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RESEARCH ARTICLE

TO STUDY ROLE OF GLYCOSYLATED HEMOGLOBIN IN HEARING COMPLICATION OF DIABETES

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ABSTRACT

Introduction: Diabetes mellitus has been implicated as independent causative factor of bilateral sensorineural hearing loss. 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 control of diabetes.
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. The hearing acuity was compared with control of diabetes. The hearing loss was highly significant in uncontrolled diabetics when compared with subjects having controlled diabetes.
Conclusion: Type 2 diabetes causes significant hearing loss in the patients, and control of diabetes is also a highly significant cause of hearing loss.

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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. (Gareth Williams and John C. Pickup, 2003) 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. (Buse *et al*., 2011) 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. (Powers, 2012) 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. (Kalli *et al*., 2012) It would be similar to presbyacusis, but with more severe losses than those expected by ageing. (Taylor and Irwin, 1978; Irani and Isaac David, 2017) Pure tone Audiometry is a simple, non-invasive test and can detect type and degree of the hearing loss. (Biswas, 2009) Pure tone Audiometry involves the estimation of the threshold of hearing for certain standardized stimuli via the air and bone conduction routes. (Kerr and Stephans, 1997) Since many studies have reported contradicting results regarding hearing impairment in diabetic patients and only a few studies are done in India on hearing impairment in diabetic patients, 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 control of diabetes.

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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 Criteria1) 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.

Group 2: 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. Group2 subjects were screened to identify the control of diabetes by grouping: $HbA_1C < 8$ and $HbA_1C > 8$.

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. Blood sample of the diabetics was collected in EDTA bulb for HbA1C analysis and were tested in the central laboratory. The sample was processed in the VITRIOS 5600 integrated system. Based on the results the diabetics were divided into two groups, one group with HbA1C < 8 (controlled diabetes) and the other group with HbA1C > 8 (uncontrolled diabetes).

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

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: shows that there was highly significant difference between the hearing loss in uncontrolled diabetics when compared with subjects whose diabetes was under control.

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 were more prone for high frequency hearing loss. There was significant hearing loss in diabetics having HbA_1C levels > 8 when compared with diabetics having HbA_1C levels < 8. This finding suggests that keeping diabetes under control can help in preventing auditory complications. The pathophysiology underlying diabetes associated hearing loss may involve the effect of diabetes-related microvascular

Table 3. Comparison of Hearing Loss in Relation to Control of Diabetes

Diabetes (n=50)	HbA1C < 8 n= 29	HbA1C > 8 n= 21	't' Value	'p' Value
PTA – R	16.07143 ± 3.115956	38.72727 ± 16.90127	5.865911	0.001
PTA – L	18.38462 ± 3.431494	38.625 ± 17.35851	5.714845	0.001

disease (microangiopathy) on the cochlea. (Lisowska *et al*., 2001) 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 through the body 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. (Costa, 1967) 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). (Williamson and Killo, 1977) Other studies show atrophy of the spiral ganglion and demyelination of the eighth cranial nerve indicating a neurological etiology to diabetes related hearing impairment (neuropathy) (Makishima and Tanaka, 1971). 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. 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 (Makishima and Tanaka, 1971). They also observed that the VIII nerve showed signs of myelin degeneration, with fibrosis of the perineurium.

Conclusion

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. Significant difference in hearing loss was observed when the HbA_1C level was high showing higher incidence of hearing loss in uncontrolled diabetics.

REFERENCES

Biswas A. 2009. ‘Clinical Audio-Vestibulometry for Otologists and Neurologists’. Fourth edition. Bhalani publishing house. New Delhi. p. 100-117.

Buse JB, Polonsky KS, Burant CF. 2011. Type 2 Diabetes Mellitus. In: Melmed S, Polonsky KS, Larsen PR, Kronenberg HM, editors. ‘William’s Textbook of Endocrinology’. 12th edition. Philadelphia: Elsevier / Saunders; p. 1371-1435.

Costa OA. 1967. Inner ear pathology in experimental diabetes. The Laryngoscope, LXXVII: 68-75.

Gareth Williams, John C. Pickup, 2003. Text book of diabetes mellitus.Blackwell publishing Ltd, Oxford, Third edition.

Irani FB, Isaac David. 2017. ‘Relation of type 2 Diabetics and haemoglobin with auditory acuity’ *IJHSR*, Vol. 7(10)

Kalli k *et al*. 2012. ‘Hearing disturbance in patients suffering from diabetes’. Otorhinolaryngologi: *Head and Neck Surgery*, 48:22-24.

Kerr AG, Stephans D. 1997. ‘Scott-Browns Otolaryngology: Adult Audiology’, Volume 2. 6th ed., Butterworth Heinemann, P. 2/1/6-9

Lisowska G, Namysłowski G, Morawski K, Strojek K. 2001. Early identification of hearing impairment in patients with type 2 diabetes mellitus. *OtolNeurotol*., 22:316–320

Makishima K, Tanaka AK. 1971. Pathological changes of the inner ear and central auditory pathway in diabetes. *Ann OtolRhinolLaryngol*., 80(2):218-28

Powers AC. Diabetes Mellitus. In: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J, editors. 2012. ‘Harrison’s Principles of Internal Medicine’. 18th ed. New York, 2968-3003

Taylor, I.G. and Irwin, J. 1978. ‘Some audiological aspects of diabetes mellitus’. *J Laryngol Otol*., 92:99-113

Williamson JR, Killo C. 1977. Capillary basement membrane disease in diabetes mellitus. *Diabetes*, 26: 65.

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