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Relationship Between Ossicular Chain Erosion and Facial Canal Dehiscence in Chronic Otitis Media Squamous

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ABSTRACT

Introduction

Chronic otitis media squamous is a gradually expanding destructive lesion and leads to complications by eroding the adjacent structures. Facial canal and ossicles are in close proximity in the middle ear space and they share the same pathogenesis of the bony erosion. Ossicular chain erosion found intraoperatively due to cholesteatoma, may suggest the likelihood of facial canal dehiscence. This study was conducted to assess the relationship between ossicular chain erosion and facial canal dehiscence in chronic otitis media squamous.

Methods

It is a retrospective chart review of patients who had mastoidectomy done for chronic otitis media squamous in Tribhuvan University Teaching Hospital from January 2014 to December 2018. The operative findings of facial canal dehiscence were correlated with ossicular chain status.

Results

Among 158 cases, facial canal dehiscence was seen in 20 (12.7%), of which, 19/20 (95%) had ossicular erosion. Majority (90%) of dehiscence was in the horizontal segment. Incus was the most common ossicle to be eroded. Among the ossicles, stapes erosion was related to the facial canal dehiscence with odds ratio of 3.216 (1.235-8.374) and p-value 0.03.

Conclusion

Among the ossicles, there is a relationship between the stapes erosion and the facial canal dehiscence in chronic otitis squamous. Erosion of ossicular chain especially stapes should alert surgeons towards the possibility of facial canal dehiscence.

Keywords: *Chronic otitis media squamous, facial canal, ossicular erosion*

INTRODUCTION

Cholesteatoma which is pathognomonic of chronic otitis media (COM) squamous type, is a pocket or cystic lesion lined by stratified squamous epithelium containing proliferative keratin.[1] Cholesteatoma is a gradually expanding destructive lesion and leads to complications by eroding the adjacent structures. Erosion caused by bone resorption of the ossicular chain and otic capsule results in profound hearing loss, vestibular dysfunction, facial nerve paralysis, and intracranial complications.[2] The bony erosion of ossicles and middle ear structures share the same multifactorial pathogenesis which is a combination of osteitis, pressure necrosis, and lysis mediated by enzymes and cytokines like tumor necrosis factor-alpha, interleukin-2, fibroblast growth factor, and platelet-derived growth factor.[3,4]

In mastoid surgery, facial canal dehiscence and erosion of ossicular chain are encountered. The incidence of facial canal dehiscence varies from 0.5% to 74%, the tympanic segment near the oval window being the commonest site followed by segment at the level of geniculate ganglion.5 Iatrogenic facial nerve injury ranges from 0.6–3.6% with the risk further increasing to 4-10% in revision cases.[6] The facial nerve is vulnerable to damage during mastoid surgery in presence of dehiscence which could be secondary to cholesteatoma related bone erosion or anatomical variations.[7] Erosion of ossicular chain usually involves multiple ossicles rather than a single ossicle, with incus being involved in 30%, stapes in 15% and malleus in 10%.[8,9]

Since the facial canal and the ossicles are in close proximity in the middle ear space and they share the same pathogenesis of the bony erosion due to cholesteatoma, ossicular chain erosion found intraoperatively may suggest the likelihood of facial canal dehiscence. This study was therefore conducted to assess the relationship between ossicular chain status and facial canal dehiscence in chronic otitis media with cholesteatoma.

METHODS

This was a retrospective study involving the chart review of 158 patients who had undergone mastoid surgery either in elective or emergency list for COM squamous type in the Department of ENT-Head and Neck Surgery, Tribhuvan University Teaching Hospital over five years from January 2014 to December 2018. It included patients of all age groups and gender. Ethical approval was taken from the Institutional Review Committee of Institute of Medicine before commencing the study.

The age, gender, associated complications of COM squamous, primary or revision mastoid surgery, and the extent of surgery were noted. The status of the facial canal and the ossicular chain were also noted. Dehiscence of the facial canal or ossicular chain erosion if found, the specific site or the ossicle involved were taken note of. The ossicular chain erosion and facial canal dehiscence were identified by inspection and palpation under the microscope. Cases in which there was no specific information regarding the status of the facial nerve and ossicular status were excluded. High-resolution computed tomography of temporal bone was not done routinely and was limited to revision cases and cases with complication.

Data was analyzed using SPSS version 25 software. Chi-square test and Fischer exact test were done for categorical variables and adjusted odds ratio was calculated keeping the statistical significance of p-value at 0.05

RESULTS

Among 158 patients, 104 (65.8%) were males and 54 (34.2%) were females. The age ranged from 8 to 63 years. The median age group was 20-40 years with 72 (45.6%) patients in this group. The facial canal was normal in 138 (87.3%) cases and dehiscent in 20 (12.7%) cases. The majority (90%) of the dehiscence was found in the horizontal segment near the oval window. Among 158 patients, four patients had complications at the time of surgery, one each of mastoid fistula, facial palsy with lateral semicircular canal fistula, Bezold's abscess, and subdural abscess. Dehiscence was found in 50% (2/4) cases with complication (Table 1). There were three revision cases for recurrence of cholesteatoma post mastoid surgery done in childhood (Table 2). There was no statistical significance between the facial canal dehiscence in revision mastoidectomy.

Out of the 20 cases with facial canal dehiscence, 19 (95%) cases had either of ossicles eroded whereas only 1 (5%) case had an intact ossicular chain (Table

Table 1. Comparison of facial canal dehiscence with different complications (n=158)

Complications	Facial canal	
	Normal	Dehiscent
Cases with complication (n=4)		
Mastoid fistula	1	0
Bezolds abscess	0	1
Facial palsy with lateral semicircular canal fistula	0	1
Subdural abscess	1	0
Cases without complication (n=154)	136	18
Total	138	20

Table 2. Comparison of facial canal dehiscence with type of modified radical mastoidectomy (n=158)

MRM type	Total	Facial canal		p-value
		Normal	Dehiscent	
Revision MRM	3	2	1	0.83
Primary MRM	155	136	19	
Total	158	138	20	

Table 3. Comparison of ossicular chain status with facial canal dehiscence (n=158)

Ossicular status	Total	Facial canal		p-value
		Normal	Dehiscent	
Intact	8	7	1	1
Erosion	150	131	19	
Total	158	138	20	

Table 4. Relationship of individual ossicular status and facial canal dehiscence (n=158)

Ossicle	Ossicular status	Total	Facial canal		p-value	Odds ratio (95% CI)
			Normal	Dehiscent		
Malleus	Intact	112	97 (61.4%)	15 (9.5%)	0.67	0.789 (0.27-2.31)
	Eroded	46	41 (25.9%)	5 (3.2%)		
Incus	Intact	13	12 (7.6%)	1 (0.6%)	0.57	1.81 (0.22-14.72)
	Eroded	145	126 (79.7%)	19 (12%)		
Stapes	Intact	109	100 (63.3%)	9 (5.7%)	0.03	3.22 (1.23-8.37)
	Eroded	49	38 (24.1%)	11 (7%)		

3). However, this was not statistically significant. Out of the 158 cases, malleus, incus, stapes erosion was found in 46, 145, 49 cases respectively (Table 4). The most common ossicular erosion found was incus 145/158 (91.77%) followed by stapes erosion 49/158 (31.01%) and the malleus erosion which was the least 46/158 (29.11%). The maximum group with facial canal dehiscence was in incus absent cases. Among the ossicles, the stapes had a significant p-value with the facial canal dehiscence (Table 4). The odds ratio was 3.22 (1.23-8.37).

Similarly, there was a higher prevalence of facial canal dehiscence in cases with both incus and stapes defect or all ossicles eroded (Table 5). Isolated incus alone had a lower prevalence of 10.96% compared to incus and stapes defect of 21.87%. Similarly, the highest prevalence was seen when all the ossicles were eroded (22.22%).

DISCUSSION

Facial canal dehiscence may be congenital due to lack of ossification of the bony canal or may arise from resorptive osteitis secondary to cholesteatoma.[10] The prevalence of facial canal dehiscence is wide, ranging from 0.5% to 74%. Interestingly its dehiscence has been reported higher in histologic studies than in operative cases due to the destruction of the bony covering of the facial nerve during processing or preparation of specimen.[11] In our study, the dehiscence was seen in 12.7% of cases. The variation ranges in different inflammatory and non-inflammatory diseases like COM squamous vs mucosal vs otosclerosis.

Table 5. Relationship of different ossicular status and facial canal dehiscence (n=158)

Ossicular status	Facial canal dehiscence	
	Ratio	Percentage
Ossicular chain intact	1/8	12.50%
Isolated incus defect	8/73	10.96%
Incus and stapes defect	7/32	21.87%
All ossicular defective	4/18	22.22%

The majority of clinical studies regarding facial canal dehiscence are related to mastoid and middle ear disease where the chronic otitis media causes the inflammatory resorptive osteitis leading to microscopic or macroscopic dehiscence. This is in contrast to the otosclerosis where the incidence is very low at 2.8 (0.5-11.4 %) in the tympanic segment.[12] The reason could be because of the lack of inflammatory mechanism in otosclerosis.

The pathophysiology of erosion of ossicle and middle ear structures including the facial canal is thought to be multifactorial resulting from the combination of osteitis, pressure necrosis and lysis mediated by enzymes and cytokines - tumor necrosis factor (TNF) alpha, interleukin-2, fibroblast growth factor, and platelet-derived growth factor.[3,4]

Malleus is the toughest ossicle for erosion compared to other ossicles. The ossicle affected most commonly was incus followed by stapes. This finding is similar to other studies.[9,13-15] In our study, amongst the 20 cases with facial canal dehiscence, 19 (95%) had ossicular chain erosion.

The exact prevalence of ossicular chain erosion in

facial canal dehiscence in literature is lacking because of the heterogeneity of the studies available. Most studies compare the facial canal dehiscence and individual ossicular status. According to Sahin et al. facial canal dehiscence was lower in intact ossicular chain 8.7%, with isolated incus erosion 3.1% compared to the erosion of suprastructure of stapes and incus 60.7%, and with total erosion of ossicular chain 43.2%.[16] In our study, there is similar low incidence in the intact ossicular group (12.5%) and isolated incus erosion group (10.96%).

Some authors strongly support that stapes erosion is closely associated with the facial canal dehiscence.[6,10,17,18] Our study also had a similar finding with erosion of stapes significantly associated to the facial canal dehiscence. In order to further analyze the finding, the regression analysis was done which supported our results with the adjusted odds ratio of 3.216 (1.235-8.374). Association of erosion of other ossicles were not statistically significant.

The erosion of facial canal and the ossicles share the same pathogenesis which explains the concurrent facial canal dehiscence and the ossicular chain erosion. In addition, incus is more at risk due to its thin blood vasculature. The close proximity of stapes with facial canal is considered a reason for stapes erosion to be associated facial canal dehiscence secondary to destructive effect of cholesteatoma.[6]

Some authors have however refuted this explanation and considered the possibility of pre-existing facial canal dehiscence in mastoid surgery.[18] This too remains debatable as various histologic studies found facial canal dehiscence to be common but considered them artefactual occurring secondary to destruction of the bone covering the facial nerve during processing or preparation of specimen.[11]

The association between the stapes erosion and the facial canal dehiscence as seen in this study helps to increase the awareness amongst young surgeons about the likeliness of facial canal dehiscence to minimize the risk of facial nerve injury especially in revision cases, those with complications, and cases with extensive granulation in the middle ear.

The positive aspect of our study is that only very few revision cases have been included in contrast to other studies. In revision cases, there is a likeliness that the ossicles mainly malleus and often incus could already have been removed in the previous surgery which could be lead to error in interpretation of relationship of ossicular erosion with facial canal dehiscence.

One of the main limitations of the study is its retrospective study design. A prospective study with a large sample is needed for further analysis.

CONCLUSION

There is a relationship between the stapes erosion and the facial canal dehiscence. Hence, in a cholesteatoma case an eroded ossicular status especially stapes should alert surgeons towards the possibility of facial canal dehiscence to minimize the risk of inadvertent facial nerve injury.

CONFLICT OF INTEREST

None declared.

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