

Dysfunction of Vestibulocochlear Nerve in Type 2 Diabetes Mellitus

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Abstract:-

➤ Introduction

Hearing loss is one of the under-recognized diabetic consequences that impacts cognitive performance and quality of life. The study was carried out to assess the prevalence of hearing impairment and to investigate the type, degree, and pattern of hearing impairment in diabetics.

➤ Materials and Methods

The study was conducted as a case-control study including 60 diabetic patients and 25 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 30-60 years was 70% compared to normal population (30%). 7 out of 13 diabetic patients in the age group of 30-40, 19 out of 27 diabetics in the age group of 40-50 & 16 out of 20 diabetics in the age group of 50-60 had hearing impairment. 18 out of 60 diabetic patients having HbA1c of < 7 and 42 out of 60 diabetic patients having HbA1c of >7 had hearing impairment. 24 out of 32 patients with diabetes duration of <1 year, 7 out of 15 patients with diabetes duration of 1-5 years, and 11 out of 13 patients with diabetes duration >5years had hearing impairment. Out of 42 diabetic patients who had hearing impairment, 27 (64%) had diabetic neuropathy.

➤ Conclusion

Diabetics frequently suffer from eighth nerve dysfunction. Its prevalence among diabetics increases with age and correlates favourably with diabetes duration and the presence of diabetic peripheral neuropathy. Its prevalence, however, did not reveal a favourable association with HbA1c levels.

Keywords: Diabetes, HbA1c, Duration of Diabetes, Hearing Impairment, Eighth Nerve Dysfunction, Neuropathy

I. INTRODUCTION

Diabetes mellitus, a set of prevalent metabolic illnesses with the phenotype of hyperglycemia, is the epidemic of the twenty-first century. Obesity and an unhealthy lifestyle are increasing the prevalence of type 1 and type 2 diabetes mellitus worldwide, with type 2 diabetes mellitus growing faster in both children and adults. Diabetes problems are becoming increasingly common as the disease's prevalence rises. Its micro and macro vascular problems are the subject of extensive research. [1].

One of diabetes's overlooked effects is hearing loss. A study comparing the quality of life of elderly diabetes and nondiabetic patients discovered that the advancement of hearing loss was associated with worsening of quality of life measures.

In the Indian subcontinent, there haven't been many studies on hearing loss in people with diabetes mellitus. This study focuses on the occurrence of hearing loss in diabetics to see if the length of diabetes or glycemic management impacts the degree of hearing loss.

II. OBJECTIVES OF THE STUDY

- To compare the hearing abilities of people with type 2 diabetes and those who do not have diabetes.
- Determine the types, degrees, and patterns of hearing loss in persons with type 2 diabetes.

III. MATERIALS AND METHODS

- *Study design:* Case-control study
- *Source of Data-* The study population was separated into two groups. Group 1 consists of 60 type 2 diabetes patients of either gender recruited from the Department of General Medicine and ranging in age from 30 to 60 years. Group 2 consists of 25 normal healthy volunteers of either sex drawn from the same age group of hospital patients as Group 1.
- *Study Duration:* January 2021 to November 2022.

➤ *Method of collection of Data*

The study's 60 type 2 diabetics and 25 non-diabetics, who are age and gender matched, were chosen based on inclusion and exclusion criteria.

- *Inclusion criteria for diabetic patients:*
 - ✓ Type 2 diabetic patients between the ages 30 and 60 years
- *Exclusion factors for cases include:*
 - ✓ Hypertension
 - ✓ History of ototoxic drug usage within the past three months.
 - ✓ Prior ear surgeries that have been performed.
 - ✓ A history of ear infections in the past.
 - ✓ A recent history of ear, throat, or nose infections.
 - ✓ Individuals who suffer from noise-induced hearing loss (as shown by pure tone audiometry at 4000 Hz.)

• *Inclusion criteria for controls:*
 Individuals in good health between the ages of 30 and 60. The age at onset of Diabetes Mellitus was documented prior to doing the hearing exam on the case population in order to calculate the patient's exact duration of diabetes. Hearing loss in the past, ear discharge, head or ear trauma, and a family history of congenital deafness were all investigated. Diabetic neuropathy was assessed using the vibration test, and sensation was assessed using the monofilament test.

The control population was chosen after meeting the inclusion and exclusion criteria. The patients and controls were age and gender matched.

Rinne's test, Weber's test, and Absolute Bone Conduction test were then used to assess hearing in both patients and controls.

Individuals who passed the foregoing clinical examinations were submitted to an otoscopic examination and Pure tone audiometry with an Amplaid 300 clinical audiometer.

Pure tone audiometry was performed in a soundproof room for both cases and controls.

Low, medium, and high frequency air and bone conduction tests were performed. The WHO classification [9] was used to grade the degree of hearing impairment.

The study was authorized by the ethical committee of Katuri Medical College and Hospital Institute.

The data was analysed using SPSS software.

IV. RESULTS

A total of sixty diabetic patients were screened. Out of which 40 were males and 20 were females. (Table 1). The mean age of the case population was 47.84 ± 6.37 . The mean duration of diabetes was $2.43 \text{ yrs} \pm 3.27$. The mean fasting glucose, mean post- prandial glucose and mean HbA1c were $178.4 \text{ mg/dl} \pm 70.34$, $278.26 \pm 77.2 \text{ mg/dl}$ and 8.68 ± 1.67 respectively. In the diabetic patients, only 15 of them had normal hearing assessment. Out of the 40 male diabetics, 32 had hearing loss whereas out of the 20 diabetic females, 13 had hearing loss. There was no statistically significant gender differences in the prevalence of hearing loss among diabetics (p value >0.05).

Table-1: Diabetic Population Characteristics

Sex	Total	Hearing loss	Normal
Male	40	32	8
Female	20	13	7

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

Study population	Hearing loss Present		Hearing loss Absent	
	n	%	n	%
Diabetic patients	42	70	18	30
Non diabetic patients	3	12	22	88

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

Age group (in years)	Mild	Moderate	Severe	Percentage(%) of persons having hearing loss
30-40	7	0	0	53
41-50	15	3	1	70.3
51-60	9	5	2	80

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

Hearing loss severity	All frequency loss	Mid/high frequency loss
Mild (25-40 db)	27	4
Moderate (40-55 db)	3	5
Severe (>55 db)	1	2

Hearing impairment was found in 42 diabetes patients in this investigation. Sensorineural hearing impairment was present in all instances. Only three of the healthy people experienced hearing impairment. (Table 2)

Hearing impairment was found in 7 of 13 diabetic patients aged 30-40 years. Hearing impairment was found in 19 of 27 diabetic patients aged 40-50 years. Hearing impairment was found in 16 of 20 diabetic patients aged 50-60 years. (Table 3)

31 (74%) of the 42 hearing impairment patients experienced hearing loss across all frequencies. And 11 (26%) had only mid and high frequency hearing loss. (Table 4)

According to WHO categorization, 31 (74%) of 42 diabetics with hearing impairment had mild hearing impairment, 8 (19%) had moderate hearing impairment, and 3 (7%) had severe hearing impairment. (Table 4)

The HbA1c of 18 diabetic patients was 7. Thirteen of the 18 patients experienced hearing loss. In addition, 31 of the 42 diabetes individuals with HbA1c levels more than 7 reported hearing loss. Hearing loss was not statistically significantly connected with metabolic control ($p > 0.05$). (Table 5)

Table-5: Correlation of HbA1c and Hearing Impairment in diabetics

Severity of hearing impairment	HbA1c <7	HbA1c >7
Mild	10	25
Moderate	1	2
Severe	2	4
Normal	5	11

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

Duration of Diabetes	Total cases	Mild	Moderate	Severe
<1 year	32	18	2	4
1-5 years	15	7	0	0
>5 years	13	10	0	2

Table-7: Correlation of Neuropathy and Hearing Impairment

Frequency of hearing loss	Neuropathy present	Neuropathy absent
All frequency	24	10
Mid/high	3	6
Normal	5	12

Out of 42 diabetic patients with hearing impairment, 32 patients had diabetes duration of less than 1 year, 15 patients had diabetes duration of 1-5 years and 13 patients had diabetes duration of 5 years. In the patients with diabetes duration of less than one year (32), 24 had hearing impairment. Out of them 18 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 (15), 7 had mild hearing impairment. Among patients with duration of diabetes above 5yrs (13), 11 had hearing impairment with 9 having mild hearing impairment and 2 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 60 diabetic patients, 28 patients were recently diagnosed to have diabetes mellitus. Out of these 28 patients, 19 (68%) of them had hearing loss at the presentation.

Out of 60 diabetic patients, 32 had diabetic neuropathy and 28 had no evidence of neuropathy. Out of 42 diabetic patients who had hearing impairment, 27 (64%) had neuropathy and 16 (36%) had no evidence of neuropathy. p value < 0.05 (Table 7)

V. DISCUSSION

The prevalence of hearing impairment in the diabetes mellitus group aged 30-60 years was 70%, compared to 12% in the age and gender matched non diabetic community (p value: 0.001). As a result, hearing impairment is more common among diabetics than among healthy people. In other investigations, the prevalence of hearing impairment in the diabetes mellitus group ranged from 0% to 93% [3,4]. The most likely mechanisms hypothesised are inner ear microangiopathy, cochlear nerve neuropathy, or a combination of the two. Elamin et al [10] advocate for the microangiopathic theory, which is backed by histological findings on the temporal bones and inner ear. Durmus et al 1980 [11] demonstrated capillary wall thickening with secondary ischemia in the cochlea and the 8th cranial nerve in diabetic people and experimental animal models. This study found that diabetics have severe hearing loss in all frequencies studied. This could be explained by microangiopathy of the vessels leading to the inner ear, as postulated by Wackym [12], or by the disease's chronic nature, as stated by De Espana [6].

Age had a clinically and statistically significant effect on hearing thresholds in diabetes patients. The prevalence of hearing impairment increased with age. This was similar to De Espana's results (1995). He discovered a link between

hearing levels and age in the diabetic group [6], and concluded that any hearing loss caused by diabetes will be in addition to that caused by age alone. Axelson [13] reached a similar finding. These findings differed from those of Kakarlapudi [14] and Dalton [15]. There are also few research that suggest that those with diabetes may develop hearing loss at a younger age. In diabetics, there were no statistically significant gender differences in the prevalence of hearing loss.

Similar to the study by Tay et al [7], the duration of diabetes did correlate with the prevalence of hearing impairment among diabetics. 28 of the 60 diabetic individuals had recently been diagnosed with diabetes mellitus. During the presentation, 19 (68%) of the 28 patients reported hearing loss. As a result, in our community, disease detection is typically delayed, occurring only after the development of microangiopathic problems.

Hearing impairment was not substantially related to HbA1c levels (p value:>0.05). This was comparable to the findings of Weng et al (2005). [8]. Similarly to the findings of Durmus [11], there was no association with blood sugar levels.

Hearing loss was closely linked to the existence of diabetic neuropathy. The frequency of hearing loss can vary depending on the site of malfunction. Low frequency hearing loss is caused by a lesion of the retrocochlear auditory nerve. High frequency hearing loss is caused by cochlear outer hair cells. [16] Thirty-three (78.5%) of the 42 deaf patients reported hearing loss in all frequencies. And 9 (21.4%) experienced only mid and high frequency hearing loss. This study shows the hearing impairment is predominantly because of auditory neuropathy.

In our population, hearing loss affects up to 75% of the population. It is frequently overlooked. Given the prevalence of hearing loss, health care professionals should consider referring patients for early audiometric testing. Audiologists who see middle-aged patients with unexplained hearing loss must also inquire about diabetes history and family history.

Diabetes and its complications must be diagnosed as soon as possible. Furthermore, all newly diagnosed patients should be evaluated for problems on a regular basis. Diabetes patients should be urged to maintain good and early blood glucose control, thereby reducing the early complication of oxidative stress. Despite reducing blood sugar levels, medication that targets signalling pathways that induce vascular dysfunction should be developed. Individuals with damaged ears should be identified and treated with hearing aids as soon as possible, increasing their quality of life.

VI. CONCLUSION

Eighth Nerve dysfunction is more common in diabetics than in healthy people, and it is usually undiagnosed, reducing quality of life. Its prevalence among diabetics increases with age. It also has a positive correlation with diabetes duration and the presence of diabetic peripheral neuropathy. However, there was no association between its occurrence and HbA1c levels. As a result, all diabetics should aggressively explore eighth nerve damage, and early rehabilitative interventions should be implemented to improve their quality of life.

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