Original Research Article

Correlation between the clinical and audiometric profiles of patients at a secondary care hospital- A Cross- sectional study

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ABSTRACT

Introduction: Pure tone Audiometry (PTA) is one of the methods to evaluate the burden of hearing loss in any population and various studies have attempted to correlate PTA thresholds with specific conditions. However not many studies correlate the symptoms and signs with the PTA results.

Objective: Analyze the data of those who underwent PTA in a secondary care hospital and to correlate their audiometric and clinical profile.

Materials and Methods: The data of 1002 patients with their demographic profile, symptoms, signs and PTA results were included. Incomplete data were excluded from the study. Statistical analysis was done to correlate the symptoms, signs and demographic profile with the type of hearing loss.

Results: Gender did not have a statistically significant influence on the type of hearing loss (p> 0.05). Sensory Neural Hearing Loss (SNHL) was the commonest type found. It was commoner in the older age group. Influence of age on the type of hearing loss was statistically significant (p<0.05). Analysing the symptoms and signs, tinnitus, aural fullness and tympanic membrane perforation had a significant influence on the type of hearing loss (p<0.05).

Conclusion: Symptoms and signs can be used as a screening tool in a population to identify those requiring evaluation by PTA. It is suggested that a standard symptom based questionnaire which can be either self-administered or can be used by a community health worker to screen the population be framed.

1. Introduction

Around 360 million people in the world suffer from disabling hearing loss which is 5.3% of world population.[1] Hearing disability is a global burden and affects not only the person's communication and vocational abilities but also affects his socio-cultural well-being.[2] In India, around 63 million people (6.3%) suffer from significant auditory loss. The National Sample Survey (NSS) 58th round (2002) had surveyed disability both in urban and rural households. It was found that hearing disability was the second most common cause of disability after locomotor disability.[3] The estimated prevalence of childhood onset deafness was found to be 2% and adult onset deafness in India was 7.6%.[4] In a systematic review done by Shukla A et al it was found that hearing loss was associated with loneliness and social isolation in older adults.[5] Pure tone audiometry (PTA) is one of the methods to evaluate the burden of hearing loss and various studies have attempted to find the correlation of PTA thresholds with specific conditions.

The studies on the hearing loss in a community are vital at all levels of health care for devising public health measures that suit the patients.[6] In a study by Braun et al the hearing loss for numbers was correlated with pure tone thresholds. They concluded that the mean threshold from the frequencies 250, 500 and 1000 Hz should be compared to the hearing loss for numbers.[7] In India, a study by Prakash S. Handi et al evaluated the hearing threshold by PTA in patients with chronic suppurative otitis media (CSOM). This

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study highlighted the importance of PTA in identifying the sensorineural component in patients with CSOM. [8]

Maeda Y et al found in their study among older Japanese patients that thresholds on the PTA is a good predictor of speech perception by speech audiometry among older persons, which could provide clinically important information for hearing aid fitting and cochlear implantation. [9] Devashri UP and others in their study on correlation of PTA findings with intraoperative findings in patients with Chronic Suppurative Otitis Media did not find the air conduction thresholds or the air-bone gap in PTA as a reliable factor to predict the intra operative ossicular status. [10]

The major causes of hearing loss and ear disease in India have been listed by the WHO survey. [11] The most common cause of reversible hearing loss was found to be Ear wax (15.9%). The next most common cause is Non-infectious in origin such as presbycusis (10.3%). Middle ear infections such as chronic suppurative otitis media (5.2%) and serous otitis media (3%) are other leading causes of hearing loss. The best way to reduce the impact of this, is to identify the etiology, degree and the type of hearing loss as early as possible and to provide an intervention. In order to identify early, diagnose and treat ear problems responsible for hearing loss and deafness, government of India has launched the National Program for Prevention and Control of Deafness (NPPCD). [12]

Pure tone Audiogram is one of the widely available tools to help in early identification and thus intervention. Based on the PTA, the degree and type of hearing loss in a patient can be identified. The data collected can be utilized to find if the clinical profile of patients undergoing audiometry correlates with their diagnosis based on PTA results. With this study, it is attempted to characterize the symptoms and signs the patients presented with and to correlate them with the audiometric profile of patients based on PTA results. This may help in identifying those in the population who would require to undergo PTA and thus early identification and timely intervention for common conditions causing correctable hearing loss.

2. Aims and objectives

To analyze the clinical profile of patients who underwent pure tone audiometry in the year 2017 at a secondary care hospital in Palakkad town, Kerala State, India and to see if there is any correlation between their audiometric profile and clinical profile.

3. Materials and Methods

This is a Cross- Sectional Study based on the clinical and audiometric data available with the Department of Otolaryngology. Institutional research committee approval was taken vide GMC/PKD/IRC/Nov18/07. Permission was taken from the custodian of the data and Institutional ethics committee clearance was obtained vide IEC/GMCPKD 10/19. The data of 1002 patients who underwent PTA between Jan 2017 to Dec 2017 was used in this study.

The following parameters were collected
Demographic Profile of patients- Age, Sex.
Presenting symptoms- Hearing loss, Tinnitus, Aural Fullness
Clinical findings- Normal Tympanic membrane (TM), Perforated TM, Retracted TM.
The type of hearing loss based on the PTA.
The data which were found to be deficient in any of these parameters and those with congenital hearing loss were excluded from the study.

Based on the audiometric results patients were divided into 4 groups:
Patients found to have Normal Hearing (NORMAL)
Patients found to have Conductive Hearing Loss (CHL)
Patients found to have Sensory-neural Hearing Loss (SNHL)
Patients found to have Mixed Hearing Loss (MIX HL)

Analysis of the data was done using SPSS Version 21 to find the correlation between the type of HL to the age, sex, various symptoms and signs.

4. Results

Among 1002 patients 534 were males and 468 were females (Figure 1). Analyzing the grouped data using Kruskal – Wallis H test with gender as grouping variable and type of hearing HL as test variable it was found that gender did not have a statistically significant influence on the type of HL (p> 0.05) for both right and left ears.

The minimum age was 5 years and maximum was 85 years. Based on the age patients were divided into 5 groups as shown in Table 1. The age group 3 and 4 constituted 31.4 and 34.6 percentage respectively.

Based on the type of hearing loss diagnosed by PTA results, the patients were divided into 4 groups as shown in Table 2. It was found that 47% of the patients who underwent PTA had SNHL. However about 10% (in the left ear) to 14.4 % (in the right ear) of the patients had normal hearing, in spite of having signs and symptoms warranting the advice of PTA.

The type of HL based on PTA results in various age groups is shown in Table 3. Comparing the types of HL in different age groups, SNHL was more common in older age groups (3, 4 and 5) with the percentage increasing with the increase in age. CHL was more common in younger age groups (1 and 2). Analyzing the grouped data using Kruskal – Wallis H test with the type of HL as test variables and age group as grouping variable it was found that age group has a statistically significant influence on the type HL (p< 0.05) for both right and left ears.

Analyzing the symptoms and signs of the patients who underwent PTA, the most common symptom was hearing loss in 98.4% and the most common sign was tympanic membrane perforation found in 27% of the patients. Correlation of the signs and symptoms with the type of hearing loss found on PTA is shown in Table 4. Analyzing the data it is can be noticed that hearing loss is the predominant symptom irrespective of the type of hearing loss. History of ear block was seen more in patients with CHL. Tinnitus was more common in patients with Mixed HL and SNHL. Injury to ear was one of the symptoms in about 6 % to 15.3% and was similar in all the groups. Among the clinical findings, retracted TM was found more in patients with CHL and TM perforation was found ranging between 43% to 49% of patients with Mixed HL and CHL.

The analysis of the symptoms and signs as grouping variable with type of hearing loss as test variable using Kruskal-Wallis H test in SPSS showed that the hearing loss and ear trauma as symptoms do not have a statistically significant influence ($p > 0.05$) on the type of hearing loss. All the other signs and symptoms have a statistically significant influence on the type of hearing loss.

Table 1: Age distribution

Age Group	Age	Number of patients	Percentage
1	< 15	79	7.90%
2	16 to 25	98	9.80%
3	26 to 45	315	31.40%
4	46 to 65	347	34.60%
5	> 66	163	16.30%

Table 2: Type of Hearing Loss

S. No	Type of HL	Right ear %	Left ear %
1.	CHL	16.8%	19.7%
2.	MIX HL	21.1%	23.3%
3.	Normal	14.4%	10.1%
4.	SNHL	47.8%	47%

5. Discussion

The data for the present study was derived from the patients attending the outpatient department of a secondary care hospital. Hence it may not be the actual representation of general population. However the study results may help to identify the symptoms and signs of patients and its implications on PTA results and thus guide in early identification of these in the population. This may further help in planning population based studies.

Among the data available for 1002 participants in this study, males contributed 53.3% and females 46.6%. Evidence from many studies points to a similar gender distribution. Ravi D et al in their study used the data
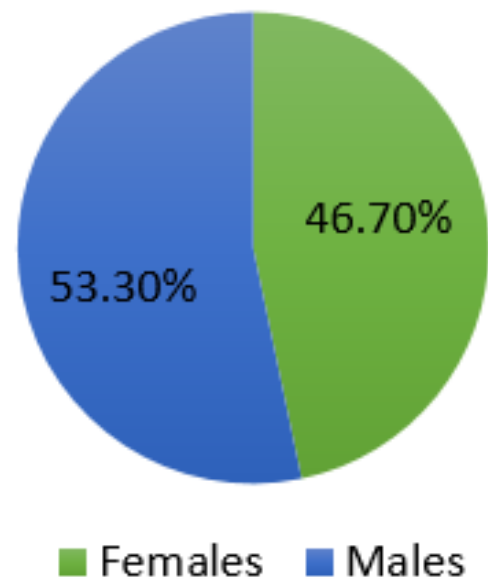

Sex distribution

46.70%

53.30%

■ Females ■ Males

Fig. 1: Sex Distribution

consisting of information regarding 1130, (56.87%) males and 857 (43.13%) females.[2] In the study by Sumanth Kanjikar et al 66.9% of the participants were male and 33.1% were females.[13] In an epidemiological study by Bisht et al out of 55.6% were males and 44.4% were females.[14] The reason for this may be in general, more males report to the outpatient department compared to females. But gender does not influence the type of hearing loss in a significant way.

The age of the participants in this study ranges from 4 years to 85 years. Maximum number of patients belonged to age group 3 and 4 (26 years to 45 years - 31.4% and 46 to 65 years - 34.6% respectively). The age at presentation will have an implication on the type of hearing loss. Similar observations were made in a study by Ravi D et al. Of the total study population, the adult group was 35.23% and the older adult group were 35.91%.[2] In another study by Sumanth Kanjikar et al they found that the age distribution of hearing loss patients showed two peaks in the 51-60 age group (21.8%) followed by 21-30 age group (20.8%).[13]

The most common type of HL observed in this study is SNHL, followed by MIX HL and then CHL. Nearly 10% to 14% patients were found to have a normal hearing. Comparing the age group with the type of HL, it was observed that percentage of patients with SNHL and MIX HL was more common in age group 3, 4 and 5. That is with increasing age the percentage of SNHL increases reaching a maximum of 65% to 68% in the age group 5. The reason for this could be the onset of presbyacusis. CHL

Table 3: Type of Hearing Loss In various Age Groups

Type of HL	Age group 1		Age group 2		Age group 3		Age group 4		Age group 5	
	Right %	Left %	Right %	Left %	Right %	Left %	Right %	Left %	Right %	Left %
CHL	48.1	58.2	28.6	33.7	21.3	25.7	9.2	9.8	1.8	1.8
MIX HL	3.8	8.9	9.2	10.2	14.6	18.1	29.1	32.3	31.9	28.8
Normal	26.6	15.2	29.6	28.6	19.7	14.3	8.9	4.3	0.6	0.6
SNHL	21.5	17.7	32.7	27.6	44.4	41.9	52.7	53.6	65.6	68.7

Table 4: Type of Hearing Loss and Symptoms and Signs

Type of HL	H/o of Hearing Loss		H/o Ear Block		H/o Ear Trauma		H/o Tinnitus		Retracted TM		TM Perforation	
	Right %	Left %	Right %	Left %	Right %	Left %	Right %	Left %	Right %	Left %	Right %	Left %
CHL	98.2	99.5	21.4	21.3	8.3	13.2	25	22.8	20.2	17.8	49.4	54.3
MIX HL	99.5	100	8.1	8.2	5.7	6	41.2	36.5	6.2	7.7	45.5	43.8
Normal	96.5	94.1	18.1	19.8	15.3	8.9	25.7	31.7	8.3	7.9	27.1	12.9
SNHL	98.5	98.1	7.7	7.4	6.5	6.4	47	48.6	2.3	1.9	11.1	10.4

was more commonly seen in the younger age groups namely group 1 and 2. Similar observations have been made in many previous studies. In a study by Sumanth Kanjikar et al sensorineural hearing loss (SNHL) type was the highest with 163 (66.5%) cases and the highest number of cases belonged to the 51-60 yeas age group.[13] In another study by Balasubramanian G.K et al, out of 1012 patients, 42% had SNHL and 15% had CHL.[15] In an epidemiological study done at Uttarakhand, Bisht RS et al found moderately severe SNHL to be the most common PTA finding. It is also consistent with the WHO census.[14]

Correlating the symptoms and signs the patients presented with, to the PTA results, it can be observed that 98.4% of patients had presented with hearing loss. Tinnitus was present in 39% and TM perforation was found in 27%. The statistical analysis shows that the presence of hearing loss as a symptom should warrant a PTA, however it may not correlate with the specific type of hearing loss found. But the presence of tinnitus correlates well with either SNHL or mixed type of HL in a significant way. The presence of tympanic membrane perforation on examination correlates significantly with CHL.

Though there are not many studies which correlate the symptoms, some studies correlated few clinical signs with specific type of hearing loss. Bisht et al found perforation of tympanic membrane as the second most common finding about 14.4% right and 24.4% left tympanic membrane perforated in patients with CHL and intact tympanic membrane in patients with SNHL which was commonest type in their study.[14] Another study by Samelli AG et al conducted in Sao Paulo found the otologic symptoms of tinnitus, itching, ear fullness, and dizziness were reported with higher frequency by individuals aged 18 or more years. They also quote another study in which vertigo and tinnitus

were among the symptoms most frequently reported by patients with sensorineural hearing loss, the more prevalent type of hearing loss in adults in that sample.[16]

To summarize it can be said that when the presenting symptom is hearing loss it is advisable to do PTA. But it may not give adequate time to intervene. It would be optimal to identify patients before they develop disabling hearing loss. Since there is a positive correlation of specific symptoms and signs with the type of HL found in PTA, evaluating patients based on the symptoms and signs can be of value in population based studies. Hence it is suggested that a standard symptom based questionnaire which can be either self-administered or can be used by a community health worker to screen the population be framed.

6. Conclusion

From this study it can be said that as age increases the chance of SNHL also increases and identifying this early may help in early intervention and rehabilitation. In the younger age group, it is predominantly CHL which is often correctable and so it is important to recognize early. The audiological symptoms and signs can be used as an important tool in population based studies to identify patients who would require to be screened with PTA, which in turn may help in early recognition and thus intervention. A standard questionnaire based on symptoms and signs can be prepared and used to study huge population.

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9. Conflict of Interest

The authors declare they have no conflict of interest.

References

1. Varshney S. Deafness in India. *Indian J Otol*. 2016;22:73–6.
2. Ravi D, Prasad H, Lakshmi M, Sahana M, J P. A Tertiary care hospital-based retrospective study evaluating age and gender differences in audiological findings. *Evolution Med Dent Sci*. 2017;6(21):1678–82.
3. National Sample Survey Organization. Disabled persons in India, NSS 58th round (July–December 2002) Report no. 485 (58/ 26/1). New Delhi: National Sample Survey Organization, Ministry of Statistics and Programme Implementation, Government of India. 2002;.
4. Garg S, Chadha S, Malhotra S, Agarwal AK. Deafness: Burden, prevention and control in India. *Natl Med J India*. 2009;22:79–81.
5. Shukla A, Harper M, Pedersen E, Goman A, Suen JJ, Price C, et al. Hearing Loss, Loneliness, and Social Isolation: A Systematic Review . *Otolaryngol Head Neck Surg*. 2020;162(6):622–33.
6. Cruz MS, Oliveira LR, Carandina L, Lima M, César-Chester LG, Barros M, et al. Prevalência de deficiência auditiva referida e causas atribuídas: um estudo de base populacional. *Cad Saúde Pública*. 2009;25(5):1123–31.
7. Braun T, Dochtermann S, Krause E, Schmidt M, Schorn K, Hempel JM, et al. Correlation of pure tone thresholds and hearing loss for numbers. Comparison of three calculation variations for plausibility checking in expertise. *HNO*. 2011;59(9):908–14.
8. Handi PS, Patil MN, Prasenkumar KR. Evaluation of hearing loss by pure tone audiometry in chronic suppurative otitis media patients. *IJOHNS*. 2018;4(5).
9. Maeda Y, Takao S, Sugaya A, Kataoka Y, Kariya S, Tanaka S, et al. Relationship between pure-tone audiogram findings and speech perception among older Japanese persons. *Acta Otolaryngol*. 2017;138(2):140–4.
10. Devashri UP, Kiran SB, Shreeya VK, Vandana S, Chaitanya B. Correlation of the Puretone Audiometry Findings with Intraoperative Findings in Patients with Chronic Suppurative Otitis Media. *MVP J Med Sci*. 2015;2(1):4–14.
11. World Health Organization. State of hearing and ear care in the South East Asia Region. WHO Regional Office for South East Asia. WHO-SEARO. SEA/Deaf/9. Available from: http://www.searo.who.int/LinkFiles/Publications_HEARING_&_EAR_CARE.pdf.
12. National Programme for Prevention and Control of Deafness (NPPCD) Operational Guidelines; 2020. Available from: http://mohfw.nic.in/WriteReadData/l892s/9025258383Operational%20Guidlines%.Accessedon.
13. Kanjikar S, Doddamani A, Malige R, Reddy N. Audiometric analysis of type and degree of hearing impairment and its demographic correlation: A retrospective study. *J Adv Clin Res Insights*. 2015;2:189–92.
14. Bisht RS, Sikarwar V, Mina R, Arya A. An epidemiological study on hearing loss and its demographic characteristics within Garhwal region of Uttarakhand. *Indian J Otol*. 2016;22:105–9.
15. Balasubramanian GK, Thirunavukkarasu R, Kalyanasundaram RB. Assessment of hearing status by pure tone audiogram-an institutional study. *Int J Otolaryngol Head Neck Surg*. 2015;4(5):375–80.
16. Samelli AG, Andrade CQD, Pereira MB, Matas CG. Hearing complaints and the audiological profile of the users of an academic health center in the western region of São Paulo. *Int Arch Otorhinolaryngol*. 2013;17(2):125–30.

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