Correlation of hearing impairment with site of tympanic membrane perforation

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Objective: This prospective study was done to assess the level of preoperative hearing impairment in different sites of pars tensa perforation in patients with chronic suppurative otitis media (CSOM) tubo-tympanic type undergoing myringoplasty.

Materials and Methods: A total of 50 patients were recruited from the outpatient Department of Otorhinolaryngology and Head and Neck Surgery from June 2003 to May 2004. Cases of CSOM tubo-tympanic type with dry central perforation, with conductive type of hearing loss were subjected to myringoplasty. Preoperative audiometric evaluations were done. Just prior to operation, examination under microscope was performed. Exact site of perforation was noted. During operation, those found to have ossicular discontinuity or fixation were excluded from this study.

Results: It was observed that the greatest hearing loss was found in big central (45dB) and posterior central (43dB); whereas least in those of anterior central (31dB) and central malleolar (34dB) perforations. The average hearing loss at 500Hz, 1000Hz and 2000Hz was 46.40 dB, 30.90 dB and 31.9 dB respectively. This showed that the hearing loss is maximum at the lowest frequencies and minimum as the frequencies increase.

Conclusion: This study shows that the posterior-central perforations cause more hearing loss than anterior-central ones. The hearing loss is maximum at the lowest frequencies and minimum as the frequencies increase.

Introduction

Perforations of the tympanic membrane (TM) can result from trauma, middle-ear disease, or the treatment of middle-ear disease. Perforations occur as a result of the disease process in chronic suppurative otitis media, which affects at least 0.5% of the population[1]. CSOM can lead to conductive hearing losses of as much as 60 dB, which constitute a serious handicap[2].

Prasansuk and Hinchcliffe [3] in their pilot study on 15 consecutive young patients with active bilateral CSOM were able to identify quantifiable clinical descriptions of perforated TM that correlated with air conduction hearing threshold levels and the threshold of hearing from the duration of the aural discharge. An audiometric study of hearing loss in perforated TM was also been reported by Anthony and Harrison in 1992[4], but they were also not been able to establish a significant quantitative correlation between the site of the perforation and the hearing loss.

However there have been reports that site of perforation affects the degree of hearing loss. Posterior perforations have a greater hearing loss than anterior perforations, probably because of round window exposure and a higher incidence of ossicular fixation. Postero-inferior perforations abolish the sound protection of the round window; hence, they will cause more hearing loss than perforations in other quadrant [5].

According to the data available from outpatient Department of Otorhinolaryngology and Head and Neck Surgery, Tribhuvan University Teaching Hospital for the year 1997/ 1998, 48.37% of patients had ear disease, out of which 29% had CSOM tubo-tympanic and 6.5% had attico-antral disease. But, so far there has been no prospective study assessing the extent of hearing loss in different sites of perforations of TM, in patients with CSOM tubo-tympanic type undergoing myringoplasty at T.U. Teaching Hospital.
Therefore this present study, which is an attempt to fulfill the lacunae of scientific research in this field, was carried out with an aims to assess the level of hearing impairment in different sites of pars tensa perforation of tympanic membrane in patients with CSOM undergoing myringoplasty and to correlate the site of perforation of pars tensa with the

preoperative level of hearing impairment in patients with the intact and mobile ossicular chain per-operatively.

Materials and Methods

This prospective, observational study was conducted among a purposive sample of first 50 consecutive patients who were undergone for myringoplasty operation in the Department of Otorhinolaryngology and Head and Neck Surgery, Tribhuvan University Teaching Hospital, Institute of Medicine, Maharajgunj, Kathmandu, Nepal from June 2003 to May 2004. Patients of both sexes who had dry ear and gave the consent to be participated in this study were included, whereas patients below 14 year of age, and with active disease, tympanosclerosis, revision myringoplasty, mixed Sensory Neural Hearing Loss (SNHL), CSOM attico-antral type, ossicular chain fixation or disruption and patients in whom ossicular chain status could not be assessed were excluded from this study.

The pre-operative assessment examinations included history taking, otoscopic examination of the ears, tuning fork test, examination of the ears under microscope (EUM). After completing the clinical examination, audiometric evaluation was performed using a clinical audiometer calibrated according to ISO standard. A pure tone air and bone conduction audiogram within one week prior to surgery were recorded at the frequencies of 250, 500, 1000, 2000, 4000 and 8000 Hz. Air and bone conduction threshold were determined with appropriate masking technique whenever indicated. "Hearing level" was defined as the mean air conduction threshold at 500, 1000 and 2000 Hz and average of these frequencies was calculated to access the hearing level. Pre-operative examination findings were further confirmed by examination under microscope (EUM) during surgery. EUM and per-operative findings were noted in a special form prepared for this study.

Surgical repair of tympanic membrane perforation was usually performed as a permeatal procedure, but if patient presented with a tiny ear canal, or if the anterior rim of the drum was obscured by a prominent bony over hang in ear canal wall, a post-auricular incision was preferred which enhanced the exposure under the above circumstances. It was carried out under local anesthesia. Two percent xylocaine with 1: 100,000 adrenaline added solution was used.

The sites of the perforations were grouped as follows (Yung MW 1983)[6]: (a) anterior central (perforation anterior to the handle of malleus), (b) posterior central (perforation posterior to the handle of malleus), (c) central malleolar (perforation around the handle of malleus) and (d) big central (large perforation involving all the quadrants and up to the annulus of the tympanic membrane).

Using computer software SPSS-11.5 did data processing and analysis. f-test, t-test and x^2-test were applied whenever necessary p values of < 0.05 were considered to be statistically significant.

Results

A total of 50 patients were enrolled in this study. The result of the study is shown in the following tables and figures.

1. Age and Sex Distribution

The age of study group ranged from 15yrs to 43 years. The most common age group affected by the disease was 15-24 years (35 = 70%) followed by 25-35 years (10 =20%) cases. The remaining 5 (10%) were in age group of 35-44 years. There were an equal numbers of male and female patients in this study. Of the 50 patients 25 (50%) were male and 25 (50%) were female.

Table 1-Age and Sex Distribution (n=50)

Age in Years	Male	Female	Total
15-24	16	19	35
25-34	7	3	10
35-44	2	3	5
Total	**25**	**25**	**50**

2. Side involved

Disease in the left ear was seen more than in the right ear. The left ear was affected in 30 (60%) patients, where as 20 (40%) in the right ear.

Table 2- Side involved (n=50)

Ear	No. of patients
Left	30
Right	20

3. Chief Complaints

All the patients complained of intermittent otorrhoea and hearing loss. Only 20% of them complained of tinnitus in the affected ears.

Table 3-Chief Complaints (n=50)

Complaints	No. of patients
Discharge	50
Hearing Loss	50
Tinnitus	10

4. Site of Perforation and Hearing Loss

A maximum hearing loss of 45 dB was observed in big central perforation and minimum hearing loss of 31dB in anterior central perforation. There was no significant difference between big central perforation (45 dB) and posterior central perforation (43dB). Hearing loss was almost equal in anterior central perforation 29.17dB and central malleolar perforation 29.5 dB. However, the hearing loss was greater in lower frequencies as compared to the higher frequencies irrespective of the site of perforation.

Table 4- Site of Perforation and Hearing Loss (n=50)

Site of perforation		Hearing loss at 500Hz	Hearing loss at 1000Hz	Hearing loss at 2000Hz	Average hearing loss	p*
Anterior central	**Mean**	35.00	29.17	29.17	31.0667	0.121306
n=6	**Std. Deviation**	4.472	3.764	7.360	3.11876	
Posterior central	**Mean**	52.14	43.57	33.57	43.3000	0.002819
n=7	**Std. Deviation**	6.362	11.443	8.018	7.00666	
Central melleolar	**Mean**	41.50	31.75	29.50	34.2300	0.0022
n=20	**Std. Deviation**	7.090	7.304	9.305	4.78023	
Big central	**Mean**	53.82	46.18	35.00	45.0706	0.000002
n=17	**Std. Deviation**	7.187	10.537	10.458	7.61280	
Total	**Mean**	46.40	38.00	31.90	38.8060	0.00001
n=50	**Std. Deviation**	9.638	11.294	9.470	8.19575	

*chi-square test

Discussion

In the present study an attempt has been made to correlate the preoperative pure tone audiometric findings with the different sites of tympanic membrane perforations. Patients below 14 years of age were excluded because all myringoplasty were done under local anaesthesia, which is little difficult to perform in that group. Similarly, patients of more than 45 years of age were excluded because, such patients may have presbyacusis and this may be asymmetrical. For calculation of average of hearing loss (air conduction threshold) three frequencies were selected. They were: 500 Hz; 1000Hz and 2000Hz. These frequencies were selected because they represent speech frequency range and elevation of threshold in these frequencies will be clinically significant. Puretone threshold audiometry has become the standard behavioral procedure for describing audiometry sensitivity; therefore, pure tone audiometry had been used for assessment of hearing level in this study.

In this study the most commonly affected age group was 15-24 years with 35 (50.93%) patients. Prasansuk S. et.al[3] studied 30 ears of 15 patients aged between 13-25 years of age. The reason behind this may be that, this is socially the active and health conscious age group.

This study consists of 25 males and 25 female patients, the ration being 1:1. Similar study done by Yung M.W[6] also had similar sex ration with 50% males and 50% females out of 100 patients.

Left ear was found to be affected more (30 =60%) patients. This finding was consistent with that of Shrestha S[7]. In her study left ear was found to be affected with 25 (50%) patients. The chief complains of all the patients were recurrent otorrhoea and hearing loss. A 20% of patients had complained of tinnitus.

Out of 50 patients, 6 had anterior central perforation, 7 had posterior central perforation, 20 had central malleolar perforation and 17 had big central perforation. The impaired air conduction threshold varied with the site of perforation, being greatest in the big central perforation (49.07 dBHL) and least in anterior central perforation (31.07 dBHL). Several ears had marked hearing loss associated with different site of perforation. This was particularly noticeable when the round window had been exposed.

In the present study an increased incidence of pre-operative hearing loss was found in big central and posterior central perforation compared with the anterior and central malleolar perforation. Yung M.W found similar findings [6], that big central and posterior central perforation had greatest hearing loss compared to other sites of perforation. He found 43 dBHL in the series of big central and posterior central perforation as well. A postero-inferior perforation results in larger hearing loss than an antero-inferior perforation [8, 9, 10]. Ahmad and Ramani[5] had also found similar findings. In their study they found 18.5 dBHL in anterior perforation and 29 dBHL in posterior perforation in 500 Hz. But they concluded: "It is seen that the difference in hearing losses between antero- and postero-inferior perforations, is appreciable only at the lower frequencies.

The usual explanation for the location dependence is that a posterior perforation is closer to the round window, and as a result the pressure acting at the round window "Cancels" the cochlear response more than the round -window pressure associated with perforations at other locations.

The result of this study was contradicted with the study conducted by Voss[11,12], which stated, "Sound transmission with perforations does not depend on perforation location." They speculated that the common clinical report, that perforation of similar size but different locations produce different hearing losses, may result from inter-ear differences in the middle-ear air-space volume.

Conclusion

In this study it has been shown that posterior-central perforations cause more hearing loss than anterior-central ones. Although the difference being more marked at lower than a higher frequencies. With the findings of this study, clinically, it becomes relevant to predict the magnitude of hearing loss based on site of the TM perforations.

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