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INTRAOPERATIVE FINDINGS DURING OPEN MASTOIDO-EPITYMPANECTOMY AT A TERTIARY CENTER

Abha Kiran KC,[1]* Bikash Lal Shrestha,[1] Laxmi Khadka,[1] Ayushi Shrestha,[1] Shreeja Shikhrakar[1]

[1] Department of ENT-HNS, Kathmandu University School of Medical Sciences, Dhulikhel Hospital, Kavre, Nepal.

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Correspondence to:
Abha Kiran K.C., Lecturer, Department of ENT-HNS, Kathmandu University School of Medical Sciences, Dhulikhel Hospital, Kavre, Nepal.
Email: abhakirankc@gmail.com
Phone: +977-9841587666

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ABSTRACT

Introduction: *Chronic otitis media is a common entity in our country. Surgical eradication of disease is the treatment of choice for squamous chronic otitis media. The objective of this study was to assess the pathology, its extent and associated complications in patients who underwent open mastoido-epitympanectomy for chronic otitis media squamous at a tertiary care center (Dhulikhel Hospital) in Nepal.*

Materials and Methods: *Medical records of 111 patients who underwent OMET at our center from June 2017 to June 2021 were analyzed retrospectively. Demographic parameters, clinical presentation, audiometric data, intraoperative pathology and their distribution, involvement of bony landmarks and ossicular chain status were recorded and analyzed.*

Result: *There were 64 male and 47 female patients included in our study. Their age ranged from 6 to 69 years. The commonest finding during examination under microscopy was posterosuperior retraction pocket (42.3%). Cholesteatoma was the commonest intraoperative pathology (86.5%), majority with cholesteatoma widespread involving both tympanic and mastoid cavities. Ossicular chain erosion was reported in 96.4% patients.*

Conclusion: *Squamosal otitis media is common in our setup, with extensive distribution of pathology in middle ear cleft, and possible bony landmarks erosion.*

Keywords: *Cholesteatoma, Chronic otitis media squamous, Open mastoido-epitympanectomy, Ossicular chain.*

INTRODUCTION

Chronic otitis media (COM) is often attributed to earlier episodes of acute otitis media, negative middle ear pressure or otitis media with effusion that results in permanent pars tensa or flaccida abnormalities.[1] Globally COM affects 65-350 million individuals/year. A large part of this burden is borne by Asia and other Pacific Islands, Sub-Saharan Africa, and the ethnic groups in Australia and North America.[2] Higher disease burden in developing countries and poor socioeconomic strata is attributed to overcrowding, poor hygienic and dietary conditions. Weighted prevalence of COM in Korea was reported at 3.8%.[3] Otitis media was prevalent in 13.2% of children attending a government school in Morang district of Nepal.[4] Prevalence of COM in various districts of Nepal have been reported between 5% to 8.18%.[5,6]

COM is classified as mucosal or squamous variants. Squamous variant includes retraction pocket (posterosuperior pars tensa and pars flaccida), atelectasis, epidermization, and cholesteatoma. Cholesteatoma is the presence of keratinizing squamous epithelium within middle ear or in other pneumatized areas of the temporal bone. Over time, the disease often progresses to involve the ossicular chain, dural and sinus plates, facial nerve

canal, bony labyrinth, and may result in extracranial and life-threatening intracranial complications.[7]

Surgical management aims to eradicate the disease with maintenance of epithelialized, self-cleaning ear and hearing capability, if possible. Surgical techniques are categorized as canal wall-up (closed) and canal wall-down (open) mastoidectomy. Canal wall-down surgeries are associated with lower rates of recurrent and residual cholesteatoma, so second-look surgeries are rarely needed.

Open mastoido-epitympanectomy (OMET) implies removal of posterosuperior canal wall and complete exenteration and exteriorization of both mastoid and epitympanum. The commonest indication for this surgery is chronic otitis media complicated by cholesteatoma.[8] Owing to the extensive disease distribution and higher rates of loss to follow-up, all patients in our study underwent OMET. Our objective was to find the intra-operative distribution of pathology, and associated complications in patients who underwent OMET for squamous disease.

MATERIALS AND METHODS

Medical records of patients who underwent OMET from June 2017 to June 2021 at Dhulikhel hospital were retrospectively reviewed. ENT Statistics (Otology Module) software Client Version:4.0.0.14, Proedition, normal model with DB version: ENT statistics DB III-3.0-492 from INNOFORCE creative solutions, Liechtenstein, 2019 was used for recording the pre-, intra- and post-operative data.

Ethical approval was obtained on 1st August, 2021 from Institutional Review Committee with protocol number 86/2021.

111 patients, both pediatric and adults, were included in our study. Incomplete medical records and revision surgeries were excluded. Secondary data on age, gender, chief complaints, side operated, examination under microscopy (EUM) findings, audiometry (average air and bone conduction across 0.5, 1, 2 and 4 kHz frequencies), intra-operative distribution of disease, ossicular chain erosion, and involvement of sinus plate, dura, facial nerve canal and semicircular canals by disease were reviewed. Microsoft Office Excel (Microsoft Corp.; Redmond, WA, USA) was used for data recording and analysis. During data processing, strict confidentiality was maintained.

RESULTS

111 patients were included in our study with 64 (57.7%) males and 47 (42.3%) females. Patients were 6 years to 69 years in age, with largest number of patients in 10-19 years age group. Age distribution is given in Table 1.

Table 1. Age Distribution of study population

Age group	Patients number (%)
< 10 years	11 (9.9%)
10-19 years	36 (32.4%)
20-29 years	25 (22.5%)
30-39 years	17 (15.3%)
40-49 years	14 (12.6%)
50-59 years	4 (3.6%)
> 60 years	4 (3.6%)
Total	111

Surgery was performed on right side in 53 patients (47.7%), and on left side in 58 patients (52.3%). The commonest complaint was discharging ear (100%), succeeded by hearing impairment (85.6%) and earache (8.1%). The various symptoms have been summarized in Table 2. 2 patients presented with mastoid abscess, 1 case with meatal abscess, and 1 patient with acute labyrinthitis. 1 patient presented with acute meningoencephalitis.

Table 2. Presenting Complaints

Complaints	Patients number (%)
Ear discharge	111 (100%)
Hearing impairment	95 (85.6%)
Earache	9 (8.1%)
Vertigo	6 (5.4%)
Tinnitus	2 (1.8%)
Headache	2 (1.8%)
Postaural swelling	2 (1.8%)
Fever, altered sensorium	1 (0.9%)
Hemiparesis	1 (0.9%)

Conductive hearing loss was documented in 90 patients (81.1%). Average bone conduction was 12.7 dB, while air conduction was 44.7 dB. Mixed hearing loss was recorded

in 5 patients (4.5%), while 2 had profound hearing loss (1.8%).

Examination under microscopy revealed posterosuperior retraction pocket (PSRP) in 47 patients (42.3%). Findings have been summarized in Table 3.

Table 3. Examination under microscopy findings

Findings	Number of patients (%)
PSRP	47 (42.3%)
Generalized Pars tensa retraction	35 (31.5%)
Attic retraction/perforation	17 (15.3%)
Central perforation with secondary epithelization	8 (7.2%)
Subtotal perforation	1 (0.9%)
Marginal perforation	3 (2.7%)
Aural polyp	6 (5.4%)
Meatal abscess	1 (0.9%)

Cholesteatoma was the commonest pathology encountered, alone in 55 patients (49.5%) and in conjunction with granulation tissue in 41 patients (36.9%). Granulation tissue only was found in 15 patients (13.5%). Pars tensa cholesteatoma was the commonest finding in 48 patients (43.2%). Pars flaccida cholesteatoma was recorded in 39 patients (35.1%). Combined attic-pars tensa cholesteatoma was recorded in 9 patients (8.1%).

Table 4. Intraoperative pathology

Pathology	Number of patients (%)
Cholesteatoma	55 (49.5%)
Cholesteatoma with granulation tissue	41 (36.9%)
Granulation tissue	15 (13.5%)

Ossicular damage was evident in 107 patients (96.4%). Malleus was the least affected ossicle, with handle being most vulnerable to necrosis in 20 patients (18%). Incus was the most vulnerable ossicle with long process undergoing necrosis in 64 patients (57.7%). Stapes superstructure was absent in 43 patients (38.7%) in our study. Austin-Kartush classification of ossicular chain status is given in table 4.

Table 5. Status of Ossicular chain

Austin-Kartush type	Number of patients (%)
M+ I+ S+	4 (3.6%)
M+ S+	48 (43.2%)
M+ S-	25 (22.5%)
M- S+	16 (14.4%)
M- S-	18 (16.2%)

M Malleus, I Incus, S Stapes

Tegmen erosion was found in 12 patients (10.8%) with exposure of middle cranial fossa dura in 8, and posterior cranial fossa dura in 4. Sinus plate erosion was documented in 6 patients (5.4%). Facial nerve canal dehiscence was noted in horizontal segment in 15 patients (13.5%), and vertical segment in 3 patients (2.7%). Lateral semicircular canal (SCC) erosion was evident in 7 patients (6.3%) and fistula was reported in 9 patients (8.1%). 1 patient (0.9%) had eroded Superior SCC.

DISCUSSION

COM squamous is a common health problem in both pediatric and adult population. Hence, we included patients of all age. Majority of our patients were 10-19 years of age, likely reflecting the care seeking behavior by younger patients.

Commonest presentation was discharging ear, succeeded by hearing impairment. Similar findings were reported in other studies.[9,10] Commonest pattern of hearing loss was conductive, attributable to the associated ossicular chain damage. Sensorineural hearing loss is the result of toxins induced injury to hair cells, especially in the basal turn of cochlea, that are believed to diffuse from middle to inner ear via round window membrane.

The commonest otoscopic finding was PSRP, as also reported by Sreedhar et al.[11] Cholesteatoma was the commonest pathology found intraoperatively in our study. Regarding the extension, majority of the cases had cholesteatoma involving the middle ear, attic, aditus, antrum, representing the extensive disease spread on presentation. This may reflect the unawareness about aural hygiene in general population and inadequate medical therapy resulting in recurrent middle ear infections. Similar distribution of cholesteatoma was found by Udaipurwala et al.[12] Similar observation was made by Shrestha and Kafle, however their study included pediatric population only.[13]

There was no case of congenital cholesteatoma in our

study. Acquired cholesteatoma can be divided into attic and pars tensa cholesteatoma. Attic or posterior epitympanic cholesteatoma passes lateral to the body of incus, and passes through aditus and antrum to reach mastoid (Figure 1). It enters middle ear via. the floor of Prussak space. Pars tensa cholesteatoma can be subdivided into sinus cholesteatoma and tensa retraction cholesteatoma. Sinus cholesteatoma is associated with posterosuperior retraction with pathologic findings in posterior mesotympanum. Tensa retraction cholesteatoma is associated with generalized pars tensa retraction with pathology distribution in anterior, inferior and posterior tympanum. 2 routes cholesteatoma involve both pars flaccida and pars tensa. Anterior epitympanic cholesteatoma originates anterior to malleus head and is exclusively found in children.[14,15] Higher incidence of pars tensa cholesteatoma was found in our study similar to the study by Black and Gutteridge which explained the more extensive distribution of cholesteatoma in our patients.[14]

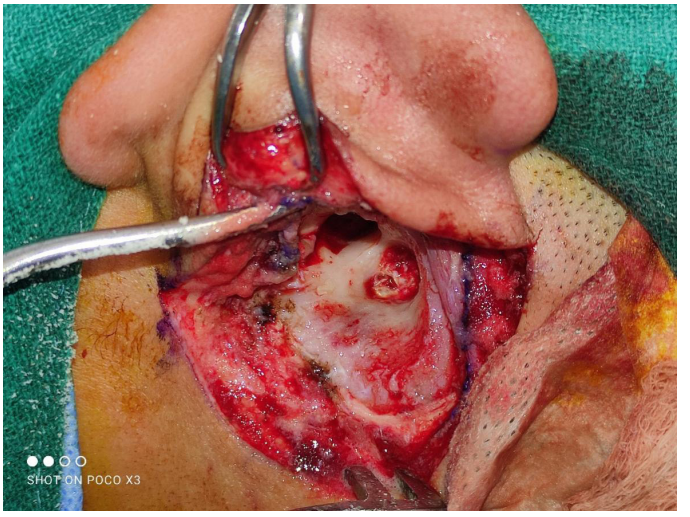

Figure 1: Pars flaccida cholesteatoma in mastoid antrum

Malleus was the least affected ossicle in our study. Similar result was demonstrated by Varshney et al., with malleus being intact in 55% cases of COM Squamous.[16] Higher rate of malleus necrosis is seen in pars flaccida cholesteatoma than pars tensa cholesteatoma, with necrosis of malleus higher in cases with cholesteatoma than in those with granulations.[17] Incus long process is the most vulnerable part of the ossicular chain, due to its delicate structure and tenuous blood supply. It was the most frequently involved ossicle in our study. Incus erosion is more common with pars tensa cholesteatoma than pars flaccida cholesteatoma due to the posterior spread of disease and also due to involvement of sinus tympani.[17] Stapes superstructure was absent in 38.7% cases in our study. The close proximity of sinus tympani with stapes may cause longer period of contact and higher pressure between the cholesteatoma and the ossicle resulting in its necrosis.[18] Stapes footplate is very resistant and hence remains intact despite involvement of entire middle ear by disease.[12] Ossicular damage is proposed to be multifactorial. Some theories include pressure necrosis, osteitis, enzyme mediated lysis, and overproduction of cytokines (TNF alpha, IL-2, FGF, PDGF) that cause hypervascularization, osteoclast activation and bone resorption.[16]

Austin proposed the classification for ossicular damage, which was later modified by Kartush. In our study, Austin-Kartush type A (M+S+) was the commonest. Similar result was reported by Kotzias et al.[19] Varshney et al. reported 9% of Type A ossicular defect in their study, however they had included 60% cases with safe and 40% cases with unsafe chronic otitis media.[16]

With the advent of antibiotics, otogenic complications have declined in terms of morbidity and mortality. However, studies still depict the higher rates in developing countries.[20] The incidence of complications was 12.6% in our study which was higher than that reported by Dongol et al. (5.6%).[21] This higher rate could reflect the late presentation to health centers due to poverty, illiteracy, inadequate access to health facilities or general neglect on the part of patient or their guardians. The commonest extracranial complication reported varies in various studies, eg. Mastoid abscess, facial palsy, and labyrinthitis.[22,23,24] The commonest intracranial complication reported in literature also tends to vary from meningitis to lateral sinus thrombophlebitis to brain abscess.[17,20,25] Complications were observed in 11 patients in our study, with 4 patients (36.4%) below 20 years of age. Higher complication rates seen in children may be due to higher incidence of otitis media owing to underdeveloped eustachian tube, poor immunity, aggressive nature of pediatric cholesteatoma, well pneumatized temporal bone and greater inflammatory

markers.[26]

The commonest extracranial complication was labyrinthine fistula, and all 9 patients had fistula in lateral semicircular canal (Figure 2). They ranged from 2 mm to 4 mm in size. The incidence is reported to be 4% to 13%.[1] Only 1 patient presented with acute labyrinthitis, while 3 others complained of vertigo. The fistula was seen in preoperative computed tomography imaging of temporal bones in all 9 patients (Figure 3). All patients underwent OMET with removal of disease overlying the fistula, and repair of fistula with temporalis muscle and fascia. Inadvertent removal of disease overlying the fistula could result in sensorineural hearing loss. None of the patients developed postoperative sensorineural hearing loss in our study.

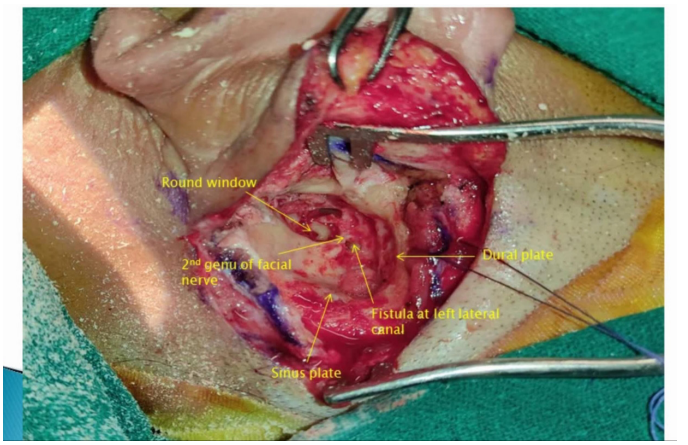

Figure 2: Intraoperative photograph of lateral SCC fistula

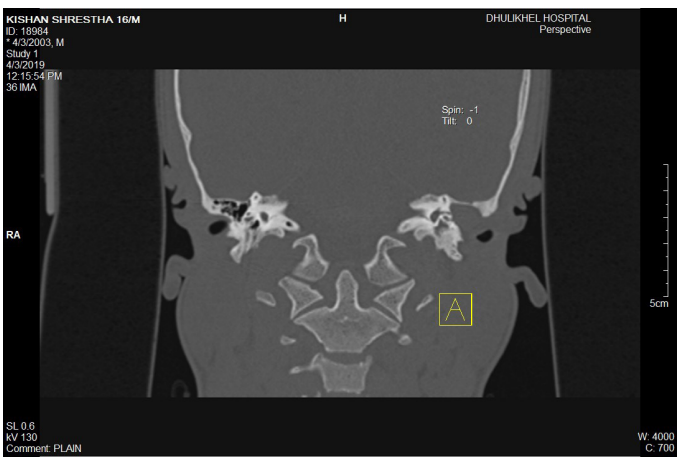

Figure 3: High resolution computed tomography showing left lateral SCC fistula

The second commonest extracranial complication was mastoid abscess. Both cases underwent drainage of the abscess followed by open mastoido-epitympanectomy, one after 5 days and the other after 2 months owing to lockdown of the nation due to Covid 19 pandemic.

The only reported intracranial complication was meningoencephalitis. The child underwent OMET after clinical improvement with 9 days of intravenous antibiotic therapy.

Multiple complications were seen in 3 patients (27.3%) with labyrinthine fistula detected in all 3 cases presenting with mastoid abscess, labyrinthitis and meatal abscess. Possibility of concurrent complications should hence always be borne in mind.

Dural plate (Figure 4) and sinus plate erosion was seen in 10.8% and 5.4% cases respectively in our study. Various rates are observed by Shaik et al.[27] (11.50%, 3.80%), Kanotra et al.[28] (6.4%, 10.6%) and Gomaa et al.[29] (14.3%, 14.28%). A higher rate was reported by Shrestha and Kafle, albeit the study included only pediatric patients.[13]

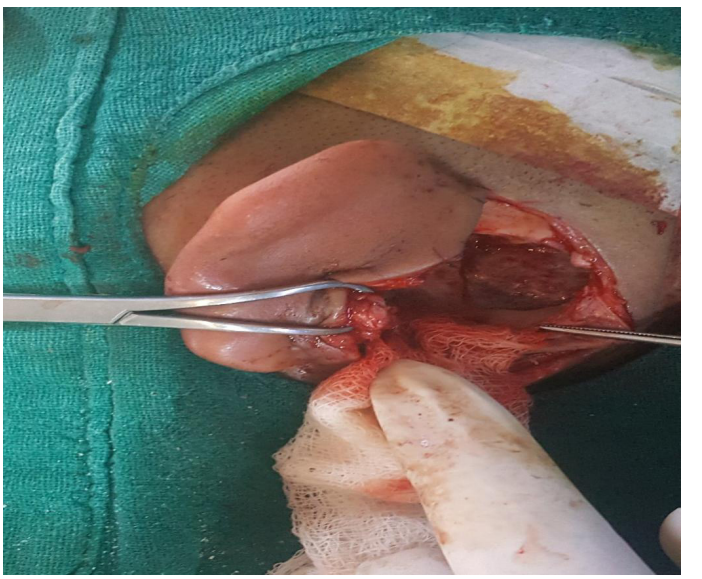

Figure 4: Exposed posterior cranial fossa dura

Dehiscent facial canal was found in 16.2% cases in our study. Facial canal dehiscence (FCD) may be due to developmental bony defects or bony erosion by cholesteatoma located in sinus tympani. FCD in the vicinity of sinus tympani also renders the nerve vulnerable to iatrogenic injuries during disease removal from sinus tympani.[18] Majority of our cases were pure

tympanic variant, located at tympanic segment directly superior to the oval window. Higher rates of sinus tympani involvement by disease in our study could have contributed to the higher FCD rates. Lower rates were observed by Shrestha and Kafle (4%)[13], Navaneethan et al. (7%)[30] and Gomaa et al. (7.14%)[29]. Similar result was reported by Kumar et al. (16.6%).[31] However, none of the patients presented with facial nerve palsy, nor did they develop it postoperatively.

The limitation of this study is its retrospective nature, which led to a significant portion of patients to be excluded owing to incomplete data set. In the future, prospective studies on the intraoperative disease distribution may be carried out according to various classification systems proposed like EAONO/JOS or ChOLE.

CONCLUSION

Cholesteatoma is a common disease in developing countries like Nepal. Majority of the patients presented with discharging ear and hearing impairment, and had ossicular damage identified intraoperatively. Chances of extracranial and intracranial complications are well documented.

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