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Original Research Article

Intracranial and extracranial complications of chronic otitis media and their management at a tertiary care center: a descriptive study

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ABSTRACT

Background: In the pre-antibiotic era complications from otitis media occurred abundantly, accompanied by high morbidity and mortality. With availability of higher antibiotics, morbidity and mortality due to chronic otitis media (COM) has reduced, but still complications due to COM remain a significant problem in developing countries. The aim is to study clinical presentation, management and outcomes of intracranial and extracranial complications of COM. Study design is retrospective case series study.
Methods: Patients admitted in department of otorhinolaryngology and head and neck surgery, S. Nijalingappa medical college and H.S.K hospital and research center, Bagalkot from May 2018 to April 2020 with COM associated with intracranial or extracranial complications were included in the study. Data of clinical presentation, associated complications, management, and follow-up were analyzed.
Results: A total of 20 patients were reviewed during study period. Of these seventeen patients had extracranial (EC) complications, while one had intracranial (IC) complications and two had both. Otalgia, otorrhea and fever were the main presenting symptoms. The encountered IC complication were lateral sinus thrombophlebitis, cerebellar abscess. Among the EC complications most common were post-auricular subperiosteal abscess, lateral semicircular canal fistula and facial paralysis. Most commonly isolated organism was staphylococcus. Surgery was main modality of treatment.
Conclusions: COM is still a significant problem in developing countries in spite of availability of antibiotics and early diagnosis is crucial in the management of complications associated. This study emphasizes the importance of early diagnosis and prompt treatment to limit the morbidity.

Keywords: Chronic otitis media, Extracranial complications, Intracranial complications, Lateral sinus thrombophlebitis

INTRODUCTION

Otitis media is an inflammation of part or all of the mucoperiosteal lining of the tympanomastoid compartment comprising the eustachian tube, the tympanic cavity, the mastoid antrum, and all the pneumatized spaces of temporal bone. Complications of otitis media have been defined as spread of infection beyond the confines of the lining mucosa of the middle-ear cleft. Both acute and chronic otitis media (COM) can cause complications. In the post-antibiotic era majority of complications result from COM, particularly in developing countries due to ignorance, poor literacy and late presentation.[1]

Complications of active COM can be classified as extracranial and intracranial. Extracranial complications denote spread of the infection to the confines of the

temporal bone. Extracranial complications (EC) are post-auricular abscess, facial palsy, petrous apicitis, labyrinthitis. Intracranial complications (IC) are denoted and when the disease spreads beyond the temporal bone to the intracranial cavity. Intracranial complications are meningitis, brain abscess, extradural abscess, subdural abscess, lateral sinus thrombosis and otitic hydrocephalus.

Traditionally ears with squamous epithelial disease have been regarded as being at more risk of serious complications as opposed to those with mucosal disease, but incidence of extracranial and intracranial complications are more commonly seen in in those cases combined with cholesteatoma and granulation tissue.[2]

Both aerobic and anaerobic organisms have been isolated from the cultures of patients of COM. Most common organism usually isolated is *Pseudomonas aeruginosa*. Surgery is the main modality of treatment of chronic otitis media. The aim of this study is to determine the clinical presentation, types and frequency of complications affecting the pediatric and adult population in our institution, the causative organism, and management of complications.

METHODS

A retrospective case series study was done in 20 patients admitted to the department of E.N.T and head and neck surgery, S. Nijalingappa medical college and H.S.K hospital and research center, Bagalkot, Karnataka from May 2018 to April 2020 over a period of 24 months.

Sample size

Sample size calculation was done using open epi software version 2. At 95% confidence level and 14% confidence limits.

Sample size was calculated according to the study conducted by Parmar et al 2020 in which post-auricular tenderness and other local signs was 88.8%.

Post-auricular tenderness is taken as p value as it is a specific sign in complications of COM (mastoiditis with post-auricular abscess).

Sample size was calculated using the formula n=[DEFF*Np(1-p)]/[(d2/Z21-α/2*(N-1)+p*(1-p)].

With a drop-out rate of 10% to follow-up and total sample size were 20.

Inclusion criteria

Patients of all age group and sex with otorrhea persisting for more than 3 months diagnosed with COM associated with intracranial or extracranial complications or both and patients willing to give informed consent for the study.

Exclusion criteria

Patients not willing to give informed consent were excluded from the study.

All patients underwent detailed clinical, otoscopic, microscopic examination. Hearing assessment was done by pure tone audiometry (PTA) in all patients except in the 5-year-old female who underwent brainstem evoked response audiometry (BERA). All routine investigations including blood investigations, pus culture and sensitivity, X-ray mastoid Schuller's view, high resolution computed tomography (HRCT) of bilateral temporal bone with contrast was done in every patient. Patient demographics, presentation, clinical course, investigations, management and postoperative outcomes were analyzed and presented in tables and figures.

Intravenous antibiotics were given to the patients for a minimum of 3 weeks, with surgical management of incision and drainage of post-auricular abscess, cortical mastoidectomy, modified radical mastoidectomy, radical mastoidectomy, with tympanoplasty as indicated after intra-operative assessment. Intracranial complications were managed along with neurosurgical intervention as indicated. Follow-up of the patients was done post-operatively or post-treatment for a period of 1 month.

Data collected was analyzed using SPSS software version 22. Means, and standard deviations were applied and simple proportions were calculated for the descriptive variables.

RESULTS

20 patients diagnosed with COM associated with intracranial or extracranial complications or both and patients willing to give informed consent for the study were included in the study.

Age distribution

Age distribution is as shown in the table 1 and Figure 1 below. Mean age of presentation was 23.65±9.571 years. Youngest patient in the study was 5 years and oldest patient in the study was 40 years (Figure 1).

Gender distribution

Out of the 20 patients, 12 were male (60%) and 8 were female (40%). Male to female ratio was 1.5:1 (Table 1).

Complications of COM

Out of 20 patients, 1 patient had intracranial complication and 17 patients had extracranial complications and 2 patients had both extracranial complications and intracranial complications. 9 patients (45%) had post-auricular abscess, 3 patients (15%) had intrameatal abscess, 5 patients (25%) had labyrinthitis, 3 patients

(15%) had facial palsy and 1 patient (5%) had petrous apicitis. 3 patients (15%) had lateral sinus thrombophlebitis and 1 patient (5%) had cerebellar abscess.

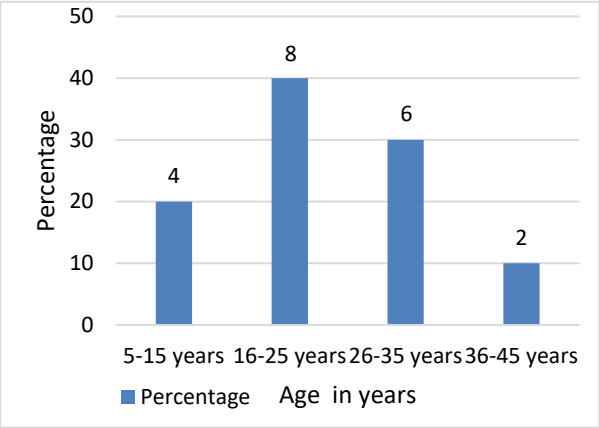

Figure 1: Age distribution.

Table 1: Gender distribution.

Gender	Frequency	Percentage (%)
Male	12	60
Female	8	40

Most common extracranial complication was mastoiditis with post-auricular abscess (45%) and second most common was labyrinthitis (25%) in this study. Most common intracranial complication was lateral sinus thrombophlebitis (15%) (Figure 2).

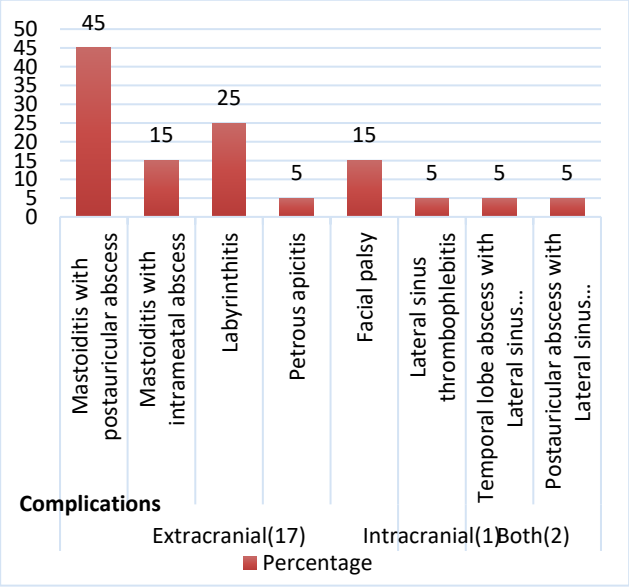

Figure 2: Complications of COM.

Clinical presentation

Most common clinical presentation in this study was otalgia (45%) and fever (45%), followed by giddiness (30%) and headache (25%). Most common clinical presentation in patients with extracranial complications was otalgia and that in patients with intracranial complications was altered sensorium (Table 2).

Table 2: Signs and symptoms.

Symptoms and signs	Frequency	Percentage (%)
Otalgia	9	45
Fever	9	45
Headache	5	25
Giddiness	6	30
Nystagmus	2	10
Facial palsy	3	15
Nausea and vomiting	4	20
Altered sensorium	3	15
Loss of consciousness	1	5
Post-auricular swelling and tenderness	9	45

Organism isolated

Most common organism isolated was *Staphylococcus aureus* (25%). Proteus vulgaris was isolated from 2 cases having intracranial complication and 1 case with intracranial complication had non fermenting gram-negative bacilli isolated. 1 case had no organism grown on culture but CSF adenosine deaminase (ADA) was high but on histopathological examination of middle ear mucosa showed granulomatous disease (likely tuberculosis). There were 11 cases in whom antibiotics were started before taking the pus sample and hence were sterile (Figure 3).

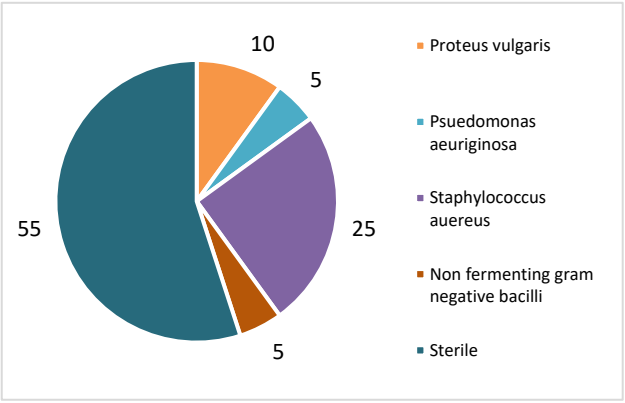

Figure 3: Organism isolated.

Hearing assessment

Hearing assessment was done by pure tone audiometry (PTA) in all patients except in the 5-year-old female who

underwent brainstem evoked response audiometry (BERA). Mean pure tone average was 44.1105±12.29369 dB HL with mean air-bone gap of 24.6±10.635 dB HL. Most of the patients in our study had moderate to severe conductive hearing loss of affected ear. Patient with cerebellar abscess had profound hearing loss on the affected side, suggesting involvement of labyrinth, by the disease process.

Radiology

Radiological assessment included HRCT of bilateral temporal bone with contrast in all the cases. 1 case showed intracranial brain abscess in the left posterior fossa and extracranial abscess in the left post-auricular region on T1 weighted magnetic resonance imaging (MRI) which on post-contrast enhancement showed hyperintense collections (Figure 5). Filling defect was seen in the left sigmoid and transverse sinus on post contrast study suggestive of thrombosis (Figure 6). HRCT temporal bone showed erosion of posterior fossa dural plate and mastoid cortex (Figure 4).

Figure 4: HRCT of left temporal bone of bony erosion of left posterior fossa dural plate.

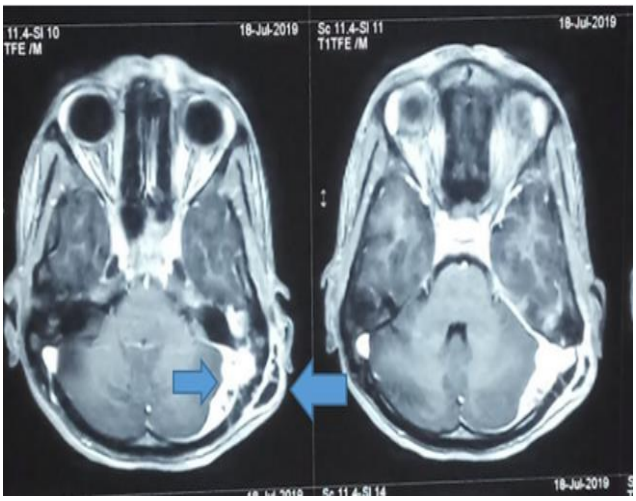

Figure 5: T1 Weighted axial MRI post contrast enhancement of hyperintense collections in left posterior cranial fossa and in left post-auricular region.

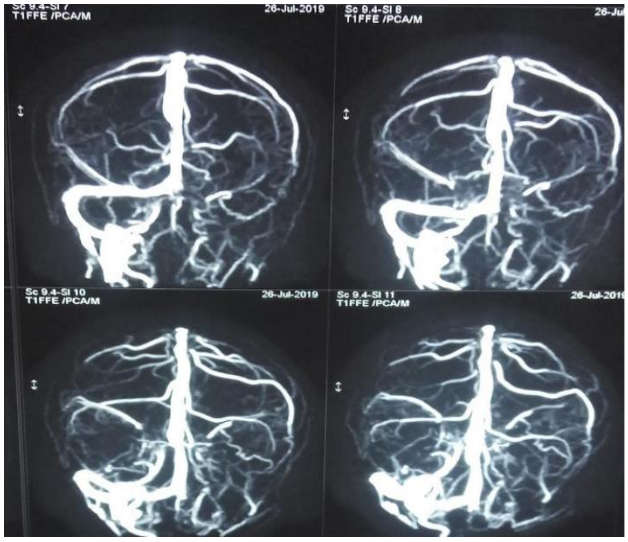

Figure 6: MRV post contrast of filling defect in left transverse and sigmoid sinus.

Management

Extracranial complications: Post-auricular abscess was drained by incision and drainage and, use of appropriate antibiotics and regular dressing followed by either cortical mastoidectomy, modified radical mastoidectomy or radical mastoidectomy with or without temporalis fascia grafting. Facial nerve paralysis was managed by decompression of facial nerve and use of steroids post-operatively. Labyrinthine fistula cases were managed by closure of fistula with temporalis fascia and soft tissue over mastoid. Petrous apicitis was managed by modified radical mastoidectomy with removal of petrous apex cells and appropriate antibiotics post-operatively.

Intracranial complications: Lateral sinus thrombosis was managed by modified radical mastoidectomy and drainage of peri sinus abscess was done after confirmation of abscess by needle aspiration without temporalis fascia grafting and dressing was done every day with cover of appropriate antibiotics. Cerebellar abscess case was managed by radical mastoidectomy followed by neurosurgical exploration by a neurosurgeon to drain the abscess via trans mastoid approach followed by appropriate antibiotics and anticoagulants postoperatively (Table 3).

Immediate post-op period and follow up

2 patients had post-operative facial palsy, for which appropriate antibiotics and steroids were given the patients recovered within 7 days. 1 patient had post-operative retention cyst in the cavity for which incision and drainage and exploration was done. Rest of the 17 patients had no post-operative complications and no recurrences.

Table 3: Management of complications.

Gender	Age (year)	Primary disease (side)	Intracranial complication	Extracranial complication	Management
Male	18	COMC (right)	-	Mastoiditis with post auricular abscess	I and D with myringotomy followed by CWD 3 weeks later
Female	12	COM (left)	-	Mastoiditis with post auricular abscess	I and D with CM 3 weeks later
Male	35	COMC (left)	-	Labyrinthitis	CWD with temporalis fascia grafting of fistula
Male	23	COMC (left)	-	Mastoiditis with Post-auricular abscess	I and D followed by CWD with type 5 tympanoplasty 3 weeks later
Female	28	COMC (right)	-	Labyrinthitis	CWD with short columella ossiculoplasty
Female	40	COM (left)	-	Petrous apicitis with Facial paralysis	CWD with FND
Female	20	COM (left)	-	Intrameatal abscess	Conservative
Male	24	COMC (left)	-	LSCC fistula with auto-mastoidectomy	CWD (inside out) with temporalis fascia grafting of fistula
Female	35	COM (right)	-	Mastoiditis with Post-auricular abscess	I and D followed by CM with temporalis fascia grafting 3 weeks later
Male	23	COMC (right)	-	Labyrinthitis with auto-mastoidectomy	CWD (inside out) with temporalis fascia grafting of fistula
Male	10	COMC (left)	Lateral sinus thrombophlebitis	Mastoiditis with Post-auricular abscess	I and D followed by CWD with FND with type 4 tympanoplasty 3 weeks later
Female	32	COM (right)	-	Mastoiditis with Post-auricular abscess	I and D followed by CM with temporalis fascia grafting 3 weeks later
Male	12	COMC (left)	Lateral sinus thrombophlebitis	-	CWD with wide meatoplasty with type 5 tympanoplasty 3 weeks later
Male	20	COMC (right)	-	Intrameatal abscess	CWD with temporalis fascia grafting
Male	19	COMC (left)	-	Intrameatal abscess	CWD with long columella ossiculoplasty with meatoplasty temporalis fascia grafting
Male	32	COMC (left)	-	Mastoiditis with Post-auricular abscess with Labyrinthitis	I and D followed by CWD with FND with temporalis fascia grafting 3 weeks later
Female	5	COMC (right)	-	Facial paralysis	CWD with meatoplasty with type 4 tympanoplasty
Male	27	COMC (right)	-	Facial paralysis	CWD with FND
Female	25	COMC (left)	Cerebellar abscess with lateral sinus thrombophlebitis	Mastoiditis with Post-auricular abscess	I and D followed by CWD with neurosurgical intervention
Male	28	COM (left)	-	Mastoiditis with Post-auricular abscess	I and D followed by CM with temporalis fascia grafting 3 weeks later

Abbreviations: COM-chronic otitis media, COMC-chronic otitis meida with cholesteatoma, LSCC-lateral semicircular canal, I and D-incision and drainage, CM-cortical mastoidectomy, CWD-canal wall down mastoidectomy, FND-facial nerve decompression.

DISCUSSION

The complications can occur in persons of all ages and both genders.

Age distribution

In a study done by Ahmed et al in which a total of 41 patients with both intracranial and extracranial complications due to chronic suppurative otitis media (CSOM) were included, the mean age of the patients was 25.43±9.67 years.[3] In a study done by Heah et al median age of presentation was 25 years.[4] In our study mean age of presentation was 23.65±9.571 years. The most common age group of presentation in our study was between 16-25 years (40%) cases which is comparable to the study done by Mohite et al in which 16-25 years (35%) was the most common.[5]

Gender distribution

In a study done by Osma et al male to female ratio was 2:1 and in a study done by Ahmed Z et al females 25 (61%) out-numbered males 16 (39%) with a female to male ratio of 1.5:1.[6] In our study 12 were males (60%) and 8 were females (40%) with male to female ratio of 1.5:1.

Types of complications

In a study done by Mohite a total 20 cases of CSOM were identified with complications, out of which 14 patients (70%) had EC while 06(30%) patients had IC complications.[5] The common complication in their study, in EC group was subperiosteal abscess-10, followed by Bezolds abscess-1, zygomatic abscess-1 and labyrinthitis-2. The complications encountered in IC group were temporal lobe abscess-1, pyogenic meningitis-2, lateral sinus thrombophlebitis-2 and extradural abscess-1.

Most common extracranial complication in our study was mastoiditis with post-auricular abscess (45%) in this study. This is similar to study done by Osma et al in which most common EC complication (64.1%) was post-auricular abscess.[6]

Most common intracranial complication in our study was lateral sinus thrombophlebitis (15%). Erosion of bone covering the sigmoid sinus can cause formation of peri sinus abscess. At first, inflammation of outer wall of sinus occurs, which later spreads to involve the intima of sinus. Platelets, red blood cells, fibrin, white blood cells adhere to inflamed area and cause mural thrombosis, which propagates obliterating sinus lumen. Perisnus abscess can also form due to venous thrombophlebitis process. In a study done by Kanganarak et al meningitis was the most frequent intracranial complication (51%), which was not encountered in our cases, probably due to early diagnosis and availability of antimicrobial drugs in the treatment of COM.[7] In contrast in a large case series study done by Wu et al among the 285 cases with extracranial and intracranial complications, labyrinthitis was the most common extracranial complication and was found in 90 patients and the most common intracranial complication was brain abscess seen in 42 cases.[8]

Clinical presentation

Most common clinical presentation in our study was otalgia (45%) and headache (45%). Post-auricular swelling and tenderness was seen in 7 cases (35%) with extracranial complications and 2 cases (10%) having both IC and EC complications. 1 patient with cerebellar abscess had high grade fever, altered sensorium, history of episode of loss of consciousness and patient also had change in voice and difficulty in swallowing and facial paralysis suggesting involvement of lower cranial nerves. 2 pediatric patients with lateral sinus thrombophlebitis presented with otalgia, episodes of giddiness, vomiting, fever and lethargy. 1 patient presented with painless otorrhea with facial nerve paralysis and triad of Gradenigo syndrome suggesting petrous apicitis. 5 patients with labyrinthitis presented with giddiness of which 2 patients had spontaneous nystagmus pointing to presence of a fistula.

Otorrhea as an obvious symptom may or may not be present. However, the development of pain or otalgia may indicate that an acute infection has supervened and that there may be a buildup of pus under pressure in the middle ear or mastoid.[9] Bony erosion causes breach in the mastoid cortex and pus accumulates under the periosteum, resulting in post-auricular swelling associated with pain, tenderness and fever. In a study done by Parmar et al.[10] most common clinical presentation was fever (97.22%) followed by post-auricular tenderness (88.8%).

In a study done by Dubey et al the clinical features of the patients were otorrhea in 63 (90%), fever in 27 (39%), mastoid abscess in 26 (37%), neck stiffness in 21 (30%), postauricular fistula in 17 (24%), vomiting in 15 (21%), meningism in 14 (20%), facial palsy in 10 (14%), loss of equilibrium in 6 (9%), and seizures in 5 (7%).[11]

The most frequent symptom of labyrinthine fistula is vertigo, often induced by straining against a closed glottis. The inflammatory process reaches the vestibule or cochlea via a fistula and the presenting symptoms seen are vertigo, otalgia, hearing loss, nausea and vomiting.[1]

Facial nerve paralysis can occur abruptly or evolve overtime. Spread of infection from middle ear and mastoid to the petrous apex through the posterosuperior tract or anteroinferior tract of air cells can lead to petrositis. The classical symptoms associated with petrous apicitis are external rectus palsy, deep seated retro-orbital pain and persistent ear discharge.[9]

Brain abscess formation is indicated by the presence of the triad of headache, high-grade fever and focal neurological deficits. The most common sites for otitic intracranial abscess are temporal lobe and cerebellum. High grade fever with a picket-fence appearance is a sign of suppurative lateral sinus thrombophlebitis and patients usually will be toxic, restless and complain of otalgia.[1]

Early detection of symptoms associated with both IC and EC complications will help in early diagnosis and prompt treatment of these complications.

Organism isolated

The predominant bacterial organisms associated with squamosal disease are staphylococcus aureus, gram negative bacilli such as *Proteus, Klebshiella* and *Psuedomonas*. In our study most commonly encountered was *Staphylococcus aureus* (25%) followed by *Proteus vulgaris* (10%). There were 11 cases in whom antibiotics were started before taking the pus sample and hence were sterile. Similarly, in a study done by Mokbel most common organisms isolated were *Staphylococcus aureus and Psuedomonas* and in a study done by Yorgancılar et al the most common bacterial organisms were *Staphylococcus aureus*, *Proteus mirabilis, Streptococcus pneumoniae*, and *Pseudomonas aeruginosa*.[12,13]

Polymicrobial cultures with a high incidence of anaerobes are usually present in brain abscess. Patients should be started on high dose of appropriate antibiotic treatment and emergency neurosurgical intervention. In our study, patient with cerebellar abscess had proteus vulgaris isolated from the pus culture and was given appropriate antibiotics according to the antibiotic sensitivity. Similarly, in a case series study done by Mustafa et al the most frequently isolated pathogens were proteus mirabilis in 33.3%, *Staphylococcus aureus* in 15% and *Pseudomonas* sp. and *Proteus vulgaris* in 12% of the 44 cases.[14]

All the patients in our study were given broad-spectrum antibiotics, pre-operatively and post-operatively for a minimum period of 2 weeks. Based on the culture and sensitivity reports, antibiotics were continued or changed. The patients in our study, including in IC complications, recovered within 7-10 days post-operatively, suggesting that appropriate antibiotics, based on culture and sensitivity reports play a vital role in management of complications due to COM.

Hearing assessment

Patients with COM usually have conductive hearing loss, but evidence concludes that sensorineural hearing loss can also occur due to toxins, which can cause damage to cochlea.[7]

Mean pure tone average in our study was 44.1105±12.29369 dB HL with mean air-bone gap of 24.6±10.635 dB HL. In a study done by Heah et al the preoperative pure-tone audiograms of eight of the nine patients showed ipsilateral conductive hearing loss with air-bone gaps ranging from 10-40 dB HL.[4]

Management

A tymanomastoidectomy is the definitive treatment in a case of COM with mastoiditis with subperiosteal abscess. All the patients with mastoiditis with post-auricular abscess were given appropriate antibiotics and drainage of abscess followed by cortical mastoidectomy or canal wall down mastoidectomy, with tympanoplasty. For a case of labyrinthitis, appropriate antibiotics followed by tympanomastoidectomy is adviced.[1] Removal of cholesteatoma matrix over a labyrinthine fistula is usually done during second stage procedure when the matrix of cholesteatoma becomes a small cyst, but in our study, a labyrinthine fistula was managed by removal of cholesteatoma matrix and covering of fistula with a temporalis fascia graft was done.[15]

The definitive treatment for facial paralysis due to COM is canal wall down mastoidectomy (CWD) with facial nerve decompression (FND) which was done in all the cases with facial palsy in our study. All the patients treated had significant improvement post operatively. 1 patient had presence of extensive granulations in the middle ear with facial palsy and petrous apicitis, suggesting tuberculous etiology, which was confirmed on histopathology report. For a case of lateral sinus thrombophlebitis, a CWD mastoidectomy was done and perisinus abscess was drained after confirmation with needle aspiration.

Brain abscess case in our study was managed by radical mastoidectomy followed by neurosurgical exploration by a neurosurgeon to drain the abscess via transmastoid approach followed by appropriate antibiotics and anticoagulants postoperatively. Tympanomastoidectomy either canal wall up (CWU) or canal wall down mastoidectomy (CWD) was done in all cases in our study. Similarly, in a study done by Sharma N et al.[16] canal wall down mastoidectomy was done in all cases. All the patients with COM complications recovered within 2-3 weeks. Except for patient who had post-operative retention cyst in the cavity, for which incision and drainage and exploration was done. Rest of the 17 patients had no post-operative complications and no recurrence.

CONCLUSION

The complications of COM can involve persons of all ages and both genders. It usually involves children and young adults, as COM usually involves younger age group which was seen in the study. Early detection of symptoms associated with both IC and EC complications will help in early diagnosis and prompt treatment of these complications. Appropriate antibiotics, based on culture

and sensitivity reports play a vital role in management of complications due to COM, especially IC complications. Hearing assessment should be done and may show moderate conductive hearing loss but sensorineural hearing loss may also occur. Definitive management of complications is tympanomastoidectomy, either CM or CWD mastoidectomy and it usually depends on the radiological evaluation and intra-operative findings.

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