Original research article

Clinical Evaluation of Sensorineural Hearing Loss in Patients with Type 2 Diabetes Mellitus

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Abstract

Background: Several Research has tried to study the link between sensorineural hearing loss (SNHL) and diabetes mellitus. Diabetes-related hearing loss has a typical presentation. The hearing loss is usually bilateral, with a gradual start that affects higher frequencies. The goal of this study is to determine the prevalence of SNHL in people with diabetes, as well as its relationship to age, gender, DM duration, and DM management and complications.

Methods: Based on the inclusion and exclusion criteria n=60 cases were selected for the study. The cases were subjected to ENT, Systemic, Audiometric, and Laboratory assessments. The Ear examination included the pinna, preauricular and post auricular areas, mastoid, external auditory canal, and tympanic membrane. *Pure tone audiometry:* Audiometric assessment was conducted in the soundproof room delivering pure tone stimuli to one ear at a time in frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz at various selected intensities.

Results: Out of n=60 cases of type 2 diabetes mellitus n=38(63.33%) cases were found to have sensorineural hearing loss and n=22(36.67%) cases were found to be normal. Based on the onset of hearing loss in this study out of the n=38 cases of sensorineural hearing loss n=36(94.73%) cases had slow onset of hearing loss and n=2(5.26%) had a sudden onset of hearing loss. Based on the pure tone audiometry findings out of n=38 detected with sensorineural hearing loss bilaterally. n=28(73.68%) cases were having mild hearing loss and n=10(26.31%) cases were having moderate hearing loss.

Conclusion: The prevalence of sensorineural hearing loss in diabetics was found to be 63.33%. The sensorineural hearing loss is generally gradual and involves high-frequency thresholds. With increasing age and diabetes duration, the hearing threshold rises. There was no specific differentiation of SNHL between males and females.

Keywords: Diabetes Mellitus, Sensorineural Hearing Loss (SNHL), Pure tone Audiometry

Introduction

The hearing gives us confidence and improves our life. We can socialize, work, connect, communicate, and even rest because we can hear. It enables us to enjoy our daily lives without restrictions. Hearing loss can result in feelings of loneliness and even sadness. The depletion of social networks has the potential to shorten our lives and reduce our quality of life. Almost every element of our life is influenced by our capacity to hear. As a result, the sense of hearing, as well as the perception of sound and its biological objectives, is not a minor matter

to be dismissed lightly. Diabetes Mellitus (DM) is a prevalent metabolic condition that results in a variety of bodily system abnormalities. Because diabetes mellitus is the most frequent kind of diabetes in the general population, the impacts it has on the body's numerous organs are more important. Hearing impairment, including hearing loss and tinnitus are the known consequences of DM, and it leads to a worse quality of life among those afflicted. [1-4] WHO predicts that by 2025 there would be 220 million diabetes globally, with a prevalence rate of 5.4 %. [5] The majority of diabetics in poor nations are in their productive years, which has important implications for healthcare demands. Modern medicine's purpose is no longer to treat diseases but to prevent and control them, therefore increasing the quality of life of individuals and humanity as a whole. Hearing loss in a patient with an incipient diabetic coma has been recognized since 1857 when Jordao AMD [6] first demonstrated it in a patient with an incipient diabetic coma. Even though the association between diabetes and hearing function has been investigated for a long time, there is presently no acceptable consensus on the subject. The most common kind of hearing loss in diabetics is bilateral sensorineural hearing loss, which affects the higher frequencies. [7-9] However, there have been a few cases of abrupt onset sensorineural hearing loss (SNHL) affecting lower frequencies. [8, 10] The sort of hearing loss observed is comparable to presbyacusis, however, individuals affected have a higher loss of hearing than one would expect at that age. This research attempts to determine if diabetes mellitus causes hearing loss, and if so, what the relationship is between the patient's age, gender, and diabetes duration.

Material and Methods

This cross-sectional study was conducted in the Department of General Medicine and ENT, Medical College, Telangana. Intuitional Ethical approval was obtained for the study. Written consent was taken from all the patients in the study.

Inclusion criteria

1. Type 2 Diabetes patients
2. Aged between 30 to 50 years
3. Males and Females
4. Willing to participate in the study voluntarily

Exclusion criteria

1. Patients already diagnosed with conductive hearing loss
2. Patients with mixed hearing loss
3. Sensorineural hearing loss other than due to Type 2 Diabetes,
4. History of trauma due to head injury,
5. Congenital hearing loss,
6. Family history of clear-cut deafness,
7. Occupational noise exposure
8. Presbyacusis in otherwise normal were excluded

Based on the inclusion and exclusion criteria n=60 cases were selected for the study. The cases were subjected to ENT, Systemic, Audiometric, and Laboratory assessments. The Ear examination included the pinna, preauricular and post auricular areas, mastoid, external auditory canal, and tympanic membrane. Tuning fork tests Rinne's Test, Weber's test, and Absolute bone conduction were performed, and results were recorded.

Pure tone audiometry: Audiometric assessment was conducted in a soundproof room delivering pure tone stimuli to one ear at a time in frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz at various selected intensities. The reference intensity level is designated ‘X’ dB at each frequency, which is the mean value of the minimal audible threshold

of pure tones in healthy individuals. The hearing threshold is taken as the least intensity of pure tone that was audible to the subject. The subject is advised to signal on hearing the least sound of any sort till it ceases. The subject is presented with various selected tones for 1 to 3 seconds and a minimum gap of 1 to 3 seconds between successive presentations. The Air conduction threshold is repeated for 1000 Hz to assess the reliability of the procedure. Air conduction thresholds in the right and left ears were marked by 'O' and 'X' respectively. The bone conduction threshold is obtained by using a bone vibrator placed on the skin over the mastoid process and assessed to a maximum of 4000 Hz. Symbols represent it '[' and ']' for right and left bone respectively. Masking is employed when the difference in right and left unmasked air conduction threshold is 40 dB or more. The hearing thresholds grading is given by 0 – 25 dB normal hearing, 26 - 40 dB mild hearing loss, 41 – 55 dB moderate hearing loss, 56 - 70 dB – moderately severe hearing loss, 71-90 dB severe hearing loss, >90 dB- profound hearing loss.
Blood investigations: The routine blood investigations such as hemoglobin, total count, differential count, and platelets to rule out anemia, leukemia, and other disorders. Fasting and post-prandial blood sugar levels were measured in the central laboratory attached to our hospital. To assess the diabetic control of the patient in the last 3 months HbA1c was done. The renal parameters like blood urea (25-45 mg/dl) and serum creatinine (0.7-1.5 mg/dl) were also taken into account. Routine urine analysis was done to monitor microalbuminuria and ketone bodies.

Statistical analysis: The information was gathered and entered into MS Excel spreadsheet, which was then analyzed using SPSS version 22. (Chicago, IL, USA). Qualitative data were stated in proportions and percentages, whereas quantitative variables were reported in mean and standard deviations. The difference between the two proportions was determined using the chi-square test.

Results

A total of n=60 cases were examined in this study. Out of n=60 n=22(36.67%) were males and n=38(63.33%) were females. The mean age of the males in this study was 44.12 ± 4.3 years and the mean age of females was 46.57 ± 3.7 years. The youngest case was a 32-year-old male patient and the oldest case was a 49-year-old female. The overall mean age of the group was 45.53 ± 5.5 years. The details of the age group-wise distribution of cases in the study are depicted in Table 1.

Table 1: Distribution of patients according to their age group

Age group (years)	*Frequency*	*Percentage*
31-35	03	5.0
36-40	15	25.0
41-45	32	53.33
46-50	10	16.67
Total	60	100.0

In this study n=60 cases of type 2 diabetes mellitus n=38(63.33%) cases were found to have sensorineural hearing loss and n=22(36.67%) cases were found to be normal. Based on the onset of hearing loss in this study out of the n=38 cases of sensorineural hearing loss n=36(94.73%) cases had slow onset of hearing loss and n=2(5.26%) had a sudden onset of hearing loss. Based on the pure tone audiometry findings out of n=38 detected with sensorineural hearing loss bilaterally. n=28(73.68%) cases were having mild hearing loss and n=10(26.31%) cases were having moderate hearing loss given in table 2.

Table 2: Distribution of Patients according to the degree of Hearing Loss

Pure Tone Audiometry (PTA)	*Frequency*	*Percentage*
<25 dB	22	36.67
26 - 40 dB	28	73.68
41 – 55 dB	10	26.31
56 - 70 dB	00	00.00
71 - 90 dB	00	00.00
> 90 dB	00	00.00

Based on the correlation between hearing loss and age groups. The age of 31 – 35 years was with least number of cases of hearing loss n=2(5.2%) out of the total n=38 cases followed by the age group of 36 – 40 were n=10(26.31%) cases and the age group 41 – 45 were n=11(28.94%) cases and age group 46 – 50 years n=15(39.47%) cases.

Table 3: Association of hearing loss with gender and laterality

Gender	Left Ear			Right Ear		
	Normal	SNHL	Prevalence	Normal	SNHL	Prevalence
Male	10	12	54.54	10	12	54.54
Female	12	26	68.42	12	26	68.42
p-value	0.266			0.266		

In this study, we found the duration of diabetes less than 5 years in n=15(25.0%) cases, between 6 – 10 years in n=34(56.67%) cases, and > 10 years in n=11(18.33%) cases. The distribution of SNHL was n=8 in cases with > 10 years of diabetes mellitus. N=22 in cases of diabetes mellitus duration 6 – 10 years and n=8 cases in the duration of diabetes mellitus less than 5 years. The overall prevalence of SNHL was 63.33% and its distribution based on the HBA1c levels is depicted in table 4. Maximum SNHL was found in cases with HBA1c levels > 8.

Table 4: Association of hearing loss of DM patients with their HBA1c Levels

HBA1c levels	Normal	SNHL	Prevalence
< 7	08	05	38.14
7 – 8	10	23	69.69
> 8	04	10	71.42
Total	22	38	63.33

In our study of n=60 cases of DM patients, n=15(25.0%) had retinopathy making it the most common complication in this group out of these n=15 patients n=11 also suffered from SNHL. N=10(16.67%) cases suffered from diabetic nephropathy out of these n=7 suffered from SNHL and n=5(8.33%) cases were from diabetic neuropathy out of which n=3 cases were with SNHL.

Discussion

In our study involving n=60 patients of type 2 diabetics of age 30 to 50 yrs from various backgrounds in social life, the prevalence of sensorineural hearing loss was found to be 63.33% which is of gradual onset and progressive type. As per the available literature in recent times, most of them has supported the association of SNHL with diabetes the results approximate those of Friedman et al., [11] (55.0%) and Aggarwal et al., [12] (64.86%). There is a wide variation of results regarding the prevalence of SNHL in diabetics due to different inclusion and exclusion criteria, methodology, and diagnostic approaches. Similar rates of prevalence of SNHL have also been reported by other various studies in this field. [13-14] Conversely,

Salvenelli, et al., [15] did not find any significant hearing loss in the diabetics included in their study. In this study out of the n=38 cases of sensorineural hearing loss n=36(94.73%) cases had slow onset of hearing loss and n=2(5.26%) had sudden onset of hearing loss. Shuen Fu et al., [16] reported a series of 68% of cases of diabetes mellitus with sudden onset SNHL. While most of the studies in this field agree with our findings of slow-onset hearing loss. Our study shows an increased prevalence of SNHL in diabetics in the older age group i.e., between 41 to 50 yrs. The prevalence of SNHL in this age group was 68.41% finding a strong association between advanced age and SNHL which shows contrast to the earlier studies carried out by Friedman et al., [11] and Cullen. R et al., [8] where did not find SNHL to have any correlation with age group. Taylor et al., [17] on the other hand, discovered a link between the diabetic group's hearing levels and their age. They concluded that any hearing loss caused by diabetes would be in addition to that caused by aging alone. Similarly, Axelson et al., [18] found that the chance of diabetics developing hearing problems increased with age. As a result, aging and diabetes may work together to raise hearing thresholds. The researchers looked at the elements that may contribute to the worsening of hearing thresholds in diabetics. One of them was diabetes duration. According to research, the hearing threshold rises as the duration of diabetes mellitus rises. [9, 19] Others argue that hearing threshold and diabetes mellitus have nothing to do with each other. [7, 9] The rise in hearing threshold is due to microvascular angiopathy in stria vascularis capillaries, which causes these vessels to become thicker than usual. Changes in vessels feeding other regions of the auditory system can also occur. [20] In our research, we found that as the duration of diabetes mellitus increased, so did the hearing threshold. It was discovered that when the length exceeds 6 years, the prevalence of hearing loss rises to a high level. HbA1C was taken into consideration since it directly gives an idea about the blood sugar control of the patient in the earlier three months. In our study prevalence of SNHL among poorly controlled patients is 71.42% whereas it is 38.14% among patients in control, which is highly significant. Kurien et al., [7] conclusively demonstrate that poorly controlled diabetics have significant hearing loss in all frequencies This could be explained by the cumulative effects of advanced glycation end products and their effects on the inner ear. [21] A comparison of hearing loss in patients with and without problems is required to understand the pathophysiology. Retinopathy, nephropathy, and neuropathy were the consequences that were compared. In comparison to those who had retinal, people who did not have retinopathy had a lower threshold. Microvascular angiopathy might be the cause of hearing loss in individuals with retinopathy, based on the increased frequency of hearing loss in people with retinopathy. [9]

Conclusion

The prevalence of sensorineural hearing loss in diabetics was found to be 63.33%. The sensorineural hearing loss is generally gradual and involves high-frequency thresholds. With increasing age and diabetes duration, the hearing threshold rises. There was no specific differentiation of SNHL between males and females. The hearing thresholds of patients with poor glycemic control [HbA1c more than 8%] were higher. Increased hearing threshold is associated with the presence of retinopathy.

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