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A HOSPITAL BASED STUDY OF PREOPERATIVE INDICATORS OF OSSICULAR DEFECT IN MUCOSAL TYPE OF CHRONIC SUPPURATIVE OTITIS MEDIA

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Abstract

Introduction: Chronic suppurative otitis media (CSOM) refers to a chronic infection of the mucosa lining the middle ear cleft. CSOM is characterized by chronic inflammation of the middle ear and mastoid mucosa. Active mucosal CSOM is often associated with resorption of parts or all of the ossicular chain (resorptive osteititis). Resorption of bone is a feature of active mucosal and active squamous epithelial CSOM.

Materials and methods: This was a Cross Sectional Analytical study conducted in the Department of ENT of KPM Hospital, Kanpur, UP from November 2021 to October 2022. As it was a time bound study, every consecutive patient of mucosal type of Chronic Suppurative Otitis Media (CSOM) fulfilling inclusion criteria were selected for the study. Patients of either sex and age above 15 years to 60 years having inactive mucosal type of Chronic Suppurative Otitis Media with pure conductive hearing loss and functioning Eustachian tube posted for Tympanoplasty were included in the study. Whereas the patients who were with squamosal type of CSOM and previous history of ear surgery in the same ear were excluded from the study. An informed written consent was taken before the conduct of the study.

Results: Ossicular necrosis was noted in 10 (23.33%) of total 45 patients. On statistical analysis, patients of age >30 years ($p=0.019$, duration of ear discharge >10 years ($p=0.003$), those having large and subtotal perforation ($p<0.001$), adhesion of tympanic membrane edges to promontory ($p=0.04$), incudostapaedial joint area exposure ($p=0.01$) and air-one gap >40 dB ($p <0.001$) were found to be statistically significantly associated with ossicular erosion.

Conclusion: All patients of mucosal type of chronic suppurative otitis media should be assessed in detail so as to get a clue of ossicular defects to be prepared for its repair and will not come as a surprise during surgery.

Key Words: Chronic suppurative otitis media, resorptive osteititis, Resorption, ear discharge.

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INTRODUCTION

Chronic suppurative otitis media (CSOM) refers to a chronic infection of the mucosa lining the middle ear cleft. CSOM is characterized by chronic inflammation of the middle ear and mastoid mucosa. Active mucosal CSOM is often associated with resorption of parts or all of the ossicular chain (resorptive osteititis).[1] Resorption of bone is a feature of active mucosal and active squamous epithelial CSOM. The ossicles thus affected typically show hyperaemia with proliferation of capillaries and prominent histiocytes. The long process of the incus, stapes crurae, body of incus and manubrium are involved in that order of frequency.2 Although ossicular erosion can occur in both types of CSOM, the incidence of ossicular erosion in tubotympanic CSOM is low. High resolution three dimensional computed tomography can help define the middle ear and identify ossicular erosion and discontinuity, however this is not a routine investigation for patients with CSOM without cholesteatoma.[3]

Malleus, incus and stapes along with tympanic membrane are vital for impedance matching mechanism of the middle ear. Necrosis of long process of the incus, Superstructure of stapes, body of incus and manubrium occur in decreasing order of frequency in Chronic Otitis Media. Complete disruption of the ossicular chain can result up to 60 dB hearing loss. Erosion or Discontinuity of the ossicular chain is confirmed only during surgery.[4] Preoperative High-Resolution Computed Tomography (HRCT) Scan of Temporal bone can give a clue of ossicular integrity. But it's high cost and degree of Radiation exposure limits its use in developing countries like India specially in cases of mucosal type of CSOM. Preoperative knowledge of ossicular discontinuity is important because it enables the surgeon to discuss with the patient the possible outcome of surgery and take the consent accordingly. Surgeon can also plan for ossicular reconstruction operation with respect to arrangement of specific instruments, consumables, prosthesis etc.[5]

Aim of our study was to determine the prevalence of ossicular chain defect and preoperative identification of clinical and audiological factors as indicators of ossicular defects in patients with mucosal type of CSOM.

MATERIALS AND METHODS

This was a Cross Sectional Analytical study conducted in the Department of ENT of KPM Hospital, Kanpur, UP from November 2021 to October 2022. As it was a time bound study, every consecutive patient of mucosal type of Chronic Suppurative Otitis Media (CSOM) fulfilling inclusion criteria were selected for the study. Patients of either sex and age above 15 years to 60 years having inactive mucosal type of Chronic Suppurative Otitis Media with pure conductive hearing loss and functioning Eustachian tube posted for Tympanoplasty were included in the study. Whereas the patients who were with squamosal type of CSOM and previous history of ear surgery in the same ear were excluded from the study. An informed written consent was taken before the conduct of the study.

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The selected patients underwent a detailed clinical examination which included otoscopic and microscopic examination and all findings were recorded. On microscopic examination, when there is permanent central perforation in Pars tensa but no inflammation of middle ear mucosa and no production of pus in the middle ear and mastoid it was diagnosed as Inactive mucosal type of Chronic Suppurative Otitis Media. Perforation of size of a single, two, three or more quadrants of Pars Tensa were classified into small, medium and large perforation respectively and if the entire Pars Tensa involved with intact annulus was considered as subtotal perforation. Preoperative Pure Tone Audiometry was done a day prior to surgery to assess the type and degree of hearing loss using "Elkon EDA Giga 3" Pure Tone Audiometer. The air and bone conduction threshold averages were calculated by taking the average of 0.5-2k Hz frequencies. The Air Bone Gap (ABG) was calculated by taking difference between air conduction and bone conduction thresholds. In Pure conductive hearing loss, Bone conduction threshold remains normal (-10 dbB to 20 dB), Air conduction threshold is more than 20 dB with Air- Bone Gap of > 20 dB. The mean Auditory Threshold was classified into <40 dB and >40 dB. Eustachian Tube Function was assessed by Toynbee's test using Impedance Audiometer "Interacoustics AT 235". In this test, if the increased or decreased middle ear pressure built up by the impedance audiometer is neutralized in swallows in a step ladder pattern then the eustachian tube is labelled as normally functioning. X-Ray both Mastoids Schuller's view was done to know the status of mastoid air cell system.

Pre-anaesthetic evaluation was done to achieve fitness for the surgery. Tympanoplasty was done by post aural approach under Local Anaesthesia with IV sedation or General Anaesthesia whichever was required. Intra-operative middle ear findings including status of middle ear mucosa, ossicular chain status, erosion of the individual ossicle and continuity of the malleo-incudal and incudostapaedial joint were noted. Temporal is fascia was used as graft material for repair of tympanic membrane perforation. Ossicular reconstruction was done in patients with ossicular chain defects by re-sculpturing the autologous ossicules or by using autologous tragal cartilage graft depending on the defect.

Statistical Analysis: Data was entered in Microsoft Office Excel 2010 and was analysed using Epi Info version 7. Frequencies and percentages of categorical variables were calculated. Association between categorical variables was assessed by the $\chi 2$ (chi- square) test. Association between audiogram and ossicular necrosis was analyzed using independent 't' test. P value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 90 patients with inactive mucosal type of Chronic Suppurative Otitis Media were included in the study with the mean age of 28.59±10.08 years with male to female ratio of 1:1.8. Out of 90 patients, 21 (23.33%) had ossicular necrosis detected under operating microscope during surgery.

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out of 21 patients having ossicular necrosis, 13 had age of more than 30 years and 8 with age below 30 years and this was statistically significant difference with Odd's ratio of 3.203 ($\chi 2$=5.476, p= 0.019). 9 out of 34 males and 12 out of 56 females found to have ossicular erosion and there was no statistically significant difference between males and females with respect to ossicular necrosis (p= 0.61). 23 patients had CSOM for more than 10 years of which 11 had ossicular necrosis while 10 out of 67 patients having the disease less than 10 years had ossicular necrosis.

There was a positive association between duration of disease and ossicular defects, which was statistically significant with the Odd's ratio of 5.23 ($\chi 2$=10.36, p= 0.003) indicating longer the duration of disease, more chances are of ossicular necrosis.

Preoperative factors		**Normal Ossicles (N=35)**	**Occicular necrosis (N=10)**	**Total Patients**	**P Value**
Age	Less than 30 years	23 (66.67%)	4 (38.10%)	27	0.019
	Greater than 30 years	12 (33.33%)	6 (61.90%)	18	
Sex	Male	12 (36.23%)	5 (42.86%)	17	0.61
	Female	22 (63.77%)	6 (57.14%)	28	
Duration of Disease	Less than 10 years	28 (82.61%)	5 (47.62%)	33	0.003
	Greater than 10 years	6 (17.39%)	5 (52.24%)	11	

Table 1: Baseline Characters of Patients with Ossicular Necrosis (n=45)

Preoperative factors		**Normal Ossicles (N=35)**	**Occicular necrosis (N=10)**	**P Value**
Size of perforation	Small & Moderate	24 (69.57%)	2 (23.80%)	0.001
	Large & Subtotal	10 (30.43%)	8 (76.19%)	
Round Window Exposure	Yes	16 (47.83%)	7 (66.67%)	0.13
	No	18 (52.17%)	3 (33.33%)	
TM edge adhesion	Yes	15 (43.47%)	7 (71.43%)	0.04
	No	20 (56.52%)	3 (28.57%)	
IS joint area exposure	Yes	11 (33.33%)	7 (66.67%)	0.01
	No	23 (66.67%)	3 (33.33%)	
Air- Bone Gap (ABG)	<40 dB	31 (89.86%)	2 (19.5%)	0.001
	=>40 dB	3 (10.14%)	9 (80.95%)	

Table 2: Association of Preoperative Clinical Parameters with Ossicular Necrosis (n=45)

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Patients with Small (16 patients) and Moderate (37 Patients) perforation clubbed together (53 patients) and shown ossicular necrosis in only 5 patients. Large (20 patients) and Subtotal perforation (17 patients) grouped together (37 patients) out of which 16 patients had ossicular necrosis. The difference in the rate of ossicular necrosis in those two groups was statistically significant ($\chi 2=$ 13.92, $p < 0.001$, Odd's ratio=7.13).

	Normal Ossicles (N=35)	**Occicular necrosis (N=10)**	**P Value**
Mean ABG	37 ±3.75 dB	52.32 ± 4.50 dB	0.001

Table 3: Comparison of Mean Air-Bone Gap (ABG) with Ossicular Status (n=45)

Air- Bone Gap of ≤ 40 dB was seen in 66 patients, of which 62 (89.85%) patients had normal ossicles. In contrast, greater proportion of patients (17 out of 24 patients) with Air- Bone Gap of >40 dB shown ossicular necrosis ($p<0.001$, highly significant) (table II). Mean ABG of study population (n=90) was 40.58 ± 9.05 dB. 69 patients with normal ossicles had Mean Air- Bone Gap (ABG) of 37 ± 3.76 dB and 21 patients with ossicular necrosis found to have ABG of 52.32 ± 4.50 dB and the difference was statistically significant.

Ossicular Necrosis	**Frequency (%) (N=10)**	**Average Hearing Loss (Mean ABG +/- SD in dB)**
Isolated Lenticular Process	1 (9.52%)	49.16 dB +/- 1.82 dB
Isolated Long Process of Incus	5 (47.62%)	50.56 dB +/- 6.32
Isolated Malleus Handle	1 (4.76%)	44.6 dB
Malleus Handle and Long Process of Incus	1 (4.76%)	52.5 dB +/- 5. 61 dB
Long process of Incus and Stapes Super-structure	2 (19.05%)	56.52 dB +/- 4.13 dB
All three ossicles	1 (4.76%)	59.54 dB +/- 2.56 dB

Table 4: Distribution of Patients and Average Hearing Loss According to Ossicular Necrosis

DISCUSSION

On analyzing the relationship between ossicular necrosis and preoperative factors, we found that that patients of age above 30 years and duration of disease for more than 10 years were significant indicators of ossicular necrosis. Jayakumar CL et al noted similar finding on bivariate analysis. This could be due to negligence of patient to seek early treatment or inadequate treatment. As per Tripathi P et al study, those who had disease for more than 5 years were more were prone for incus necrosis. According to Chole and Chao, long standing CSOM can lead to the growth of granulation tissue and inflammatory products in the middle ear cleft that leads to significant bone erosion over a period of time.[6]

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In our study, Air- Bone Gap of >40 dB was found to be statistically significant preoperative indicator for ossicular necrosis. Similar observations were made by other studies which suggest that raised Pure Tone Audiometric threshold and Air Bone gap of >40 dB are good indicators of ossicular defects in mucosal type of CSOM. in Tripathi P et al study, Incus was found necrosed more frequently in patients who had moderate or moderately severe pre-operative hearing loss and the difference was statistically highly significant (p= 0.001). According Ingelstedt S et al study, an ABG of greater than 30 dB at 2 kHz and greater than 40 dB at 4 kHz increased the probability of ossicular discontinuity to 89 %. Carillo et al studied Pure Tone Audiometric Thresholds in patients who underwent tympano-mastoidectomy and found that a wide Air-Bone Gap at higher frequencies was more suggestive of incus necrosis. In contrast to this, according to Jeng et al, Air-Bone Gap is not a good predictor of ossicular necrosis as granulations could bridge the defect between eroded ossicles thus reducing the Air-Bone Gap.[7]

Presence of Middle ear granulations was found to be statistically significant predictor for ossicular necrosis in Ebenezer J et al and Jayakumar CL et al studies. While there was no significant association with respect to middle ear polypoidal mucosa with ossicular erosion in Srinivas C et al study. We could not find granulations in our cases intraoperatively as we included only dry ears in the study which can be the reason for this while other studies included both dry and wet ears.[8]

In our study, sex of patients and round window area exposure were also analyzed but were not found to statistically significantly associated with ossicular necrosis and the finding is consistent with other studies.[9] Menon AG et al found that, visualization of the handle of malleus, long process of incus, incudostapedial joint, stapes supra structure, Eustachian tube opening and the hypotympanum is statistically significantly better with the 300 and 700 endoscopes as compared to the microscope and should be incorporated in evaluation of middle ear in cases of CSOM.[10]

CONCLUSION

The risk of ossicular erosion in mucosal type of CSOM is higher, if the disease persists for >10 years, if the margin of the perforation is adherent to the promontory and if the air-bone Gap is >40 dB. This can help the surgeon to plan for ossicular reconstruction preoperatively.

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