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Original Article

Ear, Nose and Throat Section

Otoendoscopy and Audiometry Findings as Predictors of Ossicular Dysfunction in Mucosal Chronic Suppurative Otitis Media: A Cohort Study

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ABSTRACT

Introduction: Chronic Suppurative Otitis Media (CSOM) is chronic inflammation of epithelial lining of the middle ear cleft. Ossicular discontinuity and/or erosion is known in CSOM with cholesteatoma but at times it can be associated with tubotympanic CSOM which surprises the operating surgeon. This study to determine the relationship between preoperative and otoendoscopic findings in cases of CSOM was undertaken to facilitate the surgeon in planning about dealing the disease before rather than having surprise at exploration.

Aim: To study predictors of ossicular dysfunction in cases of mucosal CSOM.

Materials and Methods: This prospective cohort study of 64 cases was undertaken at Krishna Institute of Medical Sciences, Karad, Maharashtra, India, from November 2018 to April 2020. All cases were subjected to detailed clinical, otoscopic, and microscopic examination to assess the size of perforation, granulation tissue, tympanosclerosis, exposure of incudostapedeal joint, and condition of middle ear mucosa. A pure tone audiogram was also done. All cases underwent tympanoplasty with or without cortical mastoidectomy and the intraoperative findings of ossicular erosion were noted. All cases with granulation or polypoidal mucosa on otoscopic examination as well as mastoid exploration were subjected to histopathological examination for confirmation of disease pathology. Using Chi-square test with Yates continuity correction the variables data was processed and results were analysed.

Results: Out of the 64 cases, 15 (23.4%) had ossicular erosion. Bivariate analysis showed a positive association for middle age group between 31-40 years (p-value <0.001), long-duration of disease (p-value <0.004), polypoidal middle ear mucosa (p-value <0.002), granulations in the middle ear (p-value <0.001), and also when the incudostapedeal joint was exposed (p-value <0.005) through the subtotal perforation (p-value <0.022). On audiological evaluation moderate to moderately severe hearing loss (41-70 dB HL) (p-value <0.0015), and air-bone gap >40 dB (p-value <0.001) were associated with incus erosion. Intraoperative findings like aditus block (p-value <0.001) and mastoid granulations (p-value <0.001) were also found to be significant risk factors associated with incus erosion.

Conclusion: Preoperatively identifying the predictors of ossicular dysfunction like granulation tissue in the middle ear and raised pure tone audiometric average threshold can help the surgeon to better understand pathology of the disease and helpful too while counselling the patients to meet the realistic expected outcome of surgery.

Keywords: Granulation, Ossicular erosion, Preoperative indicators, Tubotympanic

INTRODUCTION

Otitis Media (OM) is a common disease of childhood [1,2]. Chronic inflammation of middle ear cleft leads to Chronic Suppurative Otitis Media (CSOM) which presents with recurrent ear discharge or otorrhoea through a tympanic membrane perforation for periods from six weeks to three months despite medical treatment [3,4]. Updated {World Health Organization (WHO) 2004} CSOM has been an important cause of middle ear disease since prehistoric times. Its prevalence depends to a great extent on race and socio-economic factors [5]. Otorrhoea and deafness are the classical symptoms of CSOM and is commonly associated with a conductive type of hearing loss. Ear aches, vertigo, deviation of angle of the mouth are less common otologic symptoms that are more indicative of CSOM complications [6]. The CSOM has been broadly classified as Tubotympanic Disease (TTD) and atticoantral disease. The TTD is known as the safe type as it is rarely associated with serious complications and atticoantral is known as the unsafe type as it is commonly associated with serious complications. Recently, CSOM is also classified as mucosal type and squamous type, if there is a perforation of the pars tensa it is the hallmark sign of the safe type of OM and perforation or retraction of the pars flaccida with retained squamous epithelial debris respectively. A distinction can be made between active CSOM when there is inflammation and the production of pus and inactive CSOM where there is no inflammation and secretion of pus, though there is the potential for the ear to become active [7]. The TTD may also present with resorptive osteitis along with long-term inflammation of the tympanic cavity and mastoid air cells [8].

Bone resorption (increase in osteoclastic activity or avascular necrosis) is characteristic of active suppurative OM of mucosal or squamous type. The state of chronic inflammation and granulation which occurs in CSOM is responsible for the increased osteoclastic activity. The affected bony components of the middle ear such as the ossicles show features of hyperemia with prominent histiocytes and proliferation of capillaries [5]. The long process of the incus, stapes crura, body of incus, and manubrium are involved in the above described order and frequency [9].

Ossicular erosion is more common in the atticoantral type of CSOM, although it is known to occur in both safe and unsafe type. Ossicular erosion is seen only during surgery. Even though it can be diagnosed on high-resolution computed tomography it is not done routinely in all cases of CSOM without cholesteatoma.

In cases of tubotympanic CSOM as there is no definite way to diagnose ossicular discontinuity preoperatively always. The prior information about ossicular status may be imperative while making surgical plan and its execution under appropriate anaesthesia as well as the materials that may be needed during ossiculoplasty. The relevant consents can also be obtained accordingly. This study, therefore, intended to identify predictive factors of clinical signs and investigations to diagnose ossicular discontinuity in cases of tubotympanic otitis media (safe type).

MATERIALS AND METHODS

A prospective cohort study was undertaken at Ear, Nose and Throat Department of tertiary care hospital from November 2018 to April 2020. The Ethical Clearance from the Institutional Ethics Committee was sought vide letter number KIMSDU/IEC/09/2018 dated 10/12/2018. Prior informed consent was obtained from all the participants in this study. A sample size of 64 cases was deduced (by referring a study by Jayakumar CJ et al., 2016) [10].

Inclusion and exclusion criteria: All cases with CSOM of mucosal type diagnosed clinically and further confirmed by otoendoscopic examination and having age more than 10 and less than 60 years, irrespective of gender and willing to participate were included in this study. All cases that had a previous history of ear surgery in the same ear, sensorineural hearing loss, congenital ear deformities and atticoantral variety of CSOM were excluded from the study.

Study Procedure

All cases underwent a detailed clinical examination which included otoscopy, assessment of hearing using tuning fork tests, pure tone audiogram using Goodman scale [11], and otoendoscopic examination was performed. The association between ossicular erosion and factors such as age, sex, duration of disease, size of tympanic membrane perforation, tympanosclerosis, condition of middle ear mucosa, and presence of granulation in the middle ear were also searched. Cases underwent tympanoplasty or cortical mastoidectomy with tympanoplasty under general anaesthesia based on the disease condition. The intraoperative findings of ossicular erosion were obtained and analysed. Size of the tympanic membrane perforation in the pars tensa will range from small <25%, medium 25-50%, large 50-75% and the perforation extending upto the annulus i.e., subtotal [12]. All cases with granulation or polypoidal mucosa on otoscopic examination as well as mastoid exploration were subjected to histopathological examination for confirmation of disease pathology. Amongst these cases the granulation tissue and polypoidal mucosa was found during surgical exploration and confirmed by histopathology in 11 and four cases, respectively.

STATISTICAL ANALYSIS

Categorical variables were presented using frequencies and percentages. Associations between categorical variables were assessed using the chi-square test with Yates continuity correction. The p-value <0.05 was considered statistically significant. All statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) 11.0 for windows.

RESULTS

All 64 cases having CSOM of age between 10 and 60 years were grouped. The mean age group in the present study was 35±8 years. The age group of 31-40 years had 12 cases (80%) and the least common age group was 21-30 years having three cases of ossicular erosion (20%) (p-value <0.001) [Table/Fig-1].

Amongst 64 cases studied, the duration of CSOM in 32 cases was more than 10 years, out of these 11(34%) were having ossicular erosion which was statistically significant (p-value <0.038). The prevalence of ossicular erosion was seen in 5 (64%) out of 8 case with subtotal perforation (p-value <0.022), 3 (75%) out of four cases having polypoidal middle ear mucosa (p-value <0.002) and 9 (82%) out of 11 showing presence of granulation in the middle ear (p-value <0.001) which was statistically significant [Table/Fig-2].

Age group (years)	Intact ossicles n=49		Ossicular erosion n=15		p-value between age group and number of cases with ossicular erosion
	Male	Female	Male	Female	
10-20	2	11	0	0	0.001*
21-30	3	5	1	2	
31-40	7	13	1	11	
41 -50	1	4	0	0	
51-60	1	2	0	0	
Total	14	35	2	13	

[Table/Fig-1]: Age and gender wise distribution of cases.
Chi-square (χ^2) *p-value <0.05 is significant

Variables		Number of cases having CSOM n=64	Intact ossicles n=49 (%)	Ossicular erosion n=15 (%)	p-value
Duration of disease	<10 years	32	28 (87.5)	4 (12.5)	0.038*
	>10 years	32	21 (65.6)	11 (34.3)	
Side of affected ear	Right	38	28 (73.6)	10 (26.3)	0.721
	Left	26	21 (80.7)	5 (19.2)	
Size of perforation	Large	38	30 (78.9)	8 (21)	0.022*
	Medium	15	14 (93.3)	1 (6.6)	
	Small	3	2 (66.6)	1 (33.3)	
	Subtotal	8	3 (37.5)	5 (62.5)	
Mucosal status	Normal	52	43 (82.6)	9 (17.3)	0.002*
	Edematous	5	4 (80.00)	1 (20.00)	
	Pale	3	1 (33.3)	2 (66.6)	
	Polypoidal	4	1 (25.0)	3 (75.0)	
Middle ear granulation	Yes	11	2 (18.1)	9 (81.8)	0.001*
	No	53	47 (88.6)	6 (11.3)	

[Table/Fig-2]: Findings observed on otoendoscopy.
Chi-square (χ^2) *p-value <0.05 is significant

Ossicular erosion was seen in 15 cases in which 13 had involvement of incus which was localised to the lenticular process in 8 (53.3%) and to the long process in 5 (33.3%). Handle of malleus was eroded in 2 (13.3%) cases.

On mastoid exploration, significant ossicular erosion was found in eight cases (p-value <0.004) with incudostapedeal joint discontinuity, nine cases (p-value <0.001) had granulations in the middle ear cleft and five cases (p-value <0.022) showing blocked aditus. Amongst 64 cases, the number of cases having tympanosclerosis was 14 (p-value=0.267) which had no relationship with ossicular erosion [Table/Fig-3].

Intraoperative examination	Intact ossicles	Ossicular erosion	p-value
IS joint discontinuity	0	8	0.004*
Middle ear cleft granulations	2	9	0.001*
Tympanosclerosis	13	1	0.267
Status of aditus			
Patent	44	10	0.022*
Blocked	5	5	

[Table/Fig-3]: Intraoperative findings of middle ear cleft.
Chi-square (χ^2) *p-value <0.05 is significant

On accessing hearing loss, a greater proportion of cases with ossicular erosion i.e., 11 out of 15 cases were found to have moderate to moderately severe hearing loss (41-70 dB HL) than those with intact ossicles, and the difference was found to be statistically significant (p-value <0.001). Most of the cases had

significant ossicular erosion with mean air-bone gap more than 40 dB (p-value <0.001) than those with intact ossicles [Table/Fig-4].

Hearing loss (dB)	Hearing loss (dB)	Intact ossicles	Intact ossicles	p-value
0-25	Normal	3	0	0.001*
26-40	Mild	16	2	
41-55	Moderate	21	4	
56-70	Moderately-severe	9	7	
71-90	Severe	0	2	
Total		49	15	
Air-bone gap (db)				
<40 db		47	10	0.001*
>40 db		2	5	

[Table/Fig-4]: Distribution of degree of hearing loss according to the Goodman Scale. (Pure tone average of 500, 1000, 2000 Hz); Chi-square (χ^2) *p-value <0.05 is significant

DISCUSSION

In the present study, total of 64 cases with CSOM-tubotympanic type were studied to find out predictors of ossicular dysfunction.

In this study, out of 64 cases having CSOM, intact ossicles were seen in 49 and ossicular erosion was seen in 15 during mastoid exploration. The incidence of ossicular erosion in this study was (23.4%), similarly Rout MR et al., in his study mentioned that the incidence of ossicular erosion is 19% [13]. The reason for higher incidence in this study could be long-standing ear disease for more than 10 years in cases enrolled for the study and may have lead to progressive bone erosion with repeated episodes of infection. The mean age group of this study was 35±8.5 years and the majority of the cases belong to the age group between 31 to 40 years. This could be due to early surgical intervention in this age group for complaint of ear discharge. This showed similar findings with Jareen E and Vedantam R [11]. In her study ossicular erosion is more common in age group between 26 to 50 years.

Chronic inflammation usually leads to fibrogranular disease and granulation tissue formation. In the present study, among 11 cases there was granulation tissue found at exploration, of these 9 (81.8%) were with ossicular erosion and 2 (18.1%) without. Thus, the presence of granulation tissue was significantly associated (p<0.001) with ossicular erosion which correlates with the study done by Chole RA and Sudhoff HH that states the middle ear granulations are known to cause ossicular erosion [14]. In this study, there was significant number of cases with visible incudostapedial joint 8 (64%) and subtotal perforation in 5 (53.3%) having associated ossicular erosion found at surgical exploration (p-value <0.004 and p-value <0.022).In a similar study by Rasheed RA et al., and Jeng FC et al., incudo-stapedial joint exposure and subtotal perforation respectively are also associated with incus erosion [15,16].

In present study, significant cases (75%) with incus erosion (p-value <0.002) had polypoidal middle ear mucosa which was in accordance with Jeng FC et al., where 76% of cases with ossicular erosion had polypoidal middle ear mucosa [16]. Significant hearing loss was seen in cases with ossicular erosion (p-value <0.001) as compared to cases with intact ossicles. Thus, in cases with moderate to severe hearing loss, there is a high probability of ossicular erosion which is in accordance with the study done by Jareen E and Vedantam R [11].

In this study, while analysing air-bone gap among 15 cases with ossicular erosion, in which 10 showed air bone gap less than 40 dB and five showed more than 40 dB (p-value <0.001). So, the presence of a higher air-bone gap can be considered as reliable predictor for ossicular erosion which was in accordance with the study done by Carillo RJC et al., in which he found a significant correlation between a higher air-bone gap and ossicular erosion [17].

In this study, out of 10 (16%) cases that had blocked aditus on mastoid exploration, five showed ossicular erosion. Hence, the presence of a blocked aditus can be considered as a significant factor contributing to incus erosion (p-value <0.001). This correlates with the study done by Rasheed RA et al., [15]

In this study, most commonly affected ossicle was incus followed by malleus whereas stapes was not affected at all. This was in accordance with the study done by Jayakumar CJ et al., where the incus is most commonly affected [10]. In this study other factors like gender and side of CSOM were also analysed in association with ossicular erosion and were not found to be statistically significant. This correlates with study done by Kim PE et al., [18]. The key strength of the present study was to find out the predictors of ossicular dysfunction prior to surgical exploration in CSOM. This pilot work done in this study would certainly be helpful in future similar studies about determining role of MERI (middle ear risk index) in CSOM.

Limitation(s)

Sample size was small is the only limitation of the study due to time constrain.

CONCLUSION(S)

The independent preoperative findings about ossicular erosion noted in this study were reliable predictors. The prior knowledge of ossicular dysfunction and its probable cause in cases of CSOM will always remain helpful during surgical intervention. Also, it would be advantageous during preoperative counseling about possible outcome of surgery and attempting surgical improvement in hearing.

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