

Eighth Nerve Dysfunction in Type 2 Diabetes Mellitus

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Abstract

Introduction: Hearing impairment is one of the under-recognized complications of diabetes that affects the cognitive performance and quality of life. The study was conducted to estimate the prevalence of hearing impairment and analyze the type, degree and pattern of hearing impairment in diabetic population. **Materials and Methods:** The study was conducted as a case-control study including 50 diabetic patients and 20 healthy individuals after exclusion of confounding factors. Hearing assessment was done using pure tone audiometry. **Results:** The prevalence of hearing impairment in diabetics of age 35-65 years was 74% compared to normal population (15%). 7 out of 13 diabetic patients in the age group of 35-45, 19 out of 37 diabetics in the age group of 45-55 & 11 out of 13 diabetics in the age group of 55-65 had hearing impairment. 9 out of 12 diabetic patients having HbA1c of < 7 and 28 out of 38 diabetic patients having HbA1c of >7 had hearing impairment. 21 out of 27 patients with diabetes duration of <1 year, 6 out of 11 patients with diabetes duration of 1-5 years, and 10 out of 12 patients with diabetes duration >5years had hearing impairment. Out of 37 diabetic patients who had hearing impairment, 24 (64%) had diabetic neuropathy. **Conclusion:** Eighth nerve dysfunction is common among diabetics. Its prevalence among the diabetics increases with age and positively correlates with the duration of diabetes and presence of diabetic peripheral neuropathy. However, its prevalence did not show positive correlation with the HbA1c levels.

Keywords: Diabetes, HbA1c, Duration of Diabetes, Hearing impairment, Eighth nerve dysfunction, Neuropathy

Introduction

Diabetes mellitus, a group of common metabolic disorders that share the phenotype of hyperglycemia, is becoming the epidemic of the 21st century. The prevalence of type 1 and type 2 diabetes mellitus is increasing worldwide and especially type 2 diabetes mellitus is rising more rapidly both in children and adults due to obesity and unhealthy life style. As a result of increasing incidence of diabetes mellitus, its complications also increase every year. Extensive studies are being done on its micro vascular and macro vascular complications. [1]. Hearing impairment is one of the under-recognized complications of diabetes. According to a comparative study of quality of life among elderly diabetic and non-diabetic patients, the progression of hearing loss was associated with

worsening of indices of quality of life in both the groups. Screening, early identification, monitoring and rehabilitation of hearing impairment is important for improving the quality of life [2]. The presence of even minimal degree of hearing impairment affects the cognitive performance of elderly [3].

Few studies have been done in Indian subcontinent on hearing loss in diabetes mellitus. So this study was focused on the incidence of hearing loss in diabetics and also to find whether the duration of diabetes or its glycemic control influence the severity of hearing loss.

Objectives of the Study

- To compare the auditory function of type 2 diabetes patients with non-diabetic individuals.
- To analyze the type, degree and pattern of hearing impairment among type 2 diabetes patients.

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Materials and Methods

Study design: Case-control study.

Source of Data- Study population was classified into two groups. Group 1 comprises of 50 type 2 diabetic patients of either sex selected from Department of General Medicine, belonging to the age between 35 and 60yrs. Group 2 comprises of 20 normal healthy subjects of either sex selected from patient attendees in hospital belonging to the same age group.

Study Duration: November 2012 to August 2014.

Method of collection of Data.

The study comprising of 50 type2 diabetics and 20 non diabetics matched with respect to age and sex are selected based on inclusion and exclusion criteria

Inclusion criteria for diabetic patients: Type 2 diabetic patients between the ages 35 and 65 years

Exclusion criteria for cases:

- Hypertension
- History of consumption of ototoxic drugs in past three months.
- History of ear surgeries performed in the past.
- History of ear infections in the past.
- History of recent infections in the nose, throat or ear.
- Patients having a noise induced hearing loss (as shown by pure tone audiometry at 4000 Hz.)

Inclusion criteria for controls: Healthy subjects between 35 and 65 years. For the case population, before doing hearing assessment, age at onset of

Results

A total of fifty diabetic patients were screened. Out of which 32 were males and 18 were females. (Table 1). The mean age of the case population was 49.94 ± 6.57 . The mean duration of diabetes was $2.64 \text{ yrs} \pm 3.32$. The mean fasting glucose, mean post- prandial glucose and mean HbA1c were $170.4 \text{ mg/dl} \pm 63.34$, $294.26 \pm 87.7 \text{ mg/dl}$ and 8.728 ± 1.95 respectively. In the diabetic patients, only 13 of them had normal hearing assessment.

Out of the 32 male diabetics, 25 had hearing loss whereas out of the 18 diabetic females, 12 had hearing loss. There was no statistically significant gender differences in the prevalence of hearing loss among diabetics (p value >0.05). (Table 1)

Table-1: Diabetic Population Characteristics.

Sex	Total	Hearing loss	Normal
Male	32	25	7
Female	18	12	6

Diabetes Mellitus was noted to calculate the exact duration of diabetes of the patient. Previous history of hearing impairment, ear discharge, head or ear trauma and family history of congenital deafness were enquired. Diabetic neuropathy was clinically assessed by vibration test and sensation tested using mono-filament test.

The control population was selected after fulfilling the inclusion and exclusion criteria. The cases and controls were matched with respect to age and sex.

Then, clinical assessment of hearing was done in both cases and controls by doing Rinne’s test, Weber’s test and Absolute Bone Conduction test. Those who were able to understand and reciprocate the above clinical tests were subjected to undergo otoscopic examination and Pure tone audiometry using Amplaid 300 clinical audiometer. Pure tone audiometry was performed in a sound proof room for both cases and controls. Both air and bone conduction tests were performed at low, mid and high frequencies. Degree of hearing impairment was classified according to WHO classification [9].

The study was approved by the ethical committee of Velammal Medical college Hospital and Research Institute. The data was analyzed using SPSS software. Chi square tests has been used to find the significance of auditory thresholds (dB) between various categories of parameters. Analysis of variance (ANOVA) has been used to find the significance of auditory thresholds in different age groups and duration of diabetes.

Table-2: Prevalence of Hearing Loss in Diabetics and Controls.

Study Population	Hearing Loss Present		Hearing Loss Absent	
	n	%	n	%
Diabetic patients	37	74%	13	26%
Non diabetic persons	3	15%	17	85%

Table-3: Age wise characteristics of diabetic population with hearing impairment.

Age group (in years)	Mild	Moderate	Severe	Percentage of persons having hearing loss
35-45	7	0	0	53%
46-55	15	3	1	79%
55-65	7	3	1	84%

Table-4: Pattern and Severity of Hearing impairment in Diabetics.

Hearing loss severity	All frequency loss	Mid/high frequency loss
Mild (25-40 db)	25	5
Moderate (40-55 db)	1	1
Severe (>55 db)	4	1

In this study, 37 diabetic patients had hearing impairment. All cases of hearing impairment were of sensorineural type. Whereas only 3 of the healthy individuals had hearing impairment. (Table 2)

7 out of 13 diabetic patients in the age group of 35-45 years had hearing impairment. 19 out of 37 diabetic patients in the age group of 45-55 years had hearing impairment. 11 out of 13 diabetic patients in the age group of 55-65 years had hearing impairment. (Table 3)

In the 37 patients with deafness, 30 (81%) of them had hearing loss in all frequencies. And 7 (19%) had hearing loss only in the mid and high frequencies. (Table 4)

Out of 37 diabetics with hearing impairment, 30 (81%) of them had mild degree of hearing impairment, 2 (5.4%) had moderate hearing impairment and 5 (13%) had severe hearing impairment according to WHO classification. (Table 4)

12 diabetic patients had HbA1c of < 7. And among these 12 patients, 9 had hearing impairment. And among the 38 diabetic patients who had HbA1c of >7, 28 had hearing impairment. The metabolic control was not statistically significantly associated with the hearing loss (p> 0.05). (Table 5)

Table-5: Correlation of HbA1c and Hearing Impairment.

Severity of hearing impairment	HbA1c <7	HbA1c >7
Mild	7	23
Moderate	1	1
Severe	1	4
Normal	3	10

Table-6: Correlation of Duration of Diabetes and Hearing Impairment.

Duration of Diabetes	Total cases	Mild	Moderate	Severe
<1 year	27	15	2	4
1-5 years	11	6	0	0
>5 years	12	9	0	1

Table-7: Correlation of Neuropathy and Hearing Impairment.

Frequency of hearing loss	Neuropathy present	Neuropathy absent
All frequency	22	8
Mid/high	2	5
Normal	2	11

Out of 37 diabetic patients with hearing impairment, 27 patients had diabetes duration of less than 1 year, 11 patients had diabetes duration of 1-5 years and 12 patients had diabetes duration of 5 years. In the patients with diabetes duration of less than one year (27), 21 had hearing impairment. Out of them 15 had mild hearing impairment, 2 had moderate hearing impairment and 4 had severe hearing impairment. In the group of patients with diabetes duration of 1-5 years (11), 6 had mild hearing impairment. Among patients with duration of diabetes above 5yrs (12), 10 had hearing impairment with 9 having mild hearing impairment and 1 having severe hearing impairment. Duration of diabetes positively correlated with hearing loss (p=0.001) when analyzed by one way ANOVA (Table 6)

Among the 50 diabetic patients, 23 patients were recently diagnosed to have diabetes mellitus. Out of these 23 patients, 17 (69.56%) of them had hearing loss at the presentation.

Out of 50 diabetic patients, 26 had diabetic neuropathy and 24 had no evidence of neuropathy. Out of 37 diabetic patients who had hearing impairment, 24 (64%) had neuropathy and 13 (36%) had no evidence of neuropathy. p value < 0.05 (Table 7)

Discussion

The prevalence of hearing impairment in diabetes mellitus population of age 35 - 65 years was 74% when compared to the age and gender matched non diabetic population where it was only 15% (p value: 0.001). Thus, hearing impairment is more prevalent among the diabetic population compared to the healthy individuals. The prevalence of hearing impairment in diabetes mellitus population has been 0 to 93% in various other studies [3,4].

The probable mechanisms proposed are microangiopathy of the inner ear, neuropathy of the cochlear nerve or a combination of the both. Elamin et al [10] favours microangiopathic theory, which is supported by histopathological findings on the temporal bones and inner ear. Thickening of capillary wall with secondary ischemia in the cochlea and the 8th cranial nerve have been documented in diabetic patients and experimental animal models by Durmus et al 1980 [11]. This study demonstrates a significant hearing loss in diabetics in

all the frequencies tested. This could be explained by microangiopathy of the vessels to the inner ear as proposed by Wackym [12] or due to the chronic nature of the disease as explained by De Espana [6]. The effect of age on auditory thresholds in diabetic subjects was found to be clinically and statistically significant. Higher the age, more was the prevalence of hearing impairment. This was similar to the results of De Espana (1995).

He found a correlation between hearing levels and age of the subjects in the diabetic group [6] and concluded that any hearing loss due to diabetes will be additional to that due to age alone. Similar conclusions were drawn by Axelson [13]. These results were not similar to Kakarlupudi [14] and Dalton [15] studies. There also few studies to suggest that persons with diabetes may experience hearing loss at earlier ages. There were no statistically significant gender differences in the prevalence of hearing loss among diabetics.

Duration of diabetes did correlate with the prevalence of hearing impairment among diabetics similar to the study by Tay et al [7]. Among the 50 diabetic patients, 23 patients were recently diagnosed to have diabetes mellitus. Out of these 23 patients, 17 (69.56%) of them had hearing loss at the presentation. Thus recognition of the disease in our population is generally late i.e., only after the development of microangiopathic complications.

Hearing impairment was not significantly associated with the level of HbA1c (p value: >0.05). This was similar to the results by Weng et al (2005). [8]. There was also no correlation with blood sugar levels similar to results of Durmus [11].

The hearing impairment was strongly associated with the presence of diabetic neuropathy. Frequency of hearing loss can be of any type depending upon the site of dysfunction. The low frequency hearing loss arises from lesion of retrocochlear auditory nerve. The high frequency hearing loss arises from cochlear outer hair cells. [16] In the 37 patients with deafness, 30 (81%) of them had hearing loss in all frequencies. And 7 (19%) had hearing loss only in the mid and high frequencies. This study shows the hearing impairment is predominantly because of auditory neuropathy.

The incidence of hearing impairment is as high as 75% in our population. It is usually under recognized. With such high proportions of hearing loss, health care providers should consider providing referrals for early audiometric testing. Audiologists seeing middle aged patients with unexplained hearing loss must also enquire about the history of diabetes and family history of diabetes.

Early recognition of the diabetes and its complications is important. And all the newly diagnosed patients should be periodically screened for its complications. Patients with diabetes should be encouraged in their efforts to maintain good and early control of blood glucose thereby preventing the early complication of oxidative stress.

There should be development of therapy that targets signaling pathways that cause vascular dysfunction in spite of controlling blood sugar levels. People with damaged ears should be recognized early and rehabilitated early with hearing aids thereby improving their quality of life.

Conclusion

Eighth Nerve dysfunction is very common among diabetic population compared to healthy individuals, which is frequently under-recognized, impairing the quality of life. Its prevalence among the diabetics increases as age advances. and also it positively correlates with the duration of diabetes and the presence of diabetic peripheral neuropathy. However, its prevalence did not show positive correlation with the HbA1c levels.

Therefore, eighth nerve dysfunction should be actively pursued in all diabetics and early rehabilitative measures should be instituted for improvement of their quality of life.

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