



# The Mastoid Compartment of Middle Ear Cleft-A Clinic Pathological Study in Patients with Chronic Otitis Media-Mucosal Type



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## Introduction

Chronic otitis media is a major problem in India, especially in rural areas. It is estimated that 6% of Indian population suffers from chronic ear disease. This is significantly higher than the incidence reported in Western countries which is about 1.8%. To complicate matters, in India, there is general lack of awareness of the disease per se and also regarding the complications of the disease. Chronic otitis media is a sequel of acute or unresolved otitis media, particularly in children with poor socio economic conditions, and usually presents within the first 5 years of life. In the presence of a preexisting perforation or ventilation tube, infection may develop secondary to contamination from ear canal organisms or with an upper respiratory tract infection. Reflux of nasopharyngeal secretions may occur, secondary to loss of the protective middle ear air cushion with a perforation. The surgical treatment of chronic otitis media is still controversial. Tympanoplasty has been the mainstay of treatment in chronic otitis media. In non cholesteatomatous chronic otitis media, there has been much debate whether a cortical mastoidectomy is required or not.

Since Developmentally, Anatomically and physiologically middle ear is considered as middle ear cleft, extending from eustachian tube to the mastoid antrum, with mucosal continuity; it may be wise to consider the possibility of mastoid compartment pathology also, when we attempt surgical correction.

The mastoid compartment pathological changes may be:-

- A. Mucositis-polypoid mucosa, granulation tissue, cholesterol granuloma
- B. Tympanosclerosis
- C. Deposition of fibrous tissue, sclerosis
- D. Squamous metaplasia, cholesteatoma
- E. Neo osteogenesis
- F. Osteitis

## Need and Significance of Study

In squamous COM, we expect bone erosion and spread of disease posteriorly into the mastoid compartment. But what is happening in mucosal COM? Is the mastoid compartment being involved? If so, what is the nature and extent of involvement? It is important to know this in regards with the surgical management. Tympanoplasty alone is the preferred surgical management in a dry central perforation. But if there are mastoid compartment changes already existing in this patient; as long as mastoid disease is not cleared, the disease process may alter the surgical outcome.

## Methods

This prospective study comprises of 100 consecutive patients with chronic otitis media of the mucosal type. All the cases were operated during the period of January 2012 to September 2013 in the department of Otorhinolaryngology - Head and Neck surgery, Jubilee Mission Medical College and Research Institute, Thrissur. The pathological changes in mastoid compartment in cases of chronic otitis media mucosal type was observed during the surgery and histopathologically evaluated. All the patients were treated initially by a medical line of management, which consisted of antibiotics - systemic and local, antihistaminic and decongestants. All the cases were operated by senior consultants. 100 consecutive cases of chronic otitis media, mucosal type were taken for the study [1]. All of them were treated by cortical mastoidectomy with tympanoplasty. During surgery gross pathological changes in the middle ear and mastoid compartment was noted. Ossicular status and aditus patency was assessed. A specimen from the mastoid compartment (including bone and mucosa) was chistled out close to the antral region and sent for histopathological examination. Relevant history, ENT examination findings, investigations, surgical findings and histopathology report were noted. This data was statistically analysed with the help of software spss 16 and results were obtained.

## Results

In our study maximum number of patients was seen in the age group of 20-30 years. The youngest patient was 5 years and the oldest 70 years. Mean age in the study sample was 32.46 years. Out of the 100 patients studied, 42 were males and 58 were females. Maximum number of patients presented with ear discharge alone (65%). 30% patients presented with ear discharge and hearing loss. 2% patients presented with vertigo as well. Maximum number of patients in the study had ear discharge for 5 - 10 years. Mean duration of ear discharge was 6.36 years. For the purpose of comparison histopathological changes were grouped under different categories in the order of increasing severity of involvement:

- A. Mucositis-polypoid mucosa, cholesterol granuloma, granulation, caseating granuloma, fungal hyphae
- B. Tympanosclerosis, fibrosis
- C. Squamous metaplasia, cholesteatoma
- D. Neo osteogenesis
- E. Osteitis

There is significant correlation between duration of ear discharge and mastoid pathology. P value <0.05 (i.e., 0.03).

Out of the 100 patients studied, according to pure tone audiometry, 86% had conductive hearing loss and 14% had mixed hearing loss. Minimum CHL was 25 dB. Maximum CHL was 63 dB. Mean CHL was 33.78 dB. Minimum MHL was 42 dB. Maximum MHL was 66 dB. Mean MHL was 54.85 dB. 43% of patients in this study had 30-45 dB hearing loss. 40% had 15-30 dB hearing loss. Only 5% had hearing loss >60 dB. According to Eustachian tube function study 43% patients had Eustachian tube dysfunction. In this study,

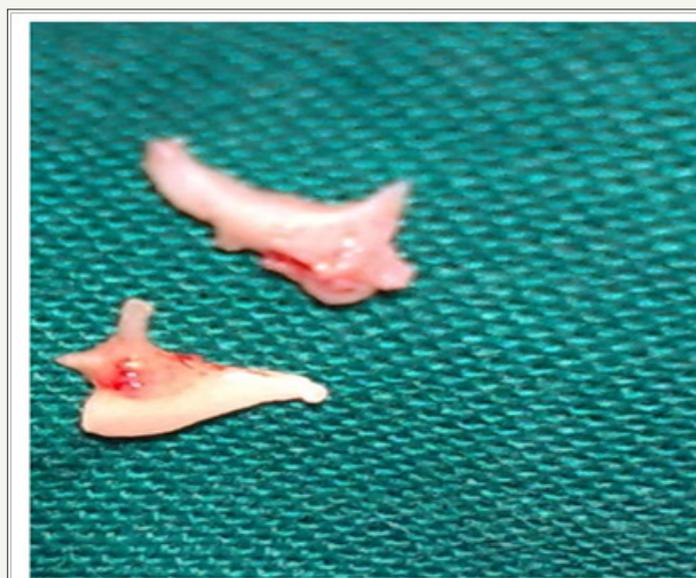
x ray showed sclerotic mastoid in 45% cases, cellular mastoid in 33% cases, and partially sclerotic mastoid in 22% cases. There is significant correlation between x ray mastoids findings and mastoid pathology. P value <0.05 (i.e., 0.005).

### Nature of Middle Ear Mucosa

In this study, middle ear mucosa was normal in 29% cases, polypoid in 26% cases. Tympanosclerotic patch was seen in 3% cases. There is significant correlation between nature of middle ear mucosa and mastoid pathology. P value <0.05 (i.e., 0.015)

### Ossicular Status

(Figure 1) In this study, ossicular chain was found intact in 39% cases. Long process of Incus was necrosed in 21% cases. Handle of malleus and Long process of incus was necrosed in 13% cases. Ossicles were covered with tympanosclerosis in 10% cases. Handle of malleus was eroded in 9%. Incudostapedial joint was necrosed in 5%. Stapes head was eroded in 3%. There is significant correlation between ossicular status and mastoid pathology. P value <0.05 (i.e., 0.002). Among the 100 cases studied, Eustachian tube orifice was blocked in 24% cases. 50% of them were due to mucosal band and remaining 50% showed polypoid mucosa extending deeper into the Eustachian tube. In our study, aditus blockage was seen in 71% cases. There is significant correlation between aditus patency and mastoid pathology. P value is < 0.05 (i.e., 0.029). Among the 71 cases with aditus blockage, 21 cases had aditus block due to a mucosal band. 17 cases showed polypoid mucosa causing blockage. Another 17 cases showed granulation tissue. Tympanosclerosis was causing blockage in 11 cases, while in 2 cases it was due to new bone formation. Cholesteatoma was causing blockage in 3 cases. In the 100 cases studied, per operative pathological changes in the mastoid was noted.



**Figure 1:** Figure of neo osteogenes is mimicking a new incus in the region of aditus with a partiality necrosed true incus side.

A combination of different pathologies was noted in most of the cases.

- a. Cholesterol granuloma noted in 15 cases
- b. Polypoid mucosa in 47 cases
- c. Granulation tissue in 24 cases
- d. Tympanosclerosis in 17 cases
- e. Congested mucosa alone in 6 cases
- f. New bone formation in 5 cases
- g. Bony destruction without cholesteatoma in 13 cases
- h. Necrosed tissue in 2 cases
- i. Frank pus in 1 case
- j. Cholesteatoma in 4 cases
- k. Sclerotic mastoid without mucosal pathology in 4 cases

Histopathology report of mastoidectomy specimen showed a combination of different pathologies in few cases. 25 cases showed osteitis, i.e., involvement of mastoid bone. Cholesterol granuloma in 12 cases. Tympanosclerosis in 15 cases. Mucositis alone in 18 cases, among a total of 22 cases reported with mucositis. Granulation in 17 cases. Fibrosis in 4 cases. Neosteogenesis in 1 case. Cholesteatoma in 4 cases. Squamous metaplasia in 9 cases. Fungal hyphae in 1 case. Caseating granuloma in 1 case. There is significant correlation between type of disease in mastoid clinically and histopathology report of mastoidectomy specimen. P value is  $< 0.05$  (i.e., 0.032). Graft uptake was seen in 99% cases. Failure was seen in only one case. Only the initial Graft uptake on 28th post operative day was assessed (as it was not an objective in our study).

## Discussion

Chronic otitis media is essentially a disease of the middle ear cleft. So surgical correction should include removal of disease from the mastoid as well, i.e., tympanoplasty with cortical mastoidectomy. In this study we tried to study the extent of involvement of the mastoid compartment in cases of chronic otitis media, various pathological changes. There by assess the need for mastoidectomy in chronic otitis media mucosal type. The primary argument in favour of mastoidectomy has been an improvement in the middle ear and mastoid environment through, clearance of diseased secretory mucosa and the ventilator mechanisms of an open mastoid system. The mastoid air cell system is thought to function, at least in part as a buffer to changes in pressure within the middle ear. According to Boyle's law, an increase in the volume available to middle ear space through a surgically opened mastoid would be protective for the tympanic membrane in response to middle ear pressure changes.

Age is a factor believed to influence the outcome of tympanoplasty. Failure of tympanoplasty has been attributed to various factors such as adenoid hypertrophy, Eustachian tube

dysfunction, and upper respiratory infections. Mastoid size has been considered to be a factor, especially in children as the mastoid air cell reservoir is considerably smaller in Children. In our study maximum number of patients was seen in the age group of 20-30 years. There were 4 cases less than 10 years of age and 16 cases in the 10-20 years age group. The youngest patient was 5 years and the oldest 70 years. Mean age in the study sample was 32.46 years.

Vartiainen reported after studying 76 cases of children for 6 years that, out of 34 cases in which he had done mastoidectomy and tympanoplasty, 33 were successful. Bluestone reported that if the tubal function is normal, tympanoplasty can be done in children also. The relevance of doing tympanoplasty in children is that this can prevent infection and ossicular necrosis in cases with recurrent otorrhoea. This is important because Type 2 or Type 3 tympanoplasty does not give as good as an improvement in hearing as that accomplished by a Type 1 tympanoplasty.

Out of the 100 patients studied, 42 were males and 58 were females. There are no definite reports in literature stating that sex of the patient affects the disease pathology or the success of surgery. In our study, patients presented with a combination of various symptoms, i.e., ear discharge, hearing loss, ear ache, itching, vertigo. Ear discharge was present in all cases. Hearing loss was seen in 34 cases. Ear ache was present in 3 cases. Vertigo in 2 cases. Itching in 1 case. Maximum number of patients presented with ear discharge alone (65%). 30% patients presented with ear discharge and hearing loss. 2% patients presented with vertigo as well. Ear discharge and hearing loss are the most common presenting symptoms in the previous studies. Maximum no. of patients in our study had ear discharge for 5-10 years. Mean duration of ear discharge was 6.36 years. In our study, it was found that there is significant correlation between duration of ear discharge and mastoid pathology. P value being 0.03 ( $< 0.05$ ). This shows that greater the duration of ear discharge greater is the extent of pathological changes in mastoid.

An average duration of 10 to 14 years elapsed between the onset of symptoms and presentation to an otologist (Ballenger's manual of otolaryngology). Out of the 100 patients studied, according to pure tone audiometry, 86% had conductive hearing loss and 14% had mixed hearing loss. Minimum CHL was 25 dB. Maximum CHL was 63 dB. Mean CHL was 33.78 dB.

Minimum MHL was 42 dB. Maximum MHL was 66 dB. Mean MHL was 54.85 dB. 43% of patients in this study had 30-45 dB hearing loss. 40% had 15-30 dB hearing loss. Only 5% had hearing loss  $>60$  dB. According to Eustachian tube function study 43% patients had Eustachian tube dysfunction. Among the 100 cases studied, Eustachian tube orifice was blocked in 24% cases. 50% of them were due to mucosal band and remaining 50% showed polypoid mucosa extending deeper into the Eustachian tube. So among the 43 cases with Eustachian tube dysfunction, 24 cases were due to anatomical obstruction of the orifice, which was removed during surgery. Eustachian tube function does have an

important role in middle ear function and, hence, in the long term success of middle ear surgery. According to George et al, in a few cases, after a variable interval of time, the grafts were seen to have got reperfused without any history suggestive of an acute otitis media. The size of the new perforation was small and it never closed by itself, suggesting the possibility of an underlying Eustachian tube dysfunction. Hence, it is advisable to do the tubal function tests by doing the modified inflation-deflation test for non intact tympanic membrane as described by Bluestone.

In this study, x-ray showed sclerotic mastoid in 45% cases, cellular mastoid in 33% cases, partially sclerotic mastoid in 22% cases. On statistical analysis, it was found that there was significant correlation between X-ray mastoids findings and mastoid pathology. P value < 0.05 (i.e., 0.005), in our study, middle ear mucosa was normal in 29% cases, polypoid in 26% cases. Tympanosclerotic patch was seen in 3% cases. According to Karan et al. [2] intraoperatively, hyperplastic mucosa was the commonest finding (32%), oedematous (20%) and polypoidal mucosa (20%) was also common. Granulations (22%) and cholesteatoma (16%) were more common in the middle ear. On statistical analysis, it was found that there is significant correlation between nature of middle ear mucosa and mastoid pathology. P value < 0.05 (i.e., 0.015).

In this study, ossicular chain was found intact in 39% cases. Long process of incus was necrosed in 21% cases. Handle of malleus and Long process of incus was necrosed in 13% cases. Ossicles were covered with tympanosclerosis in 10% cases [3]. Handle of malleus was eroded in 9%. Incudostapedial joint was necrosed in 5%. Stapes head was eroded in 3%. According to Grewal et al, incus was the commonest ossicle to be eroded (40%) followed by stapes suprastructure (20%) [4]. In tubotympanic type, 19.4% of the incus were eroded, 11.1% of the malleus and 8.33% stapes were eroded. Long process of incus was commonly eroded (50%) followed by erosion of both long and short processes (25%) [5]. Handle of malleus was eroded in 66.6% cases, while handle as well as head was eroded in 22.2% cases. While Udaipurwala et al. have reported malleus to be involved in greater numbers than stapes, Sade et al. [6] reported stapes to be involved more frequently than malleus.

In our study, aditus blockage was seen in 71% cases. On statistical analysis, it was found that there is significant correlation between aditus patency and mastoid pathology. P value is < 0.05 (ie 0.029). Among the 71 cases with aditus blockage, 21 cases had aditus block due to a mucosal band. 17 cases showed polypoid mucosa causing blockage [7]. Another 17 cases showed granulation tissue. Tympanosclerosis was causing blockage in 11 cases, while in 2 cases it was due to new bone formation. Cholesteatoma was causing blockage in 3 cases. This is an important cause for the failure of tympanoplasty. A chronic form of mucosal disease can be the cause or, sometimes, the effect of a blocked aditus. The appearance of the middle ear does not give any clue about the

patency of the aditus. The aditus was seen blocked in a few cases of dry central perforation with normal looking mucosa [8]. All these cases were due to tympanosclerosis according to Manjunath et al. According to George et al., the other causes of blocked aditus were polypoid mucosa of the attic or antrum, ballooned mucosa of the aditus and cholesterol granuloma. Most of the time the aditus block can be relieved by careful dissection of the disease. If a ballooned mucosal band is seen, it can be just incised on its dome to make the aditus patent. It is definitely advisable to preserve the mucosa, as it has great capacity to revert to normal. Otherwise, fibrosis and scarring can occur and cause secondary block [9]. In some cases of severe aditus block, the entire polypoid mucosa has to be removed to make it patent.

In the 100 cases studied, per operative pathological changes in the mastoid was noted. A combination of different pathologies were noted in most of the cases. Cholesterol granuloma was noted in 15 cases. Polypoid mucosa in 47 cases. Granulation tissue in 24 cases [10]. Tympanosclerosis in 17 cases. Congested mucosa alone in 6 cases. New bone formation in 5 cases. Bony destruction without cholesteatoma in 13 cases. Necrosed tissue in 2 cases. Frank pus in 1 case. Cholesteatoma in 4 cases. Sclerotic mastoid without mucosal pathology in 3 cases. According to Mathur et al. granulation tissue in the subepithelial region was the most common observation. In safe CSOM 86.6% cases had chronic inflammatory reaction. According to Grewal et al., the bone or cartilage was present in 14 cases (28 percent). 6 Cases (12 percent) showed necrotic bone foci and 4 cases (8 percent) showed new bone formation [11]. The new bone formation along with keratinization was present in 3 cases (6 percent). The hyaline cartilage was seen in one case (2 percent). In Mathur et al. study, only one case of safe CSOM showed osseous metaplasia, which was attributed to conversion of fibrous tissue into bone. Karan et al. [2] reported 11.1% granulations, 5.5% cholesteatoma intraoperatively and they were reclassified as unsafe disease.

Histopathology report of mastoidectomy specimen showed a combination of different pathologies were reported in few cases in our study. 25 cases showed osteitis, ie, involvement of mastoid bone. Cholesterol granuloma in 12 cases [12]. Tympanosclerosis in 15 cases. Mucositis alone in 18 cases among a total of 22 cases reported with mucositis. Granulation in 17 cases. Fibrosis in 4 cases. Neosteogenesis in 1 case. Cholesteatoma in 4 cases. Squamous metaplasia in 9 cases. Fungal hyphae in 1 case. Caseating granuloma in 1 case. Da Costa et al. identified Granulation tissue in over 95% of the temporal bones studied from individuals with a history of COM. According to meyerhoff et al. tympanosclerosis was present in 43%, cholesteatoma in 36%, and cholesterol granuloma in 21% of patients in one large histologic study of temporal bone pathology. Cholesterol granuloma was observed by Manasse (1917) and Birrel (1956). Foreign body granuloma has been reported by Hiranandani and Deshpande (1971) and attributed to left cotton threads or precipitated chloramphenicol crystals or dust particles [13]. This

was supported by Grewal et al. Mucositis was a common finding in the study by Mathur et al. Maximum number of cases (16.7%) with duration of symptoms less than one year had cystic dilated glands whereas, chronic inflammatory process was always found in the mucosa of those with symptoms for more than five years.

There was one case where definite evidence of squamous metaplasia could be demonstrated histologically according to Mathur et al. Thus the metaplastic origin of stratified squamous epithelium in cases of CSOM cannot be denied. Ten percent of safe CSOM cases had margins of perforation adherent to the medial wall of middle ear, and in all these cases keratinized stratified squamous epithelium was present thus favouring the possibility of epithelial migration. Large and subtotal perforations were often accompanied by stratified squamous epithelium [14]. Incidence of stratified squamous epithelium with or without keratinisation was also reported by Bhattacharya M and Karen et al. and Mathur et al. reported one case of large central perforation which showed tuberculous otitis media on histological examination. In our study, for the purpose of comparison, histopathological changes were grouped under different categories in the order of increasing severity of involvement:

- A. Mucositis-mucositis, cholesterol granuloma, granulation tissue, fungal hyphae
- B. Tympanosclerosis, fibrosis
- C. Squamous metaplasia, cholesteatoma
- D. Neo osteogenesis
- E. Osteitis

On statistical analysis, it was found that there is significant correlation between type of disease in mastoid clinically and histopathology report of mastoidectomy specimen. P value is <0.05 (i.e., 0.032). Only the initial graft uptake on the 28<sup>th</sup> post operative day was assessed as it was not an objective in our study. Graft uptake was seen in 99% cases. Failure was seen in only one case. A 70 year old diabetic male with severe mastoiditis. Histopathology report was mucositis with fungal hyphae. Postoperatively, antifungal was started. But blood sugar control was not optimum and there was failure of graft uptake. Hence, according to our study, there was pathological change in the mastoid compartment in all the cases. Moreover aditus blockage was seen in 71% cases. This shows the necessity of surgically clearing the disease from mastoid in cases of chronic otitis media, mucosal type. Especially in cases where the pathological change has progressed beyond simple mucositis, tympanoplasty should ideally be combined with cortical mastoidectomy to achieve long term success.

## Conclusion

Chronic otitis media continues to be a persistent problem worldwide, especially in the Indian subcontinent. Various treatments and procedures have been devised over the years

to effectively manage this disease. The aim of management is to provide a safe and dry ear and restore the hearing of the patient. This is possible by surgery, and tympanoplasty continues to be an effective surgical modality in the management of patients with chronic otitis media mucosal type. The requirement of concomitant cortical mastoidectomy remains a dilemma. Various factors contribute to the failure of tympanoplasty and it still remains a point of controversy whether a perforation should be repaired by tympanoplasty alone or cortical mastoidectomy with tympanoplasty. Most of the studies comparing tympanoplasty and tympanoplasty with cortical mastoidectomy had the shortcoming of limited duration of study and does not accurately indicate the long term success of the surgery. Infection is a very important cause of graft failure and can result from a hidden mastoid disease. A simple mastoidectomy is an effective means of re-pneumatizing the mastoid air cell system, as well as eradicating the mastoid source of infection. Our study emphasizes the fact that, chronic otitis media is a disease of middle ear cleft. So clearing the disease from middle ear alone without tackling the reservoir of hidden infection in the mastoid is equivalent to incomplete treatment of the disease. In our study it was found that there are significant pathological changes in the mastoid compartment. There is involvement of mucosa and bone, thereby proving the concept of otomastoiditis rather than otitis alone. These pathologies are reversible only by surgical removal. Hence it may be wise to combine tympanoplasty with cortical mastoidectomy in the surgical management of chronic otitis media, mucosal type.

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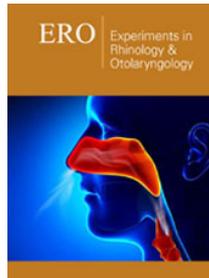
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