

Incidence and Preoperative Predictive Indicators of Incudal Necrosis in CSOM: A Prospective Study in a Tertiary Care Centre

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Abstract Both type of CSOM, tubotympanic which is considered safe as well as atticointral which is considered unsafe may lead to erosion of the ossicular chain. Discontinuity of the ossicular chain is typically confirmed only during an operation. Knowing before surgery whether the patient has an ossicular discontinuity is important because it allows the surgeon to know the possibility of performing an ossiculoplasty and obtaining patient consent. The aims is to (1) study the incidence of incus necrosis in safe and unsafe CSOM. (2) Determine the preoperative predictive factors for incus necrosis. (3) Use angled otoscopes to determine the incidence of residual disease peroperative after conventional microscopic surgery. This is a prospective study carried out in the department of otorhinolaryngology, Govt Doon medical college, Dehradun from July 2014 to July 2016. A total of 100 patients who presented with CSOM and have not undergone any surgical procedure for the same were included in this study. Patients group was divided into cholesteatoma and non cholesteatoma group. Both groups were subdivided into intact and eroded incus group and were analysed in 11 parameters which were compared statistically. Incudal necrosis is more common in cholesteatoma group. In non cholesteatoma ears subtotal perforation with exposure of IS joint is reliable indicators of incudal necrosis. In non cholesteatoma group extension of cholesteatoma to tympanic sinus and mastoid and presence of persistent discharge are reliable indicators of necrosed incus. Moderate to moderately severe hearing loss indicate incudal necrosis in both groups therefore we conclude that these parameters can be reliably

considered as predictors for incudal necrosis preoperatively.

Keywords CSOM · Cholesteatoma · Ossicles · Incus

Introduction

Chronic suppurative otitis media (CSOM) can cause a wide range of pathologies in the middle ear that includes irreversible mucosal changes, granulation tissue formation, cholesteatoma, tympanosclerosis and ossicular destruction [1].

Both types of CSOM, tubotympanic which is considered safe, as well as atticointral which is considered unsafe, may lead to erosion of the ossicular chain. The proposed mechanism for erosion is chronic middle ear inflammation as a result of overproduction of cytokines-TNF alpha, interleukin-2, fibroblast growth factor and platelet derived growth factor, which promote hyper vascularisation, osteoclast activation and bone resorption causing ossicular damage [2].

Most acquired cholesteatoma are formed by invagination of the pars flaccida into the lateral most portion of the epitympanum (the Prussak's space). Their spread is restricted by these mucosal folds around the ossicles. Posteriorly it may spread lateral to the body of the incus (superior incudal space), inferiorly into the middle ear through pouch of Von Troeltsch or anteriorly into the protympanum [3]. The common spread patterns of cholesteatomas from Prussak's space are through the posterior epitympanum, posterior mesotympanum and anterior epitympanum. The most common spread pattern of the three is the posterior epitympanic route where the cholesteatoma spreads to the superior incudal space, lateral to the

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body of the incus, potentially gaining access to the mastoid through the aditus ad antrum. The second most common is the inferior route, through the posterior pouch of von Troeltsch.

The most common ossicular chain defect encountered in CSOM is involvement of only the long process of incus with intact malleus and stapes [4]. The second most frequent defect is erosion of the supra structure of the stapes as well as loss of incus. Third, the cholesteatoma growing into the middle ear involves the malleus handle which may necessitate its removal along with the incus, however the stapes remains intact. Finally there may be loss of all ossicles except the stapedia foot plate. The erosion of the long process of the incus by cholesteatoma is the most frequently encountered defect of the ossicular chain. The reason is explained by its delicate structure and location rather than its tenuous blood supply [5].

Discontinuity of the ossicular chain is typically confirmed only during an operation. Knowing before surgery, whether the patient has an ossicular discontinuity is important because it allows the surgeon to know the possibility of performing an ossiculoplasty and obtaining patient consent. A good counselling of the patient, to explain the outcomes before embarking on the surgery of choice, to improve hearing can be done [6].

Aims of the Study

1. To study the incidence of incus necrosis in safe and unsafe CSOM.
2. To determine preoperative predictive factors for incus necrosis.
3. To use angled otoscopes to determine the incidence of residual disease per-operative after conventional microscopic surgery.

Materials and Methods

This is a prospective study carried out in the department of otorhinolaryngology. Govt Doon Medical college, Dehradun from July 2014 to July 2016.

A total of 100 patients who presented with CSOM and have not undergone any surgical procedure for the same were included in this study.

The cases were subjected to a thorough history and complete ENT examination. Otoscopy and otomicroscopy was done in every case to make a preoperative diagnosis and the groups were divided into a cholesteatoma and a non cholesteatoma group.

Preoperative pure tone audiometry was done in all patients to know the hearing status and the same was recorded. X-ray mastoid (bilateral Schuller's view) was done in all patients to assess the pathology and surgical anatomy of the mastoid. HRCT temporal bone was done in cholesteatoma group cases to see the extent of cholesteatoma. Intra-operative middle ear findings including ossicular chain status, and the erosion of the individual ossicle was noted.

Intra-operative angled otoendoscopy was done in every patient.

Both groups were subdivided into intact and eroded incus group and were analyzed in 11 parameters, which were compared statistically.

Status of incus and other ossicles in safe and unsafe ear was compared statistically. Chi square test was used to evaluate the level of significance and the P value < 0.05 was considered as significant.

Results

Out of 100 patients studied 67 (67%) had chronic mucosal disease and 33 (33%) were of chronic squamous disease. The patients were aged between 10 and 65 years. The mean age of patients was 34.06 years.

Non Cholesteatoma Group

It consisted of 67 cases out of which in 15 (22.38%) cases incus was necrosed. Patients were analysed on the basis of 11 parameters. The result of analysis of 11 parameters is shown in (Table 1). Out of 11 parameters, 5 were statistically significant. These are:

1. *Duration of disease* Results had shown that patients who have disease for more than 5 years were more prone for incus necrosis. Perforation size was not significant in these cases.
2. *Degree of hearing loss* Incus was found necrosed more frequently in patients who had moderate or moderately severe pre operative hearing loss.
3. *Type of hearing loss* Most of the patients have conductive hearing loss. 5.9% patients had mixed hearing loss and all of them were found to have necrosed incus.
4. *Perforation size* Subtotal perforation was seen in 44.77%, out of which 20.89% patients had necrosed incus.
5. *Exposed incudostapedial joint* 32.8% had exposed IS joint, and out of these, necrosed incus was seen in 14.9% cases.

Table 1 Statistical analysis of non cholesteatoma group

Parameter studied	Reference group	Incus intact n (%)	Incus eroded n (%)	P value
Gender	Male	30 (44.77)	9 (13.43)	1.00
	Female	22 (32.83)	6 (8.9)	
Age	10–20	7 (10.44)	2 (2.9)	0.9743
	20–30	13 (19.4)	5 (7.4)	
	30–40	19 (28.3)	6 (8.9)	
	40–50	8 (11.9)	1 (1.4)	
	> 50	5 (7.4)	1 (1.4)	
Side	Right	24 (35.8)	8 (11.94)	0.77
	Left	10 (14.9)	3 (4.47)	
	Bilateral	18 (26.86)	4 (5.97)	
Ear discharge	Yes	40 (59.7)	13 (19.4)	0.7192
	No	12 (17.9)	2 (2.9)	
Duration of disease	1–5 years	28 (41.79)	2 (2.9)	0.0001*
	5–10 years	16 (23.88)	5 (7.4)	
	> 10 years	8 (11.94)	8 (11.94)	
PTA degree of hearing loss	Mild	26 (38.8)	3 (4.47)	0.001*
	Mod	19 (28.35)	5 (7.4)	
	Mod-severe	7 (10.44)	7 (10.44)	
	Severe	0	0	
	Profound	0	0	
Type of hearing loss	Conductive	47 (72.3)	11 (16.41)	0.001*
	SNHL	0	0	
	Mixed	5 (7.4)	4 (5.97)	
Perforation	Central	36 (53.73)	3 (1.4)	0.010*
	Subtotal	16 (23.88)	12 (20.89)	
Exposed incudostapedial joint	Yes	12 (17.9)	10 (14.9)	0.0036*
	No	40 (59.7)	5 (7.46)	
Mastoid pneumatization	Good	34 (50.74)	9 (13.43)	0.7643
	Poor	18 (26.86)	6 (8.9)	

* P Value <0.05 is significant

Cholesteatoma Group

33 (33%) cases were in cholesteatoma group. They were analysed in 11 parameters as described in (Table 2). 20 cases (60.60%) were having incus and other ossicle necrosed. The following parameters were statistically significant:

1. Presence of ear discharge.
2. *Duration of disease* Like in non cholesteatoma group, duration of more than 5 year was associated with one or other ossicle necrosis
3. *Degree of hearing loss* Moderate, and moderate to severe hearing loss was more frequently associated with incudal necrosis. Only 1 patient with incudal necrosis had mild conductive hearing loss, and 3 had severe hearing loss.

4. *Poor mastoid pneumatization* 71.71% cases had poor mastoid pneumatization out of which 51.51% cases had necrosed ossicle.
5. *Pediatric age group* Paediatric age group patients had more frequent ossicular destruction than adults
6. *Route of cholesteatoma extension* Extension of cholesteatoma to mastoid cavity and tympanic sinus was significantly associated with ossicular necrosis

Discussion

In a study by Karja et al. 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 authors concluded that vascular bone erosion is caused by active granulation tissue. The process

Table 2 Statistical analysis of cholesteatoma group

Parameter studied	Reference group	Incus intact n (%)	Incus eroded n (%)	<i>P</i> value
Gender	Male	9 (27.27)	11 (33.33)	0.5153
	Female	4 (12.12)	9 (24.24)	
Age	10–20	2 (6.06)	3 (9.09)	0.9120
	20–30	3 (9.09)	7 (21.21)	
	30–40	3 (9.09)	9 (27.27)	
	40–50	0 (0)	1 (3.03)	
	> 50	1 (3.03)	4 (12.12)	
Side	Right	2 (6.06)	4 (12.12)	0.9092
	Left	4 (12.12)	5 (15.15)	
	Bilateral	7 (21.21)	11 (33.33)	
Ear discharge	Yes	9 (27.27)	19 (57.57)	0.0437*
	No	4 (12.12)	1 (3.03)	
Duration of disease	1–5 years	7 (21.21)	3 (9.09)	0.0376*
	5–10 years	4 (12.12)	7 (21.21)	
	> 10 years	2 (6.06)	10 (30.30)	
PTA degree of hearing loss	Mild	8 (24.24)	1 (3.03)	0.001*
	Mod	4 (12.12)	7 (21.21)	
	Mod-severe	1 (3.03)	9 (27.27)	
	Severe	0	3 (9.09)	
	Profound	0	0	
Type of hearing loss	Conductive	11 (33.33)	14 (42.42)	0.0115*
	SNHL	0	2 (6.06)	
	Mixed	2 (6.06)	4 (12.12)	
Mastoid pneumatization	Good	6 (18.18)	3 (9.09)	0.0022*
	Poor	7 (21.21)	17 (51.51)	
Extent of cholesteatoma	Attic	10 (21.21)	14 (42.42)	1.000
	Mastoid	4 (12.12)	14 (21.21)	
	Tympanic sinus	1 (3.03)	9 (27.27)	
	Middle ear	3 (9.09)	11 (33.33)	
Status of other ossicles	I only	0	8 (24.24)	0.001*
	I + S	0	2 (6.06)	
	I + S + M	0	4 (12.12)	
	I + M	0	6 (18.18)	

* *P* Value <0.05 is significant

triggered initially by infection, is the primary mechanism for destruction of ossicles both in cholesteatomatous and non-cholesteatomatous ears [7]. In our study 35 (35%), cases had incus necrosis. Out of 67 in non cholesteatoma group, 15 were having necrosed incus, and out of 33 cholesteatoma ears, 20 had necrosed incus. Thomson et al. [8] observed that the long process of incus is the most frequently affected ossicle and bone erosion is more prevalent in cholesteatoma ears than in non cholesteatoma ears but still occurred in the absence of cholesteatoma. Our study holds the identical result.

Ossicular involvement was more common in subtotal perforation of tympanic membrane than other types of

central perforation. This is due to large perforation exposing the middle ear mucosa to the atmosphere, and its external allergens such as dust, water and microbes. Continuous exposure of the ossicles resulted in inadequate vascularity and ossicular necrosis. Exposure of IS joint is also a risk factor for incudal necrosis

Incudal necrosis was seen more commonly in patients who presented with moderate or moderately severe hearing loss preoperatively. Similar observations were made by Ebenezer et al. and Mohanty et al. [6, 9].

Jeng et al. [10] observed ossicular discontinuity was higher when cholesteatoma extended into tympanic sinus and postulated that the fact that the long process of incus

and superstructure of incus was located in the vicinity of tympanic sinus might explain their vulnerability. Similar result was observed in our study.

In our study, we observed a close correlation between the origin of cholesteatoma and the part of the ossicle damaged. Cholesteatoma spreading to posterior mesotympanum presented with ossicular necrosis in more number of cases.

Persistent ear discharge and duration of disease of more than 5 years in cholesteatoma ears were significantly associated with incudal necrosis. This could be due to persistent severe inflammation that could lead to bone destruction.

Conclusion

Incudal necrosis is more prevalent in cholesteatoma group. In non cholesteatoma ears, subtotal perforation with exposure of IS joint is reliable indicators of incudal necrosis. In non cholesteatoma group extension of cholesteatoma to tympanic sinus and mastoid and presence of persistent discharge are reliable indicators of necrosed incus. Moderate to moderately severe hearing loss indicate incudal necrosis in both groups therefore we conclude that these parameters can be reliably considered as predictors for incudal necrosis preoperatively.

Compliance with Ethical Standards

Conflict of interest All the contributing authors have read the article and declare that there is no conflict of interests.

Human and Animal Rights This article does not include any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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