

Original Research Article

Cross sectional study of sensorineural hearing loss in type 2 diabetes mellitus

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ABSTRACT

Background: The objective of the study was to evaluate the prevalence of sensorineural hearing loss in type 2 diabetes mellitus and to figure out a relation between age, sex, duration of diabetes and diabetic control.

Methods: A cross-sectional study was conducted at Geetanjali Medical College and Hospital for 1.5 years. Patients were known case of diabetes mellitus type 2 without any other systemic illness included in the study. A total of 115 patients were involved in the study and the informed consent was taken. A detailed examination and history related to hearing loss and diabetes status with treatment was elicited. All basic blood investigations were performed on all the patients. All the patients were subjected to pure tone audiometry and impedance audiometry in a sound proof room.

Results: The total prevalence of sensorineural hearing loss in the study subjects was found to be 80% with most of them having mild degree of sensorineural deafness. Increase in age, longer duration and uncontrolled diabetes are the factors which had higher risk of developing sensorineural hearing loss in the study subjects.

Conclusions: There is a strong association between sensorineural hearing loss and duration of diabetes mellitus-2. The threshold of hearing loss is increased mainly at the higher frequencies with diabetes.

Keywords: Type 2 diabetes mellitus, Prevalence, Sensorineural hearing loss, Pure tone audiometry

INTRODUCTION

Hearing is one of the important sense involved in development of human skills which has been known to be affected by many diseases since. The available records suggest that hearing loss has been identified around 1500 BC in ancient Egyptian era. It was reported by Jar dao in 1857 that diabetes mellitus causes hearing loss in a case series of diabetic coma.¹ Almost 278 million people around the world have hearing loss ranging from mild to severe hearing loss and more than half of them is preventable by early diagnosis, management and treatment, in which diabetes mellitus takes a major part. India has a diabetic population of 50 million people

which is expected to be doubled by 2030.² Diabetes mellitus (DM) is a metabolic disorder, due to relative or absolute lack of insulin resulting in elevated blood glucose levels associated with long term vascular and neurological complications.³ Apart from glucose metabolism disorders, diabetes mellitus is the one most commonly related with auditory disorders. Various studies has been shown that diabetes mellitus causes different types of hearing loss, One of them is progressive, gradual bilateral sensorineural loss, affecting especially high frequencies and the elderly. Similar to that of presbycusis, but with more severe losses than those expected by aging but the relationship between the two has been highly controversial.³

The aim of the present study is to evaluate the prevalence of sensorineural hearing loss in type 2 diabetes mellitus and to figure out a relation between age, sex, duration of diabetes and diabetic control.

METHODS

Study design and setting

The present study is a cross-sectional study of 18 months duration from January 2017 to July 2018 in 115 patients of DM-2 who visited E.N.T OPD of Geetanjali Medical College and Hospital, Udaipur. The study was conducted after getting ethical clearance from ethical committee. Written and informed consent was taken from the patients and attendant.

Sample size

The minimum sample required was 115. The sample size has been calculated using the formula,

$$n = [(z_{1-\alpha/2} + z_{1-\beta})^2 PQ] / E^2$$

Inclusion criteria

Inclusion criteria were type 2 diabetic patients on anti-diabetic treatment; patients having diabetes mellitus type 2; without any other systemic illness (hypertension, coronary artery disease, thyroid disorders); willing to undergo investigations

Exclusion criteria

Exclusion criteria were patients on dialysis; history of hearing loss prior to onset of diabetes; history of ear discharge, any other otologic lesion, otosurgical intervention; patients with history of head trauma, radiotherapy, ototoxic drug intake, noise exposure and smoking.

A detailed history involving hearing loss-its duration, onset, associated symptoms and diabetes -its duration, treatment was obtained from the patients who were selected on basis of the inclusion and exclusion criteria and were then subjected to a detailed ENT examination including otoscopic examination and tuning fork tests. Patients further underwent audiometric assessment-Pure tone audiometry (PTA), impedance audiogram (IA) and blood investigations-random blood sugar (RBS), glycosylated haemoglobin (HbA1c) and renal parameters like blood urea and serum creatinine.

The hearing threshold was graded as per World Health Organization (WHO) guidelines⁴,

- 0-25 dB- hearing within normal limits;
- 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;
- >90 dB- profound hearing loss.

Statistical analysis

With alpha error of 5% and beta error of 20% and the prevalence of sensorineural hearing loss found to be 63%. Thus total of 115 patients were taken under this study. The results were shown in the form of tables. Other appropriate and suitable statistical method like descriptive statistics, Chi-square test and Pearson's correlation were used for data analysis.

RESULTS

This study is based on 115 patients who were known case of diabetes type-2, who underwent hearing assessment and the prevalence of sensorineural hearing loss (SNHL) was compared with age, sex, duration, RBS, HbA1c and anti-diabetic treatment.

Table 1: Association between age and degree of hearing loss in the subjects.

		Age (in years)				Total	P value	
		Below 40	41 to 50	51 to 60	Above 60			
PTA	Normal	Count	3	8	11	1	0.766	
		% within PTA	13.0	34.8	47.8	4.3		100.0
	Mild	Count	6	18	34	2		60
		% within PTA	10.0	30.0	56.7	3.3		100.0
	Moderate	Count	3	3	21	1		28
		% within PTA	10.7	10.7	75.0	3.6		100.0
	Moderate severe	Count	0	0	3	0		3
		% within PTA	0.0	0.0	100.0	0.0		100.0
	Severe	Count	0	0	1	0		1
		% within PTA	0.0	0.0	100.0	0.0		100.0
	Total	Count	12	29	70	4		115
		% within PTA	10.4	25.2	60.9	3.5		100.0

Table 2: Association between sex and degree of hearing loss in the subjects.

		Sex		Total	P value	
		Male	Female			
PTA	Normal	Count	12	11	23	0.740
		% within PTA	52.2	47.8	100.0	
	Mild	Count	36	24	60	
		% within PTA	60.0	40.0	100.0	
	Moderate	Count	17	11	28	
		% within PTA	60.7	39.3	100.0	
	Moderate severe	Count	2	1	3	
		% within PTA	66.7	33.3	100.0	
	Severe	Count	0	1	1	
		% within PTA	0.0	100.0	100.0	
Total	Count	67	48	115		
	% within PTA	58.3	41.7	100.0		

Table 3: Association between duration of diabetes and degree of hearing loss in the subjects.

		Duration of disease					Total	P value	
		New	<1 year	1 to 4 years	5 to 9 years	10 years and above			
PTA	Normal	Count	12	5	3	2	1	23	0.005
		% within PTA	52.2	21.7	13.0	8.7	4.3	100.0	
	Mild	Count	14	5	23	11	7	60	
		% within PTA	23.3	8.3	38.3	18.3	11.7	100.0	
	Moderate	Count	2	0	10	9	7	28	
		% within PTA	7.1	0.0	35.7	32.1	25.0	100.0	
	Moderate severe	Count	2	0	1	0	0	3	
		% within PTA	66.7	0.0	33.3	0.0	0.0	100.0	
	Severe	Count	1	0	0	0	0	1	
		% within PTA	100.0	0.0	0.0	0.0	0.0	100.0	
Total	Count	31	10	37	22	15	115		
	% within PTA	27.0	8.7	32.2	19.1	13.0	100.0		

Table 4: Association between RBS level and degree of hearing loss in the subjects.

		RBS (mg/dl)			Total	P value	
		<140	140 to 200	>200			
PTA	Normal	Count	0	4	19	23	0.642
		% within PTA	0.0	17.4	82.6	100.0	
	Mild	Count	6	15	39	60	
		% within PTA	10.0	25.0	65.0	100.0	
	Moderate	Count	1	6	21	28	
		% within PTA	3.6	21.4	75.0	100.0	
	Moderately severe	Count	0	0	3	3	
		% within PTA	0.0	0.0	100.0	100.0	
	Severe	Count	0	0	1	1	
		% within PTA	0.0	0.0	100.0	100.0	
Total	Count	7	25	83	115		
	% within PTA	6.1	21.7	72.2	100.0		

Based on pure tone audiometry sensorineural hearing loss was graded as per World Health Organization (WHO) guidelines.⁴

The prevalence of SNHL in our study is 80%. Majority of the patients are in the age group of 51 to 60 years and the prevalence of SNHL is 60.9% (Table 1). The youngest

and oldest patients were 30 years and 70 years of age. Mean age was 55.5 years.

There were 67 males and 48 females in this study. Male to female ratio is 1.39: 1. The prevalence of SNHL is more common in males than females with 58.3% and 41.7% respectively (Table 2).

Duration of diabetes mellitus has significant association with SNHL. As the duration of disease increases the

prevalence of SNHL also increases (p=0.005). Patients who had history of diabetes for 1 to 4 years found to have high prevalence 32.2% of SNHL (Table 3).

Uncontrolled RBS level >200 mg/dl and HbA1c level >10% has high prevalence 72.2% and 48.7% of SNHL respectively (Table 4 and 5). It proves that poor control of diabetes has high risk of developing SNHL.

Table 5: Association between HbA1c level and degree of hearing loss in the subjects.

		HbA1c (%)			Total	P value	
		< 7	7 to 10	> 10			
PTA	Normal	Count	4	10	9	0.411	
		% within PTA	17.4	43.5	39.1		100.0
	Mild	Count	14	18	28		60
		% within PTA	23.3	30.0	46.7		100.0
	Moderate	Count	1	11	16		28
		% within PTA	3.6	39.3	57.1		100.0
	Moderately Severe	Count	0	1	2		3
		% within PTA	0.0	33.3	66.7		100.0
	Severe	Count	0	0	1		1
		% within PTA	0.0	0.0	100.0		100.0
	Total	Count	19	40	56		115
		% within PTA	16.5	34.8	48.7		100.0

Table 6: Association between type of medication and degree of hearing loss in the subjects.

		Type of medication			Total	P value	
		Oral	Parentral	Parentral and oral			
PTA	Normal	Count	8	10	5	0.378	
		% within PTA	34.8	43.5	21.7		100.0
	Mild	Count	25	13	22		60
		% within PTA	41.7	21.7	36.7		100.0
	Moderate	Count	13	4	11		28
		% within PTA	46.4	14.3	39.3		100.0
	Moderate Severe	Count	1	1	1		3
		% within PTA	33.3	33.3	33.3		100.0
	Severe	Count	0	0	1		1
		% within PTA	0.0	0.0	100.0		100.0
	Total	Count	47	28	40		115
		% within PTA	40.9	24.3	34.8		100.0

Patients who were on oral hypoglycemic agents had high prevalence 40.9% of SNHL. But the statistical analysis show that there is no relationship between SNHL and type of anti-diabetic treatment (p=0.378) (Table 6).

DISCUSSION

Type 2 diabetes mellitus (DM2) is a chronic metabolic disorder that occurs with advancing age. It is characterized by high blood glucose or insulin resistance and relative insulin deficiency. Previous studies have

shown that, because of diabetes related oxidative damage, increased apoptosis, and intracellular calcium toxicity, result in destructive neurodegenerative changes. The histopathological studies demonstrate that the nerves and vessels of the inner ear in subjects with DM2 are damaged by the sustained hyperglycemia, leading to neuronal degeneration within the auditory system. An evaluation of the existing literature showed that the relationship between diabetes and hearing loss is still controversial. There are some studies revealed an increased risk of hearing loss in diabetes patients, while

other studies did not find any differences in hearing loss between controls and diabetes patients.

In the present study prevalence of SNHL in diabetes is 80%. Previously conducted study shows that prevalence of SNHL in diabetes ranged from 20 to 90%. The results of present study are comparable to studies conducted by Rajendran et al with prevalence 73.3% and Hlayisi et al with prevalence 74%.^{5,6} However, low prevalence was seen in study by Nagoshi et al (54%) and Friedmann et al (55%).^{7,8} Variation may be seen in prevalence because of the different study period, sample size, inclusion and exclusion criteria.

In the present study maximum number of patients (n=70) were between age the group of 51-60 years with prevalence of 60.9%. Similar result seen in the study by Venkatasubbaiah et al where the (35 to 58 years) middle age group had high prevalence 63.3% of SNHL.⁹ It is well documented that incidence of hearing loss increase with age in patients with diabetes but the present study shows that age and hearing loss do not associate with each other (p=0.766).

In the present study amongst the total 115 patients there were 67 (58.3%) males and 48 (41.7%) females (p=0.740). Male to female ratio was 1.48:1 showing males were affected more than females. Similar results were seen in the study done by Weng et al and Celik et al where males were affected more than females with male to female ratio 1.31:1 and 1.28:1 respectively.^{10,11}

The present study shows statistically association between duration of diabetes and prevalence of SNHL (p= 0.005). As duration of diabetes increase the severity of hearing loss increase. Patients with duration of diabetes more than 1 year had high prevalence of SNHL (64.3%). Krishnappa et al and Mozaffari et al showed the similar result with significant p<0.005 and 0.007 respectively but this relation was deny by Bainbridge et al (p=0.07) and Kurien et al.¹²⁻¹⁵

Association between control sugar levels and degree of hearing loss is quite controversial. In the present study glycemic control of the patients measured by RBS and HbA1c level. Present study shows that there is no association between control of sugar levels RBS (p=0.642) and HbA1c (p=0.411) and degree of hearing loss. Similar results were found in study by Bainbridge et al and Weng et al.^{14,15} But uncontrolled sugar levels with RBS >200 mg/dl and HbA1c >7% has high prevalence of 72.2% and 83.5% of SNHL respectively. Garber et al shows uncontrolled sugar level has association with SNHL (p=0.038).¹⁶

In the present study type of antidiabetic treatment and hearing loss not correlate with each other with p value not reaching a statistical significance (p=0.378). Same results suggested by Bainbridge et al and Cullen et al.^{14,17} Although oral hypoglycemic show high prevalence

40.9% and parenteral shows low prevalence 24.3% of SNHL among DM2 patients.

Pure tone audiometry shows bilateral, progressive and high frequency SNHL. Same results were found in the study by Rózańska-Kudelska.¹⁸

CONCLUSION

Prevalence of hearing loss was found to increase in patients with DM2 (80.0%). Bilateral progressive hearing loss was noted in all frequencies but characteristically higher frequency hearing loss was found in type 2 diabetic patients. There was marked increase in the prevalence of SNHL in type 2 diabetics as the duration of diabetes increases (p=0.005). Male diabetic type 2 patients were found to be more affected with SNHL than their female counterparts (M: F=1.39:1). No association was found between blood sugar levels (p=0.642), glycosylated haemoglobin (p=0.411) and type of anti-diabetic treatment (p=0.378) with the SNHL of the patients suffering from DM2.

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Conflict of interest: None declared

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

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