Assessment of Ossicular Necrosis in Tubotympanic (Mucosal) Type of Chronic Otitis Media

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ABSTRACT

BACKGROUND

We wanted to study the preoperative clinical, audiological, radiological findings & compare them with the perioperative findings of ossicular necrosis.

METHODS

100 patients were clinically diagnosed as mucosal chronic otitis media (COM). They underwent a thorough clinical, audiological & radiological examination. X-ray mastoid Schuller's view on both sides was done in all patients & HRCT temporal bone was done in 51 patients. They were then posted for surgery & findings were compared with the perioperative ossicular necrosis.

RESULTS

42 patients had ossicular defects perioperatively. Incus was found to be the most commonly necrosed ossicle & malleus was the most resistant ossicle. There was a positive association found between duration of disease, posterior perforations, large central & subtotal perforations, polypoidal middle ear mucosa, granulations over margins of perforations & audiological findings with the perioperative ossicular defects. HRCT was the most reliable investigation to predict ossicular necrosis.

CONCLUSIONS

From the study, it was concluded that all patients with mucosal COM can be assessed preoperatively for ossicular erosion. HRCT gives us a preoperative picture of the extent of ossicular necrosis & helps the surgeon in planning the surgical intervention.

KEY WORDS

COM, HRCT, Ossicular Necrosis, Mucosal, PTA

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BACKGROUND

Chronic otitis media (COM) refers to a chronic infection of the mucosa lining the middle ear cleft, which includes the middle ear, attic, aditus, antrum, mastoid air cells and Eustachian tube.¹

COM is an inflammatory process in the middle ear space that results in the long term, or more often, permanent changes in the tympanic membrane including atelectasis, dimer (formerly "monomer") formation, perforation, tympanosclerosis, retraction pocket development, or cholesteatoma. There is variable involvement of the ossicular chain. COM results from long-term Eustachian tube dysfunction with a poorly aerated middle ear space, multiple bouts of acute otitis media, persistent middle ear infection, or other chronic inflammatory stimuli.²

COM Has Been Broadly Classified into Two Types

Tubotympanic disease (safe or benign) and atticotympanic disease (Unsafe or dangerous).¹ Tubotympanic type involves the anteroinferior part of the middle ear cleft i.e. Eustachian tube, mesotympanum and is associated with central perforation. Atticotympanic type involves posterosuperior part of the cleft, i.e. attic, aditus, antrum & mastoid and is associated with an attic or a marginal perforation. The disease is often associated with the bone eroding process & the formation of cholesteatoma, granulations or osteitis. A new classification of COM: Mucosal chronic otitis media (Active & Inactive Stage) or Squamous otitis media (Active & Inactive Stage). Chronic otitis media can be classified as active, inactive, & inactive with frequent reactivation. The classification scheme followed here was developed by Nadol.³

COM-TTD (Mucosal) is characterized by chronic inflammation of the middle ear and mastoid mucosa. Active mucosal CSOM is often associated with the resorption of parts or all of the ossicular chain (Resorptive osteitis).⁴ Resorption of bone is a feature of active mucosal and active squamous epithelial COM. The ossicles, thus affected, typically show hyperaemia with the proliferation of capillaries and prominent histiocytes.⁵

Objectives

- To study the preoperative clinical findings & audiological assessment and compare it with the perioperative findings of ossicular necrosis.
- To correlate radiological findings for ossicular necrosis in the pneumatized or sclerosed mastoid.
- Correlation of high-resolution computed tomography (HRCT) temporal bone findings with the perioperative ossicular necrosis.

METHODS

100 patients, of age group 10 to 50 years and both sexes, who were clinically diagnosed as mucosal chronic otitis media, scheduled to undergo myringoplasty or tympanoplasty, patients with unilateral disease and consenting for the study

were included in our study. Patients with bilateral chronic otitis media, patients with squamous disease or marginal perforations, patients with a history of previous ear surgery or trauma (on the same side) were excluded from the study. They were subjected to a detailed history, general physical examination, and ENT examination. Tuning fork test & audiometry were done. X-ray mastoid Schuller's view on both sides was done in all patients & HRCT temporal bone was done in 51 patients. Patients were then posted for surgery & perioperative findings were noted. Correlation of the preoperative clinical, audiological, and radiological findings was done with the preoperative findings of ossicular necrosis. It was an observational prospective study done from 1st November 2014 to 31st July 2016 (21 months).

Statistical Analysis

Statistical analysis was done wherever applicable and possible based on the chi-square test and p-value. Statistically significant findings in the study were established as results.

RESULTS

After analysing the subjects in terms of history, general physical and specific otologic examination, they were then subjected to audiological examination, that is, a pure tone audiogram was done in all the patients as the preoperative hearing assessment. Also, all the patients underwent radiological assessment in the form of X-ray mastoid bilateral Schuller's view. Out of the total 100 patients, 51 patients underwent an HRCT scan of the temporal bone. After a thorough preoperative evaluation of the patients, all the patients underwent surgery and the ossicular status of the patients was analysed.

The trend of the duration of disease was found to be statistically significant. (Chi-square test = 17.18, P = 0.0006). There was maximum ossicular necrosis in patients in whom the duration of the disease was more than 10 years – 28 out of 32 patients showed ossicular necrosis (88 %) and this association was statistically significant (P = 0.0001). Also when the duration of the disease was less than 1 year, the least number of patients showed necrosis of the ossicles – only 3 out of 30 patients (10 %) showed ossicular necrosis. Even this association was statistically significant (P = 0.003). When the duration of the disease was from 1 to 5 years then ossicular necrosis occurred in 21 % of patients and when the duration of the disease was 5-10 years, the perioperative necrosis of ossicles was seen in 43 % of patients. But these findings were not statistically significant.

Individually, it was found that the maximum ossicles were found to be eroded in posterior + inferior perforations i.e. 63 %, followed by posterior perforations in which 33 % patients had ossicular necrosis. Anterior + inferior perforations showed 5 % of patients with ossicular necrosis and none of the patients with anterior perforations showed perioperative ossicular necrosis. Overall our study assessed that the total number of patients with anterior perforations (anterior & anterior + inferior) were 33 (33 %) and the total number of posterior perforations (posterior & posterior + inferior) were of 50 patients (50 %). Conclusively, 27 out of 50 patients with

posterior perforations had ossicular necrosis (i.e. 54 %). And 1 out of 33 patients with anterior perforations had perioperative ossicular necrosis (i.e., 3 %).

Size of the Central Perforation	No. of Patients	Necrosed Ossicles Seen Perioperatively	Percentage
Small	10	1	10
Moderate	22	4	18.2
Large	54	23	42.6
Subtotal	14	14	100
Total	100	42	

Table I. The Size of Perforation & the Perioperative Ossicular Findings

Middle Ear Mucosa Findings	No. of Patients	Perioperative Ossicular Status Necrosed Ossicles	Percentage
Normal	53	1	2
Congested	8	6	75
Oedematous	17	14	82
Polypoidal	22	21	96
Total	100	42	

Table II. Middle Ear Mucosa Findings & the Perioperative Ossicular Necrosis

PTA Findings (in DB)	Total	Perioperative Ossicular Necrosis	Percentage
Mild (26-40)	47	0	0
Moderate (41-55)	35	24	69
Moderately severe (56-70)	18	18	100
Severe (71-90)	0	0	0
Profound (91+)	0	0	0
Total	100	42	

Table III. Audiological Findings (Pure Tone Audiometry-PTA) & the Perioperative Findings of Ossicular Necrosis

X-Ray Mastoid Schuller's View Both Sides	No. of Patients	Perioperative Ossicular Status (Necrosed Ossicles)	Percentage
Bilateral pneumatized mastoid	29	2	7
Unilateral sclerosed mastoid	44	35	80

Table IV. Pneumatization of Mastoid (As Seen in X-ray Mastoid Schuller's View) & the Perioperative Ossicular Necrosis

Extent of Ossicular Erosion	CT Findings	Intraop. Findings	False Positive	False Negative	Sensitivity	Specificity	Accuracy
Ossicular destruction-Malleus handle (tip)	2	3	0	1	66.67	100	0.98
Malleus head	0	0	0	0	0	0	0
Incus lenticular process	13	14	0	1	92.86	100	0.98
Incus long process	8	7	1	0	100	97.73	0.98
Body of incus	0	0	0	0	0	0	0
Incus + stapes suprastructure (head of stapes)	5	9	0	4	55.56	100	0.92

Table V. Correlation of HRCT Temporal Bone Findings with Perioperative Ossicular Necrosis

DISCUSSION

In our study in COM (TTD or mucosal), the age group ranged from 11 to 50 years with a mean age of 25.01 years, which is similar to the study done by Nayak GK et al.⁶ i.e. 23.17 years & lower as compared to Haidar et al. who claimed mean age as 33.4 years. Also in our study, the maximum number of patients was 41 lying within the age group of 21-30 years. And a minimum number of patients i.e. 5 patients were in the age range of 41-50 years. The youngest patient was 11 years old and the oldest patient was 50 years old. In our study, COM (mucosal) showed male preponderance with a male to female ratio of 1.2:1. This is also in accordance with the study done by Sade et al.⁷ who reported that the incidence was 1.4 times higher in men as compared to women. In the study done by

Jose et al.⁸ males predominated (64.7 %) compared to females (35.3 %). In contrast, Jayakumar et al.⁹ who studied preoperative indicators for ossicular necrosis in COM (TTD) had female preponderance. Hence, the disease was seen more commonly in the left ear (54 %) as compared to the right ear (46 %). In our study, this was a new positive finding for COM (TTD) as no study had been done previously to show these results.

In our study, around 91 % of the population belonged to the low socioeconomic status suggesting that the lack of hygiene, poor nutritional status & reduced resistance to infection were probable causative factors.

Tuli et al.¹⁰ reported that the prevalence of deafness in rural areas is almost double than that is observed in urban areas, consequent upon the low level of literacy & lack of health consciousness, along with contributing factors like malnutrition and swimming in dirty ponds. Jung T. K et al.¹¹ revealed that low socioeconomic status and repeated exposure of many children were the most important socio-demographic risk factors.

In our study, the most common complaint was discharge from the ear which was present in all the patients 100 %. This is in accordance with Sade et al.⁷ who found that discharge was the first symptom in 62.0 % of cases and hyperacusis was present in 11.0 % of cases. In mucosal COM, on examination of the tympanic membrane, the patients having various sites of perforations were as follows. Overall, in our study, the number of posterior perforations was more, which is, 50 % in comparison to anterior perforations that is, 33 %. This is in contrast to a previous dictum that mucosal COM is a disease of the anteroinferior part of the middle ear. On examination of the tympanic membrane, the site of the perforation was found to be posterior in a maximum number of patients 50 % as compared to anterior perforations of 33 % of patients. The rest of the patients showed perforations involving all the quadrants 14 % & inferior perforations 3 %. In our study, the maximum number of patients had large central perforation seen in 54 % of patients and the least common size of perforation was small central perforation 10 %. Granulations over the margins of the perforation were seen in 8 % of the patients, more commonly over the posterior margins as compared to the anterior margins. Examination of the middle ear mucosa showed a normal mucosa in the maximum number of patients i.e. 53 %. The rest 47 % of patients showed diseased mucosa. Polypoidal type of middle ear mucosa was seen in 22 % of patients and oedematous mucosa was seen in 17 % of patients and 8 % of patients showed congested mucosa. Mild hearing loss was seen in maximum patients i.e. 47 patients (47 %) followed by moderate hearing loss, which was seen in 35 patients (35 %), moderately severe hearing loss was seen in 18 patients (18 %).

X-ray mastoid Schuller's view showed 29 % of the involved mastoid cells to be sclerotic and 44 % to be pneumatized. The rest 27 % of the patients had bilaterally sclerosed mastoid which was a normal finding in 20 % of the population. In our study, HRCT temporal bone was done in 51 patients and normal HRCT was seen in 23 patients (45.09 %). HRCT temporal bone showing ossicular destruction was seen in 28 patients (54.9 %). The incus was the most common eroded ossicle where the lenticular process was the most common part to be necrosed (26 %) followed by the long

process (16 %). Combined incus & stapes suprastructure was found to be eroded in 10 % of patients. The tip of the handle of the malleus was the least common ossicle (4 %) for ossicular erosion based on HRCT temporal bone. Surgery was performed on all patients and normal ossicles were found in 58 % of patients. Out of 42 % of the patients with necrosed ossicles, incus was the most common ossicle to be necrosed (29 %), combined incus and head of stapes erosion were seen in 9 % of patients. Malleus was the most resistant ossicle for erosion in 3 %. The lenticular process of the incus was the most common part (69 %) of incus which was susceptible to necrosis, followed by the long process (28 %). These findings were in accordance with the study done by Austin.¹² The trend of the duration of disease was found to be statistically significant. In our study, the number of patients having ossicular necrosis seen in posterior perforations was more as compared to the anterior perforations. Incus erosion was found to be more frequent in the overall posterior site of perforation, which was statistically significant. In our study, as the size of the perforation increased, the chances of ossicular necrosis also increased and this trend was statistically significant.

Individually, large central perforation & subtotal perforations were statistically significant with the findings of perioperative ossicular necrosis. Out of the 10 patients having small central perforations, 1 patient had ossicular necrosis, the lenticular process of incus was eroded. This shows that even in small central perforations, there are chances of ossicular erosion. This grading system was done according to Griffin's classification- (Griffin WL et al.) where Grade I perforation (perforation smaller than 25 % of the tympanic membrane involvement), Grade II perforation (perforation of 25-50 % of the pars tensa involvement), Grade III perforation (involving 50-75 % of the tympanic membrane pars tensa) & Grade IV perforation (involving > 75 % of the pars tensa).

In our study, it was observed that granulations over the perforation margins, polypoidal & oedematous middle ear mucosa were found to be highly significant with perioperative ossicular necrosis. Many studies done by Jeng Fuh-Cherng et al.¹³ Schachern et al.¹⁴ Chole and Choo et al.¹⁵ & Ruby et al.¹⁶ have also concluded that the presence of granulation tissues is significantly associated with erosion of ossicles in tubotympanic CSOM. In our study, there is also a significant trend in the audiological findings & the findings of ossicular necrosis. A statistically significant association was seen between moderate hearing loss & moderately severe hearing loss and the perioperative ossicular necrosis. Hence, the greater the degree of hearing loss, the more the chances of ossicular necrosis. Patients having unilateral sclerosis of the mastoid showed more cases of ossicular necrosis (80 %) preoperatively and the patients with pneumatized mastoid bone had only 80 % of the patients with unilateral sclerosed mastoid and only 7 % patients with pneumatized mastoid showed perioperative ossicular necrosis. HRCT was found to be the most reliable investigation to predict ossicular necrosis. The accuracy rate to predict the necrosis of incus lenticular process, long process & malleus handle was 0.98 %.

CONCLUSIONS

- The lenticular process of the incus was the most common part (69 %) of incus which was susceptible to necrosis followed by the long process (28 %).
- The trend of the duration of disease was found to be statistically significant.
- The number of patients having ossicular necrosis seen in posterior perforations was more as compared to the anterior perforations.
- Large central perforations and subtotal perforations were statistically significant with the findings of perioperative ossicular necrosis.
- Granulations over the perforation margins, polypoidal and oedematous middle ear mucosa were found to be highly significant with perioperative ossicular necrosis.
- A significant association was seen between moderate hearing loss and moderately severe hearing loss and perioperative ossicular necrosis.
- HRCT temporal bone gave accuracy rates of 0.98 % in detecting the erosion of the lenticular process & the long process of the incus & the malleus handle.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

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