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Original Research Article

Study of ossicular chain defects in patients with chronic otitis media

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ABSTRACT

Background: Chronic otitis media (COM) is a long-standing disease of middle ear cleft and mastoid cavity having a permanent perforation in the tympanic membrane with or without discharge. It's a worldwide health problem and it is still predominant in the modern antibiotic era. Aim was to determine the prevalence and types of ossicular chain defect in mucosal and squamosal type of COM. Also, to evaluate the hearing loss in relation to ossicular chain defect.
Methods: The study was prospective observational study conducted in Bhopal over the duration of one year (January 2019 to June 2020). Patient aged 11-70 years reporting with COM were included in the study. Details regarding sociodemographic profile and extensive examination were recorded. Data was entered into MS excel 2007, analysis was done.
Results: It was more prevalent in the age groups of 21-30years (39%) with female (53%) preponderance. Right sided ear was commonly involved (58%). Majority of the patients had tubo-tympanic disease (62%) whereas 38% had attico-antral disease. Ossicular chain was found intact in 33% cases. Average hearing loss was maximum (67.6 dBHL) when all ossicles are eroded. Hearing loss was minimum (33.6 dBHL) with isolated handle of malleus involvement.
Conclusions: COM is one of the commonest causes of preventable hearing impairment in our society, hence early diagnosis and timely intervention is needed. Awareness among patients and doctors regarding the need for better ear hygiene is necessary.

Keywords: COM, Ossicular chain defect, Tubo-tympanic disease, Attico-antral disease

INTRODUCTION

Chronic otitis media (COM), a long-standing disease of middle ear cleft and mastoid cavity having a permanent perforation in the tympanic membrane with or without discharge. It causes a wide range of pathologies in the middle ear such as granulation tissue formation, tympanosclerosis, irreversible mucosal changes, ossicular destruction and cholesteatoma.[1]

COM is a worldwide health problem and it is still predominant in the modern antibiotic era. Prevalence of COM represents a wide range of 0.4% to 33.3% globally. In India, the prevalence rate of COM is 7.8% according to surveys conducted by the world health organisation.[2] Conductive hearing loss is the most common pattern of hearing loss in COM with varying degree between 20 to 60 dB.[3]

The main function of ear ossicles is to transmit the sound-induced vibrations of the tympanic membrane to the cochlea via the oval window. Another function of the ossicles is to apply force to one window only of the cochlea. If the ossicles were missing, and the pressure of the incoming sound wave was applied equally to both windows, there would be a reduced flow of cochlear fluids.[4]

Two types of COM are tubo-tympanic and attico-antral disease. Tubo-tympanic type is considered safe while attico-antral type is considered unsafe; may lead to erosion of the ossicular chain.[5]

The incus, malleus and stapes solely or in combination are the affected ossicles. The most common ossicular chain defect of COM is involvement of only the long process of incus with intact malleus and stapes. The second common ossicular chain defect is erosion of the supra structure of the stapes as well as loss of incus.[6] Destruction of ossicular chain result in large hearing losses and its complete disruption can result in 60 dB hearing loss. Erosion or discontinuity of the ossicular chain is confirmed only during surgery.

Preoperative knowledge about ossicular discontinuity is important for surgeon. Surgeon can also plan for ossicular reconstruction operation with respect to arrangement of specific instruments, consumables, prosthesis etc.[7].

Thus, the study aimed to determine the prevalence and types of ossicular chain defect in mucosal and squamosal type of COM. Also, to evaluate the hearing loss in relation to ossicular chain defect.

METHODS

The study was prospective observational study conducted in the department of otorhinolaryngology and head and neck surgery, a tertiary care centre and teaching hospital in central India from January 2019 to June 2020. Approval from institutional ethics committee was achieved before starting the study.

Inclusion criteria

Patients with age 11-70 years, either sex, patients with CSOM and patient willing for reconstructive surgery offered to him or her were included in the study.

Exclusion criteria

Patients not willing for surgery, patients with history of ear trauma and patients having malignancy of middle ear were excluded from the study.

An informed written consent was taken before the conduct of the study. Data collection was done on set of semi structured questionnaire which included details regarding sociodemographic profile of the patients. Also, the selected patients underwent a detailed general and clinical examination of ear, nose and throat which focused on otoscopic examination of both the ears and all findings were recorded.

After completing local ENT examination patient also underwent X-ray mastoid bilateral Schuller's view and PTA to know the preoperative hearing level. HRCT was done in selected cases. Preoperatively, examination under microscope or otoendoscope was done to confirm otoscopy findings or for suction cleaning. Blood investigations and anesthesia fitness patients were taken up for ear surgeries based on preoperative findings. Intraoperatively, the condition and integrity of ossicular chain was studied. The findings were documented in an information sheet attached.

Data was entered into MS excel 2007, analysis was done with the help of Epi info version 7.2.2.2. Frequency and percentages were calculated.

RESULTS

Table 1 depicts baseline characteristics of study participants. It was found that COM was more prevalent in the age groups of 21-30 years (39%) followed by 31-40 years (23%) and 10-20 years (16%) (Figure 1). This highlights that COM was more common in young adults and working age group people. Also, COM was more prevalent in females (53%) as compared to male (47%).

Table 1: Baseline characteristics of study participants, (n=100).

Variables	No. of patients	Percentage (%)
Age group (years)		
10-20	16	16
21-30	39	39
31-40	23	23
41-50	10	10
51-60	11	11
>60	1	1
Gender		
Female	53	53
Male	47	47

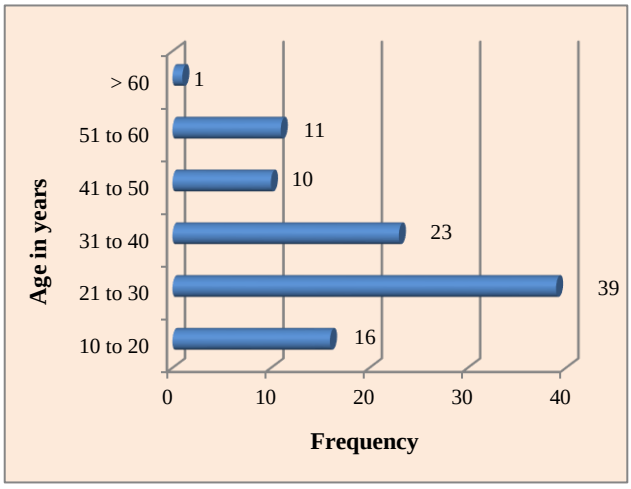

Figure 1: Distribution of study participants as per their age.

It was found that most common side affected was right sided (58%). In 26% COM patients left side was affected

whereas in 16% patients both side were affected (Table 2). Majority of COM patients had tubo-tympanic disease (62%) whereas 38% had attico-antral disease (Figure 2).

Table 2: Distribution of study participants as per side of ear affected and type of disease, (n=100).

Variables	No. of patients	Percentage (%)
Side of ear affected		
Right	58	58
Left	26	26
B/L	16	16
Type of disease		
Attico-antral disease	38	38
Tubo-tympanic disease	62	62

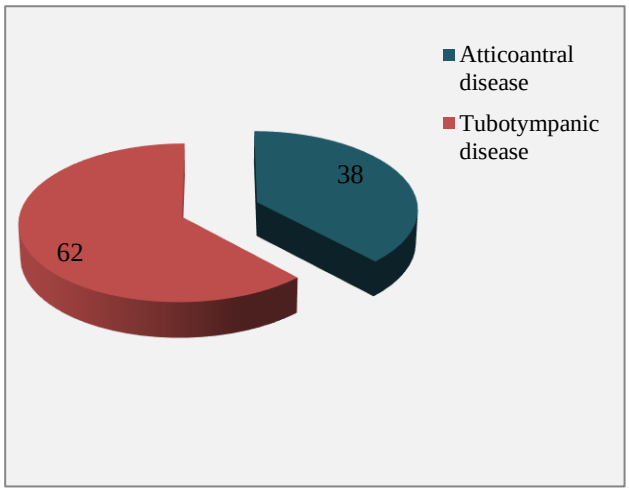

Figure 2: Distribution of study participants on the basis of type of disease.

Table 3 shows distribution of patients according to satus of ossicular chain. Ossicular chain was found intact in 33% cases whereas 67% cases eroded ossicular chain.

Table 3: Distribution of study participants according to status of ossicular chain, (n=100).

Ossicular chain status	No. of patients	Percentage (%)
Intact	33	33
Eroded	67	67

Distribution of study participants on the basis of status of malleus, incus and stapes has been shown in Table 4. It was found that head of malleus erosion was found in 4 cases, handle of malleus eroded in 18 cases, whole of malleus was absent in 2 cases and intact in 78 cases. Incus was the commonest ossicle to undergo erosion. It was intact in 59% cases; lenticular process was eroded in 23% cases and long process was eroded in 10% cases and whole of incus was absent in 8% cases. While stapes was found to be intact in 86% cases; and supra-structure erosion in 18% of the cases (Figure 3.)

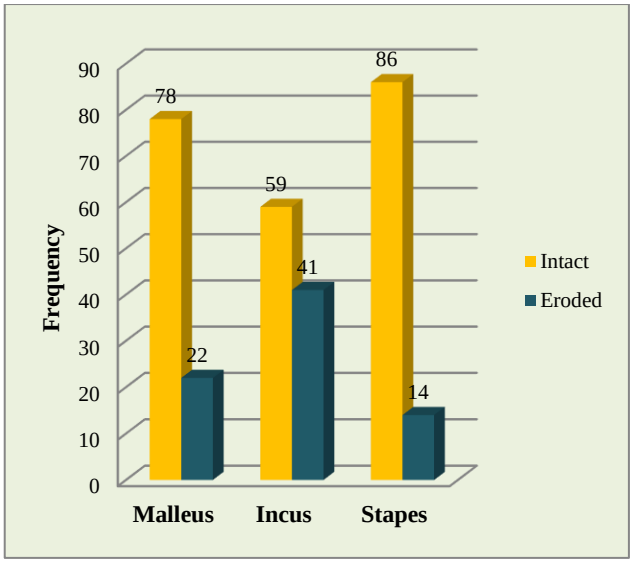

Figure 3: Distribution of study participants on the basis of status of malleus, incus and stapes.

Table 4: Distribution of study participants on the basis of status of malleus, incus and stapes, (n=100).

Variables	No. of patients	Percentage (%)
Status of malleus		
Head of malleus erosion	4	4
Handle of malleus erosion	18	18
Absent	2	2
Intact	78	78
Status of incus		
Lenticular process	23	23
Long process	10	10
Absent	8	8
Intact	59	59
Status of stapes		
Supra-structure erosion	14	14
Intact	86	86

As per Table 5, average hearing loss in relation to ossicular involvement has been displayed. Average hearing loss was maximum when all ossicles are eroded that is 67.6 dBHL. Hearing loss was minimum with isolated handle of malleus involvement that is 33.6 dBHL. Average hearing loss with incus erosion (long and lenticular process) was 44.13 dBHL.

Table 5: Distribution of study participants on the basis of average hearing loss in relation to ossicular involvement.

Ossicular involvement	Average hearing loss (dBHL)
Isolated handle of malleus erosion	33.6
Incus erosion	44.13
All ossicles eroded	67.6
Ossicular chain intact	24

Table 6: Comparison of status of malleus, incus and stapes in different studies.

Study	Malleus, (%)				Incus, (%)				Stapes, (%)	
	Intact malleus	Head of malleus erosion	Handle of malleus erosion	Malleus absent	Intact incus	Long process erosion	Lenticular process erosion	Incus absent	Stapes intact	Supra-structure erosion
Varshney et al[1]	80.67	2.67	12	6	61.33	16.67	19.33	-	78.67	21.33
Gurumani et al[13]	-	-	-	-	10	27	23	23	-	-
Hossain et al[9]	-	-	-	-	-	-	-	-	55	45
Rao et al[12]	95	1.4	2.8	-	-	-	-	-	-	-
Bangera et al[8]	80	11	6	3	65	25	3	6	77	23
Our study	78	4	18	5	59	10	23	8	86	18

DISCUSSION

COM is a prevalent middle ear pathology that constitutes tympanic membrane perforation together with a chronically inflamed middle ear mucosa. This study evaluated the prevalence of ossicular chain defects in mucosal and squamosal type of COM, types of ossicular chain defect and hearing loss in relation to ossicular chain defect.

The study comprised of total 100 patients with COM, majority of patients were in the age groups of 21-30 years (39%) followed by 31-40 years (23%). This highlighted that COM was more common in young adults and working age group people. The early presentation may be because of symptoms like reduced hearing affecting work efficiency, leading patients to seek early medical intervention. Similarly, in a study by Bangera et al.[8] It was observed that maximum COM patients (32%) were in the age group between 21 to 30, followed by next common age group between 31 to 40. In Varshney et al study the most of COM cases were observed in the age group between 16- and 25-years age group was 77 (51.33%).[1] Our findings regarding the age of the COM patient also correlates with studies of Hossain et al and Mohammadi et al in which majority of patients were between 21-35 years that is 53.33%.[9]

In current study it was revealed that COM was more prevalent in females (53%) as compared to male (47%), which correlates with that of another study of Varshney et al, where the number of female and male patients was 78 (52.00%) and 72 (48.00%).[1] Bangera et al also observed same result.[8] While in Hossain et al study majority of patients was male 36 (60%) than in female 24 (40%).[9]

Recent study observed that most common ear affected was right ear (58%). In 26% COM patients left side was affected whereas in 16% patients both sides were affected. Similarly, in Varshney et al study right ear was operated in 78 (52.00%) cases, followed by left ear in 72 (48.00%) cases.[1] Balasubramanian et al also observed same result as right ear was operated in 64 (39%), left ear operated in 67 (41%) and 20% patients had bilateral disease.[10] While contrary to this in Kumar et al study revealed that 41.2% patients underwent surgery on the right ear and 58.8% patients on left ear.[11]

Mucosal disease which is considered safe, and squamosal which is denoted to be unsafe, may lead to ossicular disintegration. In our study majority of the COM patients had tubo-tympanic disease (62%) whereas 38% had attico-antral disease. Similarly, Varshney et al found 64% cases with safe COM and 36% cases of unsafe COM.[1] In Bangera et al study out of 100 patients, 62 (62%) cases were safe COM and 38 (38%) were unsafe COM.[8]

Present research found that ossicular chain was intact in 33% cases whereas 67% cases had eroded ossicular chain. Similar results were obtained by Hossain et al study and Rao et al.[9,12] While contrary observations were reported by Bangera et al where 65% cases were intact and only 29% cases were eroded.[8]

Our study evaluated that malleus was found intact in 78 (78%), 18 (18%) had erosion of the malleus handle and erosion involved the head of malleus in 4% cases. This result is similar to Rao et al study, 95% patients had intact malleus and 2.8% had erosion of the malleus handle and 1.4% had necrosed head.[12] In Bangera et al study malleus was found to be intact in 80%, 11% cases had head erosion, 6% cases had handle of malleus erosion and malleus was absent in only 3% cases.8 The malleus was found to be the most resistant ossicle to erode in COM. Handle of malleus was found to be the commonest part of malleus to undergo erosion

In this study, it was found that incus was the commonest ossicle to undergo erosion. It was intact in 59% cases; lenticular process was eroded in 23% cases and long process was eroded in 10% cases and whole of incus was absent in 8% cases. Similarly, incus was also the most common ossicle found eroded in Bangera et al.[8] It was

intact in 65% cases, eroded in 29% cases and absent in 6% cases. The most commonly necrosed part was long process, found in 25% cases followed by lenticular process (3%). Varshney et al had a very similar incidence, incus was found intact in 61.33% cases, erosion of the lenticular process in 19.33% cases followed by long process in 16.67% case.[1] Dissimilar result was obtained in various studies the most commonly involved part of incus was long process.[13,14]

Stapes was found to be intact in 86% cases and supra-structure eroded in 18% cases. Similarly, Hossain et al noted intact stapes in 55% cases and eroded in 45% cases.[9] Varshney et al also reported intact stapes in 78.67% cases and involvement of stapes supra-structure was noted in 21.33% cases of CSOM.[1] Bangera et al also reported intact stapes in 77% cases and supra-structure was eroded in 23% cases.[9]

Hearing loss associated with different ossicular defects was assessed in current study. Average hearing loss was maximum when all ossicles were eroded, 67.6 dBHL. Hearing loss was minimum with isolated handle of malleus involvement, 33.6 dBHL. Average hearing loss with incus erosion (long and lenticular process) was 44.13 dBHL. Martins et al found that conductive hearing loss associated with the presence of cholesteatoma has been attributed to the erosion of the ossicles and disruption of the ossicular and on the presence of the cholesteatoma matrix within the middle ear.[15] In the Rout et al study, average hearing loss was maximum when all the three ossicles were absent, that is, 58.4 dBHL.[14] Hearing loss was minimum with isolated malleus handle involvement, that is, 45 dBHL. The average hearing loss was 50.2 dBHL when long process of incus was involved. Hearing loss was 57.1 dBHL in next group having involvement of long process of incus and supra structure of stapes. Table 6 depicts comparison of status of malleus, incus and stapes in different studies.

Limitation

Present study has some limitations, sample size was small and may not represent actual population. Ossicular chain reconstruction techniques were not included in this study

CONCLUSION

Our study found incus to be the most susceptible ossicle to undergo erosion and lenticular process as the most commonly necrosed part of incus. This may be due to small cholesteatoma causing limited involvement of lenticular process. COM is one of the commonest causes of preventable hearing impairment in our society, hence early diagnosis and timely intervention is needed. Awareness among patients and doctors regarding the need for better ear hygiene and care and good practices in order to avoid COM and its sequel. Preoperative knowledge of ossicular status helps the surgeon plan for proper ossicular reconstruction and counsel the patient beforehand regarding the degree of hearing attainable after surgery.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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