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Original Research Article

A cross sectional study of prevalence and association of sensorineural hearing loss in patients with type 2 diabetes mellitus

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ABSTRACT

Background: Diabetes mellitus (DM) is a chronic metabolic disorder associated with various long-term complications and among them hearing loss is one of the underestimated comorbidity. Objectives were to evaluate the prevalence of sensorineural hearing loss (SNHL) and to determine the association of age, gender, duration and control of DM with hearing loss.
Methods: A total of 130 patients aged 30-65 years with type 2 DM were included in this cross-sectional study. All patients were subjected to detailed history taking, ear, nose and throat examination followed by pure tone audiometry and measurement of glycosylated haemoglobin (HbA1c) levels.
Results: In this study, SNHL was seen in 70.76% of patients. Statistically significant association was found between the older age group, longer duration of DM and SNHL (p=0.00 and 0.002). Significant association was also seen between the severity of hearing loss and HbA1c levels with p=0.01.
Conclusions: Our study showed a high prevalence (70.76%) of SNHL among type 2 diabetic patients and evidently demonstrated significant association between age of the patients, duration of diabetes and SNHL as well as the association between glycemic control and the severity of hearing loss.

Keywords: SNHL, DM, Pure tone audiometry, Glycosylated hemoglobin

INTRODUCTION

India is considered as the global capital of diabetes nowadays with increasing prevalence of DM. DM is a metabolic disorder pertaining to hyperglycemia resulting from defects in insulin secretion, insulin action or both. It has been linked with long term vascular and neurological complications. The inner ear is one among the various organs affected leading to SNHL. Hearing loss caused by DM can be referred to as diabetes related hearing loss (DRHL), a term first proposed by Axelsson et al.[1]

A lot has been discussed regarding the association between DM and hearing loss since it was first described in 1857 by Jordao.[2] Hearing loss is usually bilateral, gradual onset, sensorineural type affecting higher frequencies. Studies have shown that the auditory pathway is susceptible to metabolic changes due to hyperglycemia leading to auditory dysfunction. Based on animal studies and autopsies of human temporal bones, microangiopathy and neuropathy changes were noted in the cochlea. The pathological manifestations included atrophy of stria vascularis, vessel wall thickening of spiral modiolar artery, degeneration of spiral ganglion neurons and auditory hair cells with loss of afferent nerve fibres.[3-5]

Hearing is essential for speech and communication. Hearing plays a vital role in maintaining relationships, participating in community activities and experiencing life events. Hence, hearing impairment hampers the quality of life of individuals. There is lack of awareness

among patients about hearing loss as a likely complication associated with DM. Therefore, patients and physicians should be sensitized about the importance of hearing screening for appropriate measures to be implemented at the earliest.

Various studies have been done to explore the relationship between DM and SNHL. Many studies have reported significant association between the duration, control of diabetes and hearing loss. Few studies have shown contradicting findings as well. The present study aims to determine the prevalence of hearing loss in diabetic patients along with significance of association between the duration of diabetes, control of diabetes and SNHL.

METHODS

This hospital based cross-sectional study was carried out over a period of one year from January 2023 to December 2023. This study was conducted at out patient and in patient sections of department of otorhinolaryngology and department of general medicine, BGS global institute of medical sciences hospital, Bengaluru, Karnataka. Informed and written consent was obtained from all the study participants. Patients who reported to department of otorhinolaryngology for evaluation of hearing impairment or hearing loss were enquired for type 2 DM. Patients who reported to department of general medicine OPD with type 2 DM or admitted with type 2 DM as in-patient were tested for hearing loss.

Patients aged 30-65 years, diagnosed with type 2 DM with minimum duration of 3 years were included in the study. Patients with type 1 DM, patients with history of ear surgery, ear trauma, chronic otitis media, middle ear pathology, family history of deafness, history of occupational noise exposure, ototoxic drug intake, patients with history of hypertension, cardiac diseases and renal failure were excluded from the study. The sample size was calculated using the standard formula for a prevalence study n=4pq/d×d (where p is the prevalence rate of SNHL in type 2 DM based on previous studies, here taken as 73%, q=100-p and d is the standard error, here taken as 8). A total of 130 patients were included in the study. Ethical clearance for the study was obtained from the Institutional ethical committee.

All patients were evaluated by relevant history and subjected to ear, nose, throat examination. All patients underwent pure tone audiometry and measurement of HbA1c levels. Pure tone audiometry was done using Hughson Westlake method. Pure tone audiometry was conducted with HAC Acoustic Audiometer at frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz for each ear. Accordingly, patients with a hearing threshold higher than or equal to 25db were considered to have hearing impairment. Based on WHO classification, the degree of hearing loss was classified as mild hearing loss (26-40 dB), moderate hearing loss (41-55 dB), moderately severe hearing loss (56-70 dB), severe hearing loss (71-90 dB), profound hearing loss (>90 dB). HbA1c results were used for categorizing glycemic control such as <7% for well controlled, 7-8% for moderately controlled and >8% as poorly controlled.

Data was entered into Microsoft excel sheet and statistical analysis was performed using statistical package for social sciences (SPSS) software version 26. Chi square test/ Fishers exact test was used to determine the association and p values of <0.05 was considered as statistically significant. The results of continuous data were presented as mean±standard deviation while mean difference between different groups were compared using independent t test.

RESULTS

A total number of 130 patients were enrolled into the study. Out of these 130 cases, 92 patients were found to have SNHL and 38 patients had normal hearing. The prevalence was calculated to be 70.76%. The mean age of patients was 54.45±7.83 years with age ranging from 30-65 years. Age wise distribution showed a greater number of patients in the age group of 50- 59 years (55) followed by 60-65 years (45). There were 21 patients in the age group of 40-49 years and 9 patients in the age group of 30-39 years. SNHL was detected more among 60-65 years age group (47.82%) followed by 50-59 years age group (39.13%). Presence of SNHL is lowest among 40-49 years age group (8.69%) and least among 30-39 years age group (4.34%). There is a progressive increase in the percentage of SNHL with the age of the patients. Statistically significant association was noted between age of patients and SNHL. This age wise distribution is depicted in Table 1.

Males accounted for 52% (68) of total patients and 48% (62) of them were females in this study. Out of 92 cases of SNHL, 44 (48%) were male and 48 (52%) were female. Statistically significant difference was not found between SNHL and gender of patients. The mean duration of type 2 DM among patients was 7.55±4.85 years with duration ranging from 3 years to 25 years. In our study, 58 patients (44.61%) had diabetes of duration 5 years or less out of which 32 patients (55.17%) were identified with SNHL, 50 patients (38.46%) had diabetes of duration 6-10 years out of which 41 patients (82%) were identified with SNHL and 22 patients (16.92%) had diabetes of more than 10 years duration out of which 19 patients (86.36%) had SNHL. It is evidently seen that as duration of diabetes increases, the predisposition to SNHL also increases. Statistically significant association was found between SNHL and duration of diabetes with p=0.002 as depicted in Table 2.

The mean HbA1c levels among the type 2 DM patients was 9.58±2.49% with values ranging from 4.6% to 17.9%. In our study, 17 patients (13.07%) had HbA1c levels less than 7 indicating good glycemic control out of

which 8 patients (47.05%) were identified with SNHL, 16 patients (12.30%) had HbA1c levels 7-8 indicating average glycemic control out of which 13 patients (81.25%) were identified with SNHL and majority of the patients-97 (74.61%) had HbA1c levels more than 8 indicating poor glycemic control out of which 71 patients (73.19%) were identified with SNHL. Statistically significant association was not found between SNHL and HbA1c levels as depicted in Table 3.

In this study, 92 patients were found to have SNHL with majority of them, 49 patients (53.26%) having mild SNHL, 28 patients (30.43%) were identified with moderate degree hearing loss and 15 patients (16.30%) had moderately severe hearing loss. None of the patients showed severe and profound hearing loss. The proportion of cases with SNHL and the distribution of various degrees of hearing loss is depicted in Table 4. Statistical analysis of association of the degree of SNHL with various variables such as age, gender, duration of DM and glycemic control showed varied results. Statistically significant association was found between the severity of SNHL and HbA1c levels with p=0.01 as depicted in Table 5. Association of severity of SNHL with age, gender and duration of diabetes was not found to be statistically significant.

Independent two sample t test was used to find significant difference in the mean age, duration of DM and HbA1c levels between patients with and without SNHL. Statistically significant difference was found between the two groups with p<0.05 as depicted in Table 6.

Table 1: Age wise distribution.

Age (in years)	Total no of patients (%)	Patients without SNHL (%)	Patients with SNHL (%)	Chi square/ Fischer's exact value	P value
30-39	9 (6.92)	5 (55.55)	4 (44.44)	30.47	0.00*
40-49	21 (16.15)	13 (61.90)	8 (38.09)		
50-59	55 (42.30)	19 (34.54)	36 (65.45)		
60-65	45 (34.61)	1 (2.22)	44 (97.77)		
Total	130 (100)	38 (29.24)	92 (70.76)		

*P value statistically significant.

Table 2: Based on duration of DM.

Duration (in years)	Total no of patients (%)	Patients without SNHL (%)	Patients with SNHL (%)	Chi square/ Fischer's exact value	P value
<5	58 (44.61)	26 (44.82)	32 (55.17)	12.45	0.002*
6-10	50 (38.46)	9 (18)	41 (82)		
>10	22 (16.92)	3 (13.63)	19 (86.36)		
	130 (100)	38 (29.24)	92 (70.76)		

*P value statistically significant.

Table 3: Based on HbA1c levels.

HbA1c (%)	Total no of patients (%)	Patients without SNHL (%)	Patients with SNHL (%)	Chi square/ Fischer's exact value	P value
<7	17 (13.07)	9 (52.94)	8 (47.05)	5.29	0.07
7-8	16 (12.30)	3 (18.75)	13 (81.25)		
>8	97 (74.61)	26 (26.80)	71 (73.19)		
	130 (100)	38 (29.24)	92 (70.76)		

Table 4: Based on degree of deafness.

Degree of hearing loss (SNHL)	No. of cases (%)
Mild	49 (53.26)
Moderate	28 (30.43)
Moderately severe	15 (16.30)
Severe	0
Profound	0
Total	92 (100)

Table 5: Based on HbA1c and severity of SNHL.

HbA1c (%)	No. of cases	Cases with SNHL (%)	Mild	Moderate	Moderately severe	Chi square/ Fischer's exact value	P value
<7	17	8 (8.69)	8	0	0	10.98	0.01*
7-8	16	13 (14.13)	10	2	1		
>8	97	71 (77.17)	31	26	14		
Total	130	92 (100)	49	28	15		

*P value statistically significant.

Table 6: Mean differences in age, duration of DM and HbA1c among DM patients.

Variables	SNHL absent, mean±SD	SNHL present, mean±SD	P value
Age (in years)	48.76±6.82	56.79±7.00	0.00*
Duration of diabetes (in years)	5.26±2.86	8.49±5.19	0.00*
HbA1c (%)	8.83±2.01	9.89±2.61	0.02*

*P value statistically significant.

DISCUSSION

Prevalence of DM is becoming increasingly common in India. Among the various complications associated with DM, auditory dysfunction resulting in SNHL is one of them. In our study, the prevalence of SNHL was found to be 70.76%. It was found in accordance with other studies. Yikawe et al found the prevalence to be 71.8%.[6] Rajendran et al found the prevalence to be 73.3%, Krishnappa et al found it to be 73.58%.[7,8] Study done by Mishra reported a prevalence of 74% in their study.[9] Malucelli et al and Tiwari found the prevalence to be 76% and 76.8% respectively.[10,11] Isa et al observed a high prevalence of 78.8% in their study.[12] However, studies done by Rajamani et al and Raveendra et al showed a lower prevalence rate of 51.3% and 42.85% respectively.[13,14]

With aging, both hearing loss as well as risk of diabetes increases. Present study showed increased percentage of SNHL in diabetics in the older age group compared to younger age group. Significant association was seen between age of patients and SNHL. As the age of diabetic patient increases, prevalence of SNHL increases. Similar results were seen in studies done by Srinivas et al, Krishnappa et al, Mishra et al and Raveendra et al.[8,9,14,15] However, studies by Mitchell et al and Horikawa et al showed that difference in hearing threshold remained consistent and not much of significant changes were seen as age progressed.[16,17]

Our study did not show any significant association between hearing loss and gender of patients. This agrees in accordance with studies done by Rajendran et al, Krishnappa et al and Mishra et al.[7-9] However, study done by Kurien et al and Cullen et al showed that male diabetics had slightly worse hearing when compared to female diabetic patients.[18,19] Female preponderance was observed in studies done by Yikawe et al, Bamanie and Al-Noury.[6,20]

Our study showed statistically significant association between the duration of diabetes and SNHL. Similar results were observed in a number of studies that as the duration of diabetes increased, the prevalence of hearing loss also increased. Studies conducted by Yikawe et al, Isa et al and Srinivas et al found significant association between duration of diabetes and SNHL.[6,12,15] Krishnappa et al observed a higher incidence (85%) of hearing loss in patients with longer duration of diabetes (>10 years). Based on the findings of a large longitudinal study done by Gupta et al having diabetes for 8 or more years was associated with a higher risk of hearing loss.[21] Age is a confounding factor for hearing loss, but in diabetics as duration of diabetes increases the presence of SNHL is more frequent. However, contradicting results was seen in studies done by Rajendran et al and Kurien et al where no association between the duration of diabetes and SNHL was observed.

HbA1c has been recognized as a better reflection of plasma glycemic status over the preceding 2 to 3 months and is considered as a reliable diagnostic biomarker for DM. Our study showed a positive relation between HbA1c and severity of hearing loss. Patients with poor glycemic control (>8%) had higher hearing loss (77.17%). The severity of hearing loss increased with poor glycemic status. Most of the cases were moderate and moderately severe hearing loss. On the other hand, patients with good glycemic control had mild hearing loss. Studies conducted by Krishnappa et al and Srinivas et al also showed a strong association between HbA1c and the severity of hearing loss.[8,15] Al Rubeaan et al also showed that patients with poor glycemic control (HbA1c>8%) had a higher rate of hearing loss than those with good glycemic control (HbA1c <8) (62.9% vs 48.3%).[22] However, Rajendran et al found that glycemic

control did not have any effect on the incidence of hearing loss in their study.[7]

Multiple authors have concluded that good glycemic control in diabetic patients reduces the incidence of SNHL. Hence, patients with DM should be advised to keep their glycemic levels under good control to prevent progression of hearing loss. According to a meta-analysis by Horikawa et al results suggested an independent association of hearing impairment and diabetes, although the possibility of residual confounding by age cannot be eliminated.[23] The meta analysis concluded that the higher prevalence of hearing impairment in diabetic patients compared with nondiabetic patients was consistent regardless of age.

CONCLUSION

Our study showed a high prevalence (70.76%) of SNHL among type 2 diabetic patients. It evidently demonstrated the association between age of the patients, duration of diabetes and SNHL as well as the association between glycemic control and the severity of hearing loss. Hence, it is important to have knowledge of auditory complications of DM while evaluating a diabetic patient, especially if the disease is long standing. Patients with type 2 DM should be encouraged for necessary audiological evaluation for early diagnosis of SNHL and advised for good glycemic control to prevent or delay its occurrence.

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