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Physiology

IMPACT OF AGE AND HEARING LOSS IN TYPE 2 DIABETES

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ABSTRACT Diabetes-related sensorineural hearing impairment affects people's ability to hear and understand sounds. We carried out this case control study with the purpose of determining the hearing loss in type II diabetes mellitus in relation to the Age of the patients using tuning fork tests and pure tone audiometry.

AIM: To study the hearing loss in type II diabetics and controls.

OBJECTIVES: 1. To study the hearing loss in relation to diabetics and controls. 2. To study the effect of age on hearing loss in diabetic patients

MATERIAL AND METHODS: 50 diabetic patients and 50 age and sex matched controls took part in the study. They were evaluated by Tuning fork tests and Pure Tone Audiometry.

RESULTS: The hearing of diabetics was significantly impaired than the non-diabetic control group. This hearing impairment was noted in all the frequencies tested. The hearing loss was significant in both ears patients with age above 41 years.

CONCLUSION: Type 2 diabetes causes significant hearing loss in the patients, and it is affected by the Age of the patient.

KEYWORDS : Audiometry, Diabetes, Sensorineural Hearing Loss, Age.

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. Diabetes Mellitus (DM) represents one of the most challenging public health problems of the 21st century and has reached epidemic levels globally[2] 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.[3] 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.[4] 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.[5] It would be similar to presbyacusis, but with more severe losses than those expected by ageing.[6] Pure tone audiometry is a simple, non-invasive test and can detect type and degree of the hearing loss.[7] Pure tone audiometry involves the estimation of the threshold of hearing for certain standardized stimuli via the air and bone conduction routes.[8] Since many studies have reported contradicting results regarding hearing impairment in diabetic patients and only a few studies are done in India, the present study is to be undertaken to determine the incidence of auditory dysfunction in type-2 diabetic persons and it's correlation with age.

AIM

To study the impact of age and auditory acuity in type 2 diabetics and controls.

OBJECTIVES

1. To record pure tone audiometry in type 2 diabetics and controls.
2. To study auditory acuity in relation to Age of diabetic patients.

MATERIALS AND METHODS

The study was conducted at MGM's medical college and hospital, Aurangabad. The subjects were divided into two groups.

- Group-1 compromised fifty voluntarily willing normal, healthy non-diabetic subjects (n=50) of either sex selected from the patient attenders in MGM hospital OPD, belonging to the ages between 20 and 50 years.
- Group-2 compromised fifty voluntarily willing diabetic patients on medication (n=50) of either sex from the OPD of department of medicine, belonging to the ages between 20 and 50 years.

METHOD OF COLLECTION OF DATA

The study of diabetics and non-diabetics are to be selected based on inclusion and exclusion criteria after taking informed, written consent and getting ethical committee approval.

INCLUSION CRITERIA (GROUP 1)

Normal, healthy subjects of either sex between 20 and 50 years who will give written consent will be included.

INCLUSION CRITERIA (GROUP 2)

Type 2 diabetic patients of either sex between 20 and 50 years who will give written consent will be included.

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.

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[9]

Pure Tone Audiometry is the most routine audiometric evaluation and the resulting pure tone audiogram is widely used as a basic description of the degree of hearing loss. Audiological examination was performed using a Pure Tone Audiometer model EDA Giga 3 of ELKON company in a sound proof room in the ENT department, MGM'S Medical College and Hospital. 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.

This test was 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) 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. Air conduction thresholds are measured for tones of 250, 500, 1000, 2000, 4000 6000 and 8000 Hertz. Bone conduction thresholds are measured for 250, 500, 1000, 2000, 4000 Hz.

STATISTICAL ANALYSIS

The data were statistically analysed with the help of MS Excel 2010. The values for mean, standard deviation and coefficient of variation (C.V.) were calculated and relationship of various parameters with each other were quantified by calculating correlation coefficient (r). 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 (paired as well as unpaired).

RESULTS

Table 1. Demographic Data for the 100 Subjects

	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	6	37
	- Mild	4	20
	- Moderate	2	10
	- Mod-Severe	-	3
	- Severe	-	3
	- Profound	-	1

Table – 1: Shows the demographic data. There were 100 subjects, controlled (Nomoglycemic) n =50 and Hyperglycemic n = 50 in the age range of 28 to 50 years. 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: Shows the comparison of hearing loss between control and Diabetic group based on pure tone average in right and left ear. The study showed highly significant increase in PTA levels in both ears in diabetic patients when 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 of Hearing Loss in Different Age Groups in Diabetics.

RIGHT EAR

Age Group	Hearing Loss (PTA)	't' Value	'p' Value
20 – 30 (n=5)	33 ± 5.76	–	–
31 – 35 (n=10)	34 ± 13.04	0.1614	0.8742
36 – 40 (n=12)	35.25 ± 8.79	0.2676	0.7917
41 – 45 (n=13)	51.17 ± 23.83	2.1785	0.0399
46 – 50 (n=10)	33 ± 9.27	2.2726	0.0337

LEFT EAR

Age Group	Hearing Loss (PTA)	't' Value	'p' Value
20 – 30 (n=5)	34 ± 7.23	–	–
31 – 35 (n=10)	34.67 ± 12.55	0.1094	0.9146
36 – 40 (n=12)	31.33 ± 1.7	0.9163	0.3704
41 – 45 (n=13)	54.28 ± 22.25	3.5576	0.0017
46 – 50 (n=10)	34.2 ± 6.37	2.7549	0.0119

Table – 3: Shows comparison of hearing loss in different age groups in diabetics. The findings show that there was significant hearing loss in the right ear in the age group of 41 to 45 years (p=0.0399) and in the age group of 46 to 50 years (p=0.0337) respectively. The findings also show significant hearing loss in the left ear in the age group of 41 to 45 years (p=0.0017) and in the age group of 46 to 50 years (p=0.0119) respectively.

DISCUSSION

Most of the 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. Friedman[10] had (55%) hearing loss and Agarwal[11] had (64.86%) hearing loss. The hearing loss was characteristically bilaterally symmetrical and progressive with gradual onset, however asymmetry in the hearing loss was also noticed in few patients. All diabetic patients who reported hearing loss had slow progressive hearing loss but Shuen Fu in 2005 reported sudden onset SNHL in diabetes.[12]. Edgar[13] in 1915 was the first to report a high frequency sensorineural hearing loss in diabetic patient. Our study also shows a higher threshold for high frequency. The hearing loss is more common in higher frequencies in the study done by Kurien M et al[14] in 1989 and Cullen R etal[15] in 1993. But this was not supported by Tay HL[16] in 1995 and he concluded that hearing loss was in mid and low frequencies while Fangcha MA[17] in 1998 found hearing loss in diabetics only in 500 Hz frequency.

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. [18]

The pathophysiology underlying diabetes associated hearing loss may involve the effect of diabetes-related microvascular disease (microangiopathy) on the cochlea. High blood glucose levels causes formation of glycoproteins on the surface of endothelial cells and also causes the basement membrane in the vessel wall to grow abnormally thicker and weaker. Therefore, these small vessels leak and slow the flow of blood resulting in tissue damage due to reduced supply of oxygen and other nutrients. Few microscopic studies show sclerosis of the internal auditory artery, thicker vessel walls of the striavascularis and of the basilar membrane.[19]

Studies show damage to the outer sheath (demyelination) of the cochlear nerve, with fibrosis of the perineurium and atrophy of the spiral ganglion (linking the cochlear nerve and the brain), indicating a neurological etiology to diabetes related hearing impairment (neuropathy) [18,20]. This could result from diabetic microvascular injury to blood vessels that supply nerves (vasa nervorum) leading to neuronal ischemia. Atherosclerosis, a consequence of diabetes, was also documented to be responsible for neuronal degeneration in the inner ear.

CONCLUSIONS

1. There was a significant increase in incidence of sensorineural hearing loss in the diabetic group as compared to the control group.
2. In the control group most of the subjects (88%) presented with normal hearing and only a few subjects (12%) presented with mild to moderate hearing loss.
3. In the diabetic group 74% of the subjects presented with sensorineural hearing loss. Thus only 26% subjects had normal hearing.
4. Age of patient plays an important role in causing hearing loss along with Type 2 Diabetes Mellitus

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