RISHI BHATTA[1]
SANA MEHRAJ KIDWAI[2]
MANITA PYAKUREL[3]
YOGESH NEUPANE[4]

Department of ENT Head & Neck Surgery
Civil Service Hospital
Kathmandu, Nepal[1]

Department of ENT HNS
Nepalgunj Medical College
Nepalgunj, Nepal[2]

PhD Fellow
Department of Public Health
Central University of Nicaragua[3]

Department of ENT Head & Neck Surgery
Tribhuvan University Teaching Hospital
Institute of Medicine (IOM)
Maharajgunj, Kathmandu, Nepal.[4]

Corresponding Author
Dr Yogesh Neupane
Department of ENT Head & Neck Surgery
Ganesh Man Singh Bhawan
Tribhuvan University Teaching Hospital
Institute of Medicine (IOM)
Maharajgunj, Kathmandu, Nepal.

Email: yogeshneupane@hotmail.com

HEARING LOSS IN CHRONIC OTITIS MEDIA-MUCOSAL TYPE, ACTIVE VERSUS INACTIVE STAGE

ABSTRACT

Objective:

The aim of this study is to compare type and degree of hearing loss in active and inactive chronic otitis media mucosal patients.

Materials and Methods:

It was a prospective analytical study of 8 months (1st Jan to 31st August 2018) where all patients of chronic otitis media (COM) mucosal active presenting in Nepalgunj medical college underwent pure tone audiometry. These patients underwent standard medical treatment (Neomycin and betamethasone ear drop) to make ear dry. Review was done in inactive stage and they again underwent audiogram. Data was analyzed to compare audiogram degree and type of both active and inactive stage.

Results:

Total ear studied was 364 and most of patients were below 40 years age. Conductive hearing loss was the commonest (58.7%) type of hearing loss. Higher air conduction (AC) and bone conduction (BC) thresholds, with increasing age, was found in both active and inactive COM mucosal. There was significant decrease in AC threshold in all patients below 60 years ($p<0.01$) after treatment. Commonest audiogram pattern change were flat curve turning into downsloping and upsloping turning into flat curve.

Conclusion:

COM-mucosal is common cause of hearing loss and mostly involves younger age groups. More than 1/3rd has sensorineural hearing loss which is more in older age. Younger age group can have worse cochlear reserve after an episode of active otitis media. Conductive hearing loss in these patients improves in all ages after treatment ,while sensorineural part might get worse in younger patients.

Keywords: Chronic Otitis Media healed, Hearing loss, Tympanosclerosis

INTRODUCTION

Chronic otitis media (COM) is clinical condition with a permanent abnormality of the pars tensa or flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure or otitis media with effusion. COM has replaced the classic term chronic 'suppurative' otitis media (CSOM) as the condition is not necessarily a result of 'the gathering of pus'. However, there is a distinct type called active COM, where there is inflammation and the production of pus. In inactive type there is no current evidence of inflammation either of the middle ear mucosa or tympanic membrane but has potential to become active at some time.[1] COM can be mucosal and squamous type. In mucosal type there is perforation of pars tensa while in squamous type there is retraction of pars flaccid or posterior superior part of pars tensa. Both types can have active and inactive stage. In active form there is inflammation within the mucosa of the middle ear and mastoid with varying degrees of oedema, submucosal fibrosis, hypervascularity and an inflammatory infiltrate including lymphocytes, plasma cells and histiocytes.[1] There is an intermediate stage called quiescent stage, where the inflammation is still persisting in form of edematous middle ear mucosa, but there is no frank pus.[2]

Active COM is chronic inflammation of the middle ear and mastoid mucosa, with recurrent discharge (at least 2 weeks) through a chronic perforation of the tympanic membrane.[3] UK National Study of Hearing [4] found overall prevalence of healed, inactive and active COM was 11.9%, 2.6% and

1.5% respectively. The prevalence of active and inactive COM together was 4.1%, with 3.1% unilateral and 1.0% bilateral disease. In a study of over fifteen thousand people in Nepal, the prevalence of deafness was found to be 16.6% of the general population.[5] It also showed 7.2% had COM mucosal and one third of preventable deafness was due to COM. It was estimated that 13.8–36.2% of hearing impairment in developing countries is due to chronic otitis media. Hearing loss causes impaired speech development in pediatric population and psychosocial problems in adults.[6] WHO estimated worldwide prevalence of 466 million hearing impaired, out of which 60% suffer from significant hearing loss.[7] It is estimated that by 2050 over 900 million people – or one in every ten people – will have disabling hearing loss. The highest incidence occurs in the first year of life (15.4 per thousand) and that 21 000 people died annually from complications of otitis media.

The sign of activity is usually evident in form of inflamed middle ear mucosa, but sometimes with granulation tissue that can be localized and polypoidal. In both active and inactive COM, if the defect involves the posterior third, ossicular chain integrity should be assessed and recorded. Active mucosal COM is often associated with destruction of the ossicular chain. The affected ossicles typically show areas of hyperaemia with proliferation of capillaries and prominent granulation tissue with bone resorption or destruction. The long process of the incus, stapes crura, body of incus and manubrium are involved in decreasing order of frequency.[1]

The majority of adults (80%) presenting with COM report a hearing impairment and approximately 70% an ear discharge.[8] Even in those with currently active COM, only around 75% will report a current discharge while 69% complain of discharge.[8] Hearing loss is the usual chief complaint in chronic otitis media (COM), however unilateral hearing loss usually goes unnoticed. Patients are bothered for treatment when they have pain and discharge in ear. This hearing loss is usually conductive, resulting from tympanic membrane rupture and/or ossicular chain fixation or erosion caused by the chronic inflammatory process. In active stage of COM, hearing usually becomes worse due to inflammation hindering proper sound transmission. Rarely there can be a case of mucosal thickening or pathology bridging the gap of ossicular discontinuity forming a mechanism to improve hearing. So hearing assessment in inactive stage refers to actual hearing loss. Sensorineural hearing loss due to COM is another important issue. While the conductive loss can be minimized through surgery, sensorineural hearing loss constitutes a permanent after defect, which is only helped by hearing aid. Relation between SNHL and COM-mucosal is not fully elucidated and there is also confusion about SNHL correlation with patient's age, disease duration and relation with the opposite ear.[9, 10, 11] What's the difference in hearing in between active and inactive stage is not fully known. Any clinically significant effect of ototoxic drugs on hearing has not been well defined. The aim of this study is to compare type and degree of hearing loss in active and inactive chronic otitis media mucosal patients.

MATERIALS AND METHODS

It was a prospective analytical study with purposive sampling which was taken over a period of 8 months (1st Jan to 31st August 2018). Approval was obtained from IRB of the medical college. Patients were not deprived of standard treatment and no additional active intervention was done in patients. All patients of chronic otitis media (COM) mucosal active presenting in OPD or emergency of Nepalgunj medical college at Nepalgunj were asked to undergo pure tone audiometry after cleaning discharge from external auditory canal. Patient history, examination finding and audiogram were recorded in proforma sheet. All age group patients diagnosed with COM mucosal, who could undergo audiometry were included in the study. Patients who couldn't undergo pure tone audiometry (small children, mentally retarded, acute otitis externa) or those who denied further investigation or to be part of study were excluded. These patients underwent standard medical treatment (Neomycin and betamethasone ear drop) to make ear dry. Patients allergic to this eardrop were excluded from study.

Review was done after 3 weeks. If the ear has turned into inactive stage, they were advised to undergo audiogram by same audiologist. Audiologist was blinded here, i.e: was not aware of previous audiogram threshold and pattern. If patients turned into quiescent stage or still in active stage,

further treatment was given. Review was done after another 3 weeks. At this time, if ear is not fully dry (quiescent or active stage), they were excluded from study. If inactive stage was acquired, these patients also underwent 2nd audiogram by same blinded audiologist. Evaluation was done by single ear surgeon throughout study period to avoid interobserver bias.

Comparison was done between types of laterality and age group. Age was categorized into 4 groups with each group of 20 years span separating children/adolescents, young adults, middle aged adults and elderly into different groups.

Comparison was done with examination finding and audiogram report. . Size of perforation has been categorized into 4 types as per size of perforation in pars tensa. Surgeon recorded size of the perforation in active stage and same surgeon was blinded while recording size of perforation in inactive stage. This was done to assess change in size of perforation in active and inactive stage.

Pure tone audiometry report was analyzed by comparing bone conduction (BC) threshold in inactive and active stage. Similarly air conduction (AC) threshold was compared between two stages. Data was analyzed using SPSS 26 software. Descriptive statistics was presented including mean, frequency and percentage. Change in BC threshold and AC threshold was noted and analyzed using Z test and p value <0.05 was taken as significant.

Audiogram configurations were categorized as upsloping (hearing loss affecting 250, 500 Hz more), flat (less than 20 dB difference between the highest and the lowest threshold), downsloping (hearing loss affecting 4,000, 8,000 Hz more) and profound (thresholds of 90 dB or more in each test frequency) hearing loss. [12]

RESULTS

There were 344 patients with active COM mucosal presented during study period. But only 280 patients could meet all exclusion criteria. There were 196 patients with unilateral COM mucosal, 104 on right side and 92 on left side; while 84 patients had bilateral disease. Hence total ear studied was 364.

Figure I shows laterality of involved ear with different age groups. Most of patients are below 40 years age and bilaterality was more commonly seen

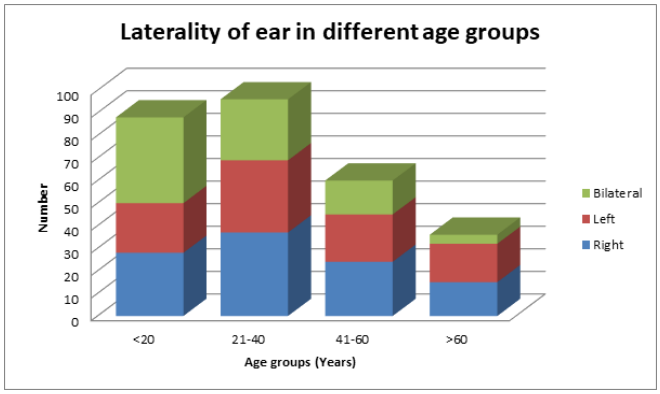

Figure I: Laterality of ear in different age groups

in younger age group. Out of 196 cases with unilateral COM –mucosal, some form of COM in contralateral ear was seen in 112 (57.1%) patients.

Audiogram reporting as per threshold was normal in 8 ears while conductive hearing loss was the commonest (58.7%) type of hearing loss. Sensorineural comprised of just 3.3 % while mixed comprised of remaining 38%.

Table 1 compares number of ears with size of perforation in both active and inactive stage. Size of perforation has been categorized into 4 types as per size of perforation in pars tensa. Most of the perforations were 25-50% group in both active and inactive COM mucosal group. In active stage most of the perforations were below 50%, while in inactive stage this proportion was changed with more cases also seen at >50% groups.

Table 1. Number of ears with different sizes of perforation in active and inactive stage

Size of perforation	Number of ears	
	Active stage	Inactive stage
<25%	112	80
25-50%	116	114
50-75%	108	108
>75%	28	62

Average bone conduction (BC) thresholds of both active and inactive stage (measured at 0.5, 1 and 2 KHz) were tabulated as per different age groups. (Table 2) It shows higher BC threshold with increasing age in both active and inactive COM mucosal. There is non significant change in BC threshold in more than 20 years age group. In children and adolescents however, BC threshold seem to be significantly increased (p<0.01) in inactive stage when compared with active stage.

Table 2. Bone conduction (BC) thresholds in active and inactive stage of COM –Mucosal

Age groups (years)	Number of ears	Active stage BC threshold		Inactive stage BC threshold		P value
		Mean (dB)	Standard deviation (dB)	Mean (dB)	Standard deviation (dB)	
<20	126	4.88	1.6	6.07	1.6	<0.01
21-40	123	5.9	2.2	5.8	2.2	>0.05
41-60	75	8.3	3.7	8.1	3.2	>0.05
>60	40	11.62	4.2	12.3	4.1	>0.05

Table 3. Air conduction (AC) thresholds in active and inactive stage of COM –Mucosal

Age groups (years)	Number of ears	Active stage AC threshold		Inactive stage AC threshold		P value
		Mean (dB)	Standard deviation (dB)	Mean (dB)	Standard deviation (dB)	
<20	126	32.6	7.8	26.4	7.7	<0.01
21-40	123	38.4	12.4	28.4	10.9	<0.01
41-60	75	36.8	11.8	30.1	12.1	<0.01
>60	40	42.4	9.3	38.3	10.4	>0.05

Table 3 shows average air conduction (AC) thresholds of both active and inactive stage (measured at 0.5, 1 and 2 KHz) tabulated as per different age groups. It shows higher AC threshold with increasing age in both active and inactive COM mucosal. There is significant decrease in AC threshold in all patients below 60 years ($p<0.01$) in inactive COM mucosal when compared with active ones. This decrement in AC threshold is not significant in >60 years patients.

Regarding audiogram pattern, 3 main types of audiogram pattern was studied: Downsloping (D) involving higher frequency, Upsloping(U) involving lower frequency and Flat curve(F) with no specific frequency involvement. The change in pattern of audiogram is depicted in Table 4.

It shows that 110/364(30%) audiogram has change in pattern of BC curve while rest showed same pattern in both active and inactive stage. Most of these changes in BC is flat curve changing into downsloping curve followed by upsloping curve changing into flat curve. Regarding change in the curve for air conduction (AC), there were 157/364 (43,1%) active stage audiogram that changed its pattern in inactive stage. Again in this category as well, commonest change were flat turning into downsloping and upsloping turning into flat curve.

Table 4: Change in audiogram pattern in inactive COM-mucosal as compared with active one

PTA curve	U→D	U→F	F→D	F→U	D→F	D→U	Total
BC	3	29	69	3	4	2	110
AC	3	46	92	8	6	2	157

U:Up sloping pattern, D: Downsloping pattern, F: Flat pattern

DISCUSSION

The two main symptoms of active mucosal COM are otorrhoea and hearing impairment. The

discharge varies in quantity and character and can be continuous or intermittent, mucoid or purulent. In patients with intermittent otorrhoea, an increase in discharge may follow a URTI or entry of contaminated water into the middle ear, most commonly when swimming. Usually discharge is profuse but sometimes when it is scanty and dries up in the canal forming crust, patient may not be aware of discharge. Active ear is usually provoked by factors such as a URTI or the ingress of water, particularly if contaminated by bacteria or irritants. However, many patients present with hearing difficulty as their main symptom. The hearing impairment is usually conductive, though older people may present primarily with age-related sensorineural hearing impairment but have an additional unilateral conductive component due to COM-mucosal. On questioning, these patients will often report that they had otorrhoea when they were younger.[1]

COM is most common cause of hearing loss in developing world in productive age group. COM-mucosal is the commonest variant with progressive hearing loss. Conductive hearing loss is the common due to direct effect of structural change in tympanic membrane and ossicular structure. In mucosal disease, the size of the perforation in the pars tensa is relevant to the hearing loss but other factors like granulation tissue, mucus, adhesions and tympanosclerosis are also of importance in determining the hearing level.[1]

Pure tone audiometry is essential tool to determine degree and type of hearing loss caused by COM. Otitis media will definitely cause some form of conductive hearing loss as sound conduction mechanism will be impaired. Significant relation is observed between degree of hearing loss with site of perforation and the duration of ear discharge. Lower frequencies are more involved in conductive loss as compared to higher frequencies. [13,14]Audiometry was done by same audiologist and evaluation was done by same surgeon in this study in both stages of diseases to decrease bias.

Age group categorization was done to segregate different groups of people with different common etiologies of hearing loss and their possible role in outcome of hearing. Younger age groups (<40 years) were commonly involved and most of the bilateral disease was also in same group. About two thirds of total ears were part of bilateral COM which favors in the theory of COM being bilateral disease. More than three fourth of bilateral COM-mucosal was seen in younger population (<40 years), probably due to more upper respiratory infection in this age group. COM mucosal was less common in >40years age probably due to healed tympanic membrane or conversion into secondary acquired cholesteatoma. Size of perforation was assessed to see difference in its size during active and inactive stage. In active stage most of the perforations were in <50% group while in inactive stage it was in 25-75% group. The apparent increase in size of perforation is due to resolved edematous tympanic membrane.

Sensorineural hearing loss component was seen in over 40% of ears in our study which is in accordance to study done by Rana et al (42.46%) [6] .However this value is higher than other studies. Yang et al found COM mucosal related SNHL was present in 22% of ears with COM.[15] However Yang et al defined SNHL after comparing with normal contralateral ear (average BC threshold greater than 10dB in 4 frequencies). As bilateral diseases were not taken, the difference can be explained.

In our study, higher AC threshold with increasing age in both active and inactive COM mucosal could be due to age related hearing loss coming into play or sensorineural component of hearing loss due to long duration and repeated infection of middle ear. The significant decrease in AC threshold in all patients <60 years with inactive diseases is consistent with clearance of impaired sound conductive mechanism due to resolution of inflammation. Hence almost all cases had improvement in hearing with resolution of inflammation, and phenomena of inflammation and edema bridging the ossicular discontinuity gap is not seen in our study.

Sometimes inflammatory processes in chronic otitis media (COM) can damage the inner ear, resulting in sensorineural hearing loss (SNHL).[11,15]Mean values of bone conduction thresholds are significantly higher in COM ears than in healthy ears suggesting need for early treatment of COM before irreversible SNHL sets in[16,17,18] The sensory cells, esp. for higher frequencies are in close proximity with inflamed middle ear, from which inflammatory toxins enter inner ear causing sensorineural hearing loss (SNHL) especially of higher frequencies. [15,18,19,20,21] Children who have recovered from chronic OM have significantly poorer hearing in the extended

high frequency (EHF) range compared with children without significant otitis media histories. [21] Some of the factors found to be associated with sensorineural hearing loss are older age[22,23], duration [6,15]extensive labyrinthine fistula, perforation size, and type of retraction[23], CT temporal bone showing soft tissue density in the antrum and round window niche. [15]There are other studies with different views on this association. Bone conduction threshold tends to increase with increasing frequency. Few authors also pointed that this may be due to Carhart's effect and not due to disease damaging inner ear. [6]

Kirtane et al.[24]showed that there is no statistical difference between the sensorineural deafness produced by mucosal and squamosal type of COM. Rana et al study[6] showed the incidence of SNHL in mucosal disease is higher than previously thought. Squamosal disease showed early progression to SNHL than mucosal disease. Higher frequencies were found to be more affected and maximum bone gap was seen at 4000 Hz.[6]

Inflammatory mediators such as free radicals and bacterial toxins can cause deterioration of inner ear function by entering the inner ear through the round window membrane and can damage hair cells in the basal turn of the cochlea. [25,26]

It has been observed that CSOM can cause temporary threshold shifts or permanent threshold shifts due to passage of inflammatory agents through the round window, which can be measured in routine audiometry. [6] Inflammatory mediators can enter the inner ear through the round window membrane, the permeability of which was demonstrated to increase in CSOM. [27] In our study all active cases underwent cleaning of discharge from the canal before undergoing audiogram. Patients using any eardrop before presenting to us were excluded from study to eliminate probable temporary thresholds change following use of eardrop. As potentially ototoxic agents are commonly used in the management of active mucosal COM, it is important to record the hearing before treatment. [1]In our study, higher BC threshold with increasing age in both active and inactive COM mucosal, could be due to age related hearing loss coming into play or sensorineural component of hearing loss due to long duration and repeated infection of middle ear. In younger age group, BC threshold is significantly increased in inactive stage which could be part of temporary threshold shift due to toxins during inflammation or by ear drops. Although some reports suggest that SNHL may occur after topical use of these preparations, no conclusive evidence is available that proves the ototoxicity of commercially available otic preparations in the human middle ear. [28]

The common changes in audiogram patterns in our study were flat turning into downsloping and upsloping turning into flat curve which can be a result of higher frequency involvement or improvement of lower frequency. Possibility of toxins or ototoxic medications causing temporary threshold shift of higher frequencies is always there. However, our study design precludes such assessments and need further study with longer follow up period and frequency specific assessment in different periods of COM-mucosal.

Traditionally it has been assumed that mucosal disease is relatively harmless except for intermittent otorrhea and element of conductive hearing loss. The documentation of insidious cochlear damage by even such safe process makes this entity to be seen in better way. In our country, where there is a high prevalence of COM in young children, the potential hazards of SNHL are obvious. Additionally, other coexisting causes of conductive hearing loss like otosclerosis, congenital ossicular involvement hasn't been ruled out in this study.

CONCLUSION

COM-mucosal is common cause of hearing loss and mostly involves younger age groups. More than 1/3rd has sensorineural hearing loss which is more in older age. Younger age group can have worse cochlear reserve after an episode of active otitis media. Conductive hearing loss in these patients improves in all ages after treatment while sensorineural part might get worse in younger patients.

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