



## Pre-Operative Predictors of Ossicular Status in Chronic Supportive Otitis Media

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Article History	Abstract
Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 03 Nov 2023	<p><b>Introduction:</b> Chronic suppurative otitis media is associated with ossicular necrosis. Both safe and unsafe CSOM have incidence of ossicular necrosis. This study will provide the much-needed insight, into the factors which can act as significant predictors for the intra operative ossicular status, and help in better preparing the patient before the surgery and need for ossiculoplasty. Furthermore, narrowing down to the most significant ly related predictors, it may also be possible to reduce the financial burden on the patient, something which is of prime importance in a resource limited country like ours.</p> <p><b>Objectives:</b> pre-operative predictors of intra operative ossicular status in chronic suppurative otitis media and effect of duration of disease on hearing threshold and ossicular-status. <b>Material and methods:</b> A descriptive observational study was done in a Tertiary care referral center. A total number of 124 patients with the clinical diagnosis of CSOM were selected from outpatient department and admitted. All patients were subjected to otoendoscopy, X-ray mastoid (Schiller's view) and pure tone audiometry. All patients underwent tympanomastoidectomy. Preoperative findings on the basis of history, examination and investigations were noted along with findings of intraoperative ossicular status. Findings were tabulated and statistical test were applied to determine significant preoperative predictors of iv intraoperative ossicular status. <b>Results:</b> Intraoperative ossicular necrosis was seen in a total number of 43 patients. On; univariate analysis, blood-stained discharge (<math>P &lt; 0.0001</math>), purulent consistency of ear discharge (<math>0 &lt; 0.0(01)</math>), associated symptoms of vertigo (<math>p = 0.0047</math>), otalgia (<math>p = 0.0019</math>), size (<math>p = 0.0042</math>) and f site (<math>p = 0.0041</math>), severity of hearing loss (<math>p = 0.004</math>), sclerotic mastoid air cell (<math>p = 0.0001</math>) had significant association with ossicular necrosis. The duration of disease and hearing threshold did not have statistically significant association (<math>p = 0.227</math>). <b>Conclusion:</b> Ossicular necrosis is best indicated by the presence blood-stained and purulent discharge, vertigo, otalgia, total perforation, severe degree of hearing loss and sclerosed mastoid. Incus was the most common necrosed ossicle followed by malleus followed by stapes, Duration of disease did not have a significant connotation with hearing threshold.</p> <p><b>Keywords:</b> Otitis media, Otoendoscopy, Ossicles, Ossiculoplasty, Necrosis, Pre-operative predictors.</p>
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### 1. Introduction

CSOM is defined as a permanent perforation in tympanic membrane (TM) with chronic middle ear infection. There are usually 2 types of CSOM i.e., tubotympanic (safe) & atticoantral (unsafe). Ossicular chain erosion can be seen in both safe and unsafe type of diseases (1). CSOM develops with onset of inflammation in the middle ear but there is a defective wound healing mechanism. There is inflammation which leads to activation of various factors and cytokines, activation leading to osteoclast activation and bone resorption. Thereby resulting in a break in continuity of ossicles (1,2).

Intraoperative ossicular necrosis can be present in both tube-tympanic and atticoantral CSOM. Thus, the surgeon can be ready for the ossicular chain reconstruction, prognosis of disease and surgical

outcome if he has preoperative knowledge of ossicular status. Attica-antral type has cholesteatoma with ossicular erosion, but ossicular discontinuity and erosion can also be seen in safe (tubotympanic) type of CSOM which often comes as a surprise for the surgeon (3,4).

Hence this study will provide the much-needed insight into the factors which can act as significant predictors for the intra operative ossicular status, and help in better preparing the patient before the surgery.

## 2. Materials And Methods

This was a descriptive study done in a tertiary referral center with a minimum number of 119 patients as per inclusion criteria of patients with a, clinical diagnosis of chronic suppurative otitis media who were planned for surgery with a age group- 09 years to 60 years. Patients who have been operated previously chronic suppurative otitis media with intra-complications, history of noise induced hearing loss or acoustic trauma, history of trauma, history of ototoxic drugs and mentally ill patients were excluded from the study. Case recording form was used for the generation of data and each of the patient was subjected to history and clinical examination of ear, nose and throat.

Findings were noted using pneumatic otoscope (Welch Allyn diagnostic otoscope of 3.5V) and Karl-Storz Rigid O-degree Oto-endoscope (0.2-4mm) and O-degree endoscope (4mm) which was done on a day prior to surgery Pure tone audiometer (Inter-acoustic AC40 and Goodman's classification was used for auditory thresholds in hertz.

X-ray Bilateral mastoid (Schuller's view) was done and pneumatization of mastoid air cells was noted. Documentation of Oto-microscopic findings done via Leica-M400E operating microscope and statistical correlation was done using Univariate analysis and p-value < 0.05 was considered statistically significant.

### Ethical Statement

This study was approved by the ethics committee of Himalayan institute of medical science, Dehradun, Uttarakhand.

## 3. Results and Discussion

Most of the patients belonged to the age group of less than 40 years with average age of patients was 29.39±10.79 years. Female predominance was seen with male to female ratio being 1:1.33. More cases were from rural areas comprising of 81 (65.3%) cases while-43 (34.6%) resided in urban areas. Ear discharge was the most common present ing complaint seen in 109 cases (87.90%) out of which unilateral ear discharge present in 89 (81.65%) and'20 (18.34%) had bilateral ear discharge, followed by hearing loss which was present in 100 cases (80. 64%).

Intraoperatively most patients had intact ossicles i.e. in 81 (65. 32%) while ossicular-necrosis was present in 43 (34. 67%) patients with CSOM. Highest ossicular necrosis was present in patients who had duration of ear discharge from 21-30 years. All the patients with 'ossicular-necrosis' had a percentage between 30-50% in almost all groups of duration of ear discharge and the result was not statistically noteworthy (p value=0.6083).

While assessing the character of ear discharge blood stained i discharge had a statistically significant association with ossicular necrosis (p value <0.0001). Amount of discharge was not found to be statistically significant (p value=0.1311) association. On the basis of consistency of discharge, purulent discharge had highest ossicular necrosis i.e., 100% and was statistically significant (p value <0.0001) (Table 1).

**Table 1:** Pro-operative predictors of ossicular status in CSOM.

Character of ear discharge		Number of patients (%)	Ossicles Necrosed	Ossicles Intact Number	p value
<b>Blood stained</b>	Present	40(36.66)	28(70),	12(30)	<0.0001
	Absent	69(63.30)	12(17.4)	57(82.6)	
<b>Consistency</b>	Mucoid	40(36.69)	9(22.5)	31(77.5)	<0.0001
	Mucopurulent	68(62.38)	30(44.1)	38(55.88)	
	Purulent	1(0.91)	1(100)	0	
<b>Associated symptoms</b>					
<b>Vertigo</b>	Present	28(22.5)	16(57.1)	12(42.85)	0.0047
	Absent	96(77.41)	27(28.1)	69(71.87)	
<b>Tinnitus</b>	Present	78(62.90)	33(42.3)	45(57.69)	0.0204
	Absent	46(37.09)	10(21.7)	36(80.26)	

<b>Otalgia Present</b>	57(45.96)	28(49.1)	29(50.87)	0.0019
Absent	67(54.03)	15(22.38)	52(77.61)	

Associated symptoms of vertigo and otalgia had significant association with ossicular necrosis with (p value=0.0047) and (p value=0.0019) respectively while tinnitus had no significant association with a p value of 0.0204 (Table 1).

Site and size of perforation were a significant preoperative predictor of ossicular status (Table 2).

**Table 2:** Otoendoscopic findings: Site of perforation

<b>Otoendoscopic findings: Site of perforation</b>				
Anterior	1(1.13)	0	1(100)	
Posterior	1(1.13)	0	1(100)	
Inferior	22(25)	2(9.09)	20(90.9)	
Anterior—inferior	14(15.90)	1(7.14)	13(92.8)	1041*

As the number of involved quadrants of *pars tensa* increases, incidence of ossicular necrosis increases (p value=0.041). While presence of cholesteatoma and granulation were not considered significant predictors with a p value=0.2705. Status of middle ear mucosa (p value =0.7616) and presence of myringo-sclerosis (p value =0.1337) did not have significant association with ossicular necrosis.

A greater portion of patients with ossicular necrosis had severe and moderately severe hearing loss and this data was statistically significant as the severity of hearing loss increases, incidence of ossicular necrosis increases (p value =0.004) while the type of hearing loss (p value =0.117) had no significant association with ossicular necrosis (Table 1). All the patients of ossicular necrosis had sclerotic pneumatization on X-ray mastoid with a significant p value of (p value of 0.0001).

#### **Duration of disease with hearing threshold:**

Only patients who had ear discharge were considered, Maximum number of patients had duration of disease less than 5 years i.e., 56(51.73%). out of which maximum had mild hearing loss i.e., 25 (44.64%) and only 2 (1.83%) had duration of disease between 21-25 years.

As the duration of disease increased, the severity of hearing loss also increased although this relation between duration of disease and hearing threshold was not statistically significant (p value of 0.227) (Table 3).

**Table 3:** Relation of duration of disease on hearing threshold (n=109)

<b>Duration of disease</b>	<b>Number of patients</b>	<b>Minimal (0-25)</b>	<b>Mild (26-40)</b>	<b>Moderate (41-55)</b>	<b>Moderately severe (56-70)</b>	<b>Sever (71-90)</b>	<b>Profound (&gt;91)</b>	<b>p value</b>
<5	56(51.37)	4(7.14)	25(44.6)	12(21.42)	12(21.42)	3(5.35)	0(0)	0.227
6-10	20(18.3)	2(10)	5(25)	7(35)	4(20)	0(0)	2(10)	
11-15	10(9.17)	0(0)	5(50)	2(20)	3(30)	0(0)	0(0)	
16-20	8(7.33)	1(12.5)	2(25)	4(50)	1(12.5)	0(0)	0(0)	
21-25	2(1.83)	0	0	1(50)	1(50)	0	0	
26-30	4(3.66)	0	0	3(75)	1(25)	0	0	
>30	9(8.25)	0	4(44.4)	4(44.4)	1(11.11)	0	0	
Total	109	7(6.42)	41(37.6)	33(30.27)	23(21.10)	3(2.75)	2(1.83)	

In our study we had ossicular necrosis in 43 patients (34.67%) which was similar to a study by Shanna et al., where ossicular necrosis was present in 35 % of the population (5). Haidar et al. reported an intact ossicular chain in 213 (76.4%) out of the 279 patients whereas in our study it was intact in 81 (65.32%) cases (6). Varshney et al. found the intact ossicular chain in 92 (61.34%) cases (7). Udaipurwala et al. found ossicular chain intact in 69 out of 145 patients (47.6%) and necrosed ossicular chain in 76(52.4%) patients of CSOM and thus had higher percentage of ossicular necrosis than our study (8). The most frequently encountered pathological osseous changes in CSOM are bone resorption, fibrous thickening of mucoperiosteum, osteitis and granulation tissue and tympanosclerosis.

Out of 109 cases of ear discharge 63.3% cases had intact ossicles and most number of patients (36 cases) were present in duration less than 5 years also 20 cases of ossicular necrosis were seen in the similar group of duration. this showed that with the increasing duration of ear discharge the proportion of ossicular necrosis also increases. Tripathi et al. in their study concluded that with a continuous ear discharge and chronicity of disease of greater than 5 years in cholesteatoma ears had a significant

association with necrosis of incus. this could be attributed to the persistent ear discharge resulting in severe inflammation and leading to bone destruction (9).

Veeranjaneyulu et al., in their study had 30 patients (60%) with history of mucopurulent discharge, 15(30%) with mucoid discharge and 5 patients (10%) with blood -stained discharge and consistency had significant association with ossicular necrosis (10). Garg et al. had 30% of the cases were having mucoid discharge in the middle ear while we had around 34% of cases with mucoid discharge which was quite similar (11). blood-stained discharge, and scanty amount of discharge are features of unsafe CSOM which has higher chances of ossicular-necrosis.

We had 28 cases where vertigo was present (22.5%) out of which 57.1% (16 cases) had ossicular necrosis is as seen in our study. Tinnitus and otalgia were present in 78 (62.9%) and 57(45.9%) cases respectively and ossicular necrosis was seen in 33 cases in which tinnitus was present and 28 cases where otalgia was present. While in study by Veeranjaneyulu et al. incidence of tinnitus was seen in 36% and vertigo in 4% cases only which was quite low than ours (10).

Even Pragya Singh et al. had a lower incidence of cases of otalgia i.e., in 11.84% and\_ tinnitus in 30.26% (12). Vertigo and tinnitus are presentations usually associated with unsafe CSOM. Otagia in CSOM points towards acute infection and unsafe CSOM thus explaining the higher incidence of ossicular necrosis. In our study, around 41 (46.59%) cases had perforation in all quadrants of pars tensa, followed by inferior in 22 cases (25%) while in study by Ebenezer et al., fifty-two percent of the patients had large perforations which had involvement of three or more than three quadrants and as far as the site was concerned, more than one third of cases had involvement of posterior-superior quadrants (13). In a study of Jayakumar et al. had 62.3% cases had a large central perforation while in our study large central perforation was present in 27 cases (30.68%) and only a small portion of patient that is 3.40% had marginal perforation and subtotal perforation was present in 13 cases (14.77%) (14).

Thakur et al. showed that large central perforation was present in 50% cases while subtotal perforation was present in 43.6% cases and 6.39% cases had small perforation while we had a lower percentage of large central perforations (15). Large perforations in our study had a higher percentage of ossicular necrosis i.e., in 37.03%. In a study by Tripathi et al. 44.7% of the population had subtotal perforation, while there were 20.89% patients having subtotal perforation who had necrosed incus while we had 14.77% patients having subtotal perforation, out of which 30.76% had ossicles necrosed (9). Rout et al. in their study had 38 cases of with ossicular. necrosis out of which 8 cases had central perforation while 30 cases had subtotal perforation (16).

Subtotal perforation and large perforation are associated. with higher ossicular necrosis. It is explained on the basis that larger perforation has more atmospheric exposure of the middle ear mucosa to the allergens present in the atmosphere such as microbes, dust and water. this results in inadequate vascularity thus resulting in higher ossicular necrosis In our study granulation was seen in a significantly higher proportion of patients with necrosis and similar result was also seen by Jeng et al. (3).

Chole stated that bone erosion can also be caused by granulation tissue. Further, they concluded that it is not only the existence of cholesteatoma which can result in bone resorption but it is the additive effect of both infection and inflammation as seen in granulation tissue which results in higher incidence of bone resorption (17). 72 cases (81.88%) having normal mucosa, 22.22% of the cases has ossicular necrosis.

In a study by Sandeep and colleagues they had thirteen (13%) cases with edematous middle ear mucosa which was similar to our study (18). Edematous middle ear mucosa can result in aditus blockage thereby decreasing the ventilation of the mastoid thus resulting in active discharge which eventually leads to ossicular necrosis. Ossicular necrosis is accounted for compromise in its blood supply as a result of edematous mucosa encasing the ossicles and the resultant persistence of infection around the ossicles.

Safe CSOM results in resorptive osteitis of ossicular chain thus resulting is resorptive osteitis. Myringo-sclerosis was seen in 20 cases only out of which 4 cases (20%) had necrosis while in rest of the cases where myringo-sclerosis was absent, 39 cases (37.5%) had ossicular necrosis. Even in the study by Thakur et al. there were 14.53% cases with ossicular erosion" over 172 patients which was though lower than us but they had 2.9% cases of tympanosclerosis in middle ear. Such low percentage of sclerosis was also seen in study by Sandeep et al. where they had 6% tympanosclerosis (15,18).

Myringo-sclerosis has significant effect on hearing thresholds. Myringo-sclerosis can also be associated with sclerosis of ossicular joints and thus resulting in fixation of ossicula chain and thus affecting hearing. Although, in our study no direct relation was 'seen between myringo-sclerosis and ossicular necrosis. Ebenezer et al. in their study had a greater proportion of patients who had moderate to

moderately severe hearing loss (41-70 dB) and this had significant association with necrosis of incus, findings of which was similar to our study (13).

Sharma et al. also had a similar result where ossicular-necrosis was maximum when X-ray mastoid showed a cavity in the mastoid. None of the patients with a cellular mastoid had ossicular disruption (5). In sclerotic X-ray there is involvement of mastoid air cells which is attributed to the bone eroding process which has higher changes of ossicular necrosis. Maximum number of patients had duration of disease less than 5 years i.e., 56(51.73%) out of which maximum had mild hearing loss i.e., in 25(44.64%) and only 11(20.83%) had duration of disease between 21-25 years. As the duration of disease increased, the severity of hearing loss also increased. Similar findings were concluded in a study done by Mahajan et al., where duration of disease had significant effect on levels of hearing threshold. In their study they, noted that 62% of patients with duration of ear discharge more than 10 years had moderate and moderately severe hearing loss as compared to 38% patients who had duration less than 10 years (19).

On analysis, incudal necrosis was most common i.e. in 23.25% when compared to malleus and stapes which were found to be necrosed in 11.62% and 2.32% respectively. Austin in his study classified ossicular chain defects in a group of 1151 ears and found out that incus necrosis was the commonest of all ossicular defects i.e., 29.50% cases (20). Contrary to our study, Sade et al., in their study found out that malleus and incus had equal incidence of necrosis (21).

Incus is most susceptible to ossicular necrosis followed by stapes because of delicate framework of these bones and increased osteoclastic activity as compared to osteoblastic activity and its poor blood supply. Although, lenticular process has higher incidence of necrosis as compared to long process-of incus in most of the studies, our study showed long process having higher incidence of ossicular necrosis.

#### 4. Conclusion

We concluded that best predictors of ossicular necrosis are blood stained and purulent ear discharge, vertigo, otalgia, total perforation, severe hearing loss and sclerosed-mastoid. Duration of disease had no statistically significant association hearing threshold. Most common ossicle to be involved was incus followed by malleus followed by stapes. This preoperative knowledge can affect the surgical decision and the surgeon can be prepared for the need for hearing reconstruction via ossiculoplasty.

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