

Original Research Article

Role of pure tone audiometry in assessing ossicular status in patients with mucosal type of chronic otitis media

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ABSTRACT

Background: Chronic suppurative otitis media (CSOM) is the disease of the middle ear cleft, which presents as hearing loss and ear discharge. This study aimed to assess the role of pure tone audiometry (PTA) in analysing the ossicular erosion in mucosal type of CSOM subjects.

Methods: The current cross-sectional study was conducted among 60 people with mucosal CSOM. Preoperative hearing was assessed by PTA. The surgeries were done and intra operative ossicular status were recorded. IBM SPSS 20 software was used for the analysis. Student t-test was used to correlate ossicular status and PTA findings.

Results: Among 60 subjects, 12 (20%) patients had eroded incus and 53 (88.3%) had normal stapes. The malleus was preserved in all patients. The result of our study showed that an average ABG of 58 dB at 500 Hz, 47 dB at 1 kHz, 41 dB at 2 kHz and 41 dB at 4 kHz in patients with ossicular erosion. ABG for 500 Hz and 1 kHz were statistically significant for eroded incus. ABG for 500 Hz, 1 kHz, 2 kHz and 4 kHz were all statistically significant for eroded stapes.

Conclusions: There is a significant difference between the PTA findings at different frequencies between intact and eroded ossicular chain. Pre-operative ABG helps us to assess the status of incus and stapes.

Keywords: Chronic otitis media, Ossicular discontinuity, Promontory, Pure tone average, Tubotympani

INTRODUCTION

Most common disease encountered in ENT today is chronic suppurative otitis media. It is characterised by recurrent and persistent infection and associated inflammation of middle ear with or without involvement of tympanic membrane. The most common etiology being Eustachian tube obstruction, otitis media with effusion.¹ In the urban population of India 16/1000 is the occurrence and 46/1000 is the occurrence in rural population.^{2,3}

Mucosal type and Squamous type are the two types of CSOM. Mucosal type seen in the common population more often. The most common complications are divided into intracranial and extracranial complications. Intracranial complications being mastoiditis, petrositis, cervical abscess. The extracranial complications are meningitis, sinus venous thrombosis, hydrocephalous. These complications now are rarely encountered due to extensive antibiotic coverage.⁵ Therefore the troublesome morbidity encountered by the patient is hearing loss for which they seek treatment.

Hearing loss is affected due to ossicular erosion caused by chronic inflammation of the middle ear cleft, leading to production of cytokines, TNF alpha giving rise to osteoclastic activity and neovascularisation. Another cause of hearing loss is the size of the perforation.⁶⁻⁸

Pure tone audiometry (PTA) is the fundamental test done in all cases of CSOM, to assess the degree of hearing loss. Screening audiometry is characterised by checking tones of fixed range, 500 Hz, 1 kHz, 2 kHz and 4 kHz. It is always checked 10 dB higher than the threshold of the individual. This study was done using the characteristic of audiogram, ABG (air bone gap). On specifically finding a range or interval of ABG for each ossicle affected, it helps to improve the quality of health care from patient and doctors' point of view. Patients can be given a clear idea about the extent of hearing improvement they can expect. The doctors can pre plan the type of surgery required.^{9,10}

METHODS

The cross-sectional study was undertaken in Shri Sathya Sai Medical College and Research Institute among patients who came to the ENT OPD during the period of December 2017 to June 2019 with typical history and clinical features suggestive of Mucosal type of COM between the age group of 18 to 60 years. and were planned for surgical procedure. After obtaining IEC approval, people who were willing to participate in the study were included after obtaining an informed and written consent. Patients with previous history of ear surgery, trauma, otosclerosis, associated SNHL and Otitis externa were excluded in this study. Pre-operative PTA was taken to find the hearing status. MK 500 III RC Model Audiogram was used. The better ear was tested

initially, first with 1000Hz sound followed by 2000 Hz, 4000 Hz, 8000 Hz, 1000 Hz again, 500 Hz and 250 Hz. Masking was done for patients when the difference between air conduction threshold of test ear and the bone conduction threshold of the opposite ear is more than 40 dB. ABG was calculated for 500 Hz, 1 kHz, 2 kHz and 4 kHz thresholds. Patients underwent tympanoplasty with or without cortical mastoidectomy under general anaesthesia. Intraoperative ossicular status were noted. Ossicular status confirmed by direct visualisation and also checking for round window reflex. All observations were then documented. Descriptive statistics was used to describe the ossicular status, ABG distribution among population and inferential analysis was used for comparison of ABG at different frequencies in relation to ossicular status. Student t-test was done to correlate ossicular status with ABG.

RESULTS

60 patients with mucosal type of CSOM had taken pre-operative PTA and their mean ABG was noted. Intra-operative ossicular status was noted and a comparative study was made on assessing the ossicular status with the ABG.

The ABG at 50 Hz, 1 kHz, 2 kHz, 4 kHz in relation with degree of hearing loss was statistically significant. The mean ABG decibel was highest in subjects with severe hearing loss (Table 1).

The ABG at 50 kHz, 1 kHz, 2 kHz, 4 kHz in relation with Ossicular status was statistically significant. The mean ABG decibel was highest in subjects with eroded ossicles.

Table 1: Comparison of ABG at different frequencies in relation to degree of hearing loss.

Air bone gap (ABG)	Audiometry			Total	P value
	Mild	Moderate	Severe		
ABG 500 Hz	32.62±7.41	47.31±10.64	63.86±3.76	40.18±13.41	<0.001
ABG 1 kHz	31.08±7.37	39.94±7.69	53.57±4.62	36.07±10.32	<0.001
ABG 2 kHz	30.70±8.85	35.88±5.760	48.43±2.637	34.15±9.45	<0.001
ABG 4 kHz	31.19±7.38	37.25±5.94	44.57±4.12	34.37±8.057	<0.001

*p value - independent t test p value <0.05 was significant p value <0.001 is highly significant.

Table 2: Comparison of ABG at different frequencies in relation to ossicular status.

Air bone gap (ABG)	Ossicular status		t value	P value
	Intact	Eroded		
ABG 500 Hz	32.95±7.161	58.47±5.713	13.112	<0.001
ABG 1 kHz	31.63±7.54	47.29±7.51	7.276	<0.001
ABG 2 kHz	31.07±8.43	41.94±7.26	4.98	<0.001
ABG 4 kHz	31.72±7.54	41.06±4.87	5.66	<0.001

*p value - independent t test p value <0.05 was significant p value <0.001 is highly significant.

Table 3: Comparison of ABG at different frequencies in relation to incus status.

Air bone gap (ABG)	Status of incus		t value	P value
	Intact	Eroded		
ABG 500 Hz	36.38±12.21	55.42±3.37	9.4	<0.001
ABG 1 kHz	34.17±10.38	43.67±5.59	4.3	<0.001
ABG 2 kHz	33.02±9.849	38.67±6.08	2.5	0.01
ABG 4 kHz	33.17±8.33	39.17±4.489	3.4	0.002

*p value - independent t test p value <0.05 was significant p value <0.001 is highly significant.

Table 4: Comparison of ABG at different frequencies in relation to stapes status.

Air bone gap (ABG)	Status of stapes		t value	P value
	Intact	Eroded		
ABG 500 Hz	37.25±11.26	62.43±3.99	11.65	<0.001
ABG 1 kHz	33.87±8.71	52.71±4.65	8.86	<0.001
ABG 2 kHz	32.36±8.47	47.71±3.59	8.58	<0.001
ABG 4 kHz	32.94±7.38	45.14±3.44	7.4	<0.001

*p value - independent t test p value <0.05 was significant p value <0.001 is highly significant.

Table 5: ROC curve analysis to predict ossicular erosion.

Test result variable	Area under the curve	Standard error	p value	Asymptotic 95% confidence interval		Cut off value to predict ossicular erosion
				Lower bound	Upper bound	
ABG 50 Hz	0.988	0.012	<0.01	0.965	1.000	>44
ABG 2 kHz	0.801	0.069	<0.01	0.665	0.937	>41
ABG 1 kHz	0.929	0.033	<0.01	0.863	0.995	>33
ABG 4 kHz	0.859	0.047	<0.01	0.767	0.951	>33.5

The result of our study showed that an average ABG of 58 dB at 500 Hz, an average ABG of 47 dB at 1 kHz, an average ABG of 41 dB at 2 kHz and an average ABG of 41 dB at 4 kHz had ossicular erosion. The mean ABG decibel was highest in subjects with eroded ossicles. The result of our study showed that an ABG of 32.95 vs 58.47 dB at 500 Hz, an ABG of 31.63 vs 47.29 dB at 1 kHz, an ABG of 31.07 vs 41.94 dB at 2 kHz and an ABG of 31.72 vs 41.06 dB at 4 kHz had intact vs ossicular erosion (Table 2).

The ABG at 50 Hz, 1 kHz, 2 kHz, 4 kHz in relation with status of incus was statistically significant. The mean ABG decibel was highest in subjects with eroded incus.

The result of our study showed that an average ABG of 55 dB at 500 Hz, an average ABG of 43 dB at 1 kHz, an average ABG of 38 dB at 2 kHz and an average ABG of 39 dB at 4 kHz had incus erosion. The mean ABG decibel was highest in subjects with eroded incus. The result of our study showed that an ABG of 36.38 vs 55.42 dB at 500 Hz, an ABG of 34.17 vs 43.67 dB at 1 kHz, an ABG of 33.02 vs 38.67 dB at 2 kHz and an ABG of 33.17 vs 39.17 dB at 4 kHz had intact vs erosion of incus (Table 3).

The ABG at 50 Hz, 1 kHz, 2 kHz, 4 kHz in relation with status of stapes was statistically significant. The mean ABG decibel was highest in subjects with eroded stapes.

The result of our study showed that an average ABG of 62 dB at 500 Hz, an average ABG of 52 dB at 1 kHz, an average ABG of 47 dB at 2 kHz and an average ABG of 45 dB at 4 kHz had stapes erosion. The mean ABG decibel was highest in subjects with eroded stapes. The result of our study showed that an ABG of 37.25 vs 62.43 dB at 500 Hz, an ABG of 33.87 vs 52.71 dB at 1 kHz, an ABG of 32.36 vs 47.71 dB at 2 kHz and an ABG of 32.94 vs 45.14 dB at 4 kHz had intact vs erosion of stapes (Table 4).

Analysis was done by ROC curve which showed that the cut-off values to predict ossicular erosion were >44dB, >41dB, >33dB, >33.5dB at 500Hz, 1 kHz, 2 kHz and 4 kHz respectively (Table 5).

DISCUSSION

In this study the role of pure tone audiometry to predict the status of ossicular erosion and correlate the findings intra-operatively with ossicular status in Mucosal type of chronic suppurative otitis media.

In this study, the minimum age group of patients was 18 years and maximum 53 years. Majority of patients were in the age group of 31 to 40 years. Among the 60 patients, 32 were male patients and 23 females. These patients had presented to the OPD with chief complaints of ear discharge and hearing loss. In this study following

clinical examination among 60 patient's majority had small perforation followed by medium size perforation and rest had large size perforation. 23 patients had inferior quadrant perforation. According to WHO classification of hearing loss: mild (26 to 40 dB), moderate (41 to 60 dB), severe (61 to 80 dB) and profound (>81 dB), the patients were classified. 37 patients (61.7%) had mild conductive hearing loss, 16 patients (26.7%) had moderate hearing loss and 7 patients (11.6%) had severe hearing loss. In the study only 17 patients had ossicular erosion. For each frequency, 50 Hz, 1 kHz, 2 kHz and 4 kHz the mean ABG were 40.18 (13.41), 36.07 (10.32), 34.15 (9.45) and 34.7 (8.06) respectively.

Incus was eroded in 12 patients (20%), in the long process of incus. Using student t-test, to correlate the ossicular status with ABG it was found to be significant for 500 Hz and 1 kHz. Stapes erosion was seen in 7 patients (11.6%), found significant for 500 Hz, 1 kHz, 2 kHz and 4 kHz. In cases with ossicular erosion the average ABG at 500 Hz was 58 dB, at 1 kHz was 47dB, at 2 kHz was 48dB and 41dB at 4 kHz. For correlation the average ABG for intact ossicles were 32.95dB at 500 Hz, 31.65 dB at 1 kHz, 31.07dB at 2 kHz and 31.72dB at 4 kHz. As already mentioned in this study most patients had come with complaints of ear discharge and hearing loss which was similar to the other studies. 37 patients (61.7%) had mild hearing loss followed by 16 patients (26.7%) had moderate hearing loss, found similar to other studies. No cases of malleus erosion was seen (resistant ossicle) also found consistent with other studies.

It was noted that larger the chronicity of the infection, the higher the degree of hearing loss. When comparing the mean ABG with other studies, Dudda et al result showed mean ABG for intact ossicles was 24.09±9.83 dB, another study done by Srinivas et al found the mean ABG was 23.9±9.8 dB and eroded ossicles was 35.1±10.3 dB. It was found to be statistically significant. Average ABG was 58 dB at 500 Hz, 47 dB at 1 KHz, 41 dB at 2 kHz and 41 dB at 4 kHz. The mean ABG when comparing intact versus eroded ossicles were: 32.95dB/53.7dB (500 Hz), 31.63 dB/47.29 dB (1 kHz), 31.07 dB/41.94 dB (2 kHz) and 31.72 dB/41.06 dB (4 kHz). Incus erosion was found significant at 500 Hz and 1 kHz. Stapes erosion was found significant at 500 Hz, 1 kHz, 2 kHz and 4 kHz.

CONCLUSION

The result of our study showed that an ABG of 32.95 vs 58.47 dB at 500 Hz, an ABG of 31.63 vs 47.29dB at 1 kHz, an ABG of 31.07 vs 41.94 dB at 2 kHz and an ABG of 31.72 vs 41.06 dB at 4 kHz had intact vs ossicular erosion. Incus erosion was found significant at 500Hz and 1 kHz. Stapes erosion was found significant at 500Hz, 1 kHz, 2 kHz and 4 kHz. Limitations of the study should have included the preoperative details like profession, symptoms, associated infections. Probability sampling should have been used to avoid errors. Using helical CT would have further supported the study.

Recommendations

This study was aimed at assessing the role of PTA in analysing ossicular erosion in patients with mucosal CSOM. The result of the study showed that PTA showed a higher ABG in eroded ossicles patients compared to intact one. Our recommendations are that PTA can be used as an effective screening tool to assess the status of ossicles. The increased ABG suggests an early intervention and planning to proceed to the next level of management/surgery. PTA should be done routinely in diseases affecting ossicles, so that early diagnosis and decision regarding the type of surgery needed to restore the hearing and balance can be undertaken.

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