

# Middle Ear Cleft in Chronic Otitis Media: A Clinicohistopathological Study

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**Abstract** Chronic mucosal diseases of middle ear cleft or chronic suppurative otitis media has been traditionally defined as a chronic inflammation of the middle ear and mastoid usually associated with perforation of the tympanic membrane and otorrhoea. Understanding the pathology and pathogenesis of chronic suppurative otitis media is important in predicting the management, prognosis and sequelae of the disease. The present prospective study was conducted to evaluate the clinical, intraoperative and histopathological changes in middle ear cleft. 100 patients diagnosed with CSOM who underwent surgery were taken. The mucosa and granulation tissue was removed along with ossicles wherever indicated and sent for histopathological examination. On clinical examination, 72 cases were found to be of tubotympanic type and 28 cases of atticofurcular variety. However, intraoperatively, of the tubotympanic cases 8 were found to be of unsafe type which was also proven histologically. Stratified squamous epithelium was revealed in most of the cases accompanied by changes in the submucosa. Ossicular chain was involved in 40 cases with incus being the commonest bone to be eroded.

**Keywords** Chronic suppurative otitis media · Middle ear mucosa · Histopathology

## Introduction

Chronic suppurative otitis media is defined as chronic inflammation of the middle ear and mastoid cavity which present with recurrent ear discharge or otorrhoea through a tympanic membrane perforation [1]. Existence of chronic suppurative otitis media has been documented since prehistoric times. The significance of ear discharge as a potent cause of infirmity and death was perhaps recognized by Hippocrates in 460 BC who considered it secondary to suppuration of brain [2]. Incidence of chronic suppurative otitis media varies from 0.5–2% in developed countries whereas in developing countries it varies from 3–57%. In India, incidence of chronic suppurative otitis media is up to 30% with prevalence rate of 16/1,000 population in urban and 46/1,000 in rural areas [3].

Chronic suppurative otitis media is usually of safe/tubotympanic type in developing countries. Safe ear disease also known as tubotympanic disease is characterized by a central perforation of the pars tensa with the inflammatory process affecting the mucosa of the middle ear cleft. Unsafe ear disease or atticofurcular disease is typified by a marginal perforation of the posterosuperior pars tensa or pars flaccida [4, 5]. Cholesteatoma is frequently present in chronic suppurative otitis media with posterosuperior perforations. All cases of chronic suppurative otitis media including those described as safe can be associated with complications. Therefore, the term safe does not adequately categorize any case of chronic suppurative otitis media [6]. Understanding the pathology and pathogenesis of chronic suppurative otitis media is important in predicting the management, prognosis and sequelae of the disease.

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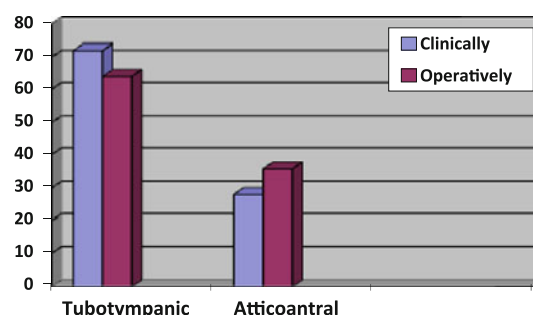
## Methods

The present study was carried out in Department of ENT and Department of Pathology, Government Medical College, Amritsar on 100 consecutive patients from 22nd December 2008 to 7th May 2010 who were diagnosed with chronic suppurative otitis media and underwent surgical exploration after thorough clinical examination and investigations. The mastoid antrum was opened, attic and antrum inspected for any pathology, i.e., condition of mucosa, presence of granulation tissue or cholesteatoma. The mucosa and granulation tissue were removed along with ossicles wherever indicated and sent for histopathological examination in 10% formalin with 4% EDTA. Paraffin sections were made after decalcification of the tissue and stained by Haematoxylin and Eosin. The findings of all cases were evaluated by the same surgical and pathological team. The sections were examined under high power magnification. We tried to study the correlation of the pre-operative clinical and otoscopic observations, examination under magnification (EUM), with the findings at operation and the histopathological findings. The relative incidence of cholesteatoma was evaluated along with the incidence of cholesteatoma in central perforation/safe otitis media. Ossicles were examined histologically wherever indicated to study whether such ossicles can be used as autograft/homograft. Patients included in the study were in the age group of 10–50 years. Patient refusal, those with complications of chronic suppurative otitis media and contraindications of surgery were excluded from our study. The clinical and histopathological findings were compiled and correlated in accordance with standard statistic parameters and compared on spss 10.0.

## Results

58% patients were less than 30 years of age. The mean age was 26.08 years with SD of 9.64. Male:Female ratio was 1:1.2 in the present study. There was slight female preponderance. Unilateral involvement was seen in 68% cases while both ears were involved in 32% cases. 72% of the cases were of the safe or tubotympanic type and 28% of atticotympanic type on clinical examination. However, intraoperatively there were 64% cases of safe type and 36% cases with unsafe pathology (Chart I).

The commonest presenting symptom was ear discharge seen in all the cases with a mean duration of  $7.78 \pm 9.60$  years, followed by decreased hearing seen in 82% of the cases. Tinnitus was also frequent (46%), followed by itching (26%), vertigo and ear ache (22%) each and mass in ear (6%). On otoscopic examination, Perforation was seen in 80 cases, while retraction pockets were present in 20 cases (mostly in posterosuperior quadrant), 12



**Chart I** Type of CSOM

cases had plastered TM of which 6 were associated with retraction pockets. Granulations were seen in 2 cases, while tympanosclerosis was observed in 8 cases all associated with perforations. Whereas isolated TM perforation (97.2%) was commonest in tubotympanic otitis media, retraction pockets specially in the posterosuperior quadrant, either isolated or associated with perforation, granulations or plastered TM was frequent in atticotympanic variety (72%). Mean hearing loss in atticotympanic was  $47.76 \pm 13.64$  and in tubotympanic it was  $43.27 \pm 12.15$  db. 88% cases had pure conductive hearing loss while 12% had mixed hearing loss.

On surgical exploration (68% Cortical Mastoidectomy with Tympanoplasty, 32% MRM with type 3 tympanoplasty), hyperplastic mucosa was the commonest pathology in the antrum as well as the middle ear. Granulations in middle ear were seen in 22% cases. 16 patients had cholesteatoma localized in middle ear as compared to 6 in antrum. Granulations (50%) and cholesteatoma (42.9%) were the commonest findings followed by hyperplastic polypoidal (28.6%) mucosa in atticotympanic variant. In the tubotympanic type, hyperplastic mucosa (33.3%) was the commonest finding followed by edematous mucosa and tympanosclerosis (19.4%). Eight cases which were clinically classified as safe were found to be unsafe operatively.

**Table 1** Operative findings in atticotympanic and tubotympanic variants

CSOM	Atticotympanic (n = 28)		Tubotympanic (n = 72)		P value
	Absent	Present (%)	Absent	Present (%)	
Hyperplastic	20	8 (28.6)	48	24 (33.3)	>0.05 (NS)
Glue	28	0	70	2 (2.8)	>0.05 (NS)
Edematous	22	6 (21.4)	58	14 (19.4)	>0.05 (NS)
Polypoidal	20	8 (28.6)	60	12 (16.7)	>0.05 (NS)
Tympanosclerosis	26	2 (7.14)	58	14 (19.4)	>0.05 (NS)
Granulations	14	14 (50)	64	8 (11.1)	S (<0.01)
Cholesteatoma	16	12 (42.9)	64	4 (5.5)	S (<0.01)
Normal	28	0	64	6 (8.3)	>0.05 (NS)

Of these 8 cases, 4 had granulations while 4 had granulations alongwith cholesteatoma (Table 1).

Incus was the commonest ossicle to be eroded (40%) followed by stapes suprastructure (20%). Malleus (18%) was the most resistant. Handle of malleus was eroded in 66% cases while handle as well as head was eroded in 22% cases, malleus was absent in 2 cases. Long process of incus was commonly eroded (50%) followed by erosion of both long and short processes. Incus was absent in 25% cases. 93% of the incudi were eroded in the atticoantral variant as compared to 50% stapes and 35.7% mallei. In tubotympanic type, 19.4% of the incus were eroded, 11.1% of the malleus and 8.33% stapes were eroded. Hence ossicular erosion was more in cases of atticoantral otitis media (Table 2).

Epithelium was of stratified squamous type in 60% of the cases while keratinized stratified squamous epithelium was seen in 18% cases. Cuboidal epithelium was seen in 14, 6% had pseudostratified squamous and 2% had pseudostratified columnar epithelium. Of the 8 cases identified as atticoantral operatively, 2 had keratinized stratified squamous epithelium, while rest had stratified squamous epithelium with granulation tissue microscopically also. An increase in inflammatory cells was seen in all the cases. Fibrosis was increased in 84% cases, 70% amongst these showing minimal increase. Increase in vascularity was seen in 62% cases with discreet increase in 46% cases. Calcification was seen in 30%, ossification in 32% while neogland formation was seen in 4% cases. Lymphocytes were increased in all cases, while an increase in plasma cells was seen in 94% cases. An increase in histiocytes was seen in 48% cases, giant cells were observed in 16% cases. On microscopic examination, the cases with unsafe pathology had either granulations or cholesteatomatous changes. Of the 8 reclassified cases 2 had characteristic appearance of cholesteatoma while 6 had stratified squamous epithelium with granulation tissue. Ossicles were removed in ears with atticoantral pathology

**Table 2** Ossicular status in atticoantral and tubotympanic COM

Ossicle	Atticoantral (%)	Tubotympanic (%)
Malleus (18)		
Eroded	10 (35.7)	8 (11.1)
Not eroded	18	64
Incus (40)		
Eroded	26 (92.8)	14 (19.44)
Not eroded	2	58
Stapes (20)		
Eroded	15 (53.5)	5 (6.94)
Not Eroded	13	67

(28) and in tubotympanic cases (34) where ossicular pathology was suspected. Ossicles were removed in cases which were found to be of unsafe variety intraoperatively. Necrosis was seen in 50% cases of ossicles where there was atticoantral pathology, whereas amongst the ossicles studied in tubotympanic variant, necrosis was seen in 8 of the 34 ossicles examined histologically (Table 3).

Though increased inflammation was seen more in ossicles with atticoantral COM (35.7%) as compared to tubotympanic otitis media (23.8%), the association was not statistically significant according to standard *P* values. No evidence of squamous epithelial cells was found in the ossicles. Other microscopic changes like increased vascularity, fibrosis, ossification, calcification also had no significant association (Table 4).

Patients were on regular follow up for a period of 3 months. 4 cases had stitch abscess which recovered after drainage. 2 were seen in 2nd postoperative week due to infection, while another 2 were seen after the 3rd postoperative week which were due to non absorption of chromic catgut. 12 cases had secondary perforation. Granulations were seen in 6 cases which were managed by chemical cautery. There were no postoperative neurological complications.

**Table 3** Showing histological status of ossicles

Necrosed/ Healthy	Total	Operatively AA (n = 8) (%)	Tubotympanic (n = 34) (%)	Atticoantral (n = 28) (%)
Necrosed	24 (34.3)	2 (25)	8 (23.5)	14 (50)
Healthy	46 (65.7)	6 (75)	26 (76.5)	14 (50)

**Table 4** Showing ossicular status in tubotympanic and atticoantral variants

Finding	Degree	Atticoantral (%) n = 28	Tubotympanic (%) n = 42
Ossicles	Healthy	14	32
	Necrosed	14 (50)	10 (23.8)
Inflammation	–	18	32
	+	10 (35.7)	10 (23.8)
Fibrosis	–	26	38
	+	2 (7.14)	4 (9.52)
Ossification	–	24	42
	+	4 (14.2%)	0
Calcification	–	24	38
	+	4 (14.2)	4 (9.52)
Increased vasculature	–	24	40
	+	4 (14.2)	2 (4.76)

## Discussion

In the present study there were 72% cases of tubotympanic otitis media and 28% cases of otitis media of atticofurrow type. However, on surgical exploration, unsafe otitis media was seen in 36% cases while safe otitis media was in 64% cases. The incidence of otitis media of the atticofurrow variety in other studies [1, 5] was found to be slightly higher on surgical exploration. This was due to occurrence of granulations and cholesteatoma in cases which were otherwise found to be of tubotympanic type on clinical examination.

According to our study, on otoscopy, perforation was seen in 80% cases, retraction pockets were seen in 20% cases which were most common in posterosuperior quadrant. Large central perforations involving all the quadrants was seen in 50% cases, while 27% had subtotal perforations. 6 cases had marginal perforation. 72% atticofurrow cases had retraction pockets. Of the 8 cases which were later found to be atticofurrow type, 6 had large central perforations, while 2 had subtotal perforation. Retraction pockets were found in about 63% cases of unsafe ears by Grewal et al. [7]. Memon et al. [6] reported about 89% cases which had central perforation in CSOM which was similar to our observation.

Intraoperatively, hyperplastic mucosa was the commonest finding (32%), oedematous (20%) and polypoid mucosa (20%) was also common. Granulations (22%) and cholesteatoma (16%) were more common in the middle ear. In the atticofurrow variant granulations and cholesteatoma were seen in 50% each and in those cases in which they were found intraoperatively (11.1% granulations, 5.5% cholesteatoma) they were reclassified as unsafe disease (8 cases) in our study. Azevedo et al. [8] suggested granulation (63%) to be more common than cholesteatoma (21%) in unsafe diseases. Unusual finding such as the presence of central perforation in 2 cases of unsafe disease which was contrary to the common observation of marginal or attic perforation, retraction pockets associated with unsafe disease has been reported in the same study which is similar to our observation.

According to our study incus was the commonest ossicle to be eroded (40%) followed by stapes suprastructure (20%). 93% of the incudi were eroded in the atticofurrow variant as compared to 50% stapes and 35.7% mallei. 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%). Handle of malleus was eroded in 66.6% cases while handle as well as head was eroded in 22.2% cases. Incus has been reported to be the commonest ossicle affected, however, regarding erosion of malleus and stapes there have been contradictions as to which ossicle is

commonly involved. While Udaipurwala et al. [9] have reported malleus to be involved in greater numbers than stapes which contradicts our study, Sade et al. [10] reported stapes to be involved more frequently than malleus.

Epithelium of stratified squamous type was the commonest (60%) followed by keratinized stratified squamous in 18% cases. Inflammation of middle ear submucosa was seen in all cases. Of the 8 cases identified as atticofurrow operatively, 2 had keratinized stratified squamous epithelium, while 6 had stratified squamous epithelium with granulation tissue microscopically also. No significant correlation was in degree of inflammation and other histological findings between the atticofurrow and tubotympanic variant. An increase in lymphocytes was seen in all cases, an increase in plasma cells was also common (94%). Similar to our study incidence of stratified squamous epithelium with or without keratinisation was highest as also reported by Bhattacharya M [11]. Changes in submucosa was inflammatory cell infiltration mainly by lymphocytes (98%), histiocytes (10%) and plasma cells (6%) according to Bhattacharya M11 and Grewal et al. [7].

Ossicles were necrosed in 24% cases while 46% cases were healthy of all the ossicles which were examined histologically. 50% ossicles were necrosed in unsafe variety as compared to 23.5% cases in safe otitis media. 28.6% cases of necrosed ossicles had increase in inflammatory cells, fibrosis was seen in only 8.6% cases. Though increased inflammation was seen more in ossicles with atticofurrow COM (35.7%) as compared to tubotympanic otitis media (23.8%) the association was not statistically significant. There was no evidence of squamous epithelial cells in the ossicles removed from cholesteatomatous cases. Though ossicular necrosis is more in tubotympanic otitis media, several studies [11, 12] show variable percentage. Incidence of ossicular involvement of even up to >90% in atticofurrow otitis media has been reported [13]. No ossicular involvement by squamous epithelium/cholesteatoma similar to our study was also reported by Rupa et al. [13].

## Conclusions

The incidence of unsafe otitis media in clinically safe cases was 11.11%. Hence it is not always possible to predict the pathological changes and the involvement of the middle ear mucosa based on clinical findings. Metaplasia is generally present in cases of chronic otitis media along with infiltration of submucosal tissues with chronic inflammatory cells mostly lymphocytes which is universal. These histological changes were possibly reversible because persistent changes postoperatively would lead to failed uptake of graft and persistently discharging cavity. Histologically, inflammation is more in ossicles in cases of atticofurrow otitis media, however, association of the degree of

inflammation fibrosis, calcification and increased vascularity was statistically insignificant. There was no evidence of squamous epithelial cells in the ossicles removed indicating that they can be used judiciously as auto/homograft after proper treatment and autoclaving which destroys chronic inflammatory cells. It can be concluded hence that although the histopathological examination of the middle ear mucosa and the ossicles becomes exhaustive but it is definitely advised that such studies be done at least in tertiary institutions.

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