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Original Research Article

Relation of Type 2 Diabetes and Hemoglobin with Auditory Acuity

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ABSTRACT

Introduction: Diabetes-related sensorineural hearing impairment affects people's ability to hear and understand sounds. This is a case control study with the purpose of determining the hearing loss in type II diabetes mellitus in relation to the Hemoglobin of the patients.
Method: 50 diabetic patients and 50 age and sex matched controls who have satisfied inclusion and exclusion criteria and have consented to participate in study were enrolled. They were evaluated by Tuning fork tests and Pure Tone Audiometry.
Result: The hearing of diabetics was significantly impaired than the non-diabetic control group. This hearing impairment was noted in all the frequencies tested. Significant difference in hearing loss was observed when the hemoglobin level was low and within normal limits (below 14 gm/dl). However, at high hemoglobin levels, the difference in hearing loss among control and diabetic group was statistically non-significant.
Conclusion: Type 2 diabetes causes significant hearing loss in the patients, and it is affected by the Hemoglobin of the patient particularly at low levels.

Key words: Audiometry, Diabetes, Sensorineural hearing loss

INTRODUCTION

Diabetes Mellitus 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. [1] Among glucose metabolism disorders, diabetes mellitus is the one most commonly related with auditory disorders. Type-2 diabetes mellitus (T2DM) is the predominant form of diabetes worldwide accounting for 90% of cases globally. One of the worst affected nations in the South East Asia region is India. [2] The most common complications of diabetes are diabetic ketoacidosis, hyperglycemic hyperosmolar coma, diabetic retinopathy, macular oedema, neuropathy, coronary artery disease, peripheral vascular disease and cerebrovascular disease. [3] Hearing impairment is one of the under recognized complications of diabetes. The characteristic finding in diabetes mellitus is a progressive, gradual, bilateral symmetrical sensorineural hearing loss (SNHL) particularly in higher frequencies. [4] It would be similar to presbycusis, but with more severe losses than those expected by ageing. [5] Pure tone Audiometry is a simple, non-invasive test and can detect type and degree of the hearing loss. [6] Pure tone Audiometry involves the estimation of the threshold of hearing for certain standardized stimuli via the air and bone conduction routes. [7] Since many studies have reported contradicting results regarding hearing impairment in diabetic patients and only a few studies are done in India hearing impairment in diabetic patients in relation with heamoglobin level, the present study is undertaken to determine the incidence of

auditory dysfunction in type-2 diabetes persons and whether or not such auditory dysfunction could be correlated with the Hemoglobin levels.

MATERIALS AND METHODS

Study Design: Present study is a case control study involving 100 subjects, divided into two groups. Group-1 compromised 50 voluntarily willing normal, healthy subjects Group-2 compromised 50 voluntarily willing diabetic patients.

Method: Group 1: Inclusion Criteria included normal, healthy subjects of either sex between 20 and 50 years. Exclusion Criteria 1) Hypertension 2) Diabetes mellitus, 3) History of consumption of ototoxic drugs in past three months, 4) History of ear surgeries, 5) History of recent infections in ear, nose or throat.

Group2: Inclusion Criteria included Type 2 diabetic patients of either sex between 20 and 50 years. Exclusion Criteria 1) Hypertension 2) History of consumption of ototoxic drugs in past three months. 3) History of ear surgeries, 4) History of recent infections in ear, nose or throat. Informed and written consent, questionnaires including personal information (age, H/o of surgery, drugs, occupation) was obtained. Institutional ethical committee had cleared the project.

Tests for Hearing: The tuning fork tests- Weber test, Rinne test and Absolute bone conduction tests were done for both the ears of all subjects.

Pure Tone Audiometery - is the most routine audiometric evaluation. It is based on the measurement of hearing thresholds for a range of pure tones presented through earphones according to the ascending method (Hughson – Westlake, up 5, down 10 method) Audiological examination was performed using a Pure Tone Audiometer model (EDA Giga 3 of ELKON). The audiometer [ELKON EDA Giga 3] is an electronic device that produces pure tones, the intensity of which can be increased or decreased in 5-dB steps. It was performed in a sound proof room in the ENT department, MGM'S Medical College and Hospital. The patient was described what will happen during the test and the purpose of the test. Ear phones were used to test hearing by air conduction and a small vibrator placed over the mastoid was used to test hearing by bone conduction. All audiometers incorporate a calibration circuit, which allows the output sound level to be set at each frequency. The signals presented to the subject by an audiometer were characterized by its frequency, sound pressure level and wave form which were all controlled. Biological calibration was done every day before starting the test. Both air and bone conduction were tested for each ear. Air conduction thresholds were measured for tones of 250, 500, 1000, 2000, 4000 6000 and 8000 Hertz. Bone conduction thresholds were measured for 250, 500, 1000, 2000, 4000 Hz.

Statistical analysis: The hearing loss was evaluated on the basis of the values of PTA obtained for right and left side. PTA values exceeding 25 indicated hearing loss. On the basis of PTA >25, the comparisons within and among various groups were evaluated by students t test. 'p'value >0.05 was considered non significant, 'p'value <0.05 was considered significant, 'p'value <0.01 was considered highly significant,

RESULTS AND DISCUSSION

100 subjects (group1, normal, healthy n-50) and (group 2, diabetic n-50) that have satisfied the inclusion and exclusion criteria were selected.

Table 1: Comparative statistics: of age, blood sugar level (fasting and post meal) Pure Tone Audiometry (right & left ear)

	Parameter	Control (n=50)	Diabetic (n=50)
1	Age	39.3 ± 6.42	40.34 ± 6.13
2	BSL – F	85.46 ± 6.34	190 ± 53.23
3	BSL – PP	112.4 ± 6.43	285.06 ± 74.42
4	PTA – R	17.86 ± 6.58	25.04 ± 16.32
5	PTA – L	17.74 ± 5.43	26.58 ± 16.02
6	SNHL Total - Mild - Moderate - Mod-Severe - Severe - Profound	6 4 2 - - -	37 20 10 3 3 1

Table – 1: Shows the comparative data. There were 100 subjects, controlled, nomoglycemic n =50 and hyperglycemic n = 50 in the age range of 28 to 50 years. In the control group the fasting sugar and post meal glucose ranged from 76 to 102 mg/dl. and 98 to 124 mg/dl. The fasting blood glucose and post meal glucose in hyperglycemic group ranged from 96 to 368 mg/dl and 120 to 556 mg/dl. Based on pure tone average a total of 6 subjects in controlled group were found to have SNHL (4 mild and 2 moderate) and 37 subjects in hyperglycemic group (20 mild, 10 mod, 3 mod-severe, 3 severe and 1 profound) were found to have SNHL.

Table-2 Comparison of Hearing Loss between Control and Diabetic Group

Hearing Loss	Control (n=50)	Diabetic (n=50)	't' Value	'p' Value
SNHL – R	17.86 ± 6.57	25.04 ± 16.31	2.885963	0.004799
SNHL - L	17.74 ± 5.43	26.58 ± 16.01	3.69526	0.000362

Table – 2: showed highly significant increase in PTA levels in both ears in diabetic patients where compared with controls. Based on this observation, it was found that diabetic subjects were more prone to developing SNHL when compared with controls.

Table- 3 Comparison between Hemoglobin and hearing loss in diabetic and control groups.

Hb gm %	Groups	Mean ± SD (Right ear)	t value	P value	Groups	Mean ± SD (Left ear)	t value	P value
< 10	Controlled diabetics	15.25±2.16 38.5±21.5	7.608	0.0001	Controlled diabetics	13.25±3.11 38±23	7.5405	0.0001
10 to 14	Controlled diabetics	18.30±6.99 15.71±3.20	3.413	0.0009	Controlled diabetics	18.04±5.32 28.46±15.83	4.1539	0.0001
>14	Controlled diabetics	15.75±2.86 16±3.26	0.407	0.6844	Controlled diabetics	16±6.20 15±2.16	1.0770	0.2841

Table – 3 shows significant difference in hearing loss when the hemoglobin level was low and within normal limits (below 14 gm/dl). However, at high hemoglobin levels, the difference in hearing loss among control and diabetic group was statistically non-significant.

DISCUSSION

Most of the recent studies show an association of SNHL with diabetes. This study also supports the association of SNHL with diabetes with an incidence of 74% as compared to 12% among non-diabetics. All diabetic patients who reported hearing loss had slow progressive hearing loss In this study diabetic patients had a higher threshold for high frequency. This study showed significant difference in hearing loss, when the hemoglobin level was low (below 14 gm/dl). One of the possible reasons is ischemic damage to inner ear due to reduced blood flow via the labyrinthine artery (which is highly sensitive to ischemic). Another potential mechanism is that reduced iron in the body causes the breakdown of lipid saturase and desaturase, both of which are important in energy production and, consequently, the production of myelin. If the myelin coating the auditory nerve is damaged, hearing could be reduced. [8]

The pathogenic effects of diabetes on the ear can be broadly grouped into neuropathic, angiopathic, and a combination of the two. The tissue effects of diabetes are thought to be related to the polyol pathway, where glucose is reduced to sorbitol. Sorbitol accumulation is implicated in neuropathy by causing a decrease in myoinositol content, abnormal phosphoinositide metabolism, and a decrease in Na+/K+ ATPase activity. [9] Makishima and Tanaka observed severe atrophy of the spiral ganglion in the basal and middle turns of the cochlea in diabetic patients with SNHL. They also observed that the VIIIth nerve showed signs of myelin degeneration, with fibrosis of the perineurium. The diabetic patients with Microangiopathic changes in the endolymphatic sac, stria vascularise and

basilar membrane were noted to have the greatest degree of hearing loss. [10,11]

CONCLUSIONS

In present case controlled study there was a significant increase in incidence of sensorineural hearing loss in the diabetic group as compared to the control group.

There was significant increase in hearing loss in diabetics when the hemoglobin level was low and within normal limits of 10 to 14 g/dl. as compared to controlled subjects with low and normal heamoglobin (10 to 14g/dl.) However, at high hemoglobin levels, the difference in hearing loss among control and diabetic group was non-significant.

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