Section: Otorhinolaryngology

Original Research Article

A STUDY ON CORRELATION BETWEEN PURE TONE AUDIOMETRY AND INTRAOPERATIVE FINDINGS IN PATIENTS WITH CHRONIC OTITIS MEDIA

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Abstract

Background: Chronic Otitis Media (COM) is a prevalent inflammatory condition affecting the middle ear, often leading to conductive hearing loss and other related complications. This study aims to investigate the correlation between Pure Tone Audiometry (PTA) results and intraoperative findings in patients diagnosed with COM, with the intention of enhancing our understanding of the relationship between audiological assessments and the underlying anatomical and pathological changes observed during surgery. **Materials and Methods:** A cross sectional was conducted on a 111 patients diagnosed with COM, who underwent surgical interventions between November 2018 to April 2020. Preoperative PTA results, including air and bone conduction thresholds, were collected and categorized according to severity of hearing loss. Intraoperative findings during surgical procedures, encompassing the extent of middle ear pathology, presence of cholesteatoma, ossicular chain status, and other relevant observations, were meticulously documented. **Result:** Majority of patients had mild hearing loss (45.04%). Moderate hearing loss was seen in 41.44 % of patients and moderately severe hearing loss seen in 13.52 % of patients. Severe and profound hearing loss was not present in any patient. In patients of COM 89.2% (99) had conductive hearing loss and 10.8% (12) had mixed hearing loss while sensorineural hearing loss alone was not seen in any patient. The mean PTA in intact ossicle group in this study was 41.72±9.65dBHL and in eroded ossicle group was 49.19±9.18dBHL. The difference in the mean PTA between intact ossicle group and eroded ossicle group was statistically significant(p value <0.001). The mean ABG in intact ossicle group was 29.99±4.47dB and eroded ossicle group was 41.08±6.47dB. There was a statistically significant difference in the mean ABG between the two groups in this study (p value <0.001). **Conclusion:** Multiple ossicles were seen eroded when hearing loss was moderate. If left untreated, COM results not only in progression of conductive hearing loss but also predisposes to the development of mixed hearing loss. This highlights the need for the early surgical intervention in COM patients to prevent worsening of hearing. This study reinforces the idea of using preoperative audiometry to assess the degree and type of hearing loss, which not only helps in documenting the preoperative status of patients' hearing which is supportive in the event of medico-legal issues, but also helps in predicting the intra-operative findings in a case of Chronic Otitis Media.

INTRODUCTION

Otitis media is an important and a highly prevalent disease of the middle ear and poses serious health problem worldwide especially in developing countries where large percentage of the population lack specialized medical care, suffer from malnutrition and live in poor hygienic environmental conditions.[1]

Chronic otitis media is a persistent inflammation of the middle ear or mastoid cavity, and is characterized by recurrent or persistent ear discharge through a perforation of the tympanic

membrane.[2] In spite of the fact that the complications of COM can be fatal, hearing impairment is regarded the main health issue.[3]

The worldwide prevalence of COM is 65–330 million people and 60% of this population has a hearing impairment.[4] This disease is more common in developing countries. In India, the prevalence of COM is 16/1000 in urban population and 46/1000 in rural population.[5] COM is a condition characterized by persistent or recurrent ear discharge (otorrhoea) of 6–12 weeks duration through a perforation of the tympanic membrane leading to thickening of the mucosa and polypoidal changes.

Sound waves are the pressure variations created by the vibrating objects, which is transmitted by air. In COM, due to the perforation in the tympanic membrane and erosion of the ossicular chain, there is defective middle ear function leading to hearing loss. Perforation of the tympanic membrane is a very common cause of conductive hearing loss as there is loss in the vibrating area of tympanic membrane. This defects if not treated may lead to complications such as sensorineural hearing loss, intracranial infection, mastoiditis, meningitis, and subdural abscess.

Pure tone audiometry is the main hearing test used to identify hearing threshold levels of an individual, enabling determination of the degree, type and configuration of a hearing loss,[6] and thus providing a basis for diagnosis and management. Pure-tone audiometry is a subjective, behavioral measurement of a hearing threshold, as it relies on patient responses to pure tone stimuli.[7] Pure-tone audiometry provides ear specific thresholds, and uses frequency specific pure tones to give specific responses, so that the configuration of a hearing loss can be identified. In our setting, pure tone audiometry is a routine preoperative procedure for tympan mastoid surgeries while computed tomography is less widely used.This study aims to determine the ability of pure tone audiometry to predict the intra-operative findings in COM.

MATERIALS AND METHODS

Study Design: Cross sectional study

Duration of study: November 2018 to April 2020

Source of data: Patients presenting to the ENT OPD at Darbhanga Medical College, Bihar, India.

Place of Study

Department of Otorhinolaryngology, Darbhanga Medical College and Hospital, Bihar, India.

Sample size: 111 patients diagnosed with COM

Calculated with a precision of 5%, prevalence of Chronic otitis media in India, according to WHO, being 7.8% and confidence limit being 95%

Collection of data: One hundred and eleven (111) patients with Chronic Otitis Media were enrolled for the study. These patients were chosen randomly. A detailed history taking and clinical examination was performed. Relevant hematological and radiological examinations were also performed. A pure tone audiometry was performed. The patients then were subjected to a tympanoplasty or tympan mastoid surgery. All middle ear and mastoid findings like tympanic membrane status, ossicular chain integrity and mobility, soft tissue pathologies like cholesteatoma, polyps, granulation tissue, tympanosclerosis were recorded in the patient's postoperative notes. The preoperative pure tone audiometry and intraoperative findings were studied to determine their correlation.

Inclusion Criteria

- Patients aged between 15 to 60 years diagnosed with Chronic Otitis Media were enrolled in the study.

Exclusion Criteria

- Patients less than 15 years of age and more than 60 years of age
- Patients who have already underwent a prior tympanomastoid surgery
- Patients with a history of temporal bone trauma
- Patients with any other systemic disorders viz Diabetes, Hypertension, Tuberculosis etc

Methodology: The present study was conducted after obtaining clearance and approval from the Institutional Ethics Committee of the institution, verbal consents were taken from the patients. This study was conducted in the Department of Otorhinolaryngology and it was a cross-sectional study. The study was done from November 2018 to April 2020. Patients were diagnosed as COM by detailed history, through ear, nose, and throat examination. Patients aged between 15 to 60 years were included in the study. The total number of patients in the study was 111.

Perforations were grouped as anterior central, posterior central, central perforation, and subtotal on the basis of their position. Site of perforation was morphologically classified arbitrarily, the demarcation with vertical line passing through the handle of malleus. Perforation anterior to the handle of malleus categorized as anterior central perforation, behind the handle of malleus as posterior central perforation in pars tensa. Central perforation term was used for perforations which had either involved both the anterior and posterior quadrants together like anteroinferior+posteroinferior or had involved more than 2 quadrants like anterosuperior+anteroinferior+posteroinferior.

Subtotal perforation when only rim of tympanic membrane is present.

Perforations in pars tensa of tympanic membrane were also categorized according to size of perforation as small, medium, large, and subtotal. When single quadrant of pars tensa is involved it was termed as small, when two quadrant were involved it was termed as medium, when three quadrant were involved it was termed as large perforation, and when four quadrant were involved

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with only rim of tympanic membrane present, then it was termed as subtotal perforation.

Statistical Analysis: Data was checked for accuracy and completeness then coded and entered into (Statistical Package for the Social Sciences) version 23.0 for analysis. The results presented in frequency tables, cross tabulations and figures. Categorical data are presented as frequency with percentages. Continuous data with normal distribution are presented as mean with standard deviation.

RESULTS

In this study, we evaluated pure tone audiograms from 111 patients suffering from COM, with age ranging from 15 years to 60 years. Most of the patients i.e. 46 (41.4%) of these patients were in 15 to 30 years age group [Table 1]. 35 (31.5%) patients were in the age range of 31- 40 years.

Sex distribution of the study subjects is mentioned in [Table 2].Out of 111 patients 58 (52.3%) were females whereas 53(47.7%) were males.

[Table 3] shows the type of COM among study subjects. 28 (25.23%) patients had squamosal COM and 83 (74.77%) patients had mucosal COM.

[Table 4] shows the distribution according to the type of surgery. 75 (67.57%) patients underwent tympanoplasty whereas 36 (32.43%) patients underwent mastoidectomy also.

Intra-operative findings in patients of COM are mentioned in [Table 5].Ossicular defect was found in 33.33% (37) cases. 24 patients (21.62%) had subtotal perforation. 20 patients (18.02%) had myringosclerosis affecting the tympanic membrane. Cholesteatoma was present in 28 patients. 10 patients (9.01%) had granulations. 23 patients (20.72%) had marginal perforations.

Distribution according to the site of erosion of ossicle is mentioned in [Table 6]. Incus (alone in 12 cases and 16 in combination with other ossicles) was the most common ossicle eroded, with long process being the most commonly eroded part followed by malleus (alone in 8 cases and 21 in combination with other ossicles) and stapes (alone in 1 case and 8 in combination with other ossicles). Multiple ossicles were eroded in 16 patients.

Distribution according to the degree of hearing loss is mentioned in [Table 7]. Majority of patients had mild hearing loss (45.04%). Moderate hearing loss was seen in 41.44 % of patients and moderately severe hearing loss seen in 13.52 % of patients. Severe and profound hearing loss was not present in any patient.

Distribution according to type of hearing loss is mentioned in [Table 8]. In patients of COM 89.2% (99) had conductive hearing loss and 10.8% (12) had mixed hearing loss while sensorineural hearing loss alone was not seen in any patient.

Comparison of PTA and ABG in eroded and intact ossicles is mentioned in [Table 10]. The mean PTA in intact ossicle group in this study was 41.72±9.65dBHL and in eroded ossicle group was 49.19±9.18dBHL. The difference in the mean PTA between intact ossicle group and eroded ossicle group was statistically significant(p value <0.001). The mean ABG in intact ossicle group was 29.99±4.47dB and eroded ossicle group was 41.08±6.47dB. There was a statistically significant difference in the mean ABG between the two groups in this study (p value <0.001).

Comparison of mean hearing loss and air bone gap in terms of various erosion of ossicles is mentioned in [Table 11]. Differences in pure tone average hearing loss was found to be statistically significant with varying ossicular erosion,with a p value = 0.017 in cases of sole involvement of Incus and p value of <0.001 in remaining ossicular involvement. The difference in air bone gap (ABG) with ossicular erosion was also statistically significant with a p value = 0.008 in cases of sole involvement of Incus and p value of <0.001 in remaining ossicular involvement.

Table 1: Age Distribution

Age Group	Frequency	Percentage
15-30 years	46	41.4
31-40 years	35	31.5
41-50 years	24	21.6
51-60 years	6	5.4
Total	111	100.0

Table 2: Sex Distribution

Sex	Frequency	Percentage
Female	58	52.3
Male	53	47.7
Total	111	100.0
Male: Female Ratio	1:1.1	

Table 3: Type of Disease

Type of Disease	Frequency	Percentage
Squamosal	28	25.23
Mucosal	83	74.77
Total	111	100.0

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Table 4: Type of Surgery

Type of Surgery	Frequency	Percentage
Tympanoplasty	75	67.57
Tympanoplasty + Mastoidectomy	36	32.43
Total	111	100.0

Table 5: Intra-operative findings in patients of COM

Intra-operative Findings	Frequency	Percentage
Ossicles Intact	74	66.67
Perforation	111	100
Ossicular Defect	37	33.33
Subtotal Perforation	24	21.62
Granulations	10	9.01
Cholesteatoma	28	25.23
Myringosclerosis	20	18.02
Marginal Perforation	23	20.72

Table 6: Distribution according to Site of Erosion of Ossicles

Erosion of Ossicles	Frequency	Percentage
Malleus only	8	21.62
Incus only	12	32.43
Stapes only	1	2.70
Malleus + Incus	9	24.32
Incus + Stapes	3	8.11
Malleus + Incus + Stapes	4	10.81

Table 7: Distribution according to the Degree of Hearing Loss

Degree of Hearing Loss	Frequency	Percentage
<25 dB (Normal)	0	0
26-40 dB (Mild)	50	45.04
41-55 (Moderate)	46	41.44
56-70 dB (Moderately Severe)	15	13.52
71-90 dB (Severe)	0	0.0
>90 dB (Profound)	0	0.0
Total	111	100.0

Table 8: Type of Hearing Loss

Type of Hearing LossearHa	Frequency	Percentage
Conductive Hearing Loss	99	89.2
Mixed Hearing Loss	12	10.8
Sensorineural Hearing Loss	0	0.0
Total	111	100.0

Table 9: Ossicles eroded in terms of Various Degree of Hearing Loss

Degree of Hearing Loss	Malleus	Incus	Stapes	Malleus +incus	Incus+ stapes	Malleus+ incus+ stapes
<25 dB (Normal)	0	0	0	0	0	0
26-40 dB (Mild)	1	3	0	1	0	0
41-55 (Moderate)	4	7	1	5	2	2
56-70 dB (Moderately Severe)	3	2	0	3	1	2

Table 10: PTA and ABG in Eroded and Intact Ossicle

Parameters	Intact Ossicle (n=74)		Eroded Ossicle (n=37)		p value
	Mean	±SD	Mean	±SD	
PTA dBHL	41.72	±9.65	49.19	±9.18	<0.001
ABG dB	29.99	±4.47	41.08	±6.47	<0.001

Table 11: Mean Hearing Loss and Air Bone Gap in terms of Various Erosion of Ossicles

Parameters	Hearing Loss in dBHL			Air Bone Gap in dB		
	Mean	±SD	p Value	Mean	±SD	p Value
Malleus Only	50.63	±9.85	<0.001	40.88	±7.51	<0.001
Incus Only	46.58	±9.99	0.017	39.5	±7.57	0.008
Stapes Only	51.00	±0.00	<0.001	39.00	±0.00	<0.001
Malleus + Incus	49.11	±7.34	<0.001	42.00	±6.48	<0.001
Incus + Stapes	51.00	±8.54	<0.001	44.67	±4.16	<0.001
Malleus + Incus + Stapes	52.50	±8.54	<0.001	42.00	±2.83	<0.001

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DISCUSSION

This study was done to determine the correlation between Pure Tone Audiometry and intra-operative findings in patients diagnosed with Chronic Otitis Media.In this study, most (72.9%) of the COM patients with hearing loss were found in the age group of 15 to 40 years, which is comparable to the observations made in the studies conducted by Priyadarshini et al.[8]

These findings were in fair agreement with those reported earlier by others. Salman A A et al, in their study observed the most common age group was 21-30 years.[9]

In this study assessing the hearing loss in patients with COM, there was slight female preponderance for the occurrence of COM, with male to female ratio at 1:1.1. This is similar to the observations made by Priyadarshini et al in their studies.[8]Alireza Karimi-Yazdi et al in their study observed, male: female ratio as 1:2.[10]

In the present study the primary complaints of the patients were ear discharge, seen in 94 (84.7%) cases and decreased hearing seen in 87 (78.4%) cases. 12.6% (14) of patients had complaint of tinnitus, otalgia was seen in 9.9% (11) of patients and vertigo in 3.6% (4) of patientssimilar to findings of El-Sayed.[11]

Intra-operatively ossicular defect was found in 33.33% (37) cases. 20 patients (18.02%) had myringosclerosis affecting the tympanic membrane. Cholesteatoma was present in 28 patients. 10 patients (9.01%) had granulations. 14(12.61%) patients had total perforation and 24(21.62%) patients had subtotal perforation.

D Shrestha et al in their study on 100 patients of COM of attico-antral type observed that cholesteatoma was present in 61 cases and granulation tissue was present in 27 cases.[12] In a similar study done by D.K. Banskota et al. cholesteatoma was found in 87.28 % cases and granulation tissue in 12.71 % cases.[13]

Ossicular erosion with discontinuity of ossicular chain was present in 37 (33.33%) patients while 74 (66.67%) patients had intact ossicles. Incus (alone in 12 cases and 16 along with other ossicles) was the most common ossicle eroded, with long process being the most commonly eroded part followed by malleus (8 alone and 13 along with other ossicles) and stapes (1 alone and 7 along with other ossicles). Multiple ossicles were eroded in 16 patients.

S. Gurumani in his study showed that incus was most commonly affected ossicle and was most commonly seen in patients with subtotal perforation of tympanic membrane.[14]These findings are consistent with those of Udaipurwala et al,[15] and Shreshtha et al.[16]

Incus was found to be the most commonly eroded ossicle in studies by Tos et al, Srinivas et al.[17]Kartush found erosion of long process of incus with an intact malleus handle and stapes superstructure (type A) as the most common defect.[18]Austin reported the most common ossicular defect to be the erosion of incus with intact malleus and stapes.[19]Mohanty et al in their study observed that incus necrosis is best predicted by the presence of moderate to moderately severe hearing loss (45 to 70dBHL).[20]

Majority of cases (89.2%) in our study had pure conductive hearing loss and 10.8% cases had mixed hearing loss. Tuz et al,[21] also found conductive hearing loss as the predominant type in chronic otitis media.

The hearing loss increases as the perforation size increases and also air bone gap is less in small size (involving single quadrant) perforation as compared to subtotal size perforation. It is consistent with other studies. We observed that the larger the perforation on the tympanic membrane the greater the decibel loss in sound perception.

Maharjan M et al observed that patients having larger perforations (involving all four quadrants) showed greater hearing loss with large air bone gap. Smaller perforations involving single quadrant showed lesser loss. They found significant relationship between hearing loss and size of perforation, with strong trend for hearing loss to increase as the perforation size increases.[22]

CONCLUSION

On the basis of history, otoscopic examination and Pure tone audiometry values (specially the degree of hearing loss), we can get an idea of the ossicular chain integrity preoperatively. The ossicular chain integrity is more commonly compromised in patients presenting with moderate to severe hearing loss and the most common ossicle eroded is incus.

Multiple ossicles were seen eroded when hearing loss was moderate. If left untreated, COM results not only in progression of conductive hearing loss but also predisposes to the development of mixed hearing loss. This highlights the need for the early surgical intervention in COM patients to prevent worsening of hearing. This study reinforces the idea of using preoperative audiometry to assess the degree and type of hearing loss, which not only helps in documenting the preoperative status of patients' hearing which is supportive in the event of medico-legal issues, but also helps in predicting the intra-operative findings in a case of Chronic Otitis Media.

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