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Histopathological Study of Middle Ear Cleft Mucosa in CSOM Cases

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Abstract
Chronic Suppurative Otitis Media is a chronic inflammatory ear disease of middle ear cleft accounting for nearly 30% of the outpatient visits in practice of ENT. CSOM clinically presents with otorrhoea for more than 4 weeks, with defect in the tympanic membrane and hearing loss. Pathogenesis is a result of Eustachian tube dysfunction and impaired ventilation of the middle ear cleft resulting in permanent changes in the periosteum and mucosa of the mastoid antrum and air cells. The amount of discharge depends on these changes and further impairs the mechanism of ventilation of the cleft. As few papers are present in the literature highlighting the microscopic changes of tissue in CSOM, a study is conducted to observe the types of Histopathology in CSOM. To study the various Histopathological types of mucosa of middle ear cleft in CSOM cases. Seventy six patients undergoing mastoid exploration for the treatment of CSOM were included in the study. All the patients irrespective of active or inactive status of the ear disease were subjected to Mastoidectomy and sent for Histopathology. A single pathologist was asked to report all the specimens. The Histopathology reports are described depending upon the type of tissue, vascular pattern, infiltration of cells, presence or absence of Keratosis and giant cells. Among the 76 patients 58 were females and 18 were males. 58 patients presented with Tubo-tympanic and 18 with Attico Antral type of CSOM. The commonest type of tissue pathology was reported as infected hypertrophied mucosa with infiltration of lymphocytes, plasma cells and occasional histiocytes in 44.82% of the Tubo-tympanic variety CSOM. Attico Antral type showed Cholesteatoma flakes (Keratosis) with vascular stroma infiltrated with inflammatory cells. Infiltration of chronic inflammatory cells was observed in 63.14% of the patients. Histopathological study in CSOM of both Tubo-tympanic and Attico Antral types varie. The HPE in the TT type principally shows granular leucocytes with hyperplasia of mucosa infiltrated and in few cases cholesterol granuloma formation or mucosal edema in others. Similarly, HPE of Attico Antral type showed vascular stroma infiltrated with inflammatory cells with cholesteatoma flakes (keratosis). Understanding the histopathological study, at the time of exploration of the mastoids in the surgical treatment of CSOM gives an insight to the necessity of clearance of the diseased mucosa from the auditus, antrum and air cells for the Tympanoplasty success.

OPEN ACCESS

Key Words
Chronic Suppurative Otitis Media (CSOM), histopathology, mastoid exploration, middle ear cleft, tympanoplasty

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INTRODUCTION

Chronic Suppurative Otitis Media is defined as a chronic inflammation of the mucosal lining of the middle ear cleft, clinically characterized by recurrent otorrhoea, perforation of the tympanic membrane and deafness[1]. In developed countries the incidence of CSOM is from 0.5% to 2% and in developing countries it is 3 to 57% while in India it is 30% urban: 16/1000 and rural: 46/1000[2]. Conventionally it is divided as; Tubo tympanic and Attico Antral types with the disease limited to the meso and hypo tympanum of the middle ear in the former and epi tympanum in the later. In both the type's mastoid antrum and air cells are involved with variable degree. The surgical treatment consists of Tympanoplasty with Mastoidectomy in both the types.

The success of this surgery depends upon various factors including clearance of the disease from the middle ear cleft including the antrum, air cells and the auditus, to reestablish aeration between middle ear and the mastoid air cell system. This view is supported by Holmquist J and Bergstrom B in their study of mastoid air cell system in mastoid surgery[3].

Also Recently undertaken studies have shown the role of Mastoidectomy in improving the results of Tympanoplasty[4,5]. The mastoid factors influencing the success of results are the pneumatization of the air cell system and presence of inflammatory disease in it. Diamont, Flisberg, and Zigmont documented in their studies that clinical ear disease is associated with small air cell systems.

Although there is difference of opinion regarding the cause and effect relationship between small mastoid systems as a cause or result of inflammation of the middle ear disease[6-9]. The increase in success rate of Tympanoplasty by few authors preclude the necessity of Mastoidectomy[10]. Review of literature showing Histopathological examination (HPE) studies of the mucosa of the middle ear cleft in these types are very few. The present study attempts to report the HPE of mucosal disease cleared during Mastoidectomy surgery in our institute.

MATERIALS AND METHODS

Seventy six patients undergoing Mastoid exploration for CSOM were included in the present study conducted at Mamata General Hospital attached to a teaching institute in Khammam, Telangana. The study period was between April 2023 and March 2024 a period of 12 months. Demographic data like age, sex, and social status, place of living and ethnicity of the patients was recorded. All the patients were subjected to thorough ENT examination including microscopic ear examination, Diagnostic Nasal Endoscopy to assess the status of the middle ear cleft and presence of septic foci. Radiological investigations like X-Ray of both the mastoids, CT scan of the temporal bones in case of Attico Antral disease were undertaken. Necessary laboratory investigations were conducted to prepare the patients for the surgical procedure.

Inclusion Criteria:

- Patients aged above 15 years with clinical diagnosis of CSOM are included
- Patients with history of otorrhoea for more than 6 months are included

Exclusion Criteria:

- Patients with history of otorrhea 3 weeks prior to surgery
- Patients with history of Allergic rhinitis, Acute or Chronic sinusitis are excluded
- Patients with complications of CSOM are excluded

Audiological evaluation of the patients was undertaken with pure tone audiometry to include Air conduction thresholds and bone conduction thresholds. Patients with Tubo-tympanic type of CSOM were subjected to mastoid exploration, clearance of the disease in mastoid antrum, air cells and auditus with an intact canal wall and Type I Tympanoplasty procedure.

Patients with Attico Antral disease were subjected to mastoid exploration, clearance of the disease in air cells, middle ear including epi-tympanum and around ossicles with a canal wall down with procedure and a Type 3 Tympanoplasty. The type of mucosal disease in the middle ear cleft was noted and excised material was sent for HPE from all then patients. Post-operative treatment consisted of intravenous antibiotics, oral decongestants and NSAIDs for a period of 1 week before removal of post aural sutures. All the patients were examined under microscope after 6 weeks for the healing of the graft and audiological evaluation was done after 3 months.

RESULTS AND DISCUSSIONS

The present prospective study was conducted at Mamata General Hospital, Khammam, Telangana between April 2023 and March 2024 for a period of 12 months. 76 patients were included from among the 94 patients operated for CSOM depending on the inclusion and exclusion criteria. The youngest patient was 15 years old and the eldest one was aged 65 years. The mean age was 30.05 and the median was 23.5. There were 60 (78.94%) female patients and 16 (21.05%) male patients with a female to male ratio were 3.75:1.

Thirty patients were (39.47%) from urban area and 46 (60.49%) were from rural back ground. 40 patients (52.63%) were from a low socio-economic group, 18 (23.67%) from middle income group and

Table 1: Showing the incidence of age sex, social status and uban/rural background of the patients (n=76)

Age Group	Male-16	Female-60	Urban-30	Rural-46	Low Socio-economic-40	Middle-18	High Socio-economic 18
15-25	10	30	16	24	18	14	8
26-35	0	14	8	6	8	4	2
36-45	2	8	2	8	6	0	4
46-55	2	4	2	4	2	0	4
56-65	2	4	2	4	6	0	0

Table 2: Showing the incidence in both the ears (n=76)

Disease Type	Right	Left	Bilateral
Tubo Tympanic-58	26	20	12
Attico Antral-18	6	4	8

Table 3: Showing the nature of perforation and pneumatization of mastoids on X-ray (n=76)

	Tubo-tymapnic-58				Attico Antral-18			
Observation	Central Perforation	Subtotal Perforation	Acellular Mastoids	Cellular Mastoids	Attic Perforation	Posterior Marginal perforation	Acellular mastoids	Celluar mastoids
Number of patients	40	18	34	24	12	06	14	04

Table 4: Showing the operative findings (n=76)

Extent of Disease	Tubo Tympanic Type-58	Attico Antral Type-18
Disease limited to middle ear alone (ME)	12	0
Disease limited to ME + Antrum	28	8
Disease in ME + Antrum + Air cells	10	6
Disease in ME + Antrum + Air cells + up to tip of Mastoid	8	4

Table 5: Showing the pre-operative PTA values (n=76)

PTS dB	Tubo Tympanic Type-58	Attico Antral Type-18
25-35	28	0
36-45	12	4
46-55	10	10
56-65	8	4

Table 6: Showing the HPE findings (n=76)

Histopathological study	Tubo Tympanic Type-58	Attico Antral Type-18
Infected hypertrophied mucosa with infiltration of lymphocytes, plasma cells and occasional histiocytes	26-(44.82%)	2-(11.11%)
Tympanosclerosis with chronic inflammatory cells	12-(20.69%)	0
Granulation tissue (Cholesterol crystals with giant cell reaction)	8-(13.79%)	0
Cholesterol Granuloma	10-(17.24%)	2-(11.11%)
Keratosis flakes, vascular stroma with foreign body giant cell reaction	2-(3.44%)	14-(77.77%)
Edematous Hypertrophied mucosa	2-(3.44%)	0

18(23.67%) belonged to high income group (Table 1).

Among the 76 patients 58 (76.31%) were diagnosed as Tubo-tympanic type and 18 (23.68%) patients as Attico Antral type of CSOM. Twenty six (44.82%) of the Tubo-tympanic type and 6 (33.33%) of Attico Antral type were affected in the right ear. 20/58 (34.48%) and 4/18 (22.22%) of the patients with Tubotympanic and Attico Antral type respectively were affected in the left ear. Bilateral affection was observed in 12/58 of Tubotympanic and 8/18 of Attico Antral type CSOM. Only 4 patients underwent surgery in both the ears in this study and hence 78 ears were operated upon (Table 2).

Among the Tubo-tympanic-58 patients, central perforation was observed in 40 (68.96%) and subtotal perforation in 18 (31.03%). In Attico Antral type of CSOM in 18 patient's attic perforation was observed in 12 (66.66%) and posterior marginal perforation in 6(33.33%). Among the Tubotympanic CSOM patients the mastoid X-Ray showed Acellular nature in (58.62%) and cellular mastoids in (41.37%). Among the Attico Antral type of CSOM Acellular mastoids was observed in 6(66.66%) and cellular mastoids in 3 (33.33%) patients (Table 3).

Intra Operative findings showed the disease limited to middle ear (ME) alone in 12/58 (20.68%), involving ME and antrum in 28 (48.27%), involving ME, antrum and air cells was in 10 (17.24%) and ME, antrum, air cells and up to the tip of mastoid in 8 (13.79%) of the patients with Tubo-tympanic type of CSOM. Similarly, among the Attico Antral type of CSOM the corresponding findings were 00, 8(44.44%), 6(33.33% and 4 (22.22%), (Table 4).

Pre-Operative PTA values among the Tubo-tympanic type of CSOM group showed 28 (48.27%) in the range of 25-35 dB loss, 12 (20.68%) in the range of 36-45 dB, 10(17.24%) in the range of 46-55 dB and 8 (13.79%) in the 56-65 dB loss. A PTA study of Attico Antral type of CSOM showed loss of hearing in the range of 36-45 dB in 4 (22.22%), in the range of 46-55 dB loss in 10 (55.55%) and in the range of 56-65 dB in 4 (22.22%) patients (Table 5).

The diseased mucosa was either curetted from the explored antrum or excised with a iris scissors was sent for HPE and the tissue diagnosis as described by the same pathologist is described and shown in the Table 6. The commonest type of HPE was Infected hypertrophied mucosa with infiltration of lymphocytes,

plasma cells and occasional histiocytes 44.82% followed by Tympanosclerosis with chronic inflammatory cells in 20.69% and cholesterol granuloma (cholesterol crystals with giant cell reaction) in 13.79% of the cases. Similarly, among the Attico Antral type of CSOM, Keratosis flakes, vascular stroma with foreign body giant cell reaction was observed in 77.77% of the cases. Granular leucocytes infiltration of the diseased hypertrophied mucosa was found to be 63.14% in the present study (Table 6).

Chronic Suppurative Otitis Media (CSOM) is a common Middle ear cleft disease in ENT practice. According to WHO definition the history of otorrhoea for more than 2 weeks considered as CSOM whereas most of the Otologists adopt a longer duration; six weeks[11]. In India the prevalence rate is on higher side 7.8% when compared to Europe where it is 0.9% in children and 0.5% in adults[12]. Presence of inflammatory disease in the mastoid antrum and its air cell system is a crucial risk factor in the success of Tympanoplasty procedures.

It also influences the pneumatization of the air cell system which acts as a buffer air reservoir to ventilate the middle ear. Holmquist and Bergstrom were of the opinion that Mastoidectomy increases the chances of success in Tympanoplasty in patients with non-cholesteatomatous CSOM[3]. In the present study Tubo-tympanic type of CSOM was in 58 (76.31%) and Attico Antral type was in 18(23.68%) patients.

The incidence of Attico Antral disease is higher in another study[1]. 1(2.63%) patient diagnosed as Tubo tympanic type clinically but showed in Histopathological reports suggestive of Attico Antral type in the present study. All the patients were subjected to mastoid exploration irrespective of the disease being actively discharging or dry ear in the present study.

A basic principle of achieving good post-operative ventilation of the middle ear and mastoid air cell system which enhances the healing process and success rate of Tympanoplasty procedure suggested by Holmquist and Bergstrom was applied in this study. They also suggested that Mastoidectomy enhances aeration of mastoid air cell system in patients with poor tubal function and small mastoid air cell system[3]. Vikas Kakkar *et al*., in their study of role of Mastoidectomy on the result of Tympanoplasty showed that in patients with discharging ears Mastoidectomy proved the presence of hypertrophied mucosa in all the patients (100%) as compared to dry ears (18%).

They concluded that there is a strong association between disease in the Antrum and the presence of discharging ear[13]. They also found that the communication between the middle ear and the mastoid antrum was blocked in 75% of the patients with discharging ears when compared to 7% in patients with dry ears[13].

Many authors also support the view of Holmquist and Bergstrom to perform Mastoidectomy prior to Tympanoplasty, but very few studies prove with statistical significance that Mastoidectomy combined with Tympanoplasty yields better success rate than Tympanoplasty alone[14,15]. In a study by Gaafar H, Maher A *et al*., showed that aural polypi consisted of oedematous connective tissue stroma infiltrated by chronic inflammatory cells and numerous blood vessels. The surface is covered by intact stratified squamous epithelium. The histochemical study revealed altered permeability of the blood vessels and the real factor in producing a polyp. No glandular activity was found in polypi but there was increased metabolic activity in the inflammatory cells[16]. In the literature few authors have shown the prevalence of Cholesteatoma in central perforation as much as 3.4%[17].

The present study showed Intra Operative Infected hypertrophied mucosa with infiltration of lymphocytes, plasma cells and occasional histiocytes was found in 26 (44.82%) of the patients, Tympanosclerosis with chronic inflammatory cells was found in 12 (15.78%), Granulation tissue was in 8 (10.52%), Cholesterol Granuloma in 10 (13.15%), Keratosis flakes, vascular stroma with Foreign body giant cell reaction in 2(2.63%) and oedematous mucosa was observed in 2 (2.63%) of the Tubo-tympanic patients. Similarly, HPE of mucosa in Attico Antral diseases patients showed Keratosis flakes, vascular stroma with foreign body giant cell reaction in (18.42%), infected hypertrophied mucosa with infiltration of inflammatory cells in 2 (2.63%), and cholesterol granuloma in 2 (2.63%). In a similar study by Karan Sharma et al., they observed the incidence of hyperplasic mucosa commonest in 32%, oedematous polypoidal mucosa in 20% and Cholesteatoma in 16% of their patients[18]. In comparison typical Cholesteatoma features was observed in 18.42% of the Attico Antral disease patients in the present study. Azevado *et al*., suggested granulation (63%) to be more common than Cholesteatoma (21%) in unsafe diseases[19].

According to a study by Bhattacharya *et al*., changes in sub mucosa was inflammatory cell infiltration mainly by lymphocytes in 98%, histiocytes 10% and plasma cells in 6%[20]. In the present study also showed features of hypertrophied mucosa with infiltration of lymphocytes, plasma cells and occasional histiocytes was observed more commonly in 63.14% of the patients.

CONCLUSIONS

Chronic Suppurative Otitis Media results in mucosal changes in the middle ear cleft. Though the

mastoid antrum and air cells are normally lined by simple squamous epithelium on a basement membrane, they show a varied Histopathological picture in CSOM of both Tubo-tympanic and Attico Antral types. The HPE in the former principally shows hyperplasia of mucosa infiltrated with granular leucocytes and in few cases mucosal oedema or cholesterol granuloma formation in others.

Similarly, HPE of Attico Antral type showed Cholesteatoma flakes (Keratosis) with vascular stroma infiltrated with inflammatory cells. Understanding the histopathology and applying its knowledge at the time of exploration of the mastoids in the surgical treatment of CSOM gives an insight to the necessity of clearance of the diseased mucosa from the auditus, antrum and air cells. It also helps in understanding its impact on success of the surgery and avoidance of revision operation in those patients where mastoid exploration is not undertaken. The cause of hyperplasia and thick mucosa resembling middle ear mucosa is to be further studied in depth in order to understand its cause. Factors like absence of ventilation from middle ear leading to development of negative pressure within the antrum and air cells are to be probed.

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