

Original Research Article

Prevalence of sensorineural hearing loss in type 2 diabetes mellitus

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ABSTRACT

Background: The association of sensorineural hearing loss (SNHL) in diabetes mellitus patients is known since decades, yet there is no clear consensus among previous studies, with respect to the prevalence of SNHL in type 2 diabetes patients and the effect of duration and control of diabetes on hearing acuity. Hence the objectives of this study are to find the prevalence of SNHL in type 2 diabetes patients and to find the effect of duration and control of diabetes on hearing loss.

Methods: The present study was conducted on 86 type 2 diabetes patients attending Navodaya Medical College Hospital, Raichur and age and gender matched 86 non-diabetic controls in the age group of 30-65 years, selected based on inclusion and exclusion criteria. After detailed history taking and clinical examination, all subjects underwent FBS, PPBS estimation and HbA1c evaluation was done for diabetic patients. All underwent pure tone audiometry and the findings were recorded and analyzed.

Results: Diabetes patients had insidious onset, gradually progressive, bilaterally symmetrical SNHL. SNHL is prevalent in 67.44% of type 2 diabetes patients compared to 23.26% of controls. It is aggravated with the increasing age and duration of diabetes. Poor control of diabetes showed increased prevalence of SNHL compared to good control of diabetes.

Conclusions: There is increased prevalence of SNHL in type 2 diabetes patients and it is more evident in patients with long duration of diabetes and more pronounced in patients with poor diabetic control.

Keywords: Sensorineural hearing loss, Diabetes mellitus, Glycosylated Hemoglobin

INTRODUCTION

Diabetes mellitus is a metabolic disorder due to relative or absolute lack of insulin resulting in elevated blood glucose levels associated with long term vascular and neurological complications.¹ WHO factsheet on Diabetes states that the number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014 and the global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014 and its prevalence has been rising more rapidly in middle and low-income countries.² Over 5% of the world's population that is 466 million people have disabling hearing loss and 432 million of these are adults.³

Hearing loss in severity may vary from being mild degree to severe and profound degree and in general it is of Conductive, sensorineural or mixed type. Diabetes mellitus has been implicated as independent causative factor of sensorineural hearing loss (SNHL).⁴ Hearing loss in diabetics is described as progressive, bilateral sensorineural type usually affecting the higher frequencies.^{5,6} Though there were incidences where authors have reported the possibility of having early onset sensorineural loss, hearing loss in low and medium frequencies and the occurrence of unilateral sudden hearing loss.⁷⁻⁹

Regarding the duration of diabetes and hearing loss, it is found that the mean hearing thresholds in patients with diabetes of less than 10 years of duration were far better than those with more than 10 years of duration and other studies also support that the threshold becomes poorer as duration of diabetes increases, while some studies state that there is no relation between hearing threshold and duration of diabetes.¹⁰⁻¹⁴

In the presence of these varied findings, the nature of hearing loss in diabetes mellitus has to be investigated with an emphasis on finding the relationship between duration of diabetes, glycemic control and hearing loss. Hence, the aim of this study is to find out the prevalence of SNHL in patients with type 2 diabetes mellitus and correlate with age and gender matched controls.

Objectives

The objectives of this study are to find the prevalence of sensorineural hearing loss in type 2 diabetes mellitus patients and compare it with age and gender matched non-diabetic controls and to find the effect of age, gender, duration of diabetes and the control of diabetes on hearing acuity and the common frequencies of hearing affected by diabetes mellitus.

METHODS

This cross sectional period prevalence study was conducted between December 2016 to October 2018 in Navodaya Medical College Hospital, Raichur on 172 subjects comprising of 86 Type 2 Diabetes patients and age and gender matched 86 Non- Diabetic controls in the age group of 30-65 years, selected based on inclusion and exclusion criteria.

Inclusion criteria

Patients having type 2 diabetes in the age group of 30-65 years and control group comprising of age and gender matched non-diabetic controls among patient's attenders visiting the hospital in the same age group.

Exclusion criteria

Patients with history of any ear disease, ear surgery, head or ear trauma, patients with family history of deafness, history suggestive of noise induced hearing loss, history suggestive of infections like chicken pox/small pox, malaria, jaundice, typhoid, cholera and patients with systemic diseases including hypertension, HIV, TB, renal disorder.

Procedure

The study was approved by Institutional Research Ethical Committee. Written consent was obtained from all the subjects enrolled in the study after explaining to them in detail about the study in their own language. After

detailed history taking, all the subjects underwent general physical examination and complete ENT examination including tuning fork tests. After that all subjects underwent FBS, PPBS estimation and glycated hemoglobin levels [HbA1c] estimation was done for diabetic patients. All diabetic patients underwent only pure tone audiometry with frequencies ranging from 500 Hz to 8000 Hz. Both air and bone conduction tested for each ear. Their hearing thresholds were compared with non-diabetic control group.

Statistical analysis

Quantitative data was measured in terms of mean and standard deviation (S.D). Qualitative data was measured in terms of proportions and percentages. Analysis was done using student's t-test. Significance level is taken as 0.05 with the corresponding confidence level of 95. P value < 0.05 considered as significant. Statistical analysis was done using IBM SPSS version 23 software.

RESULTS

The study included 172 subjects comprising 86 type 2 diabetes patients and age and gender matched 86 non-diabetic controls in the age group of 30-65 years. Equal number of diabetic 'cases' and non-diabetic 'controls' were enrolled in each of 7 age groups with 5 years gap from 30 to 65 years. Both cases and controls group had 49 females (57%) and 37 males (43%) with male: female ratio being 1:1.32.

Prevalence of SNHL in diabetic patients

58 out of 86 diabetic patients had hearing loss and rest 28 diabetic patients were having normal hearing. The type of hearing loss was determined with the help of Audiogram. All 58 diabetes patients were having bilateral symmetrical sensorineural hearing loss. In comparison 20 of 86 non-diabetic controls were having SNHL. Prevalence of 67.44% of sensorineural hearing loss was found among diabetic patients compared to 23.26% among non-diabetic control group (Table 1).

Prevalence of SNHL in diabetic patients according to age group

In diabetic patients, the prevalence of SNHL was highest among 46-50 years age group (22.41%) followed by 51-55 years age group (18.97%). In non-diabetic controls the prevalence of SNHL was highest among 61-65 years age group (40%), elderly subjects followed by 56-60 years age group (25%) (Table 2). Hence, there was pattern of more prevalence of SNHL with increasing age. Whereas there was no such pattern among diabetic cases, suggesting that diabetes may be responsible for the prevalence of SNHL among diabetic cases and not the age (Table 2).

Table 1: Prevalence of SNHL in diabetic cases and non-diabetic controls.

	SNHL Present	Prevalence of SNHL (%)	SNHL Absent	Absence of SNHL (%)	Total
Diabetic cases	58	67.44	28	32.56	86
Non-diabetic controls	20	23.26	66	76.74	86

Table 2: Prevalence of SNHL in diabetics cases and non-diabetic controls according to age group.

Age groups (years)	Cases with SNHL	Prevalence of SNHL in cases (%)	Controls with SNHL	Prevalence of SNHL in controls (%)
31-35	6	10.34	1	5
36-40	5	8.62	1	5
41-45	9	15.52	1	5
46-50	13	22.41	2	10
51-55	11	18.97	2	10
56-60	8	13.79	5	25
61-65	6	10.34	8	40

Table 3: Prevalence of SNHL in diabetic cases and non-diabetic controls according to gender distribution.

Gender	Diabetics with SNHL	Prevalence (%)	Non-diabetics with SNHL	Prevalence (%)
Male	22	37.9	8	40
Female	36	62.1	12	60

Table 4: Degree of hearing loss in diabetes mellitus patients.

Degree of hearing loss	Diabetics with SNHL	Prevalence (%)
Mild SNHL	33	56.9
Moderate SNHL	23	39.7
Moderately severe SNHL	2	3.4
Severe SNHL	0	0.0
Profound SNHL	0	0.0
Total	58	100.0

Table 5: Degree of hearing loss according to age group in diabetes patients.

Age group (years)	Number of diabetic cases	Cases with SNHL	Mild SNHL	Moderate SNHL	Moderately severe SNHL
31-35	11	6	4	1	1
36-40	14	5	2	3	-
41-45	13	9	4	4	1
46-50	14	13	8	5	-
51-55	13	11	6	5	-
56-60	12	8	8	-	-
61-65	9	6	1	5	-
Total	86	58	33	23	2

Table 6: Duration of diabetes and percent proportion of SNHL.

Duration of diabetes (in years)	No. of diabetic cases	Cases with SNHL	Percent proportion (%)
<5	42	18	42.86
6 to 10	26	22	84.61
>10	18	18	100.00

Prevalence of SNHL gender wise

SNHL was found 62.1% prevalent in diabetic females and 37.9% in diabetic males (Table 3) although the prevalence picture was similar in Non-diabetic patients with respect to gender distribution with 60% females and 40% males having SNHL.

Degree of hearing loss in diabetes mellitus patients

The degree of hearing loss as observed among 58 diabetic patients who had hearing loss, is predominantly of mild degree (56.9%) followed by moderate degree (39.7%) and moderately severe being the least (Table 4). No one had severe or profound degree of hearing loss.

With regards to degree of sensorineural hearing loss according to age group in Diabetes patients, mild degree of sensorineural hearing loss was common in 46-50 and 56-60 years age group followed by 51-55 years age group. Whereas moderate hearing loss was found commonly in 46-50, 61-65 and 56-60 age group; very few cases of moderately severe hearing loss were present (Table 5).

Duration of diabetes and prevalence of SNHL

The percent proportion of patients with SNHL among patients with duration of diabetes more than 10 years was highest followed by patients with 6-10 years of duration of disease and the least proportion was seen in patients with less than 5 years of duration of disease (Table 6).

Table 7: Duration of diabetes and degree of SNHL.

Duration of diabetes (years)	No. of diabetic cases	Cases with SNHL	Mild SNHL	Moderate SNHL	Moderately severe SNHL
<5	42	18	13	5	-
6-10	26	22	11	10	1
>10	18	18	9	8	1
Total	86	58	33	23	2

Table 8: HbA1c and percent proportion of SNHL.

HbA1c (%)	No. of diabetic cases	Cases with SNHL	Percent proportion (%)
HbA1c <7	31	11	35.5
HbA1c 7-8	17	11	64.7
HbA1c >8	38	36	94.7

Table 9: HbA1c and degree of SNHL.

HbA1c (%)	Number of diabetic cases	Cases with SNHL	Mild SNHL	Moderate SNHL	Moderately severe SNHL
HbA1c <7	31	11	11	-	-
HbA1c 7-8	17	11	10	1	-
HbA1c >8	38	36	12	23	1
Total	86	58	33	24	1

Table 10: Effect of diabetes on frequencies of hearing.

Frequencies of hearing in Hz	Auditory thresholds in dB				P value by student t-test at 95% confidence interval
	Means of auditory thresholds in cases (dB)	Standard deviation (SD)	Means of auditory thresholds in controls (dB)	Standard deviation (SD)	
250	24.88	8.48	21.72	3.68	<0.0001
500	30.15	8.86	21.98	3.61	
1000	32.03	10.7	20.49	4.07	
2000	34.91	11.22	19.59	4.47	
3000	36.34	11.62	19.36	5.2	
4000	40.73	12.16	20.99	4.51	
6000	45.96	12.8	20.67	4.49	
8000	51.13	13.89	20.41	4.34	

Duration of diabetes and degree of SNHL

Moderately severe SNHL was present in patients with duration of diabetes more than 5 years. Moderate SNHL was common finding in patients with 6 to 10 years of duration diabetes followed by patients with more than 10 years of duration of disease. Mild SNHL was present more commonly in patients with less than 5 years of duration of diabetes followed by 6-10 years of duration of disease. There were no cases with severe SNHL and profound SNHL (Table 7).

Control of diabetes and SNHL

HbA1c value is a measure of control of diabetes. The results of this study show that the percent proportion of SNHL among diabetes patients with HbA1c more than 8% is highest (94.7%) followed by patients with HbA1c between 7-8% (64.7%) and the least was seen among diabetes patients with HbA1c less than 7% (35.5%) (Table 8).

Control of diabetes and degree of SNHL

Moderately severe degree SNHL exclusively and moderate degree SNHL predominantly (95.6%) found in patients with HbA1c more than 8% and Mild degree of SNHL was also commoner in this group. Patients with HbA1c <7% had only mild SNHL (Table 9).

Effect of diabetes on frequencies of hearing

There are statistically significant differences in the means of air conduction thresholds at all frequencies from 250 Hz to 8000 Hz between diabetic cases and non-diabetic controls and these differences are more in higher frequencies from 3000 Hz to 8000 Hz. The same is shown in the Table 10.

DISCUSSION

Diabetes mellitus is known to cause bilateral progressive SNHL. With aging, both hearing loss as well as risk of diabetes increases. In our study the prevalence of hearing loss was found to be 67.44% which is of insidious in onset, bilateral and gradually progressive sensorineural type. Most of studies have supported association of SNHL with diabetes, while some rule out the association. Studies which have supported possible association between diabetes and hearing loss are by Jorgensen et al in 1961, Friedman et al in 1975, Taylor et al in 1978, and Cullen et al in 1993.^{6,3,12,15} While other few studies have ruled out the association such as study by Axelson et al in 1968.⁵ Lower prevalence was observed in studies conducted by Kakarlapudi et al (13.1%), Somogyi et al (34%) and Saini et al (30%).¹⁶⁻¹⁸

This study showed a prevalence of sensorineural hearing loss in 67.44% of type 2 diabetics. The results were comparable with previous studies like that of Aggarwal et

al (64.86%) and Rajendran et al (73.3%).^{19,20} Krishnappa et al found the prevalence of SNHL among type 2 diabetic patients to be 73%, which are all comparable to our calculated prevalence.²¹ Other studies also reveal various prevalence rates. However, a higher prevalence of sensorineural hearing loss was noted in few studies like study conducted by Harkare et al (74%) and a very high prevalence was noted in a study done by Rózańska-Kudelska et al (95%) among the diabetics patients.^{22,23} The wide variation in prevalence of sensorineural hearing loss in diabetics may be due to difference in methodology. Some discrepancies of our study with those of other authors can be explained by the fact that these different studies had variations in the period of study, different inclusion and exclusion criteria and the heterogeneity of the study populations. The hearing loss is usually of gradually progressive sensorineural type. Contradictory to our study, Weng et al in 2005 reported a series of 68 sudden onset of SNHL in diabetes.²⁴ This study shows presence of only insidious onset SNHL in diabetes.

Age and SNHL in diabetes

Our study shows that the prevalence of SNHL in diabetes patients was highest among 46-50 years age group (22.41%) followed by 51-55 years age group (18.97%) but lesser in 56-60 years age group and least being in 61-65 years age group. There was no pattern of increasing prevalence of SNHL with increasing age as seen in control group suggesting that other factors may be responsible for the prevalence of SNHL in diabetes and not just the age.

Gender and SNHL in diabetes

SNHL was found 62.1% prevalent in diabetics females and 37.9% in diabetic males although the prevalence picture was similar in non-diabetic patients with respect to gender distribution. There was no agreement found in other studies. Kakarlapudi et al did not comment on their gender distribution.¹⁶ The disagreement is due to variation on composition of population with respect to gender. Austin et al found that their patient population of 302 subjects had only 34 women.²⁵ Vaughn et al had a patient population of 694 subjects of which only 27 were women.²⁶ Therefore, it was necessary to design a study of diabetes patients with age and gender matched controls.

Duration of diabetes and SNHL

An association between duration of diabetes mellitus and SNHL was made in this study showing that patients with more than 10 years of diabetic duration had maximum prevalence of hearing loss when compared to lesser years of duration of diabetes. Thimmasettaiah et al in their study done in Bengaluru, stated that diabetes of more than 5 years duration were found to have more hearing impairment (79%) as compared to freshly detected diabetics (42%).²⁷ Few studies including Mitchell et al,

had shown significant relation between duration of diabetes and the hearing loss.²⁸ Pemmaiah et al found that among 47 patients who had diabetes for more than 10 years, 29 patients (61.7%) showed at least mild hearing loss.²⁹ However, contradicting results were seen in a number of studies where no association between both was observed.^{11,12,16}

Diabetic control and SNHL

In this study, diabetic patients with poor control of disease had increased presence of SNHL (percent proportion being 94.7%) when compared with diabetic patients with moderate control (64.7%) and good control of diabetes. These results were comparable to that of studies published by Kurien et al and Tay et al.^{11,30} Study by Panchu et al showed HbA1c had a strong association with hearing loss. Sumathi et al concluded in their study that poorer the glycemic status, more severe was that hearing loss.³² However, some studies have shown no correlation between glycemic control and hearing loss like Dalton et al and Salvaneli et al. Both do not show an association between glycosylated hemoglobin levels and hearing loss.^{33,34} Our study shows that poorly controlled diabetics have significant hearing loss.

Frequencies affected

This study shows hearing thresholds are affected more in higher frequencies but hearing loss in lower frequencies were also seen, as stated by Kurien and Cullen.^{11,12} Tay in 1995 stated that the hearing loss was seen in mid and low frequencies and same was the finding by Irwin and Taylor while Fangchao found hearing loss in diabetics only in 500Hz frequency.^{13,35} Other studies which have reported higher frequencies being affected more in diabetics are Cullen et al, Rajendran et al and Bainbridge et al.^{12,20,36} Axelsson et al has showed no significant relation between the two.⁵ The possible reason why high frequency sounds were affected more was, due to accelerated atherosclerosis, thickening of basement membrane, which decreases blood flow to cochlea, mainly to the basal and middle turn leading to cell degeneration and loss of high frequency hearing sounds.

CONCLUSION

The conclusion of this study is that, there is increased prevalence of sensorineural hearing loss in type 2 diabetes mellitus patients compared to age and gender matched non-diabetic controls. Sensorineural hearing loss is more evident in patients with history of longer duration of diabetes and it is more pronounced in patients with poor diabetic control.

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