Original Research Article

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 otitis media describes chronic middle ear disease and is defined as 'chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharge or otorrhoea through a tympanic membrane perforation. There is increased vascularity along with mucosal and submucosal inflammation and thereby increased inflammatory cells within the lamina propria that traverse through the broken basement membrane and enter middle ear lumen. **Materials and Methods:** This was a Cross Sectional Analytical study conducted in the Department of ENT, Santhiram Medical College and General Hospital, Nandyal from 1st March 2017 to 28th Feb 2019. 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:** 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. **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.

Keywords: Chronic otitis media, vascularity, perforation, lamina propria.

Introduction

Chronic otitis media describes chronic middle ear disease and is defined as 'chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharge or otorrhoea through a tympanic membrane perforation[1]. There is increased vascularity along with mucosal and submucosal inflammation and thereby increased inflammatory cells within the lamina propria that traverse through the broken basement membrane and enter middle ear lumen[2].

This will lead to osteitis with bone destruction in and around middle ear cleft. Presence of osteitis will in turn result in formation of granulations as well. Although ossicular erosion can be seen in both types of chronic otitis media, its incidence is comparatively low in mucosal type. The use of high resolution CT scan of temporal bone is valuable for detection of early erosive changes in the ossicles, particularly in the smaller parts such as the incudostapedeal junction[3].

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But this is not done routinely in mucosal type of COM[4].

Hence it is necessary to correlate clinical and audiological data so as to suspect ossicular damage this knowledge of ossicular necrosis before surgery can useful in pre-operative counselling, necessary preparation for anaesthetist for a longer duration of surgery and adequate preparation to address the ossicular damage[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, Santhiram Medical College and General Hospital, Nandyal from 1st March 2017 to 28th Feb 2019. 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. 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 5 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. Temporalis 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.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki Declaration of 1975, as revised in 2008.

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.As shown in Table I, 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 (table I).Association between preoperative Clinical parameters and Ossicular Necrosis was studied as shown in Table II. For statistical analysis purpose, 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). On otomicroscopic examination, round window niche was visible through perforation in 47 patients, but proportion of ossicular necrosis (14 patients) was not statistically significant in them ($\chi 2$ = 2.79, p=0.13). Adhesion between margins of Tympanic membrane perforation and promontory was seen in 45 patients of which 15 patients had ossicular necrosis and this was statistically significant correlation ($\chi 2$ = 5.03, p= 0.04, Odd's ratio= 3.25). The incudostapaedial joint area was visible in 37 patients and 14 patients had ossicular destruction with significant relationship ($\chi 2$ = 7.39, p= 0.01, Odd's ratio= 4) as shown in Table II.

Table 1: Association of Baseline Characters of Patients with Ossicular Necrosis (n=90)

Preoperative factors		Normal Ossicles (N=69) Frequency(%)	Ossicular Necrosis (N=21) Frequency (%)	Total Patients (n=90)	Chi- Square	P value	Odd's Ratio (95% CI)
Age	<30 years	46 (66.67%)	8 (38.10%)	54			
	>30 years	23 (33.33%)	13 (61.90%)	36	**5.476**	**0.019**	**3.203 (1.16-9.23)**
Sex	Male	25 (36.23%)	9 (42.86%)	34			**1.32(0.48-3.5)**
	Female	44 (63.77%)	12 (57.14%)	56	**3.006**	**0.61**	
Duration of disease	<10 years	57 (82.61%)	10 (47.62%)	67			**5.23 (1.81-15.06)**
	>10 years	12 (17.39%)	11 (52.24%)	23	**10.36**	**0.003**	

Table 2: Association of Preoperative Clinical Parameters with Ossicular Necrosis (n=90)

Preoperative factors		Normal Ossicles (N=69) Frequency	Ossicular Necrosis (N=21) Frequency	Chi- Square	P value	Odds Ratio (95% CI)
Size of perforation	Small and moderate	48 (69.57%)	5 (23.80%)			
	Large and total	21 (30.43%)	16 (76.19%)	13.92	<0.001	7.13 (2.37-24.33)
Round window exposure	Yes	33 (47.83%)	14 (66.67%)			
	No	36 (52.17%)	7 (33.33%)	2.29	0.13	2.18 (0.78-6.06)
TM edge adhesion	Yes	30 (43.47%)	15 (71.43%)			3.25
	No	39 (56.52%)	6 (28.57%)	5.03	0.04	(1.12- 9.37)

IS joint area exposure	Yes	23 (33.33%)	14 (66.67%)	7.39	0.01	4 (1.41-11.27)
	No	46 (66.67%)	7 (33.33%)			
Air bone Gap	≤40 dB	62 (89.86%)	4 (19.05%)	41.28	<0.001	
	>40 dB	7 (10.14%)	17 (80.95%)			

Table 3: Comparison of Mean Air-Bone Gap (ABG) with Ossicular Status (n=90)

	Normal Ossicles (N=69)	Ossicular Necrosis (N= 21)	t- Test	P Value
Mean ABG	37 + 3.76 dB	52.32 + 4.50 dB	15.60	<0.001
Mean Air- Bone Gap (n=90) = 40.58 + 9.05 dB				

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

Ossicular Necrosis	Frequency (%) (N=21)	Average Hearing Loss (Mean ABG +/- SD in dB)
Isolated Lenticular Process	2 (9.52%)	49.16 dB +/- 1.82 dB
Isolated Long Process of Incus	10 (47.62%)	50.56 dB +/- 6.32
Isolated Malleus Handle	1 (4.76%)	44.6 dB
Malleus Handle and Long Process of Incus	2 (9.52%)	52.5 dB +/- 5. 61 dB
Long process of Incus and Stapes Super-structure	4 (19.05%)	56.52 dB +/- 4.13 dB

Discussion

Defects of the ossicular chain may occur in all chronic middle ear diseases. Although it is most commonly seen in squamosal type of CSOM, it has been well established that it can also be seen in mucosal type of CSOM. Ossicular erosion in mucosal type of Otitis media is due to hyper vascularization, osteoclast activation, and bone resorption by means of overproduction of cytokines like Tumour Necrosis Factor (TNF)- alpha, Interleukin 2, Fibroblast Growth Factor and Platelet Derived Growth factor[6]. CSOM is thus an inflammatory process with a defective wound healing mechanism. It is more harmful when it stays for longer duration and when it is nearer to the ossicular chain. Ossicular necrosis more commonly occurs in finely constructed parts of the chain, mainly long process of incus and stapes superstructure where osteoclastic activity is abundant as compared to weak osteoblastic activity[7].

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)[8]. 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.

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[9].

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. 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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