

Original Research Article

Sensorineural hearing loss in patients with type 2 diabetes mellitus: a hospital based cross sectional study

Karishma*, Varanasi Swetha, Chandra Mouli Sileveru

Department of Otolaryngology, Santhiram Medical College and General Hospital, Nandyal, Andhra Pradesh, India

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*Correspondence:

Dr. Karishma,

E-mail: 1234karishma.ks@gmail.com

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ABSTRACT

Background: One of the most important of the five senses in human beings is hearing. It plays an important role in the development of speech, cognitive and communication skills. The decrease in length, quality of life and depletion of social networks can be caused by hearing impairment. Therefore, the sense of hearing, perception of sound and its biological purposes, can't be lightly dismissed. Diabetes mellitus is a common metabolic disorder that causes impairment in various systems of the body. One of the complications of diabetes mellitus is hearing impairment and tinnitus which in turn leads to decreased quality of life in affected individuals.

Methods: 75 type 2 diabetes mellitus patients age group of 35 -55 yrs with or without aural symptoms (deafness, tinnitus) were taken into the study.

Results: prevalence of sensorineural hearing loss (SNHL) was found 60%. Prevalence of SNHL is lowest among 35-40 age group (12.5%) and highest among 51-55 age group (80.5%). Prevalence of SNHL among the diabetic patients was calculated and it was noted to be 36.8%, 60% and 74% with the duration of diabetes ≤ 5 yrs, 6-10 yrs, ≥ 11 yrs. respectively.

Conclusions: SNHL is prevalent in 60% of type II diabetic patients.

Keywords: Sensorineural hearing loss, Diabetes mellitus, Tinnitus

INTRODUCTION

One of the most important of the five senses in human beings is hearing. It plays an important role in the development of speech, cognitive and communication skills and overall development of a person.¹ The decrease in length and quality of life and depletion of social networks can be caused by hearing impairment. Therefore, the sense of hearing, the perception of sound and its biological purposes, can't be lightly dismissed and is not a trivial consideration. It is very important to identify the impairment and treat it as early as possible.² Diabetes mellitus (DM) is a common metabolic disorder that causes impairment in various systems of the body. It affects almost all the systems in the body if left uncontrolled. One of the complications of diabetes mellitus is hearing impairment and tinnitus which in turn

leads to decreased quality of life in affected individuals.^{3,4} The typical hearing impairment in diabetes mellitus is bilateral, progressive, sensorineural hearing loss (SNHL) which affects mainly the higher frequencies. Rarely sudden onset hearing loss, affecting the lower frequencies is also noted. In developing countries, the majority of diabetics are in the productive period of their lives, which has a major implication in the health care needs.⁵ The goal of modern medicine should not only be treatment of diseases but also their prevention and control improving quality of life.

Aim and objectives

Aim and objectives of current study were; to estimate the prevalence of SNHL in Type 2 diabetes mellitus patients, to study the association of hearing loss with the following

factors in type 2 diabetes mellitus like age, gender, duration of diabetes and severity of hyperglycemia.

METHODS

Study type, location and duration

It is a prospective study conducted at department of otorhinolaryngology at Santhiram medical college and general hospital, Nandyal, Andhra Pradesh From June 2023 to November 2023.

Sample size and method of data collection

Total 75 type 2 diabetes mellitus patients age group of 35-55 yrs with or without aural symptoms (deafness, tinnitus) were taken into the study.

Inclusion criteria

Inclusion criteria were; patients with type 2 diabetes on oral hypoglycemic drugs and patients with type 2 diabetes in the age group of 35-55 years.

Exclusion criteria

Exclusion criteria were; Patients with type2 diabetes 55 years, Patients on dialysis and chronic renal failure, Patients with hearing loss prior to onset of diabetes. Patients with history of head trauma, ototoxic drug intake, noise exposure, Patients with history of any ear disease and ear surgeries and Patients with diabetes and on insulin.

Procedure

Subjects were selected on the basis of inclusion and exclusion criteria. Informed consent was taken from them after explaining them about the study in their own understandable language. Subjects underwent routine systemic, ENT, audiometric and laboratory assessment. A detailed examination of the ears including the pinna, pre auricular and post auricular area, mastoid, external auditory canal and tympanic membrane was done. Tuning fork tests such as Rinne's, Weber's and Absolute Bone Conduction tests were performed. The patient's blood was subjected to routine blood investigations as hemoglobin, total count, differential count and platelets to rule out anemia, leukemia and other blood disorders. Fasting and postprandial blood sugar levels were measured. To assess the diabetic control of the patient in the last 3 months HbA1c was done and graded as: <7%-good control, 7-8%-moderate control and >8%-poor control.

Once the investigations were done and extent of disease is established, Pure tone audiometry was done. Pure tone stimulus is given to one ear at a time in frequencies of 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz and 8000Hz at various selected intensities. The duration of the

presentation of each stimulus is for 1-3 seconds and interval of 1-3 seconds between successive stimuli. The reference intensity level is designated 'X' dB at each frequency, which is the mean value of minimum audible threshold of pure tones in healthy individuals. Hearing threshold is taken as the least intensity of pure tone that was audible to the subject. Air conduction threshold is repeated for 1000Hz to assess the reliability of the procedure. Air conduction thresholds in the right and left ears were marked by 'O and X' respectively. Bone conduction threshold is obtained by using bone vibrator placed on the skin over the mastoid process and assessed to a maximum of 4000Hz. It is represented by symbols 'and' for right and left bone respectively. Masking is employed when the difference in right and left unmasked air conduction threshold is 40 dB or more. The hearing threshold grading according to WHO guidelines are graded as: ≤ 25 dB-normal hearing, 26-40 dB-mild hearing loss, 41-55 dB-moderate hearing loss, 56-70 dB-moderately severe hearing loss, 71-90 dB-severe hearing loss and ≥ 91 dB-profound hearing loss.

RESULTS

The occurrence of SNHL in diabetic patients was studied under the following parameters: prevalence of SNHL, age of the individual, gender of the individual, duration of diabetes and diabetes control.

Table 1: Prevalence of SNHL.

Characters	N	%
SNHL	45	60
Normal	30	40

Table 2: Distribution of patients according to degree of hearing loss (n=75).

PTA	N	%
<25	30	40
26-40	40	53.4
41-55	4	5.3
56-70	1	1.3

Range: 18.3-61.6.

Table 3: Distribution of patients according to age group (n=75).

Age (years)	N	%
35-40	8	10.6
41-45	12	16
46-50	19	25.3
51-55	36	48

Range: 35-55, Mean: 49.8 $\pm$ 4.7

In our study involving 75 type 2 diabetic patients, 45 patients (60%) were found to have SNHL and 30 patients (40%) were found to have normal hearing. In our study of 75 diabetes patients 30 had normal hearing, 45 patients had hearing loss in both the ears. Out of the 45 patients

with hearing loss 40 had mild hearing loss, 4 had moderate hearing loss and 1 had moderately severe hearing loss.

In our study prevalence of diabetes was more among 51-55 age group (48%) and least among 35-40 age group (10.6%). As the age advances, number of diabetic patients increase and majority of patients are in the 51-55 age group. In left and right ears, there is a progressive

increase in the prevalence of SNHL with the age of the patient. Prevalence of SNHL is lowest among 35-40 age group (12.5%) and highest among 51-55 age group (80.5%). Out of 75 diabetes patients 38 were females and 37 were males. Females constituted 50.7% of total patients and males constituted 49.3%. Association of hearing loss of DM patients with gender of the patient is not significant in both the ears as shown by the p value.

Table 4: Association of SNHL with age in left and right ear.

Age (years)	Left ear			Right ear		
	No hearing loss	SNHL	Prevalence	No hearing loss	SNHL	Prevalence
35-40	7	1	12.5	7	1	12.5
41-45	8	4	33.3	8	4	33.3
46-50	8	11	57.8	8	11	57.8
51-55	7	29	80.5	7	29	80.5

p<0.001

Table 5: Distribution of patients according to gender.

Gender	N	%
Male	37	49.3
Female	38	50.7

Table 6: Association of SNHL with gender in left and right ear.

Gender	Left ear			Right ear		
	No hearing loss	SNHL	Prevalence	No hearing loss	SNHL	Prevalence
Male	15	23	60.5	16	23	60.5
Female	15	22	59.4	15	22	59.4

p=0.713

Table 7: Distribution of patients according to duration of DM.

Duration of diabetes (years)	N	%
<5	19	32
5-10	25	33.3
>10	31	34.7

Range: 1-13, Mean: 7.6±3.6

Table 8: Association of SNHL with the duration of dm in left and right ear.

Duration of diabetes (years)	Left ear			Right ear		
	No hearing loss	SNHL	Prevalence	No hearing loss	SNHL	Prevalence
<5	12	7	36.8	12	7	36.8
5-10	10	15	60	10	15	60
>10	8	23	74	8	23	74

p<0.001.

In our study 19 patients (32%) had diabetes of duration 5 yrs. or less, 25 patients (33.3%) had 6-10 yrs duration, 43 patients (34.7%) had more than 10 yr duration. In both left and right ears of 19 subjects with <5 yrs duration of diabetes, 7 developed SNHL (prevalence of 36.8%). In 25 subjects with 5-10 yrs duration, 15 developed SNHL (prevalence of 60%) and in 31 subjects of >10 yrs duration, 23 developed SNHL which is highly significant. It is clearly seen that as duration of diabetes increases, the predisposition to SNHL also increases. Out

of the 75 diabetic patients 20 had HbA1c level less than 7 indicating good glycemic control, 15 had values between 7 and 8 indicating moderate glycemic control whereas 40 patients had values more than 8 indicating poor glycemic control.

In both left and right ears, the well-controlled group has less prevalence of SNHL (15%) compared to moderately controlled (66.7%) and poorly controlled group (80%).

Table 9: Distribution of patients according to HbA1c levels.

HbA1c	N	%
<7	20	26.7
7-8	15	20
>8	40	53.3

Range: 6-12, Mean: 8.4±1.6

DISCUSSION

The effect of diabetes in SNHL and its association to age, gender, onset, duration and glycemic control has been studied for over many years. 75 type 2 diabetes mellitus patients were selected and they were assessed for having SNHL. Also, they were evaluated based on; Prevalence of SNHL, Age, Gender, Duration of diabetes and Control of diabetes.

Table 10: Association of SNHL with HbA1c levels in left and right ear.

HbA1c levels	Left ear			Right ear		
	No hearing loss	SNHL	Prevalence	No hearing loss	SNHL	Prevalence
<7	17	3	15	17	3	15
7-8	5	10	66.7	5	10	66.7
>8	8	32	80	8	32	80

p<0.001

Prevalence of SNHL

Most of the studies have supported the association of SNHL with diabetes as per the available literature in recent times. In our study involving 75 patients of type 2 diabetes of age 35 to 55 yrs, the prevalence of SNHL was found to be 60% which is of gradual onset. In a study done by Friedman et al the prevalence of SNHL was found to be 55% among the type 2 diabetes mellitus patients.⁶ Aggarwal et al showed a prevalence of 64.86% in their study. Srinivas et al conducted a study and reported a 66% prevalence of SNHL in type 2 diabetes subjects.⁷ Shafeeq et al concluded in their study that 62.5% of the diabetes mellitus patients had SNHL.⁸ Rajendran et al found a SNHL prevalence of 73.3% in their study population of diabetes mellitus subjects.⁹ Due to different inclusion and exclusion criteria, methodology and diagnostic approaches there is a wide variation of results in the prevalence of SNHL in diabetics. The results of this study are matching with the results of Friedman et al, Kakarlapudi et al, Zelenka et al, Wackym et al, Garber et al, Srinivas et al, Shafeeq et al, Rajendran et al.⁶⁻¹³

Age

Review of literature shows varying results in different studies done through the years. In the present study, type 2 diabetic patients in the age group of 35 -55 yrs were taken and were divided into 4 age groups, 35-40yrs, 41-45 yrs, 46-50 yrs, 51-55 yrs and the prevalence of SNHL was 12.5%, 33.3%, 57.8% and 80.5% respectively and thus showing association between advanced age and SNHL. The p value was calculated and it was significant. In a study done by Aziz et al it was observed that with increasing age there was an increased prevalence of hearing loss in diabetes mellitus patients.¹⁴ Subjects in the age group of 21-30 had no hearing loss, in 31-40 age group 14% had increased hearing threshold, in 41-50 age group 43.9% had increased hearing threshold, in 51-60

age group 42.1% had increased hearing threshold. The p value was calculated and it was statistically significant. The results of the present study correlate with the results of Aziz et al, Sunkum et al, Irwin et al, Shafeeq et al.¹⁴⁻¹⁷ The results of this study are in contrast to the earlier studies carried out by Friedman et al, Kurien et al, Cullen et al, Jankar et al.^{6,16-20}

Gender

Many studies have compared the prevalence of SNHL in male and female diabetic patients. A multitude of varying results have been observed. In the present study 49.3% were males and 50.7% were females. Shafeeq et al conducted a study and concluded that among the type 2 diabetes patients, males had increased hearing threshold than females.¹⁷ Irwin et al conducted a study and concluded that female diabetic patients had more prevalence of hearing loss compared to male diabetic patients.

Studies conducted by Srinivas et al, Jankar et al, Rajendran et al concluded that there is no association between gender and increased hearing threshold among type 2 diabetes patients.¹⁶⁻²² In the present study, SNHL was found in 60.5% of female diabetics and 59.4% of male diabetic patients. The p value was 0.713 and it was statistically insignificant. Our study correlates with the studies of Srinivas et al, Jankar et al, Rajendran et al and showed no significant difference in SNHL among males and females in type 2 diabetes patients.^{9,21,22} The results of the present study are in contrast to that of Shafeeq et al and Taylor et al.^{16,17}

Duration of diabetes

In the present study the subjects were categorized into three groups based on duration of diabetes ≤5 yrs, 6-10 yrs, ≥11yrs. The prevalence of SNHL among the diabetic patients was calculated and it was noted to be 36.8%, 60% and 74% with the duration of diabetes ≤5 yrs, 6-10

yrs, ≥ 11 yrs respectively. In a study done by Srinivas et al the prevalence of SNHL were 35.7%, 68.75%, 85% with the duration of diabetes ≤ 5 yrs, 6-10 yrs and ≥ 11 yrs respectively.²¹ Our study correlates with Srinivas et al and showed an increased hearing loss with increasing duration of diabetes.²¹ It was seen that as the duration of diabetes increases to more than 6 years the prevalence of hearing deficit increases to a greater extent. The prevalence of SNHL increased to 74% with the duration of diabetes mellitus for more than 10 years.

Control of diabetes

Different studies have used different parameters of diabetic control to analyze the result. Some studies have taken FBS, PPBS as the parameter to know the diabetic control. Some studies have taken HbA1c as the variable to know the control of diabetes. The association of control of diabetes and SNHL has been most controversial through the years and to contemplate this HbA1c has been taken as a parameter in many studies. HbA1C directly gives an idea about the blood sugar control of the patient in the past three months. In the present study, the patients were categorized as good control, moderately controlled and poorly controlled diabetes based on HbA1c levels < 7 , 7-8 and > 8 respectively. In the present study, patient distribution according to HbA1c levels < 7 , 7-8, > 8 are 26.7%, 20% and 53.3% respectively. The prevalence of SNHL is 15%, 66.7% and 80% in patients with HbA1c levels < 7 , 7-8 and > 8 respectively showing a strong association between poorly controlled diabetes and prevalence of SNHL as p value was < 0.001 . The occurrence of SNHL in diabetics depends on the control of the disease according to many studies. In a study done by Srinivas et al the prevalence of hearing loss was seen to be increasing with poorly controlled diabetes i.e. HbA1c levels > 8 .²¹ Shafeeq et al conducted a study in diabetic patients and observed that the hearing loss was more in patients with poorly controlled diabetes than in patients with well controlled diabetes.¹⁷ Most of the studies have stated that a better control of diabetes delays or prevents the onset of SNHL in that person. Many studies have suggested that diabetes causes increased hearing threshold. It was tried to identify the cause by many and based on their conclusions, the probable mechanisms that affect the hearing threshold in diabetics are microangiopathy of the inner ear, neuropathy of the cochlear nerve, a combination of both, outer hair dysfunction and disruption of endolymphatic potential.²²

CONCLUSION

SNHL is prevalent in 60% of type II diabetic patients. SNHL in diabetes mellitus is usually gradual and bilaterally symmetrical. Hearing threshold increases with increasing age and increased duration of diabetes. There was no gender differentiation in increased hearing thresholds. Patients with poorly controlled diabetes (HbA1c > 8) had increased hearing thresholds.

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

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