

Prevalence of sensorineural hearing loss among the patients with Diabetes MellitusAprajita Singh^{1*}, Shahzad Ahmad², Yatendra Singh³¹Junior Resident, Department of Otorhinolaryngology & Head and Neck Surgery, Government Medical College, Haldwani, Uttarakhand, India²Professor and Head, Department of Otorhinolaryngology & Head and Neck Surgery, Government Medical College, Haldwani, Uttarakhand, India³Assistant Professor, Department of Medicine, Government Medical College, Haldwani, Uttarakhand, India

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Abstract

Hearing loss is a very common problem worldwide affecting all age groups & leading to marked disability and handicap. Among the causes such as multiple sclerosis, syphilis and autoimmune disorders, Diabetes is the most common of all. Thus, the present study was conducted to evaluate the relation and degree of sensorineural hearing loss with Diabetes Mellitus along with its severity. For the study, a total of 300 patients were enrolled with complaints of hearing loss and or tinnitus. A complete ENT evaluation was done on the patients. Mean age of the patients was 49.54 ±8.9. About 80.7% patients complained of hearing loss while tinnitus was present in 58.3% of diabetes patients. The association between age and hearing loss was statistically significant with older patients (p<0.001) as compared to younger ones. Association between type of diabetes and sensorineural hearing loss was also statistically significant. The diabetic subjects had higher hearing threshold with bilateral mild to moderate degree sensorineural hearing loss. Age of diabetic patient and duration of diabetes, type of diabetes and levels of HbA1c had significant correlation with hearing loss.

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Introduction

Hearing loss is a very common problem worldwide affecting all age groups & leading to marked disability and handicap. The WHO lists hearing loss in the 20 leading causes of burden of disease and as most common cause of disability worldwide. A person who is not able to hear and with hearing thresholds of 25dB is said to have hearing loss. This hearing loss can be of mild, moderate, severe or profound degree and depending on pathways of sound transmission disturbed – hearing loss can be conductive, sensorineural or mixed type. Common causes of include occlusion of external auditory canal, tympanic membrane perforation and ossicular discontinuity and fixity, congenital or caused by trauma, infections of inner ear, ototoxic drugs and systemic diseases like diabetes, multiple sclerosis, syphilis and autoimmune disorders etc. Diabetes Mellitus is one of the common cause of hearing loss among people of different age group. Failure to report along with insufficient medical history collection and confounding variables such as age, sex, duration of diabetes, glycemic control, smoking led to difficulty in establishing relationship between diabetes and sensorineural hearing loss. Thus, the present study was conducted to evaluate the relation and degree of sensorineural hearing loss with Diabetes Mellitus along with its severity. Also, to draw attention to sub clinical hearing loss which often goes unnoticed until it is too late to arrest/slow down its progression[1-3]

Material and Methods

The present study was a hospital based cross sectional study conducted on Diabetic Patients who attended the Department of ENT and Medicine, Dr. Sushila Tiwari Government Hospital and GMC Haldwani. A total of 300 patients were enrolled with complaints of hearing loss and or tinnitus from the period of January 2021 to September 2022.

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Inclusion criteria

- Diabetes Mellitus patients
- Age between 15-60 years
- Tympanic membrane must be intact

Exclusion criteria

- Patient who did not give consent for study or who gave consent but were not willing to undergo the tests
- Patients with conductive hearing loss or mixed hearing loss.
- Patients with history of radiotherapy
- Patients suffering from autoimmune disorders, multiple sclerosis, syphilis, hypothyroidism, renal failure, blood dyscrasias.
- History of intake of ototoxic drugs >6months
- Hearing loss due to viral infections like mumps, measles, have etc[4-8]

The study was conducted after taking informed consent and complete history was recorded on pre-structured proforma and complete ENT examination was done. The evaluation include Fasting blood sugar, Post prandial blood sugar, Random blood sugar, HbA1c, Blood urea, Serum creatinine, Fundus examination, Nerve conduction velocity/ monofilament test (if required). Sensorineural Hearing Loss Characteristics are: Positive Rinne test, i.e. AC > BC, Weber lateralized to better ear, Bone conduction reduced on ABC test, More often involving high frequencies., No gap between air and bone conduction curve on audiometry. Statistical analysis was performed using IBM SPSS version 26. The data was expressed in frequency and mean value. The mean values of the data were compared using independent T test for comparing two groups. For comparing categorical variables, chi square test was used. Person correlation was used for correlating the data. The p-value of <0.05 was considered to be significant while value of <0.001 was considered to be highly significant[9-12]

Results

A total of 300 patients were enrolled for the present study. Mean age of the patients was 49.54 ±8.9. About 80.7% patients complained of hearing loss while tinnitus was present in 58.3% of diabetes patients.

Patients with complaint in right ear were 70.7% while 71.7% patients' complained of decrease in hearing in left ear. Majority of patients were diabetic for 6-10 years (67.3%) followed by 0-5 years (18.3%), 11-15 years (13.3%) and least 1% had diabetes for more than 15 years. Upon examination, 47 (15.7%) cases had normal right and left ear. Mild SNHL was observed in 162(54%) in right ear and 125 (41.7%) in left ear. The moderate SNHL was present in 59 (19.7%) and 71 (23.7%) in right and left ear, respectively. In right ear, 27 (9%) cases had severe hearing loss while 55 (18.3%) had severe hearing loss in left ear and chronic hearing loss was more common in right with total 1.7% (5 cases) compared to 2 (0.7%). The mean age of the patient who presented with normal hearing was 43.53±12.53 while in patients were who presented with SNHL was 50.66±7.7. The association between

age and hearing loss was statistically significant with older patients (p<0.001) as compared to younger ones. In the present study, males (54%) outnumbered the females (46%). Among males, 57.4% had normal hearing and 53.4% had SNHL while among females, 42.6% and 46.6% had normal hearing and SNHL, respectively. No statistical significance (p<0.606) was observed between gender and hearing loss. The SNHL was more prevalent among patients with lower- middle socioeconomic strata (17% vs 34%) and upper lower SES than normal (6.4%vs24.1%). This association was statistically significant (p<0.001). Out of 253 subjects who had SNHL only 4.7% had type I diabetes and 95.3% had type II diabetes. This association was statistically significant (Table 1).

Table 1: Association between type of diabetes and sensorineural hearing loss

Diabetes	normal		SNHL		Total		p-value
	N	%	n	%	n	%	
Type I	16	34.0%	12	4.7%	28	9.3%	<0.001
Type II	31	66.0%	241	95.3%	272	90.7%	
Total	47	100.0%	253	100.0%	300	100.0%	

The patients who had no hearing loss (0-5 years: 44.7 vs 13.4%) had less duration of diabetes then the ones who presented with SNHL. The patients who presented with diabetes for more than 11 years all had SNHL. The mean duration of diabetes in patients who presented with SNHL was 8.27± 2.83 while in patients who did not present with SNHL it was 5.64± 1.72. This association was statistically significant (p<0.001) (Table 2).

Table 2: Comparison between diabetes duration and sensorineural hearing loss

Hearing loss (Db)	Normal		SNHL		p-value
	Mean	SD	Mean	SD	
	5.64	1.725	8.27	2.835	<0.001

A total of 105 (35%) patients were presented with diabetic retinopathy (29.7% mild, 5.3% moderate). However, it was observed that 74.5% of patients with normal hearing had normal eye examination while 63.2% of patients who presented with SHNL had normal fundus examination. No significant association was observed between diabetic retinopathy (assessed by fundus examination) and sensorineural hearing loss (Table 3).

Table 3: Comparison between fundus examination and sensorineural hearing loss

Fundus examination	Normal		SNHL		Total		p-value
	n	%	n	%	N	%	
MILD NPR	12	25.5%	77	30.4%	89	29.7%	0.131
MODERATE NPR	0	0.0%	16	6.3%	16	5.3%	
NORMAL	35	74.5%	160	63.2%	195	65.0%	
TOTAL	47	100.0%	253	100.0%	300	100.0%	

When variables were compared with normal hearing and SNHL, it was observed that Pure tone average in right ear, Pure tone average in left ear in decibels and Blood urea were found to be significant factors for hearing loss (Table 4).

Table 4: Comparison between grouped variables among patients with normal hearing and SNHL

	Normal (n=47)		SNHL(n=253)		t-value	P-value
	Mean	SD	Mean	SD		
Pure tone average in right ear	20.83	3.403	40.65	11.354	-6.64	<0.001
Pure tone average in left ear in decibels	21.51	2.527	43.06	12.400	-8.90	<0.002
FBS	174.00	35.605	184.98	46.069	-1.5	0.122
post prandial blood sugar	259.38	95.65	270.35	92.62	-0.74	0.46
Random blood sugar	254.30	73.76	239.41	81.42	1.17	0.24
HbA1C(%)	8.35	1.59	9.05	1.62	-2.72	0.008
Blood urea	40.79	30.82	35.17	7.97	2.50	0.01
serum creatinine	0.98	0.54	1.00	0.35	-0.30	0.76

Duration of diabetes had an average week and statistically significant relationship with PTA in left and right ear (Table 5).

Table 5: Correlation between duration of diabetes and levels of sugar with PTA in right and left ear

		Pure tone average in right ear in decibels	Pure tone average in left ear in decibels	Duration of diabetes
Duration of diabetes	Pearson Correlation	.377**	.258**	1
	Sig. (2-tailed)	.000	.000	
	N	300	300	300

** . Correlation is significant at the 0.01 level (2-tailed).

Discussion

The present study was conducted on 300 patients with diabetes mellitus at Department of ENT, Government Medical College, Haldwani, in order to evaluate the sensorineural hearing loss in patients with diabetes mellitus.[13-18]

In the present study, the mean age of patients was 49.54 ± 8.9 . The similar results were shown by the study done by Kumar et al (2021) who showed the mean age of the patients with diabetes to be 45.0 ± 9.9 years. In another study by Bhat et al (2021) the mean age of the patients with DM was 52.13 ± 13.31 years. In a study conducted by Samelli et al. (2017) the mean age of the patients with DM was 57.4 ± 9.0 years which was higher than found in the present study.

In present study, slight predominance of males (54%) is seen as compared to females (46%). Dosemanne et al. in their study conducted to evaluate the SNHL in diabetes found 68.3% patients to be males and 31.7% patients to be females. Kumar et al. also showed male predominance. Similar results were found by Samelli et al where male dominance was 45.5%. The reason behind male dominance was unknown. However, it is believed that central obesity, or visceral adiposity, is a stronger risk factor for diabetes type 2 than BMI. Central obesity has also been found to be a strong risk factor. Hypothetically, central obesity could be associated with the higher risk of diabetes type 2 prevalence in men, given that men are more prone to android adiposity with greater abdominal adiposity, compared with women who are more likely to exhibit gynoid adiposity.

In our study 242/300 (80.7%) patient complained of hearing loss while tinnitus was present 175/300 (58.3%) of diabetes patients. The study by Pandey et al (2016) observed 69.10% patients with hearing loss and 39.02% patients had tinnitus. Another study by Mausavi et al (2021) also showed that 66/250 (26.4%) of patients had tinnitus.

Our study found that majority of patients (67.3%) were diabetic for 6-10 years and mean duration was 7.86 ± 2.85 years. In a study by Samenelli et al the mean time from diagnosis was 4.0 ± 5.13 years. A meta-analysis by Akinpelu et al (2014) included data from 18 studies and obtained results (OR: 1.91; 95% CI: 1.47–2.49) similar to our crude analysis. This meta-analysis included people with type 2 diabetes (26–70 years old) and a disease duration of 2.9–14.6 years. Diabetes is caused by a glucose/insulin pathology, which can have a direct effect on sensory and support cells of the cochlea. Macro- and micro-vascular insults that lead to reduced blood flow, oxygen exchange, and ion transport are primary complications of hypertension and diabetes that affect the ear. Research suggests that neuropathic hearing loss may be minimized by vasodilating treatments that improve nerve blood flow. Healthful diets and adoption of healthy lifestyle in general have been suggested to prevent the progression of both diabetes and hearing loss.

Hearing loss was bilateral in the study population and mild to moderate hearing loss was observed. The results were similar to Harkare et al who reported the hearing loss was bilateral sensorineural type with mild to moderate degree. The study by Srinivasan et al showed that out of the 33 subjects with hearing deficit, 27 had mild hearing loss and 6 had moderate hearing loss. Maran et al reported that out of the 29 subjects with hearing loss, 24 had mild hearing loss and 5 had moderate hearing loss[19-21]

Our study showed statistically significant association with older patients while in younger age group the prevalence of hearing loss was comparatively less. Age is another variable that could play a role in hearing loss. Axelsson et al showed that the incidence of pure tone hearing loss increases with age in patients with diabetes, even after correction for senile deafness. In the study by Harkare et al also incidence of sensorineural hearing loss was increased with the age of diabetics. However, there was no significant association between age and sensorineural hearing loss (p value= 0.98). Srinivasan et al showed that there is a progressive increase in the percentage of SNHL with the age of the subjects. Presence of SNHL is lowest among 31-35 age group, where no one had hearing loss and highest among 46-65 age group (78.12 %). Maran et al also showed the same results. However, the present study was in contrast with the study conducted by Kurien et al and Cullen et al, who found that there is no correlation between

age of the patient and occurrence of SNHL in diabetes mellitus. Our study shows increased percentage of SNHL in diabetics in the older age group than in younger group. It is difficult to distinguish whether hearing loss in diabetes is due to normal process of aging or due to biochemical and the vascular abnormalities associated with diabetes.

No significant association was seen among gender and SNHL which implies that gender was equally distributed among patients with and without SNHL. The results of the present study were in accordance with Srinivasan et al who showed the percentage of female diabetes having SNHL is more (71.4 %). But when we analyzed statistically, the p -value was not significant (p value 0.495). In present study %age of females having SNHL was 85% and of male, it was 83.3%. Harkare et al who showed males with sensorineural hearing loss (72.72%) were slightly more as compared with females (70.05%).

Out of 253 subjects who had SNHL only 4.7% had type I diabetes and 95.3% had type II diabetes. This association was statistically significant. However, in a study by Harkare et al 3 out of 5 Type I diabetic patients had sensorineural hearing loss while 71 out of 95 Type II diabetics were showing sensorineural hearing loss. This shows no significant difference in hearing loss among Type I & Type II diabetics. This was in discordance with the present study. Mozaffari et al in their study showed that despite the small number of patients with type 1 DM, these patients were significantly more likely to have a severe grade of SNHL than patients with type 2 DM. However, there was no significant correlation between type of DM and presence of SNHL in their study. The association between hearing impairments in both type 1 and type 2 diabetes is generally accepted and a meta-analysis including cohorts of type 1 and type 2 diabetes patients reported that the association between diabetes and hearing impairment was not influenced by the type of diabetes.

Significant association was observed between mean duration of diabetes and hearing loss in our study. Srinivas et al showed significant association between the duration of the DM and SNHL. 35 % diabetic patient had SNHL if duration is < 5 years compared 85 % whose duration was > 10 years. It was also noted that there was increase in hearing threshold with increase in duration of DM. It was seen that as duration increases > 6 years, the percentage of hearing deficit increases to a greater extent. The increase in hearing threshold is attributed to microvascular angiopathy occurring in capillaries of striavascularis which make these vessels thicker than normal. These changes can occur in vessels supplying other parts of auditory system as well. Older diabetic patients had higher incidence of hearing loss and they had severe grade hearing loss. This result is supported by Virteniemä et al. Older diabetic patients had higher incidence of hearing loss and they had severe grade hearing loss. This result is supported by Virteniemä et al. and Fangcha et al. However, studies done by Kurien et al. and Cullen et al., did not show any correlation between duration of diabetes and hearing loss. (p value for duration of DM and SNHL is 0.0114). Kakarlapudi et al in their investigation studied the duration of diabetes in relationship to hearing loss but no clear conclusion was drawn.

In the present study, 35% patients were presented with diabetic retinopathy but no significant association was observed between diabetic retinopathy and diabetic retinopathy. Harkare et al in their study showed strong association between diabetic complications and sensorineural hearing loss (p value <0.01). Diabetics with one or more complications had high incidence of sensorineural hearing loss (60 patients out of 67) than those without diabetic complications (14 patients out of 33). Kurien et al also found that patients without complications had relatively lower level of sensorineural hearing loss as compared to patients with diabetic complications. Taylor and Irwin reported that almost 70% of their adult diabetics had hearing impairment. This occurred more commonly when retinopathy was present. Parving A in his study of 20 patients with diabetic microangiopathy did not find correlation between hearing impairment and angiopathy as well as neuropathy. Hearing loss in diabetic patients in the current study was pure sensorineural hearing loss.

In present study, the incidence of SNHL was more among patients with complications, however, it was not statistically significant. We found HBA1c of patient with SNHL (9.05 ± 1.62) to be significantly more

than with normal hearing (8.35±1.59). However, FBS levels and RBS did not show any significant association. The FBS in people with normal hearing was however less (174±35.60 vs 184.98±46.06) the difference was not significant statistically. In a study by Kumar et al both FBS and glycemic control were not associated with the incidence or severity of SNHL. The FBS levels were higher in diabetic patients with SNHL (175.3 vs. 157.7 mg/dL), and the proportion with SNHL was higher among patients with uncontrolled DM (55.9% vs. 44.1%). These differences were not statistically significant. This demonstrates that glucose metabolism may not be the most important issue for the development of SNHL, and perhaps only acts as an aggravating factor. Tiwari et al showed that the groups with the lowest (5.1%–7%) and the highest (>13.0%) HbA1c levels had no cases with severe SNHL and a large majority of cases in both these groups had hearing loss of a mild degree. The group with HbA1c levels 9.1%–11.0% had the highest number (3) of cases with the severe hearing loss, whereas the 11.1%–13.0% group had the highest proportion (1 out of total 4, i.e., 25%) of cases with the severe hearing loss. A number of studies have shown a positive correlation between HbA1c levels and the severity of hearing loss, while some have found no correlation. Multiple authors have concluded that good glycemic control in diabetic patients reduces the incidence of SNHL[22-26]

Conclusion

The diabetic subjects had higher hearing threshold with bilateral mild to moderate degree sensorineural hearing loss. Age of diabetic patient and duration of diabetes, type of diabetes and levels of HbA1c had significant correlation with hearing loss. While considering sensorineural hearing loss to be a consequence of diabetes, a metabolic assessment may be useful for patients presenting with hearing loss so as to reduce the high rate of undiagnosed diabetes mellitus in the community. On the other hand, routine screening for hearing loss in diabetes patients may also be helpful to diminish comorbidities among them and improve their quality of life.

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