Section: Miscellaneous

Original Research Article

ASSOCIATION BETWEEN DIABETES MELLITUS & HEARING LOSS–A PROSPECTIVE OBSERVATIONAL STUDY IN THE TERTIARY HEALTH CENTER IN MUMBAI, INDIA

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ABSTRACT

Background: Elevated serum glucose levels resulting from either absolute or relative insulin insufficiency define the heterogeneous constellation of disease syndromes known as diabetes mellitus. There is no cure for this to date with disease management focussed on preventing the associated chronic complications. **Aims:** To study the type and extent of hearing loss in people with type 2 diabetes mellitus and how blood sugar levels and the duration of diabetes affect the severity of hearing loss. **Materials and Methods:** A study involving 65 adult patients who had been diagnosed with type 2 diabetes mellitus for longer than five years was carried out as a prospective observational study. Those whose hearing loss was caused by any other ear disorders were excluded. Blood sugar, Serum creatinine, HbA1c, and pure tone audiometry were done for the patients included. **Results:** 13[20%] patients had HbA1C <7%, 20 had HbA1c between 7-7.9 and 32 had HbA1C >8. 52.3%patients had diabetes for 5-9 years, 35.4% for10-14 years [35.4%], 10.8% for15-19 years and 1.5% for >20 years. In the right ear, 13 patients experienced mild sensorineural hearing loss (SNHL), and 17 and 11 patients experienced moderate and severe SNHL. In the left ear, 13 patients had mild sensorineural hearing loss (SNHL), 14 had moderate SNHL, and 13 had severe SNHL. Compared to patients with normal and mild hearing loss (SNHL), those with moderate and severe SNHL in both ears had a significantly higher mean duration of diabetes mellitus ($p<0.05$). Comparing the HbA1C levels of patients with mild, moderate, & severe sensorineural hearing impairment, those with more severe levels had higher levels. [$p<0.05$]. **Conclusion:** Longer duration of diabetes mellitus and poorly controlled diabetes mellitus is associated with severe sensorineural hearing loss.

INTRODUCTION

Due to a relative or total deficiency of insulin, diabetes mellitus is a heterogeneous constellation of disease syndromes characterized by elevated serum glucose levels. As of now, there is no known cure for this; instead, disease management aims to avoid the chronic complications that are linked to it. Loss of hearing is one complication of the diabetes mellitus. As per WHO's World Report on Hearing 2024,[1] 1 in 5 people have hearing loss at this time. These numbers see a sharp upward projection with an estimated 1 in 4 persons expected to be suffering from hearing loss by 2050. One of the biggest threats to world health is diabetes mellitus. Due to the high global population suffering from this condition, the number of patients facing the complications of diabetes is exceptionally high. The two main categories of complications associated with diabetes mellitus are microvascular (nephropathy, neuropathy, and retinopathy) and macrovascular (stroke, peripheral artery disease, and coronary artery disease).[2] Early detection of diabetes and screening for possible complications are critical to the success of disease management.[3] One of the main characteristics of diabetes mellitus that can cause various systemic complications is microangiopathy. Diabetes patients may experience hearing loss as a

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result of cochlear microvascular involvement.[4] Diabetic patients' hearing loss has also been linked to neuropathy and genetic mutations in mitochondrial DNA.[5] While the other complications of diabetes mellitus have been well established, there is a paucity of literature as far as hearing loss is concerned. The research that are currently available identify hearing loss as a complication of diabetes; however, the degree to which diabetes control and hearing loss are related, as well as the length of diabetes, remain unclear. Our prospective study was designed to shed light on this association. Early detection of hearing loss and treatment is important to prevent associated morbidity to the patient.

Aims and Objectives

1. To test hearing of patients with long-standing diabetes mellitus
2. To measure the threshold for hearing and investigate the proportion of patients suffering from sensorineural, conductive, and mixed hearing loss.
3. To investigate the effects of the duration of disease and severity and its control on the hearing thresholds of patients.

MATERIALS AND METHODS

A prospective observational study was carried out in a medical college in Mumbai. The institutional ethics committee gave the study its prior approval. A study by Diniz TH et al,[6] was used to determine the sample size, and 65 was the result. This study was conducted over a two-year period. Adult patients diagnosed with type 2 diabetes mellitus at least five years ago were included in the study. The following three criteria were used to diagnose diabetes mellitus: i) More than 200 mg/dl of random blood sugar; ii) more than 126 mg/dl of plasma glucose during fasting iii) After two hours, plasma glucose levels greater than 200 mg/dl during an oral glucose tolerance test. The study included individuals with diabetes mellitus who had the illness for longer than five years. Patients with a history of hearing loss, regardless of the cause, were not included in the study. Among the exclusion criteria were patients with any chronic ear disease, a history of ear trauma, a history of ototoxic drug use within the last two months, a history of chronic exposure to loud noise, or a family history of hearing loss. 65 patients who met these requirements were added to the research. Prior to enrolling the patients in the study, their written informed consent was obtained. A thorough history was taken, and tuning fork tests and an ear examination were performed. Blood tests for serum creatinine, HbA1C, and blood sugar levels during fasting and after meals were performed on each patient. An audiologist conducted pure tone audiometry in a room with standard sound treatment. Mean and standard deviation were used to present quantitative data. To compare the groups, an ANOVA and Student's t-tests were employed. P-values were considered significant if they were less than 0.05.

RESULTS

The research study comprised 32 male & 33 female patients. Ages 56 to 60 was the commonest age group[38.5%], followed by 46-50yrs[26.1%],51-55 years [24.5%], and 41-45 years [10.8%]. Table 1 shows the patient distribution according to the duration of diabetes mellitus. The mean age was 52.77±5.15 years. 15patients had a normal basal metabolic rate[18.5-24.5kg/m2], 32patients were overweight[25-29.9kg/m2] & 18patients were obese[>30kg/m2]. The Mean fasting blood sugar level was 165±60.32mg/dl. The mean post-prandial blood sugar was 234.91± 84 mg/dl. The mean serum creatinine level was 1.37±1.39mg/dl. The distribution of patients as per HbA1C levels is given in Table 2.

Table 1: Patient distribution based on years of diabetes mellitus duration

Duration of Diabetes Mellitus	Number of patients	%
5-9 years	34	52.3%
10-14 years	23	35.4%
15-19 years	7	10.8%
≥20 years	1	1.5%
Total	65	100%
Mean ±SD	9.59 ±3.65	

Table 2: Patient distribution based on diabetes mellitus control

Control of Diabetes – HbA1C %	Number of patients	% of patients
<7%	13	20
7-7.9 %	20	30.8
≥8%	32	49.2
Total	65	100
Mean ± Standard deviation	7.38 ±1.07	

There were 50patients with hearing loss in their right ear & 49 in their left. Table 3 shows the distribution of patients by type of hearing loss. Table 4 displays the patient distribution by years of diabetes and extent of hearing impairment.

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Table 3: Patients are categorized according to the type & extent of their auditory impairment

Type of hearing loss		Right ear		Left ear	
		No. of patients	%	No. of patients	%
Normal hearing		14	21.5	16	24.6
Sensorineural hearing loss [SNHL]	Mild	13	20	13	20
	Moderate	17	26.1	14	21.5
	Severe	11	16.9	13	20
Conductive	Mild	7	10.8	5	7.7
	Moderate	1	1.5	1	1.5
Mixed	Mild	1	1.5	1	1.5
	Severe	1	1.5	2	3.1
Total		65		65	

Table 4: Patients are grouped according to "the severity of their hearing loss and the duration of their diabetes

RIGHT EAR			LEFT EAR		
Duration of Diabetes [in years]	Normal - Moderate SNHL	Severe SNHL	Duration of Diabetes [in years]	Normal - Moderate SNHL	Severe SNHL
Mean	9.116279	14.4	Mean	8.785714	13.66667
Variance	9.200443	13.37778	Variance	6.416376	13.87879
Observations	43	10	Observations	42	12
P value	**0.001144203**		*P value*	**0.000784087**	

A Student t-test was used to compare the length of diabetes mellitus in patients with severe sensorineural hearing loss to that in patients with normal, mild, and moderate sensorineural hearing loss. The left and right ears underwent separate testing. Compared to patients with normal, mild, or moderate sensorineural hearing loss in both ears, patients with a significantly longer history of diabetes mellitus were those with severe sensorineural hearing loss.

Patients with" mild conductive "hearing loss in the right ear were suffering from diabetes for an average of 6.57 years. Patients with mild conductive hearing loss in the left ear were suffering from diabetes for an average of 6.8 years. The average duration of diabetes in patients with moderate conductive hearing loss was 5.2 years. There was no discernible relationship between the duration of diabetes and conductive hearing loss.

For patients with severe mixed hearing loss in the right ear, the average length of diabetes was 6 years, whereas for patients with mild mixed hearing loss in the right ear, it was 8 years. Patients with mild mixed hearing loss in the left ear had a mean diabetes duration of 12 years, while those with severe mixed loss had a mean duration of 13 years. The length of diabetes did not significantly correlate with mixed hearing loss.

The HbA1C levels of patients with mild, moderate, & severe sensorineural hearing loss" were compared using a single-factor ANOVA test.

Table 5: "Relationship between sensorineural hearing impairment and diabetes mellitus management

Groups	Number of ears with hearing loss	Sum	Average HbA1C levels	Variance
MILD SNHL	26	196.6	7.561538	1.409662
MODERATE SNHL	28	217.4	7.764286	0.977196
SEVERE SNHL	26	216	8.307692	0.585538
P value = 0.023914				

The relationship between sensorineural hearing loss and diabetes mellitus management is displayed in Table 5. Individuals with sensorineural hearing loss ranging from mild to" severe exhibit notably different HbA1C levels (p-value < 0.05). Higher HbA1C levels were associated with more hearing loss in our investigation.

Control of diabetes did not significantly correlate with either mixed or conductive hearing loss.

DISCUSSION

Numerous studies have been conducted on the consequences of diabetes mellitus, but hearing loss in particular has not received the attention it deserves. Research on how diabetes mellitus affects hearing is scarce. Our study's patient demographics are comparable to those reported in research by Sachdeva K et al,[7] Darad H,[8] and Yikawe SS et al.[9] Sachdeva K et al,[7] report that 23 [74.2%] of the 31 patients with diabetes mellitus who also had hearing loss had a history of diabetes for longer than five years. Diabetes patients with a diagnosis dating back more than five years had higher rates of hearing impairment [79%] than those with a diagnosis less than five years [42%], according to Thimmasettaiah N et al.[10] This is consistent with the findings of our study, which showed that individuals who had diabetes mellitus for a longer period of time had noticeably higher levels of hearing loss. Out of 47 patients with diabetes for more than ten years, 29 patients [61.7%] had at least mild hearing loss, according to a study by Pemmaiah KD et al.[11] In a study by Darad H,[8] hearing loss was evaluated as

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one of the possible complications in patients with diabetes mellitus. Out of the 150 patients, 89 have experienced the illness for more than a decade. A study by Sachdeva et al,[7] found that diabetic patients with hearing loss had higher fasting blood sugar levels than diabetic patients without hearing loss. In our research, we discovered a similar relationship between diabetic patients' higher HbA1C readings and the degree of hearing loss. According to our research, conductive or mixed hearing loss and diabetes mellitus are unrelated. Longer durations, older age groups, and uncontrolled diabetes mellitus were found to be significantly correlated with sensorineural hearing loss,[12] according to a study by Srinivas CV et al. A Lasisi OA et al,[13] study found that patients with diabetes mellitus with the ailment for more than ten years had an average hearing threshold of 66dB, while patients with the condition for less than ten years had an average hearing threshold of 51dB. Diniz TH et al. reported the audiological characteristics of patients with diabetes mellitus and contrasted them with individuals without the condition in comparable age groups in a cross-sectional clinical trial. It was found that the diabetes group's audiograms were categorized as normal in 37% of cases, whereas the case group's pure tone audiometry test results showed sensorineural(38percent), mixed(24percent), & conductive(1percent). 68% of the control group's audiograms were being regarded as normal even though they showed conductive (2%), mixed (4%), and sensorineural (26%), hearing loss.[6]

CONCLUSION

Patients having diabetes mellitus for a longer duration have worse hearing thresholds. Additionally, inadequate management of blood sugar levels raises hearing thresholds, particularly in individuals with HbA1C >8%. Severe sensorineural hearing loss is linked to both poorly controlled and longer-lasting diabetes mellitus. All long-term diabetic patients should have a routine hearing evaluation to detect, prevent, and treat sensorineural hearing loss early on. Further research is needed to determine if hearing loss indicates the onset of other systemic complications. Diabetic patients need to be educated on the need to maintain strict glycemic control to avoid this complication.

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