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Relation between the duration of disease and audiogram findings in tubotympanic type of chronic suppurative otitis media after myringoplasty

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Abstract
Introduction: Chronic Suppurative Otitis Media (CSOM) has been an important cause of hearing loss and ear discharge in people affected by it for a significant time now. Its prevalence is more in developing countries where the socioeconomic status is low. Poor and overcrowded living conditions, poor hygiene and nutrition have been suggested as a basis for the widespread prevalence of CSOM in developing countries. Pure Tone Audiometry is the easiest and the most basic procedure which needs to be performed on any patient who has history of hearing loss irrespective of the nature of the disease and the cause surrounding it. Every initial evaluation for CSOM should include audiometric testing via air and bone along with pure tone thresholds.
Aims & Objectives: To co-relate the hearing loss to the duration of the disease in the ear in patients with CSOM and to also associate the same to the corresponding hearing changes after Myringoplasty.
Materials & Methods: Sixty patients were taken to be part of the study after following a strict inclusion and exclusion criteria. With proper consent, they underwent Pure Tone Audiogram and Myringoplasty. Their Air Bone Gap and Air Conduction Threshold results were tabulated with the duration of the disease and a consensus was reached at.
Observations & Results: It was observed that the hearing loss was much lesser if the duration of the disease was lesser than one year. As the diagnosis was delayed, both the AB gap and the mean AC threshold went up. The early closure of the perforation can significantly bridge the AB gap but the same cannot be said about the AC threshold as it seemed to be lesser affected by the duration.
Conclusion: It can thus be concluded that AC threshold is quietly independent of the changes in the diseased middle ear as compared to the AB gap. This makes it a stronger tool in the assessment of hearing. The early diagnosis and management of Tubotympanic type of CSOM can not only help in preventing complications but also aid in better hearing protection which in-turn helps in better social survival.

Keywords: chronic suppurative otitis media; myringoplasty; air conduction; bone threshold

Introduction

Chronic Suppurative Otitis Media (C.S.O.M.) is defined as a chronic inflammation of the middle ear and mastoid cavity which presents with recurrent ear discharges through a tympanic perforation. It is most likely a result of an earlier acute otitis media, negative middle ear pressure because of a non-patent Eustachian Tube or Otitis Media with Effusion [1]. It is one of the commonest conditions encountered in the Outpatient Department of Otorhinolaryngology in most developing countries.

The most common presenting complaints include hearing loss and ear discharge [2]. In adults, the presence of this disease produces social stigma thereby affecting day to day activities. In adolescents, it results in disturbances socially and emotionally thereby causing reduction in academic performance. This can often pose a significant economic burden on the family [3].

Histopathological changes can develop in the middle ear and mastoid in C.S.O.M. which may or may not be due to inadequately treated episodes of Acute Otitis Media [4, 5]. Some changes are the direct result of infection, while others like inflammation represent the host response to the disease process. Adding up, these changes lead to the symptoms and signs which play an important role in determining the success or failure of Tympanomastoid surgery.

Although C.S.O.M. is a multifactorial disease, microbial virulence factors including toxins and cell wall constituents such as lipopolysaccharide (LPS), peptidoglycan (PG) and lipoteichoic acid (LTA) are thought to be important in its pathogenesis. While bacterial toxins may directly damage the mucosal cells, they can also trigger an inflammatory reaction that may injure the mucosa of the middle ear [6]. These changes can produce complications which are directly related to the disability faced by the patient. Thus, the early diagnosis and management of the disease becomes all the more necessary to achieve good results.

Pure Tone Audiometry is the easiest and the most basic procedure which needs to be performed on any patient who has a history of hearing loss irrespective of the nature of the disease and the cause surrounding it. Every initial evaluation for C.S.O.M. should include audiometric testing with air and bone along with pure tone thresholds. The degree of hearing loss is helpful in

determining the severity of the middle ear disease.
Myringoplasty is defined as a surgical procedure in which the reconstruction is limited to closure of the Tympanic Membrane perforation which is aimed at preventing recurrent infection of the middle ear [7]. Myringoplasty prevents the exposure of the middle ear mucosa to external pathogens thereby restoring the vibrating area of the neotympanum and improving the hearing capability [8].
Based on the amount of hearing loss, it should be possible to grossly predict the duration of the disease, size and site of the perforation on pars tensa and the condition of the ossicular chain. The aim of this study is to correlate the findings of the Audiometry i.e. Air Bone Gap (AB Gap) and Air Conduction Threshold (AC Threshold) to the duration of the disease in the ear and also associate the same to the corresponding hearing changes after surgery.

Materials and Methods

This was carried out in our Institute for a duration of 18 months in 2017-18.
Source: Patients presenting to the ENT OPD with hard of hearing, ear discharge and a dry central perforation of pars tensa on examination.
Sample Size: Sixty (60).
Type of Study: Prospective Study.
Statistical Analysis: All statistical analyses were performed using SPSS Statistics 19 for Windows (IBM Corp., Armonk, NY, USA). Samples were compared and evaluated by means of a Paired Student T-test. A P-value of <0.05 was considered statistically significant. The confidence interval was set at 95%.
All the patients were put thorough a detailed and complete clinical examination of Ear, Nose and Throat. Special attention was given to otoscopic examination, tuning fork tests & audiometry. The hearing level was recorded with a pure-tone audiometer.

Inclusion Criteria

1. Perforation should be of central type i.e. in pars tensa with intact annulus.
2. Mucosal type Chronic Suppurative Otitis Media (Tubotympanic disease).
3. Ear should be dry for at least 4 weeks pre-operatively.
4. Tuning fork tests should show hearing to be longer by bone conduction than air conduction i.e. pure conductive deafness.
5. Pure Tone Audiometry should reveal only conductive deafness.
6. Adequate cochlear function should be present i.e. good cochlear reserve.
7. The disease should be limited to one ear with the other ear having normal anatomy. The normal opposite ear also helps as a control for reference.
8. Eustachian Tube should be patent.
9. Patients should be willing to take part in the study.

Exclusion Criteria

1. Evidence of septic foci in nasopharynx, paranasal sinuses or throat.
2. Squamous type of CSOM.
3. Complications of CSOM.
4. Patients with Mixed or pure Sensorineural Hearing Loss in the affected ear.
5. Disease present in the only hearing ear.

Parameters for assessment

1. Duration of the Disease.

Duration of the disease affects the extent, presence or absence of complications and time required for recovery. The duration of the disease is divided into the following categories to aid in a detailed study –

- < 1 Year
- 1 – 2 Years
- 2 – 3 Years
- > 3 Years

2. Pure Tone Audiometry.

The pre-operative Pure Tone Audiogram was taken before the surgery and the post-operative Audiogram was taken 12 weeks after the surgery.

Surgical procedure

Myringoplasty with tragal perichondrium was performed under local anaesthesia. The procedure was done by the same Surgeon to avoid bias. In all the cases an underlay technique was used.

Observations and Results

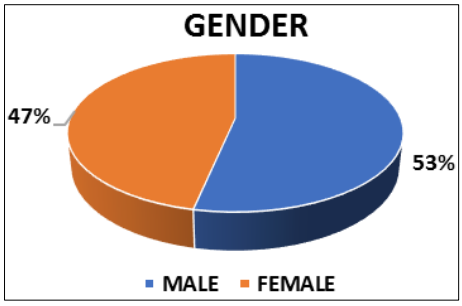

Fig 1: Distribution Based on Gender

Table 1: Distribution Based on Duration of the Disease (in years)

Duration of Disease in years	Number	Percentage
< 1	11	18.3
1 – 2	25	41.7
2.1 – 3	18	30
> 3	6	10
	60	100

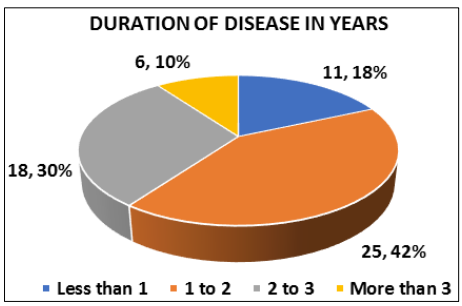

Fig 2: Distribution of Cases Based on the Duration of Disease (in years)

The percentage of Males in the study was 53% and Females 47%. [Figure 1] A large section of patients presented to the OPD with the disease being prevalent for atleast one year. [Figure 2] [Table 1]

Table 2: Pre-Operative Mean of Air Bone Gap and Air Conduction Threshold

Duration of Disease	Mean AB Gap Pre-Operative	Mean Air Conduction Pre-Operative
< 1 Year	14.82	31.93
1 – 2 Years	21.17	42.30
2 – 3 Years	21.56	43.84
> 3 Years	31.08	64.13

It is clear that the hearing loss is much lesser if the duration of the disease is lesser than one year. As the diagnosis is delayed, both the AB gap and the mean AC threshold increase. [Table 2]

Table 3: Post-Operative Mean of Air Bone Gap and Air Conduction Threshold

Duration of Disease	Mean AB Gap Post-Operative	Mean Air Conduction Post-Operative
< 1 Year	8.79	24.49
1 – 2 Years	13.76	31.64
2 – 3 Years	12.72	32.19
> 3 Years	23.01	48.56

Table 4(a) Significance of Duration of Disease When Compared to Each Other

Duration of Disease 1	Duration of Disease 2	Mean difference	Standard Error	Significance	95% confidence interval	
					Lower bound	Upper bound
< 1 Year	1 – 2 Years	-10.3676	2.8288	.007	-18.439	-2.296
	2 – 3 Years	-11.9081	3.8031	.024	-22.658	-1.158
	> 3 Years	-32.1970	2.5963	.000	-39.977	-24.417

Table 4(b)

Duration of Disease 1	Duration of Disease 2	Mean difference	Standard Error	Significance	95% confidence interval	
					Lower bound	Upper bound
1 – 2 Years	< 1 Year	10.3676	2.8288	.007	2.296	18.439
	2 – 3 Years	-1.5404	3.5998	.998	-11.683	8.602
	> 3 Years	-21.8293	2.2881	.000	-28.393	-15.266

Table 4(c)

Duration of Disease 1	Duration of Disease 2	Mean difference	Standard Error	Significance	95% confidence interval	
					Lower bound	Upper bound
2 – 3 Years	< 1 Year	11.9081	3.8031	.024	1.158	22.658
	1 – 2 Years	1.5404	3.5998	.998	-8.602	11.683
	> 3 Years	-20.2889	3.4201	.000	-30.127	-10.451

Table 4(d)

Duration of Disease 1	Duration of Disease 2	Mean difference	Standard Error	Significance	95% confidence interval	
					Lower bound	Upper bound
> 3 Years	< 1 Year	32.1970	2.5963	.000	24.417	39.977
	1 – 2 Years	21.8293	2.2881	.000	15.266	28.393
	2 – 3 Years	20.2889	3.4201	.000	10.451	30.127

The mean Air Bone Gap pre-operatively for a diseased ear of less than one-year duration was found to be 14.82 dBHz and post operatively it was found to be 8.79 dBHz, an improvement of 40.68%. The same values for a diseased ear between 1 – 2 years were found to be 21.17 dBHz and 13.76 dBHz, an improvement of 35%. The values for a diseased ear between 2 – 3 years were found to be 21.56 dBHz and 12.72 dBHz, an improvement of 41%. The corresponding values for a diseased ear of more than 3 years were found to be 31.08 dBHz and 23.01 dBHz, an improvement of 25.96%. [Tables 2 & 3] Thus, it can be argued that an early closure of the perforation can significantly bridge the AB gap. [Table 4]

The mean air conduction threshold pre-operatively for a diseased ear of less than one-year duration was found to be 31.93 dBHz and post operatively it was found to be 24.49 dBHz, an improvement of 23.3%. The same values for a diseased ear between 1 – 2 years were found to be 42.3 dBHz and 31.64 dBHz, an improvement of 25.2%. The values for a diseased ear between 2 – 3 years were found to be 43.84 dBHz and 32.19 dBHz, an improvement of 25.45%. The corresponding values for a diseased ear of more than 3 years were found to be 64.13 dBHz and 48.56 dBHz, an improvement of 24.29%. [Tables 2 & 3] Although the mean air conduction thresholds in all the groups improve after surgery, there is no significant difference between groups. This indicates that the duration of disease does not affect the Air Conduction as much as it does to the Air Bone Gap. [Table 4]

Discussion

Chronic Suppurative Otitis Media with perforation of pars tensa is one of the main causes of conductive hearing loss in developing countries like India.

Myringoplasty is defined as the reconstruction of the Tympanic

Membrane without involving the ossicular chain. "Myringoplastik" was a term introduced by Berthold [9] in 1878 but the modern era of Tympanoplasty did not begin until the 1950's with the work of Zollner and Wullstein. Many different techniques and grafting materials have been used to close tympanic membrane perforations like full thickness skin graft, split skin, cornea, amniotic membrane, fat, vein, perichondrium & dura. Off late composite tissue grafts like temporalis fascia and perichondrium are becoming popular techniques because of their high take rate, easy availability in sufficient quantity and approachability in the vicinity of the operative field [10, 11].

Sakagami *et al* observed Chronic Suppurative Otitis Media as main cause of conductive hearing loss. In their study, 82 out of 91 cases undergoing Myringoplasty, had a tympanic membrane perforation with an intact ossicular chain. In these cases, the secondary cause of conductive hearing loss was considered to be the rigidity of the ossicular chain. These changes which happen in the middle ear are variable. The quality of ear discharge and the amount of time the discharge has been present in the middle ear is directly proportional to the hearing loss [12].

There have been extensive studies about the causes of hearing loss in patients with C.S.O.M. Some studies have pointed out that changes in hearing are directly related to frequent episodes of otorrhoea [13, 14].

Occasionally, elevated Bone Conduction Threshold has been observed in various audiometric recordings in patients suffering from C.S.O.M [15].

In this study, we assess the relationship between the duration of disease in the middle ear and the changes in hearing thresholds. All the patients were taken up for surgery after proper consent and in accordance with the strict inclusion and exclusion criteria. The surgery was performed by the same surgeon with the same instruments and technique to prevent bias. The pre-operative audiogram was taken before the surgery and the post-operative audiogram 12 weeks after the surgery since it takes 12 weeks for the mucosa of the middle ear to regenerate, as documented in various past studies [16].

Plenty of other researches have proved that the hearing of the patient (Air Conduction and Air Bone Gap) has improved after successful surgery irrespective of the method used with respect to the graft material, approach and anaesthetic technique [17, 18, 19, 20].

Our motive was to appreciate the same in our sample group and associate it with the time of diagnosis and the time of surgery.

In our study, we found that the AB gap improved by 41% when the diagnosis was made within 1 year from the onset of the first symptom. However, the AB gap improved only by 26% when the diagnosis was made after 3 years from the onset of the first symptom. This can be explained by the various middle ear changes because of the disease, such as:

- Rigidity of the ossicular chain because of calcification and granulation.
- Tympanosclerosis.
- Impairment of Round Window Baffle effect.

On the same lines, although the AC threshold improved in separate groups, the range was between 23-25% which means that the AC threshold is independent of the changes in the diseased middle ear.

Conclusion

This study shows that Air Conduction Threshold is independent of the changes in the diseased middle ear as compared to the Air Bone Gap. This shows that Air Bone gap is a more sensitive tool of hearing assessment.

Early closure of the perforation results in better bridging of the bone and air conduction thresholds.

Hence, it can be concluded that the early diagnosis and management of a Pars Tensa perforation in Tubotympanic type of C.S.O.M. can not only help in preventing complications but also aid in better hearing protection which in-turn helps in better social survival.

Compliance with Ethical Standards

We have received a written consent from every patient with respect to the medication administered, procedure and also the risks and benefits were explained in detail. Each form was thoroughly read and signed by both the patient and an attender to the patient. The study was approved by the research ethics committee of the Institute and it adheres to the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Conflict of Interest

There were no conflicts of interest in the conduct of this study.

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Nil

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