until investigation is completed may allow the disease to proceed beyond the stage at which recovery is

possible. The priority of treatments such as administration of systemic antibiotics, neurosurgical treatment of the complication and treatment of the ear lesions should be judged by an experienced otologist. It is hoped that this study might give some options and awareness to all otolaryngologists and general practitioners which will result in earlier diagnosis, prompt treatment, and a further reduction in mortality.

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