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Original Research Article

Association of sensorineural hearing loss in type 2 diabetes mellitus patients: an analytical cross sectional study

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ABSTRACT

Background: The association of sensorineural hearing loss 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 100 type 2 diabetes patients and age and gender matched 100 non-diabetic controls in the age group of <50 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, DPOAE and BERA and the findings were recorded and analyzed.
Results: Diabetes patients had insidious onset, gradually progressive, bilaterally symmetrical SNHL. SNHL is prevalent in 73% of type 2 diabetes patients compared to 16% 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, PTA, DPOAE, BERA

INTRODUCTION

Type 2 diabetes mellitus (DM) is a syndrome of chronic hyperglycemia due to relative deficiency of insulin, resistance to insulin or both.[1] Type 2 diabetes mellitus occur as a result of obesity and lack of exercise.[2] Some people are genetically more prone to diabetes.[3] Globally as of 2015, it was estimated that there were 392 million people with type 2 diabetes making up about 90% of diabetes cases.[4,5] This is equivalent to about 6% of the world's population.[5] Women seem to be at greatest risk as do certain ethnic groups such as south Asians, pacific islanders, Latinos and Native Americans.[6-11] Diabetes affects multiple systems of the body including ear, it causes neuropathy of the 8th nerve (vestibulo-cochlear nerve).[7] The pathophysiological changes that accompany diabetes may similarly causes injury to vasculature or the neural system of inner ear. The hearing loss associated with diabetes is sensorineural type and it account for about 90% of patients. The term sensorineural hearing loss (SNHL) used to indicate that there is either a cochlear or retrocochlear lesion. Sensorineural hearing loss is more common in diabetics than non-diabetics and severity of hearing loss seemed to correlate with progression of diabetes mellitus.[8] SNHL is a type of hearing loss in which root cause lies in inner ear or

sensory organ (cochlea and associated structure) or the vestibulocochlearnerve (cranial nerve 8).[9] Identification of SNHL is usually made by performing pure tone audiometery (PTA) in which bone and air conduction thresholds are measured. Tympanometery and speech audiometery may be helpful. PTA is the main hearing test used to identify hearing threshold levels of an individual, enabling determination of the degree, type and configuration of hearing loss and thus providing a basis for diagnosis and management.[10,11] PTA is described as the gold standard for assessment of hearing loss.[12] Distortion product otoacoustic emission (DPOAE) and BERA are valuable in assessing subclinical auditory dysfunction as consequences of diabetes and can be utilized in early screening of cochlear and retrocochlear hearing loss. The cochlear and retrocochlear auditory system needs regular evaluation in patients of diabetes. BERA can prove to be an advantageous method to detect both eighth nerve and CNS impairment at the earliest. Apart from BERA, DPOAE was a reliable, non-invasive test for early detection of damage to cochlear functions.[13] Wave V latencies in diabetes mellitus group suggest retrocochlear involvement and it also suggests central pathology.[14,15] Wave I-V delay (interpeak latencies) in diabetes mellitus suggest delay in transmission of the auditory stimulus in the auditory pathway of diabetes mellitus, at level of brainstem and mid brain. It is thus anticipated that the results of the review will provide an insight into possible relationship between type 2 diabetes mellitus and hearing loss.

Objectives

Objectives of the current study were; to compare the proportion of SNHL among patients with type 2 DM versus age and sex matched people without type 2 DM, to assess the relationship of hearing threshold with duration of diabetes and to correlate the DPOAE and BERA in diabetes mellitus.

METHODS

The present analytical cross sectional study was conducted in department of otorhinolaryngology, head and neck surgery, Government medical college Srinagar, for period of one and a half year (April 2019 to May 2020) after obtaining the ethical clearance from the Institutional Ethical Committee. The study was comprised of two groups, a study group and a control group. Study group included patients who were diagnosed as type 2 DM attending diabetic clinic in Endocrinology OPD while the control group comprised of age and sex matched non-DM individuals. Both groups were subjected to thorough audiological evaluation.

Inclusion criteria

Inclusion criteria for current study were; biochemically proven hyperglycemic patients, age less than or equal to 50 years of both genders.

Exclusion criteria

Exclusion criteria for current study were; patients with any other systemic illness or metabolic disorder, gestational, patients on ototoxic drugs or any ear surgery done/occupational exposure to noise, noise induced hearing loss, patients with CSOM and CHL and patients with congential SNHL.

The present study was a comparative study with population of 100 diagnosed patients of diabetes mellitus and control group consists of 100 non-DM patients. All these individuals were evaluated with a detailed clinical examination and appropriate investigation. All these individuals were evaluated with a detailed clinical examination and appropriate investigation, such as PTA, BERA and DPOAE.

Statistical analysis

Data was entered in Microsoft Excel Spreadsheet. Continuous variables were summarised as mean and standard deviation (SD). Categorical variables were summarised as frequency and percentage. The reported p values were based on analysis, in which $p<0.5$ was considered significant.

RESULTS

Gender distribution of patients having type 2 DM is shown in (Table 1). It consists of 31 males and 69 females, more than two-third patients were females. Demographic profile of DM group and non-DM group total of 100 patients of DM were taken out of which 31 were are males and 69 were females is shown in (Table 2).

Table 1: Gender distribution.

Gender	N	%
Male	31	31.0
Female	69	69.0
Total	100	100.0

Table 2: Demographic details.

Parameters	Diabetic group	Non-diabetic group
Mean age (years)	43.20 (SD 6.54)	34.61 (SD 8.85)
Mean fasting blood sugar	133.95±27.83 (Range 81-253)	106.08±3.69 (Range 100-118)
Mean post prandial blood sugar	173.81±41.19 (Range 107-346)	129.68±9.99 (Range 108-148)
Mean HbA1c	7.81±0.86 (Range 5.4-9.6)	6.003±0.244 (Range 5.3-6.5)

The mean age of patients was 43.20, mean fasting blood sugar was 133.95±27.83, mean PP blood sugar was 173.81±41.19 and mean HbA1c was 7.81±0.86. Control group consists of non-DM patient's total of 100 patients, were taken in control group in which 46 are males and 54 are females.

Table 3: Grade of hearing loss in study participants.

PTA	N	%
Normal	27	27.0
Minimal SNHL	15	15.0
Mild SNHL	18	18.0
Moderate SNHL	23	23.0
Severe SNHL	5	5.0
Profound SNHL	12	12.0
Total	100	100.0

Table 4: Distribution of study patients according to DPOAE.

DPOAE	N	%
Refer	68	68.0
Pass	32	32.0
Total	100	100.0

Mean age of patients was 34.61, mean fasting blood sugar was 106.08±3.69, mean post-prandial blood sugar was 129.68±9.99 and mean HbA1c was 6.003±0.244. Grade of hearing loss in study participants is depicted in (Table 3). It shows that only 27 patients had normal hearing and 73 patients had SNHL whereas 15 patients in this group had minimal hearing, 18 had mild SNHL, 23 had moderate, 5 had severe SNHL and 12 patients had profound SNHL. Distribution of study participants with type2 DM according to DPOAE is shown in (Table 4). The above table shows that out of 100 patients. 68 had DPOAE refer whereas 32 patients had DPOAE pass. Comparative BERA results of DM and non-DM is shown in (Table 5). wave V grossly delayed in DM group as compared to non-DM with all frequencies (i.e. 70, 80 and 90) whereas interpeak latencies of wave I-V at 70 db frequency is almost equal in DM and non-DM group but it increase with increase in frequencies (i.e. 80 and 90 db).

DISCUSSION

The present cross-sectional study entitled "Association of sensorineural hearing loss in type 2 diabetes mellitus - An analytical cross-sectional study was conducted in the department of otorhinolaryngology and head and neck surgery, SMHS hospital, GMC Srinagar (Kashmir). In the present study total of 100 diabetes mellitus and 100 non-diabetes mellitus were studied. All these patients underwent tuning fork tests and otoscopic examination. This was followed by PTA, DPOAE and BERA screening. Mean age of DM group was 43.20 years whereas mean age of non-DM was 34.61 years. All the patients were under 50 years of age. Out of 100 DM, 31 were males and 69 were females. All the patients were less than 50 years of age which exclude possibility of presbyacusis and also they had no other otological or metabolic disease. The cases were already diagnosed with DM. Study by Ashish et al conducted on diabetic patients consisting of similar age group between 18-50 years of age.[16] It was found in their study that majority of them had minimal hearing loss followed by mild hearing loss. 30% of patients had normal hearing in both ears. Rajendran et al conducted a similar study in the age group 40-50 years and found that number of people affected with SNHL among the diabetes is 73.3% when compared to that of controls.[17] The mean fasting blood sugar levels of DM group was 133.95±27.83 and it was ranging from 81 to 253 whereas mean fasting blood sugar levels of non-DM group was 106.08+3.69 and it was ranging from 100 to 118. The mean post prandial blood sugar levels of DM group was173.81±41.19 and it was ranging from 107 to 346 whereas mean post prandial blood sugar levels of non-DM group was 129.68±9.99 and it was ranging from 108 to 148. The mean HbA1c of DM group was 7.81± 0.86 and it was ranging from 5.4 to 9.6 whereas in non DM mean HbA1c was 6.003±0.244 and it was ranging from 5.3 to 6.5. In the present study, after PTA evaluation, it was found that in the study group only 27 patients had normal hearing whereas 73 patients had SNHL. Out of 73 patients; 15 having minimal SNHL, 18 had mild SNHL, 23 had moderate SNHL, 5 had severe and 12had profound hearing loss. In control group following result was found; 84 had normal hearing whereas 16 patients had SNHL. This study corresponds to the study conducted by Ashish et al who had similar results as of ours study. In his study he found only 30% of patients had normal hearing and 70% had SNHL.[16-18] Sunkun et al conducted a similar study on DM patients and found in his study that 82% had SNHL.[18] Rajendran S et al[17] conducted a similar study on DM patients and in his results 73.3% of DM patients had SNHL as compared to 6.7% of that of non-DM patients. Dadhich conducted a similar study and it was found in this study that 73 % patients had SNHL.[19] Tiwari conducted a similar study and he also found 76.8% patients of DM had SNHL.[20] Thus these studies had similar results as of present study and it shows that DM had effect on hearing. In the present study, DPOAE"S show that that out of 100 DM patients, 68% patients had result refer and 32% had result pass whereas in control group only 8 patients had result refer and 92 had result pass. The result of present study corresponds to the study conducted by Ferreira et al in which 78.9% had DPOAE"S absent.[21] Asimilar result was found by Prabhu et al which revealed absence of OAE"S in 68% in patients with type 2 DM.[22] Joshi et al conducted a similar study and found that in DM patients.[23] Ferreira et al conducted a study and found that DPOAE was absent in most of patients of DM.[21] The OAE absent (refer) in patients having hearing loss show cochlear damage. The OAE present (pass) in patients having hearing loss might suggest cause of auditory neuropathy.

Table 5: Comparative BERA results of diabetic and non-diabetic groups.

Wave latencies	Intensity (dBnHL)	Non-diabetic group Mean±S.D.	Diabetic group Mean±S.D. (ms)	P value
V	70	6.01±0.27	6.56±1.52	<0.001
I-V	70	3.54±0.08	3.81±0.26	<0.001
V	80	5.67±0.22	6.51±1.46	0.004
I-V	80	4.11±0.13	4.78±0.43	0.035
V	90	5.32±0.20	6.57±1.48	<0.001
I-V	90	4.87±0.25	5.58±0.61	<0.001

In this way; specific test for assessment of central auditory system would be relevant to indicate audiologic diagnosis of patients with type 2 diabetes mellitus. In present study latencies of wave V and interpeak latencies of wave I-V were studied at frequency 70, 80 and 90 db in both DM and non DM patients. It was found in present study that that latency of wave V was grossly delayed at all frequencies whereas interpeak latencies of wave I-V was almost normal at 70 db frequency but it increase with increase in frequencies (i.e. at 80 and 90 db). This study corresponds to study done by Joshi et al who found that absolute latencies of BERA were significantly delayed in for waves II and V and significantly delay was notice in interpeak latencies (IPL) of wave I to III and wave I to V.[23] Chhaya et al found that there was significant difference for BERA abnormalities (for 70, 80 and 90 db) in study group when compared to controls.[24] Siddarth et al done a study on topic, brainstem auditory response in type 2 DM.[25] Bera testing was performed and patterns of latencies III and V and interpeak latencies I to III, III to V and I to V were estimated at 70, 80 and 90 db NHL and was found that there was significant latency differences of wave 3 and interpeak latency I to III and III to V and I toV and highly significant difference in wave V between control and study group at 70 db NHL. Highly significant difference was also noted in latencies of interpeak I to III and I to V while significant differences were seen in latencies of wave III and V and interpeak latencies of III and V between control and study group at 80 db NHL. Between control and study group at 90 db NHL, there was significant latency difference in wave I, III and V. It was concluded from this study that BERA help in early detection of central neuronal axis involvement in type 2 DM. Singh et al conducted a study on variation of latency of wave V.[26] The analysis of study revealed that there has been progressive rise in latency of wave V. Delay in interpeak latency of wave I-V show that that there is delay in transmission of auditory stimulus in auditory pathway in DM at level of brainstem and midbrain. Large sample studies are needed to confirm the findings of the present study and compare it with the literature worldwide available. A need for a controlled study is warranted in identifying those values that may have a positive influence on hearing thresholds.

CONCLUSION

This study concludes that the diabetics are at definite risk of developing auditory dysfunction, therefore it is recommended that all newly diagnosed diabetic patients should undergo a complete audiological evaluation at the time of diagnosis and a regular half yearly or yearly follow up is warranted for early detection of damage to auditory functions.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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