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OTOLOGY

Intracranial complications of chronic otitis media

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Abstract The objective of this study was to review our experience on intracranial complications (ICC) secondary to chronic otitis media (COM), and to investigate its clinical characteristics and treatment approaches. From January 1996 to December 2012, 17 patients with ICC secondary to COM were identified and included in this study, and were analyzed retrospectively. 13 out of these 17 cases (76.4 %) have cholesteatoma. The most common intracranial complication is brain abscesses (52.9 %), followed by meningitis (29.4 %), perisinus abscess (11.7 %), and epidural abscess (6 %). All patients underwent emergency mastoidectomy within the first 24 h after clear diagnosis. 7 patients underwent brain abscess drainage or abscess excision at the time of ear surgery. The mortality rates are 0 %. No recurrence was found in the 24-month follow-up period. Cholesteatoma was strongly associated with ICC. An early diagnosis and active surgical intervention in collaboration with proper antibiotic treatment is the key to cure.

Keywords Abscess · Cholesteatoma · COM · ICC · Surgery

Introduction

Intracranial complications (ICC) of chronic otitis media (COM) are potentially dangerous or even fatal. With the development of antibiotics and medical technologies, the incidence and mortality has decreased significantly in the current post-antibiotic era. In the developed countries, the incidence rate has dropped to 0.04 % [1], but a mortality rate of 8–26.3 % is still high enough to draw our attention [2]. In developing countries, otogenic intracranial complications still pose a considerable challenge with a high incidence rate [1, 3–6]. In China, COM complicated with ICC is quite frequently seen in hospitals, with a higher incidence rate in the rural population than in the city population. To make things worse, the abuse of antibiotics may change the characteristic disease course leading to increased difficulties in early and definite diagnosis. Moreover, the lack of awareness and knowledge of this disease among clinical practitioners is another cause of misdiagnosis and delayed treatment. In this study, we did a retrospective chart review of 17 patients with ICC secondary to COM, admitted to our department over a 10-year period from January 1996 to December 2012. We studied as well as summarized their clinical characteristics, diagnostic and treatment approaches. Our primary goal is to alert the clinical community that heightened awareness, early diagnosis and timely treatment are crucial for reducing the incidence and mortality of this disease.

Patients and methods

A retrospective chart review was undertaken to analyze the clinical characteristics of 17 patients with ICC secondary to COM. In our country, Ethical approval is not needed for retrospective chart review studies. These 17 patients were admitted into the Otolaryngological-Head and Neck Surgery Department of Anhui Provincial Hospital from Jan 1996 to Dec 2012. They were all from the rural area of Anhui Province, and had been under antibiotics treatment for 7–20 days, 10 days on average, before admission.

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Preadmission treatment was to no avail, some were with aggravated situations. All of the 17 patients had been scheduled for emergency middle ear and head CT scanning immediately after admission, and six of them underwent MRI test of the head.

All patients were given an empirical combined treatment of third-generation cephems and metronidazole on admission. After proper evaluation and preparation, emergent mastoidectomy was performed on all patients within the first 24 h after admission. Neurosurgeons were invited to do intracranial abscess drainage or abscess excision at the time of mastoid surgery. During mastoidectomy, the careful exploration of sigmoid sinus and epidural spaces should be carried out and potential lesions should be removed should there be any. If bony damages were encountered, make sure the infected bone tissues were removed clearly until normal meninges are seen. For sigmoid sinus phlebothrombosis, all the purulent secretions and granulation tissues should be cleared away from the surface of sigmoid sinus. There is no need for incision if no blood could be drawn from the sinus. However, if there are any signs of infection, necrosis, thrombosis, purulence or fistula formation, the sinus wall should be cut open at the upper and lower turnings to remove potential thrombus.

Pus was collected during the operation and was sent for bacterial culture in addition to the bacterial culture of ear discharge and blood. The protocols of antibiotic treatment were adjusted timely according to the results of bacterial culture and drug sensitivity test. A telephone follow-up of all patients was carried out for 17–36 months, with a mean period of 24 months.

Results

A total of 17 patients were identified, 12 male and 5 female. They aged from 12 to 62 years, with a mean age of 32. 10 of the 17 (58.8 %) had CSOM in the left ear, the other 7 (41.2 %) in the right. All reported a positive history of malodorous otorrhea lasting 6 months to 30 years, 5 years in mean. 16 of the 17 (94.1 %) had headache, 11 (64.7 %) had fever, 3 (17.6 %) had neck stiffness, and 2 (11.8 %) were recorded with apathy. Complaint of hearing loss was present in all patients. 2 of 17 (11.8 %) was found with facial palsy.

Of all patients, 13 (76.4 %) had cholesteatoma, and 4 (23.6 %) had granulation tissues in the middle ear. The most common intracranial complication was brain abscess, diagnosed in 9 out of 17 patients (52.9 %), and followed by meningitis in 5 patients (29.4 %), perisinus abscess in 2 patients, and epidural abscess in 1 patient. Of the 13 COM patients with cholesteatoma, 9 (69.2 %) had brain abscess, 2 had perisinus abscess, 1 epidural abscess, and 1 meningitis. The four patients with granulation tissues were all diagnosed with meningitis. Of the patients with brain abscess, five had temporal lobe abscess, four had cerebellar abscess, and five had concomitant meningitis. All the above-mentioned information is listed in Table 1. In the 13 patients with cholesteatoma, both preoperative and intraoperative CT scanning showed cranium damage, six in temporal lobe bone plate, six in sigmoid sinus bone plate, and one in sino-meningo triangle bone plate. Relationships between the intracranial lesions and bone plate damage are demonstrated in Table 2. No bone plate damage was found in the four patients with granulation tissues.

All of the brain abscess, perisinus abscess and epidural abscess were found on the side of the affected ear.

All patients underwent emergency mastoidectomy within the first 24 h after admission. In the meantime, neurosurgeons were invited into the operation team to do brain abscess drainage or abscess excision. 2 patients with immature abscess underwent abscess excision 1 week after admission. As to the two patients with sigmoid perisinus abscess and the one with epidural abscess, pus was removed during mastoid surgery.

Microbiological findings showed that 10 of 17 (58.8 %) bacterial cultures reported positive results. The most commonly isolated organism was *Proteus mirabilis*

Table 1 Summary of intracranial complications

	No. of cholesteatoma (13, 76.4 %)	No. of granulation otitis media (4, 23.6 %)	Total no. (17)
Temporal lobe abscess	5	−0	5 (29.4 %)
Cerebellar abscess	4	−0	4 (23.5 %)
Epidural abscess	1	−0	1 (5.8 %)
Perisinus abscess	2	−0	2 (11.6 %)
Meningitis	1	4	5 (29.4 %)

Table 2 Bone plate damage distribution among patients with cholesteatoma

	Sigmoid sinus bone plate	Temporal lobe bone plate	Sino-meningo-triangle bone plate
Temporal abscess	−0	5	−0
Cerebellar abscess	4	−0	−0
Epidural abscess	−0	−0	1
Perisinus abscess	2	−0	−0
Meningitis	−0	1	−0

(40 %), followed by anaerobes (30 %), *Staphylococcus aureus* (20 %), and *Pseudomonas aeruginosa* (10 %).

No death occurred during and after operation. All of the 17 patients were cured. No recurrence was reported during the 24-month follow-up period.

Discussion

Previous series studies reported that otogenic intracranial complications have a high prevalence rate among young people, especially in the first, second and third decade of life, with a higher rate in male than in female and equal rate at both the left and right side [3]. In our present series, the mean age of the 17 patients was 32, and there are obviously more male patients than female ones. Left side was more frequently involved than the right side. The common clinical symptoms and signs of chronic otitis media include malodorous otorrhea, headache, fever, meningeal irritation signs, and neurological signs attributable to abscess formation [6, 7]. Since all patients had undergone antibiotic treatment for a mean period of 10 days before admission into our department, their symptoms and signs were not as typical as expected. Only three patients had rigid necks, and two were reported with apathy but without evident neurological signs. All patients (100 %) presented malodorous otorrhea, 94.1 % headache, and 64.7 % headache. CT scanning is helpful and reliable for the diagnosis of this disease, with a diagnostic rate of 92.75 % [5]. It is crucial for detecting and locating intracranial abscess and middle ear lesions. MRI has great advantages in the diagnosis of brain abscess, encephalitis, sigmoid sinus phlebothrombosis, and like lesions in soft tissues [8]. In the present series, all of the 17 patients underwent CT scanning, and nine of them were diagnosed with brain abscess by CT scanning alone. MRI scanning found one patient with sigmoid sinus phlebothrombosis and three with meningitis. CT and MRI scanning also played an important role in the process of surgical treatment and postoperative evaluation.

In this study, 9 of 17 (52.9 %) patients had brain abscess, followed by 5 cases of meningitis, 2 cases of perisinus abscess and 1 case of epidural abscess. These findings are comparable to those presented in the previous reports [9, 10]. Otogenic brain abscess is often found in the cerebral tissues adjacent to ipsilateral temporal bone, most commonly in the temporal lobe and then the cerebellum [1]. Single lesion is more common, yet multiple abscesses are not without possibility. In our series, all the intracranial complications except meningitis were found in the cerebral tissues adjacent to ipsilateral temporal bone. Radiological imaging studies found only single lesion in the nine patients with brain abscess, five were in the temporal lobe, four in the cerebellum.

Cholesteatoma is the main cause of intracranial complications in CSOM, and COM with cholesteatoma is strongly associated with brain abscess [4, 10, 11]. Similarly in our study, cholesteatoma was encountered in 13 of 17 patients (76.4 %), and all patients with brain abscess were concurrent with cholesteatoma. Cranium damage and meninges exposure were present in all COM with cholesteatoma patients. Due to its severe invasiveness, cholesteatoma could easily destroy its surrounding bony tissues, amongst which, bone plate of sigmoid sinus (6 cases were invaded in the present series) was most liable to the damage, followed by bone plate of the temporal lobe (6 cases) and bone plate of sino-meningo triangle (1 case). In this study, nine patients with brain abscesses, two with sigmoid perisinus abscess, and one with epidural abscess were concurrent with cholesteatoma as well as cranium damage. The intracranial lesions were close to the damaged bone plate and on its same side (Table 2). Based on the above-mentioned findings, we suggest that the inflammatory process may expand into meningitis and the intracranial tissues by way of damaged bones caused by cholesteatoma, which destroys the surrounding bone tissues enabling the direct contact between the infectious lesion and intracranial tissues.

A variety of pathogens could be attributed to COM, including aerobes, anaerobes, and fungus and so on [4–7, 10]. They could vary from one area to another. According to our report, in 10 out of 17 patients (58.8 %), pus collected from the ear and abscess showed bacterial growth, 40 % of them were *Proteus mirabilis*, 30 % anaerobes, 20 % *Staphylococcus*, and 10 % *Pseudomonas aeruginosa*. Although only 58.8 % of the cultures showed growth of bacteria, it underestimated the positive rate of bacterial culture. This was probably due to the high failure rate of anaerobic culture and the fact that all patients had been undergoing antibiotic treatment on admission. Both the previous reports [4–7, 10] and our present experience suggest that a combination of broad band, blood–brain barrier (BBB) permeable antibiotics such as the third or fourth generation cephems and metronidazole should be administrated in adequate dose before microbiological results were available. Timely adjustment of antibiotic treatment protocols is strongly recommended once bacterial culture and drug sensitivity tests results were obtained.

Early mastoidectomy should be attempted within the first 24 h after admission for the sake of lowering mortality [3, 12]. Timely and active surgical removal of the infectious source in the middle ear, which can help to enhance the sensitivity of antibiotics in combating intracranial abscess as well as reduce the recurrence rate of ICC [13]. But there are also debates regarding the timing of ear surgery for COM cases with intracranial complications. Some authors recommend a two-step surgical approach,

i.e., emergency brain abscess drainage by neurosurgeons followed by a secondary mastoidectomy by otologists [14–16]. In this series, all 17 patients underwent an emergency mastoidectomy within the first 24 h after admission. In two patients with sigmoid perisinus abscess and one patient with epidural abscess, direct removal of the lesions was achieved in the ear surgery alone. For the 7 of 9 patients with brain abscess, neurosurgeons were invited to perform abscess drainage or excision surgery at the time of ear surgery. For the other two patients with immature brain abscess, mastoidectomy was performed alone and brain abscess drainage was undertaken later at right time. No death occurred during and after the operations, and a 100 % cure rate was achieved. There was no recurrence during the follow-up period. We believe that active surgical intervention in both the ear and brain could not only safely remove the infectious source and improve antibiotic sensitivity, but also more efficiently prevent the relapse of infection before a review surgery.

Conclusion

Intracranial complications of COM constitute a wide spectrum of clinical entities, and may still be life-threatening even in developed countries. Cholesteatoma was strongly associated with ICC. Management of patients with ICC secondary to COM is challenging, requiring timely diagnosis, active surgical intervention, and appropriate antibiotic treatment. In cases of COM patients presenting otorrhea, headache and fever, intracranial complications should be highly suspected. Temporal and head CT and MRI scanning are crucial for clear diagnosis. Active simultaneous ear and intracranial surgery is a favorable approach.

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