

A cross sectional study of ossicular chain disruption in COM patients and associated pre-operative predictors in a tertiary care center

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Abstract

Aim: Both types of COM, mucosal as well as squamous may lead to erosion of the ossicles. Pre-operative assumption of ossicular necrosis enables the surgeon to plan surgical steps, duration for surgery and arrangement for specific equipments and materials required for ossiculoplasty. Our objective was to find out magnitude of ossicular chain discontinuity in COM patients and to find out its association with clinical presentation like duration of discharge and hearing loss, otoscopic examination, findings of X-Ray mastoid (lateral/oblique) and pure tone audiometry (PTA). **Method:** This is a descriptive type hospital based cross sectional study. 100 patients were included in the study. All the patients underwent preoperative otoscopy, PTA and X ray mastoid. All patients underwent needful otological surgery in form of tympanoplasty or mastoid surgery and findings including ossicular chain status and erosion of the individual ossicles were noted. **Results:** Ossicular chain was found to be disrupted in 43 cases. Our study showed positive correlation for retraction pathology (p=0.00), long standing history of ear discharge (p=0.269), sclerosed mastoid (p=0.00). Moderate type of conductive hearing loss was also associated significantly with ossicular necrosis (p= 0.00, 0.112). Incudo-stapedial joint exposure had no significant relation with ossicular erosion. **Conclusion:** We conclude that history, otoscopic findings, PTA and x-ray mastoid can be reliable pre-operative predictors of ossicular erosion. Ossicular chain erosion was more prevalent in patients having cholesteatoma, long duration of ear discharge & hearing loss, retraction pockets as compare to perforation, postero-superior quadrant involvement, moderate CHL and sclerosed mastoid.

Keywords ossicles; erosion; chronic otitis media; pre-operative presumption; cholesteatoma.

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Introduction

Chronic otitis media (COM) can give rise to ossicular discontinuity. Ossicular chain erosion may be a finding of active mucosal as well as squamous type of COM. This proclivity of ossicular erosion is quite higher in squamous type of COM, due to the existence of cholesteatoma and/or granulations [1]. The suggested mechanism for ossicular erosion in COM is chronic inflammation as a result of overproduction of cytokines-TNF alpha, interleukin-2, fibroblast growth factor and platelet derived growth factor, which promote hyper-vascularization, osteoclast activation and bone resorption leads to ossicular destruction [2]. The commonest ossicle confronted erosion in COM is the long process of incus due to its delicate structure, location and its tenuous blood supply. Second most common ossicle to get eroded is the supra structure of the stapes. Lastly the disease process in the

middle ear involves the handle of malleus. If timely intervention not done than progression of disease can lead to erosion of all ossicles except the stapedial foot plate [3]. Being a crucial part of hearing mechanism ossicular discontinuity reveals as conductive hearing loss (CHL) which results in communication problems impeding social interaction and professional life. CHL can be picked up by pure tone audiometry (PTA). It can be a useful tool to predict ossicular disruption pre-operatively but, it is confirmed when middle ear is explored intra-operatively [4]. In this scenario, preoperative information about ossicular status becomes important as the surgeon can be prepared for performing ossiculoplasty well in advance. Also, patients can be informed of the realistic estimate of hearing improvement after surgery. There are very few reports in the literature explicitly describing the relationship between preoperative findings and ossicular discontinuity as there is considerable ambiguity with respect to the reliability of the preoperative parameters. This information is also useful for anesthetists to use a longer acting anesthetic agent according to the estimated duration of surgery [5]. This study attempts to observe intra-operative ossicular status in both mucosal and squamous type of COM and to identify the relationship between different

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preoperative parameters and ossicular defects that could only be observed during surgery.

Material and methods

This is a hospital based cross-sectional, descriptive, observational type of study conducted in a prospective manner in the department of otorhinolaryngology and head & neck surgery of our institute from June 2018 to October 2019. 100 cases of COM both mucosal and squamous type were enrolled in the study. Patients with history of ear discharge and decreased hearing diagnosed as COM and being planned for the surgery were included in the study after getting written and informed consent. Those who had history of previous ear surgery for the same disease, who had history of trauma, were unfit for surgery and didn't want to participate in the study were excluded. The study was approved from the institutional review and ethical board. Demographic data and a detailed history with regard to otorrhoea, deafness, tinnitus, otalgia, vertigo, headache, fever, double vision was taken, and recorded in a systematic order, with special consideration of associated symptomatology suggestive of any impending or already established complications of the pathology. All the patients underwent preoperative otoscopy, PTA, X ray mastoid (Lateral / oblique) view, examination under microscope (EUM), hematological investigations and pre-anesthetic checkup (those whom planned for getting operate under general anaesthesia). In history special concern was on duration of discharge, duration of hearing loss and other symptoms. On otoscopy/EUM size & site of perforation and Incudo-stapedial joint status (if exposed) was noted and degree and type of hearing loss was noted by PTA. Needful otological surgery was performed in form of tympanoplasty or mastoid surgery. Intraoperative middle ear findings including ossicular chain status, and the erosion of the individual ossicles were noted. Ossicular status was correlated with clinical presentation and analyzed. A collected data was stored in M.S. Excel software. Qualitative data was expressed in rates & proportion. Continuous variables were summarized as mean and standard deviation and were analyzed using independent sample t test. Appropriate statistical test was used to see association Alfa significance. P-value <0.05 was considered as statistically significant.

Results

The present study was conducted on 100 patients, out of which 73 were in the non-cholesteatoma group and 27 were in the cholesteatoma group. There were 58 females and 42 males in the study population i.e. female dominance was noted. There was no age bar in the study, cases of all age groups were included. Mean age of the study subjects was 26.22 ± 10.88 years. Regarding laterality of disease 51 patients had left ear involved and 49 had right ear involved in the pathology. 39 patients had complaint of ear discharge from < 5 years, 29 had the same from 5-10 years and remaining 32 had it from > 10 years. In respect of hearing loss, 49 patients were suffering from hearing loss for < 3 years, 27 patients for 3-5 years and rest 24 patients for > 5 years. All subjects underwent PTA which showed 94 cases had conductive hearing loss (CHL), 1 had sensori-neural hearing loss (SNHL) and 5 had mixed hearing loss i.e. CHL was dominant in study population. After calculating degree of hearing loss from PTA, we noted that maximum cases (51%) had moderate hearing loss followed by mild (45%), moderately severe (2%) and severe (2%) hearing loss. On otoscopic examination, 27 cases found to have retracted tympanic membrane (TM) whereas remaining 73 had perforated TM. Table 1 is showing site of TM involved in pathology. 21 patients showed exposed incudo-stapedial joint whereas in 79 cases it was not exposed. X-ray mastoid was showing well pneumatization in 51 cases followed by diploic in 26 and sclerosed in 23 cases. Study population was divided into cholesteatomatous and non-cholesteatomatous groups and evaluated for ossicular chain status [Table 2, Figure 1]. 57 cases had intact ossicular chain and 43 found to have its disruption. Table 3 and figure 2 is

showing details of ossicular erosion. We studied pre-operative determinants and their association with ossicular chain status. Data related to various pre-operative factors and ossicular chain status is tabulated in table 4. After observing various factors pre-operatively and correlating them with ossicular status noted intra-operatively, we found that ossicular chain erosion was more prevalent in patients having cholesteatoma, long duration of ear discharge & hearing loss, retraction pockets as compare to perforation, postero-superior quadrant involvement, moderate CHL and sclerosed mastoid. Exposed I-S joint had no correlation with ossicular erosion.

Discussion

Defects of the ossicular chain may occur in all chronic middle ear diseases, with or without cholesteatoma. Discontinuity of the ossicular chain is confirmed only during an operation. The ability to predict the presence of ossicular discontinuity in a patient using certain pre-operative factors, would be of benefit in allowing the surgeon to plan ahead with regard to the need for an ossiculoplasty and also to give the patient a realistic explanation of the expected outcome. In our study there were 100 patients with mean age of 26.22 years and maximum ossicular chain disruption was found in patients of age group of 21-30 years which was 34.9%. Jayakumar et al [5] reported the age of patients ranged from 15 to 56 years and the mean age was 29 years. Majority of the patients were in the age group of 21-30 years (40.6%) and Anglitiou et al [6] also reported that the most commonly affected age group was between 18 and 30 years. This early presentation may be due to increased awareness to health issues and difficulty in hearing affecting the efficiency of work, leading patients to seek early medical intervention. In our study there were 58 females and 42 males. Ossicular disruption was found in 58.1% of females and 41.9% of males. In a study conducted by Jayakumar et al [5] more than two-third (68.1%) of the patients were women. The study by Srinivas et al [7] comprised of 47 patients, 16 (34%) males and 31 (66%) females. There was no statistically significant difference between males and females with respect to ossicular discontinuity ($P = 0.857$). Out of 100 patients in our study 51 patients had disease in left ear and 49 in right ear. Ossicular disruption was found more in right ear which was 51.2%. To the best of our knowledge no previous studies focused on this aspect. In the present study out of 43 cases of ossicular disruption, maximum cases had history of discharge from 5-10 years (37.2%). Whereas Jayakumar et al [5] reported ossicular necrosis in patients having >10 years duration of discharge. Saurabh Varshney et al [1] observed that duration of ear discharge ranged from 6 months to 50 years, with maximum 39 cases (26.00%) having duration between 10 and 15 years. In a study by Srinivas et al [7] among five patients who had ossicular defects, four had duration of the disease for more than 10 years, there was a positive correlation between duration of disease and ossicular defects. In this study retraction pathology showed more ossicular disruption that is 53.5% as compared to perforation. In central and subtotal perforation, central one had more disruption (30.2%). This finding was not in relation with study of Rout et al where subtotal perforation showed more ossicular disruption compared to central one [8]. On evaluation of the perforation in a study by Srinivas et al [7] 36 patients (76.5%) had a central perforation (including small, medium, and large central perforations), while 11 (22.5%) patients had a subtotal perforation. Among five patients with ossicular defects, two (40%) had central perforation, while three (60%) had subtotal perforation. Study of Tripathi et al [3] also showed that ossicular involvement was more common in subtotal perforation than other types of perforation. Our study showed that ossicular disruption was more in pathologies which was involving the postero-superior quadrant of tympanic membrane. In study by Tos et al [9] maximum disruption was found of incus (74-88%) followed by malleus and stapes. Ebenzer et al [4] observed that incus and malleus were eroded on equal frequency (16%) followed by stapes erosion. Study by Thomson and his colleagues [10] also reported that incus

is the most common ossicle to be involved in necrosis. Similarly, our study also described the same finding. Our study showed that exposure of IS joint on otoscopy does not correlate with necrosis of ossicles as out of 43 cases of disrupted ossicles, only 9 cases had exposed IS joint (p = 0.816). In study by Tripathi et al [3] 32.8% cases had exposed IS joint, and out of these, necrosed incus was seen in 14.9% cases. Exposed incudo-stapedial joint had positive correlation with 8 out of 13 patients having ossicular necrosis (p=0.005) in study by Rasheed et al [11]. Ebenezer et al [4] noted IS joint erosion in 23 out of 150 patients. Ossicular necrosis, according to all the current studies on the subject, predominantly affects the long process of incus. This has been the finding in patients with and without cholesteatomatous ear disease. Mirko Tos [9] studied 674 ears of COM without cholesteatoma found that 56 (8.31%) cases had necrosis of the long process of the incus and incus was the most common ossicle to undergo necrosis, irrespective of the type of disease. Similarly, Jeng et al [12] found that of the 153 ears without cholesteatoma studied, 17 (11.1%) had ossicular necrosis, all of which occurred in the region of the incudo-stapedial joint. The present study was conducted on 100 patients, out of which 73 were in the non-cholesteatoma group and 27 were in the cholesteatoma group. Non-cholesteatoma group consisting of 73 patients carried an incidence of 39.5% of ossicular chain disruption while in cholesteatoma group it was found to be 60.5% in 27 patients. In a study by Karja et al [13] regarding the ossicular chain erosion in chronic suppurative otitis media, in infected ears without cholesteatoma, the ossicular chain was disrupted in 59–78% cases. The prospective study by Srinivas et al [7] included a total of 47 patients diagnosed to have tubo-tympanic type of COM out of which 42 (89%) patients had intact ossicles and 5 (11%) patients had ossicular discontinuity. In the present study, hearing loss associated with ossicular defects was evaluated and conductive type (88.4%) of hearing loss with moderate

degree (67.4 %) was found to be more associated with disrupted ossicles. In study by Tripathi et al [3] most patients were of conductive hearing loss with moderate, and moderate to severe hearing loss, more frequently associated with incudal necrosis (p=0.01). Jayakumar et al [5] also found that moderately severe hearing loss was a significant indicator in bivariate analysis which corroborates with findings. In a study by Ebenezer et al [4] moderate to moderately severe hearing loss (41- 70 dB) was the finding in most cases of incus necrosis (91.7%). In study by Tripathi et al [3] 71.71% cases had poor mastoid pneumatization out of which 51.51% cases had necrosed ossicle. Jeng et al [12] found that 12 out of the 17 cases in their study with ossicular discontinuity had poorly -pneumatized mastoids, as judged by their appearance on mastoid X-rays. A less pneumatized mastoid would signify a long-standing active ear disease and thus point towards chances of having ossicular necrosis.

Conclusion

Present study concludes that history, pre-operative PTA, otoscopy and x-ray mastoid all are few pre-operative predictors which point towards ossicular status of the patient to some extent. Incus is the most frequently encountered ossicle in erosion process. We found that ossicular chain erosion was more prevalent in patients having cholesteatoma, long duration of ear discharge & hearing loss, retraction pockets as compare to perforation, postero-superior quadrant involvement, moderate CHL and sclerosed mastoid. Exposed I-S joint had no correlation with ossicular erosion.

Ethical Approval

All procedures performed in presented study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Table 1: Site of tympanic membrane involved in disease

Site	Ossicular chain status					
	Intact		Disrupted		Total	
	N	%	N	%	N	%
All quadrants	37	64.9	18	41.9	55	55.0
Antero-inferior	9	15.8	1	2.3	10	10.0
Inferior	1	1.8	0	0.0	1	1.0
Postero-inferior	4	7.0	1	2.3	5	5.0
Postero-superior	6	10.5	23	53.5	29	29.0
Total	57	100.0	43	100.0	100	100.0

* p-value = 0.000

Table 2: Ossicular chain discontinuity and association with cholesteatoma

Group	Ossicular chain status						p-value
	Intact		Disrupted		Total		
	N	%	N	%	N	%	
Cholesteatoma	1	1.8	26	60.5	27	27.0	0.000
Non-cholesteatoma	56	98.2	17	39.5	73	73.0	
Total	57	100.0	43	100.0	100	100.0	

Table 3: Ossicular status

Ossicular status	N	%
Intact	57	57.0
Isolated incus erosion	34	34.0
Incus + stapes erosion	2	2.0
Incus + malleus erosion	7	7.0
Total	100	100.0

Table 4: Showing various pre-operative factors and associated ossicular chain status

Factors	Ossicular chain status				Total (%)	p-value
	Intact		Disrupted			
	N	%	N	%		
Sex						

Male	24	42.1	18	41.9	42 (42)	0.857
Female	33	57.9	25	58.1	58 (58)	
Laterality of disease						
Right	27	47.4	22	51.2	49 (49)	0.862
Left	30	52.6	21	48.8	51 (51)	
Duration of discharge						
< 5 years	25	43.9	14	32.6	39 (39)	0.269
5-10years	13	22.8	16	37.2	29 (29)	
>10 years	19	33.3	13	30.2	32 (32)	
Duration of hearing loss						
< 3 years	32	56.1	17	39.5	49 (49)	0.015
3-5 years	9	15.8	18	41.9	27 (27)	
>5 years	16	28.1	8	18.6	24 (24)	
Type of hearing loss						
Conductive	56	98.2	38	88.4	94 (94)	0.112
Sensorineural	0	0	1	2.3	1 (1)	
Mixed	1	1.8	4	9.3	5 (5)	
Degree of hearing loss						
Mild	35	61.4	10	23.3	45 (45)	0.000
Moderate	22	38.6	29	67.4	51 (51)	
Moderately severe	0	0	2	4.7	2 (2)	
Severe	0	0	2	4.7	2 (2)	
TM findings						
Central perforation	55	96.5	13	-	68 (68)	0.000
Retraction pocket	1	1.8	26		27 (27)	
Subtotal perforation	1	1.8	4		5 (5)	
I-S joint						
Exposed	12	21.1	9	20.9	21 (21)	0.816
Not exposed	45	78.9	34	79.1	79 (79)	
Mastoid pneumatization						
Pneumatized	45	78.9	6	14.0	51 (51)	0.000
Diploic	9	15.8	17	39.5	26 (26)	
Sclerosed	3	5.3	20	46.5	23 (23)	

*TM- tympanic membrane, *I-S incudo-stapedial

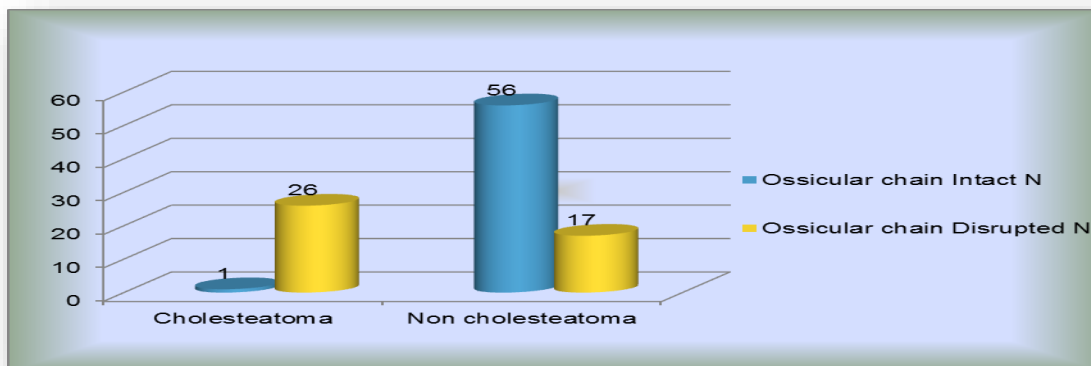


Fig 1: Ossicular chain discontinuity and association with cholesteatoma

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