A Study of Correlation of Size and Site of Perforation with Deafness

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ABSTRACT

Introduction: Otitis media is an inflammation of a part or all the mucoperiosteal lining of the middle ear cleft. It is a highly prevalent disease of the middle ear. Chronic suppurative otitis media is a serious health problem worldwide and it is more critical in developing countries where large percentage of the population lack specialized medical care, suffer from malnutrition and live in poor hygienic environmental conditions. because of the high incidence of conductive hearing loss caused by central perforations of tympanic membrane, the conflicting reports regarding the effect of perforations on hearing loss, this project has been under taken to study the clinical profile of CSOM & effects of tympanic membrane perforations on the degree of hearing loss. **Material & methods:** The present study was carried out in 500 patients (640 ears) presenting with unilateral or bilateral perforations of tympanic membrane, in the Department of E.N.T., Sir T. Hospital, Bhavnagar. It was carried out during the rime period of November 2008 to February 2010. **Results:** The perforations occupying all the four quadrants were maximum in 205 cases (i.e. 32.0%). In perforations involving two quadrant, it was observed that in perforations located over antero-superior + antero-inferior quadrants, those occupying 25-50% of effective vibratory surface area of tympanic membrane had significantly greater hearing loss than those involving <25% of effective tympanic membrane surface area. In perforations involving three quadrants, were seen to be distributed over antero-superior + antero-inferior + poster-inferior quadrants. The significant difference in mean average hearing losses of perforations involving <25% and 25-50% of effective vibratory surface area of tympanic membrane, showing that some increase in size of perforation, so long the perforation is confined to three quadrants produce significant effect on hearing loss.

Conclusion: It was observed that in perforations located over antero-superior + antero-inferior quadrants, those occupying 25-50% of effective vibratory surface area of tympanic membrane had significantly greater hearing loss than those involving <25% of effective tympanic membrane surface area.

Keywords: Deafness, Otitis Media, Perforation

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INTRODUCTION

Otitis media is an inflammation of a part or all the mucoperiosteal lining of the middle ear cleft. It is a highly prevalent disease of the middle ear. Chronic suppurative otitis media is a serious health problem worldwide and it is more critical in developing countries where large percentage of the population lack specialized medical care, suffer from malnutrition and live in poor hygienic environmental conditions.

Discharging ear and deafness are the major otolaryngological problem faced in India. Chronic suppurative otitis media (CSOM) is probably the commonest disease seen in an ENT clinic[1]. 30% of the patients attending in ENT outpatient department suffer from chronic suppurative otitis media[1] . Middle ear infections are almost universally associated with hearing loss, mostly conductive in nature[2] . Chronic suppurative otitis media (CSOM) was found to be a single major cause responsible for 60.27% cases of conductive deafness[3].

Normal hearing is a complex physiology where acoustic energy from the low impedance air in the external ear is transmitted to the high impedance fluid in the inner ear. Apart from the mechanics of its transformer action, the middle ear has to provide acoustic separation of the round window from the oval window. It has been shown that the cochlea is equally sensitive to sound entering the scala vestibuli via the stapes or entering the scala tympani via the round window[4]. When sound vibrations enter both windows with equal intensities and at the same moment, i.e. with the same phase, the perilymph column would be unmoved, because the pressure exerted by the footplate at the oval window would be exactly resisted by pressure, acting in opposite direction, on the round window membrane. The hearing gain from this sound protection of the round window by tympanic membrane is mentioned to be 17 db[5]. The large effective surface area of an intact and normally vibrating tympanic membrane plays a major role in the middle ear transformer mechanism. The loss of this surface area by perforation is bound to cause deafness[6]. The degree of hearing lose has been extensively studied in human cadavers[7] but not much published work is

available on any detailed clinical study in human beings. Most authors have generally stated that small perforations have little effect on hearing and only low tones are affected[4]

It has been a general view that the hearing loss increases with the size of the perforation, more so if it is in the postero-inferior quadrant[6]. It was found that the maximum average loss occurred at 250Hz., the loss being less in small perforations (less than 2mm diameter) than in larger ones; less in perforations away from manubrium than those touching the manubrium, and also less in perforations of the antero- inferior quadrant that in those on the postero-inferior quadrant[8].The present study is an effort to test the validity of above concepts.

A normally functioning Eustachian tube is also an essential physiologic requirement for a healthy middle ear and normal hearing.

To sum up, because of the high incidence of conductive hearing loss caused by central perforations of tympanic membrane, the conflicting reports regarding the effect of perforations on hearing loss, this project has been under taken to study the clinical profile of CSOM & effects of tympanic membrane perforations on the degree of hearing loss.

This study was carried out in the Department of E.N.T., Sir T. Hospital, Government Medical College, Bhavnagar during the period of November 2008 to February 2010.

Objectives:

1. To study the clinical profile of safe CSOM in patients ranging from 15-55 years of age.
2. To assess the site of perforation in patients of safe CSOM with dry perforations.
3. To determine the size of perforation in patients of safe CSOM with dry perforations.
4. To measure the amount of hearing loss in patients of safe CSOM with dry tympanic perforations by pure tone audiometry.
5. To correlate the amount of hearing loss in relation with the site and size of perforation.

MATERIAL AND METHODS:

(A) MATERIAL: All cases of safe type of CSOM in the age group of 15-55 yrs. who presented with dry tympanic membrane perforations were included in the study. Besides, patients of the above age group, with safe but discharging ears (active CSOM) were treated to make it dry. Their aural swabs were collected for culture and sensitivity and managed accordingly. Subsequently they were also included in the study. In our study patients below 15 yrs. of age were not included as they would not have cooperated in the measurement of hearing, size and site of tympanic membrane perforation. Patients beyond 55 yrs. of age were dropped from the study to avoid superimposition of sensorineural hearing loss (presbyacusis) on conductive hearing loss. A total of 640 ears in 500 patients were studied in the period from November 2008 to February 2010.

(B) METHODOLOGY: All the cases underwent detailed history taking followed by a thorough general and physical examination and examination of ear, nose and throat. The relevant details were recorded on a proforma specially prepared for this purpose. These cases were than subjected to following investigations.

(C) INVESTIGATIONS: Pure Tone Audiometry: , Paper patch test, was done

(D) Assessment of the site and size of tympanic membrane perforation:

Patients with dry tympanic membrane perforations were taken for examination under microscope. Operating microscope of HS moller wedel international was used. The margins of the perforation, location of the perforation and middle ear mucosa were observed. CSOM with marginal perforations were excluded from the study.

The tympanic membrane was divided into four quadrants by imaginary lines-one passing through the umbo & lateral process of malleus and another perpendicular to the first line and passing through umbo (Logan Turner, 1988). The perforations were grouped according to the quadrant or quadrants in which they were located, i.e. antero-superior, antero-inferior, postero-superior, postero-inferior and combined (involving 2, 3 or all 4 quadrants). The perforations were also divided into malleolar i.e. those touching handle of malleus & non-malleolar, i.e. perforations not touching handle of malleus (Ahmad & Ramani 1979).

For the measurement of the size of perforation, thin and transparent plastic paper was taken and over it graphs of 1 × 1 sq. mm were drawn. Oval, roughly 9mm × 8mm sizes, pieces were cut from the plastic paper and these plastic pieces were sterilized before using for the purpose of measurement by the following method: a steel box containing two compartments was taken. The intervening plate between the two compartments was perforated like a sieve. The plastic papers were kept in the upper compartments, covered in gauze pieces while formalin tablets were kept in the lower compartments. The steel box was tightly sealed and kept one day before use.

Under operating microscope with magnifications 2.5X sterile piece of plastic paper (with graph imprinted on it) was kept over the perforated tympanic membrane. Number of squares occupying the perforation was directly counted. In half or more of any square was within the perforation, then it was taken to be one whole square and if less than half a square mm was within the perforation, it was not included in counting. Immediately after measurement, mirror image of tympanic membrane perforation with number of squares occupying it was depicted on the proforma for permanent record and future reference if required

RESULTS AND DISCUSSION:

CLINICAL PROFILE OF CSOM:

(A) Age incidence: Age range of the patients studied was 15-54 yrs the maximum number of patients i.e. 250 (50%) were in the age group of 15-24 yrs and the least number, i.e. 25 (5%) in the range of 45-54 yrs. the number of patients also decreased with the increase in age.

(B) Gender: The number of males was more than the number of females. There were 275 (55%) males and 225 (45%) females in the study.

(C) Aetiology: Infection was the most common aetiology of tympanic membrane perforation 460 cases (92%) and in 40 patients (8%) trauma was the cause of tympanic membrane perforation.

(D) Otological examination: 70 Patients in dry tympanic membrane perforations, out of which 19 patients had bilateral perforations. Thus 430 ears were discharging at the time of examination. Out of the 65 patients with discharging ears had bilateral ear discharge. All the cases of traumatic origin had unilateral ear involvement. Thus involvement of one ear was seen in 360 patients (72%) and of both the ear in 140 patients (28%).

(E) Presenting complaints: Otorrhoea was the most common presenting complaint (430 cases) followed by hearing loss (410 cases), tinnitus (100 cases), and itching in ear (50 cases). There were 40 cases of traumatic perforations. (Table – 1)

Table 1: Presenting complaints in patients of tympanic membrane Perforations (n = 500)

Presenting Complaints	No. of patients	Percentage
Otorrhoea	430	86%
Hearing impairment	410	82%
Itching in ear	50	10%
Tinnitus	100	20%
Trauma to ear	40	8%
Pain in ear	75	15%
Others *	50	10%

* In other Cases of Deviated nasal septum (Rt. /Lt.), chronic tonsillitis, hypertension, diabetes mellitus.

MEASUREMENT OF HEARING LOSS:

(A) Average hearing loss: The average hearing loss of 640 ears was studied and was found in the range of 16-65 dB conductive hearing loss. Maximum number of cases were found to have mild hearing loss (64.1%) followed by slight hearing loss (20.7%). (Table 2)

Table 2: Average hearing loss in 640 of dry tympanic membrane Perforations (n = 640)

Grade of hearing loss	Average hearing loss(dB)	No. of ears(n=640)	Percentage
Slight	16-25	133	20.7%
Mild	26-40	410	64.1%
Moderate	41-65	97	15.2%
Total		640	

(B)Hearing loss according to size of perforation:

Table 3: Hearing loss according to size of perforation (n=640)

Size of perforation		No of ears(n=640)	Average loss in dB
In sq.mm	In%		
1 – 14	< 25%	271 (42.4%)	27.1
15 – 27	25 – 50%	272 (42.5%)	31.4
28 – 41	50 -75	97 (15.1%)	43.5

(C) Hearing loss in malleolar and non-malleolar perforations: The hearing loss of the entire study group was divided according to those tympanic membrane perforation touching handle of malleus

termed as malleolar perforations (ML) and those not touching handle of malleus termed as non-malleolar perforations (table 4).

Table – 4: Hearing loss in malleolar (ML) and non-malleolar (NML) Perforations (n = 640)

Size of perforation		Malleolar perforation		Non-malleolar perforation	
In sq.mm	Percentage	No. of ears (n=339)	Average hearing loss (dB)	No. of ears (n=301)	Average hearing loss (dB)
1-14	<25	98	24.5	173	25.4
15-27	25-50	144	30.7	128	28.3
28-41	50-75	97	43.5	-	-

(D) Hearing loss in different frequencies irrespective of site and size of perforation: Hearing loss of the entire study group on pure tone audiometry in different frequencies was calculated. It was observed that hearing loss was greatest at 250Hz. (34.0) and least at 8000Hz. (20.8)

DISCUSSION: The perforation of tympanic membrane was found to be located at different sites. The perforation occupying all the four quadrants was largest in number 205 (32%). Site wise distribution of the perforation is shown in table 10. No perforation occupying only antero-superior quadrant or only postero-superior quadrant or combination of postero-superior + postero-inferior + antero-inferior quadrant was encountered in this study.

Table –5: Site distribution of perforation (n=640)

Site of perforation	No. of ears	Percentage
Single quadrant A.I. P.I.	 96 77	 15% 12%
Two quadrant A.S. + A.I. P.S. + P.I. A.I. + P.I.	 64 19 128	 10% 03% 20%
Three quadrant A.S. + A.I. + P.I	 51	 8%
All four quadrant A.S. + A.I. + P.I. + P.S.	 205	 32%
Total	640	100%

A.I. - antero-inferior quadrant
P.I. - Postero-inferior quadrant
A.S. + A.I. - antero-superior + antero-inferior quadrant
P.S. + P.I - Postero-superior + postero-inferior quadrant
A.I. + P.I. - antero-inferior + postero-inferior quadrant
A.S. + A.I. + P.I - -antero-superior + antero-inferior+postero-inferior quadrant
A.S. + A.I. + P.I. + P.S. - antero-superior + antero-inferior + postero-inferior + postero-superior quadrant

(A) Perforation involving single quadrant: In perforation located in the antero-inferior quadrant only, smallest size was of 4 sq.mm with corresponding hearing loss of 18 dB, while largest size perforation was of 12sq.mm and had an average hearing loss of 25 dB (table XI). It was seen that as the size of perforation increased, degree of hearing loss also increased. Further in identical size perforations, hearing loss was more in malleolar perforations as compared to non-malleolar perforations (table 6).

Table -6 : Correlation of hearing loss in single quadrant perforation

A. I. (n=96)			P. I. (n=77)		
No. of Ears	Size of perforation	Average hearing loss	No. of Ears	Size of perforation	Average hearing loss
13	6	20	14	10	29.5
6	12	25	12	10	27
9	12	27	4	8	24
4	9	24	13	12	32.5
12	9	26	6	9	27
21	10	26	4	6	20
9	10	25.5	3	4	19
6	8	21	10	10	27
6	6	19	5	6	21
4	4	18	6	12	30
6	10	24			

(B) Perforations involving two quadrants: In perforations occupying two quadrants, i.e. antero-superior + antero-inferior, postero-superior + postero-inferior and antero-inferior + postero-inferior, it was again observed that as the size of the perforation increased the hearing loss also increase and in identical sized perforations malleolar perforations caused greater hearing loss as compared to non-malleolar ones. (Table 7 & 8)

Table 7: Correlation of hearing loss in perforation occupying two quadrants

Tympanic membrane perforation				Average hearing loss in dB
Site of Perforation	No. of Ears	Size of perforation		
		In sq.mm	In %	
A.S. + A. I. (n=64)	5	9	>25%	20
	6	9		21
	9	10		23
	5	12		24
	13	14	25-50%	26
	16	14		29
	10	6		19
P.S. + P.I. (n=19)	4	10	<25%	26
	4	12		25
	2	14	25-50%	30
	9	9		25

Table 8: Correlation of hearing loss in perforation occupying two quadrants

Tympanic membrane perforation				Average hearing loss in dB
Site of Perforation	No. of Ears (n=128)	Size of perforation		
		In sq.mm	In %	
A.I. + P.I. (n=128)	10	15	>25%	29
	6	18		30
	15	20		28
	8	24		33
	9	16		30
	8	18		28
	15	16	25-50%	25
	13	18		26
	17	20		27.5
	14	24		29
	5	24		31
	8	20		29

(C) Perforations involving three quadrants: Perforation occupying three quadrants were located over antero-superior + antero-inferior + postero-inferior quadrants. Most of the perforations in this group were malleolar with the sizes of perforation ranging from 14 mm to 24 mm and the corresponding hearing losses ranging from 22 dB to 38 dB

(D) Perforations involving all four quadrants: There were 205 perforations in this group. All the perforations in this group were malleolar. Hearing loss increased as the size of perforation increased. They were grouped according to the area of the tympanic membrane involved and it was found that perforation involving 50-75% area i.e. 28-41 sq.mm had significantly greater hearing loss than other groups

CONCLUSION: The perforations of tympanic membrane were found to be located at different sites. The perforations occupying all the four quadrants were maximum in 205 cases (i.e. 32.0%). In single quadrant perforations, there were perforations occupying either antero-inferior or postero-inferior quadrants. In both the groups the sized perforations had significantly greater hearing loss than smaller sized perforations. In identical sized perforations, malleolar perforations had greater hearing loss than the non-malleolar perforations.

In perforations involving two quadrant, it was observed that in perforations located over antero-superior + antero-inferior quadrants, those occupying 25-50% of effective vibratory surface area of tympanic membrane had significantly greater hearing loss than those involving <25% of effective tympanic membrane surface area. In the perforations involving <25% of effective vibratory surface area of the tympanic membrane, those perforations in postero-inferior quadrants had significantly greater hearing loss than those perforations in antero-superior + antero-inferior quadrants. Hence posterior perforations cause more hearing loss than anterior perforations.

In perforations involving three quadrants, were seen to be distributed over antero-superior + antero-inferior + poster-inferior quadrants. The significant difference in mean average hearing losses of perforations involving <25% and 25-50% of effective vibratory surface area of tympanic membrane, showing that some increase in size of perforation, so long the perforation is confined to three quadrants produce significant effect on hearing loss. Perforations occupying 50-75% of vibratory

surface area of tympanic membrane had significantly greater hearing loss than those occupying 25-50% of tympanic surface area. In perforations occupying all four quadrants, perforations occupying 50-75% of vibratory surface area of tympanic membrane had significantly greater hearing loss than those occupying 25-50% of tympanic surface area. All the perforations were malleolar.

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