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Evaluation of Auditor Functions in Diabetic patients in a tertiary care center, central India

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ABSTRACT

Background: sensorineural hearing loss (SNHL) is the common entity among uncontrolled diabetes patients, mainly in long term hyperglycemia. SNHL is mild to severe in nature. **Aims and Objectives:** The aims of this study were to evaluate sensory neural hearing loss in patients with diabetes mellitus (DM). **Materials and Methods:** We undertook that this prospective observational study which includes patients presented with DM to the department of ENT in Chirayu Medical College and Hospital, Bhopal, Madhya Pradesh, was planned for hearing evaluation during period of June 2020-November 2021, total 42 patients of age group 25-65 years were taken for the study. **Results**: On hearing assessment 29 (69.04%) cases were having SNHL and 13 (30.95%) cases were having normal hearing. Only 10 (23.80%) control were having SNHL and 32 (76.19%) control were having normal hearing. There was statistically significant association found between diabetes and SNHL. SNHL was found in less number of young cases and it was found in most of old age patients. **Conclusion:** The severity and prevalence of hearing loss are more if duration of hyperglycemia is more and if delay in starting treatment in diabetic child. SNHL is bilateral and mostly mild in the early stage.

Key words: Diabetes mellitus; Pure-tone audiometry; Sensory neural hearing loss

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INTRODUCTION

Auditory function is one of the important special senses which are important in our day to day life. Hearing enables us to communicate with family friends and colleagues and share feelings and knowledge with them. Hearing integral part of speech, which directly or indirectly affect our personal, social and economic status and quality of life.

Diabetes mellitus (DM) is a chronic disease caused by insufficient production of insulin hormone from pancreas gland or its ineffective use which leads to increase sugar level (Hyperglycemia).DM is of mainly of four types, type 1 diabetes is due to autoimmune destruction of pancreatic beta cells. is also known as insulin dependent diabetes or juvenile onset diabetes as it starts from childhood, type 2 is due to defect in insulin secretion and its metabolism, secondary diabetes related to genetic predisposition, drug use, unknown cause;-gestational diabetes[1].

Data shows that total burden of DM in India was around 40.9 millions till 2016 and by 2025 it would be around 69.92 million[2].

Chronic hyperglycemia (DM) is known for its long term complication which may be microvascular or macrovascular. Microvascular complications affect kidney, eyes, and peripheral nerves while Macrovascular complication includes coronary artery, cerebral artery, and peripheral artery[3].

The most common causes of auditory function pathology are related to glucose, thyroid, and supra-adrenal metabolic disorders. Among glucose metabolism disorders DM is

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closely associated with auditory functions. Long term hyperglycemia leads to diffuse thickness of basal membrane, which may also happen with vascular endothelium so known as diabetic microangiopathy. Microangiopathy is more evident in skin capillaries, skeletal muscles, renal glomeruli, renal medulla and auditory pathway[4].

Pathogenesis of this impairment of hearing in diabetics is not fully understood and histopathologic studies on the inner ear of diabetics have been scanty. Factors related to the diabetic disorders have been thought to be duration of the disease, age of the patient, blood sugar level, blood pressure, toxic effects of unknown metabolic products, and chronic disturbance of blood supply due to arteriosclerosis in the labyrinth and bleeding in the labyrinth or acoustic nerve. There are some reports denying the significance of these factors[5].

Human ear can hear sound waves between the frequencies of 20- 20,000Hz. Most of our speech sound waves are in range of 500- 4000Hz and the normal conversation sound is in between 45 and 60 dB. Degree of hearing loss depends upon tympanic membrane, ossicular status, cochlea and auditory nerve function. Pure tone audiometry is great tool to identify type and degree of hearing loss.

PTA and impedance audiometric test can differentiate cochlear and retro cochlear hearing loss up to some extent, BERA is most sensitive, accurate, noninvasive, cost effective objective tool to diagnose cochlear and retrocholear pathology in children and adult[6].

Aims and objectives

The aims of this study were to evaluate sensory neural hearing loss in patients with DM.

MATERIALS AND METHODS

We undertook that this prospective observational study which includes patients presented with DM to the Department of ENT in Chirayu Medical College and Hospital, Bhopal, Madhya Pradesh, was planned for hearing evaluation during period of June 2020-November 2021, total 42 patients of age group 25 to 65 years were taken for the study.

Inclusion criteria

Total 42 diabetic patients (diagnosed by standard criteria) of age group25 -65 years were taken for the study and similar age control was taken.

Age-matched 42 non diabetic without any ear complaints control group presented to outpatient clinics of otorhinolaryngology were also reviewed.

This study was conducted in patients, subjected to detailed history, ENT examination, and audiological evaluation.

Exclusion criteria

Those patients who showed hearing defects in the family, intrauterine infections, perinatal hypoxia, patient with external and middle ear pathology, long term therapy with amino glycosides, acoustic trauma in the past and previous ear surgery were excluded from the study.

Patients diagnosed with DM underwent pure tone audiometry. All these investigations were routine and noninvasive, ethical approval has been taken from concerning institutional Ethical Committee. In our study detailed audiological assessment done in patients who were clinically proven diabetic to evaluate degree and nature of hearing loss.

Prior selections for the study impedance audiometry were done in all the subjects. All diabetic patients were treated during and after study. Follow up audiometry is done in hearing impaired patients after 3 months and 6 months.

Pure tone audiometry was done after obtaining normal values in 32 healthy persons. Normal hearing was taken as threshold level of below 25 dBHL at all frequency from 500 to 8000Hz.

Statistical analysis

All results were analyzed and calculated statistically by using the SPSS program (Statistical Package for Social Sciences) version 22. Statistical analysis had done for two groups (control and diabetic group). Various statistical data were calculated by Pearson chi-square test or Fisher's exact test. P-value ≤ 0.05 considered at statistically significant.

RESULT

In our study total 42 patient of age group 25-65years were taken. The mean age of control and diabetic group was 48.2 years and 51.5 years.

Out of 42 diabetic case;19 (45.23%) were male and 23 case (54.76%) were female. while among 42 controls, 25 (59.52%) were male and 17 (40.47%) were female. Statistically insignificant difference was found in SNHL according to gender among both cases. On clinical assessment otoscopy was normal in all patients.

The mean FBS was 165.23 mg/dl, PPBS 210 mg/dl and glycosylated haemoglobin (HbA1c) 7.9% in diabetic group and mean of control group was FBS 105.65 mg/dl, PPBS 160 mg/dl and HbA1c 5.2%.

Table 1: Comparison of PTA (air conduction and bone conduction) among control group and diabetic group

Test	Ear	Control Group (n=42)		Diabetic Group (n=42)		P value
		Mean	SD	Mean	SD	
PTA (Air conduction in dB)	Right	11.15	1.65	17.50	9.43	0.001
	Left	10.80	1.45	18.31	9.98	0.004
Bone Conduction (dB)	Right	11.15	1.19	14.42	7.59	<0.001
	Left	7.20	1.72	14.90	7.91	<0.001

P-value<0.05=significant; Not significant (p>0.05)

Table 2: Distribution of hearing loss and with their HbA1c Levels in the study Subjects

HbA1C	Sensory Neural Hearing Loss		Total	P value
	Absent	Present		
<7	6	2	8	P-<0.05
7-8	2	4	6	
>8	5	23	28	
Total	13	29	42	

P<0.05=significant

Impedance audiometry

The mean ear canal volume in control group was 1.19 ml in the left earand1.16 ml in the right on other hand in diabetic patients ear canal volume was 0.91ml in the left and 0.87 ml in the right.

The mean static compliance was 0.50 ml and 0.51 ml in the right ear in control and in diabetic group and in the left ear it was 0.66 ml and 0.67ml respectively.

Mean middle ear pressure was 7.85 daPa and 1.54 daPa in control and diabetic group respectively.

Pure tone audiometry

Average air conduction threshold at frequencies 500Hz, 1000Hz and 2000Hz was calculated.

The mean air conduction threshold in the right ear of control group was 11.15dB and diabetic group was 17.50dB in the left ear it was 10.80dB and 18.31dB respectively

Bone conduction threshold

Mean bone conduction in the right ear was 11.15 dB and 14.44dB and in the left ear was 7.20dB and 14.91dB in control and diabetic group respectively. Comparison of air and bone conduction shown in Table 1.

Hearing loss

On hearing assessment 29 (69.04%) cases were having SNHL and 13(30.95%) cases were having normal hearing. SNHL was found inonly10 (23.80%) control and 32 (76.19%) control was with normal hearing. Out of the 29 subjects with hearing loss, 24 had mild hearing loss and 5 had moderate hearing loss.

There was statistically significant association found between diabetes and SNHL. SNHL was found in less number of young cases and it was found in most of old age patients. It showed that as age increases, frequency of SNHL is also increased. There was statistically significant association was found between age and sensorineural hearing loss among cases while among control no significant difference found in SNHL according to age.

Out of the 42 diabetic subjects, eight had HbA1c level < 7 indicating good glycemic control, six had values between 7 and 8 indicating average glycemic control, whereas 28 subjects had values more than eight indicating poor glycemic control. Distribution of SNHL and their HbA1C levels shown in Table 2.

Comparing Speech Increment Sensitivity Index (SISI) with hearing loss among cases and controls showed that SISI was less than 70% among 14 cases and 40 controls while it was 70–100% among 28 and two case and controls respectively.

DISCUSSION

DM is known for its long term complication of any part of our body from brain to diabetic foot. SNHL is also one of its complication hence knowledge of these complication is mandatory for medical professionals as well as patients so that early precaution can be taken to prevent these complications.

In our study on hearing assessment 29 (69.04%) cases were having SNHL and 13(30.95%) cases were having normal hearing. Only 10 (23.80%)control were having SNHL and 32 (76.19%) control were having normal hearing.In study of Agarwal et al the sensorineural deficit was found 69% and 64% of the diabetics with (Group B)and without (Group A) neuropathy respectively[7].

In our study SNHL was found in less number of young cases and it was found in most of old age patients. It showed that as age increases, frequency of SNHL is also increased. There was statistically significant association was found between age and SNHL among cases while among

control no significant difference found in SNHL according to age. In study of Srinivas et al[2] SNHL in older age group clarifies the strong association between advanced age and SNHL (P-0.0256), which is contrast to the earlier studies carried out by Friedman et al[8] and Cullen and Cinnamond et al[9]. It is difficult to distinguish whether hearing loss in diabetes is due to normal process of aging or due to biochemical and the vascular abnormalities associated with diabetes.

Srinivas et al showed significant association between the duration of the DM and SNHL. 35 % diabetic patient had SNHL if duration is < 5 years compared 85 % whose duration was > 10 years. It was also noted that there was increase in hearing threshold with increase in duration of DM. It was seen that as duration increases > 6 years, the percentage of hearing deficit increases to a greater extent. The increase in hearing threshold is attributed to microvascular angiopathy occurring in capillaries of striavascularis which make these vessels thicker than normal. These changes can occur in vessels supplying other parts of auditory system as well. Older diabetic patients had higher incidence of hearing loss and they had severe grade hearing loss. This result is supported by Virteniemi et al[10].

In our study patients with poor control of DM and elevated HbA1c had increased SNHL similar finding seen in the study of Srinivas where incidence of SNHL among poorly controlled patients with HbA1c was 85.71 % whereas it was 62% and 38 % among patients in moderately controlled and well controlled with HbA1c 7–8, and\7 respectively**,** hence screening of all patients with diabetes for hearing loss in a multicenter longitudinal study in future may provide a clearer understanding of the relationship between diabetes and hearing loss. Diabetic patients can be advised to keep their glycemic levels under good control to prevent hearing loss.

In our study SISI with hearing loss among cases and controls showed that SISI was less than 70% among 14 cases and 40 controls while it was 70–100% among 28 and two case and controls respectively.

Study of Mishra and Poorey et al[11] association of Speech Discrimination Score (SDS) with hearing loss revealed that most of (58%) cases had 80–90% SDS score while most of the (82%) controls had 90–100% SDS score ($p = 0.001$). A study conducted by Curhan et al[12] found that diabetes had a negative effect on auditory function in aged type 2 diabetic subjects. The speech discrimination test that measures both the peripheral and central auditory systems also showed a decline in diabetics.

In our study association of SDS with hearing loss revealed that most of 22 (52.38%) cases had 80–90% SDS score while most of the 35 (83.33%) controls had 90–100% SDS score.

In our study SISI was less than 70% among 15 (35.71%) and 40 (95.23%) subjects in cases and controls while it was 70–100% among 27 (64.26%) and 2 (4.76%) subjects in cases and controls. Similar result found in the study of Fransen et al[13].

Limitation of the study

Limitation of the our study was less sample size, results may be altered on increasing sample size

CONCLUSION

Neurological disturbances such as speech delay, motor delay and lower IQ were reported in children with DM 1. The severity and prevalence of hearing loss are more if duration of hyperglycemia is more and if delay in starting treatment in child. SNHL is bilateral and mostly mild in the early stage

The aim of the present study is to study the hearing loss among children with DM 1and its management in form of hearing rehabilitation and auditory verbal therapy. The early Screening program in pediatric center for DM 2 may significantly decreased hearing impairment cases and associated pathology.

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RM-Concept and design of the study, prepared first draft of manuscript;, Interpreted the results; **VT-** reviewed the literature and manuscript preparation; **RC-** Concept, coordination, statistical analysis and interpretation; **KM-** revision of the manuscript and correspondence of the manuscript.

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