



A COMPARATIVE STUDY OF PURE TONE AUDIOMETRY (PTA) IN WELL CONTROLLED DIABETICS AND UNCONTROLLED DIABETICS

Diabetology

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ABSTRACT

Introduction: As it is known that Diabetes-mellitus (DM), the non-communicable metabolic disorder is associated with several complications, which include angiopathy neuropathy, retinopathy and nephropathy. For vestibulo-cochlear damage, angiopathic and neuropathic complications are considered as a topmost cause in diabetic patients. Objective of the study was done to compare SNHL in uncontrolled type 2 Diabetics with well controlled diabetics. And to find out effect of control of diabetes on hearing acuity & which frequencies of hearing affected by diabetes-mellitus.

Methodology: Present study was conducted on 30 uncontrolled type 2 diabetics & 30 well controlled diabetics in the age group of 30-60 years, selected based on inclusion and exclusion criteria. After detailed history taking and clinical examination, all patients underwent HbA1C evaluation. All subjects underwent PTA (Pure Tone Audiometry) & findings were recorded and analysed. **Result & Statistical Analysis:** The uncontrolled diabetics with SNHL is 83% when compared to the control is 57% which is highly significant (p value=0.0486). Uncontrolled diabetics patients had insidious onset, gradually progressive, bilaterally symmetrical SNHL. The audiogram of poorly controlled diabetics was suggestive of moderate to severe SNHL which was more towards higher frequencies. SNHL is aggravated with increasing age. In well controlled diabetic SNHL was minimal to mild SNHL which is mainly due to age, but in uncontrolled diabetic SNHL is mainly due to poorer control of diabetes, not only due to age. **Conclusion:** The uncontrolled type 2 diabetics had significant bilateral, moderate to severe SNHL as compared to well controlled diabetics of similar age. The glycaemic control-HbA1C has significant co-relation with severity of hearing loss.

KEYWORDS

Diabetes mellitus, Sensorineural hearing loss, HbA1C.

INTRODUCTION

The prevalence of DM is increased more rapidly in South Asia as compared to any other region of the world.[1][2] Diabetes mellitus is a non-communicable metabolic disorder which occurs due to defective function of insulin. Diabetes mellitus can be divided into two broad categories on the basis of their pathophysiology: Those having very little or no insulin secretory capacity – will produce insulin dependent type 1 DM & those who have insulin secretory capacity but have defect of insulin function, due to resistance at receptor/post-receptor levels, increased glucose output production from liver – will produce non-insulin-dependent DM or Type 2 DM. [3][4] The term HbA1C refers to glycated haemoglobin (Hb). It develops when Hb, a protein within red blood cells that carries oxygen throughout the body, joins with glucose in the blood, becoming 'glycated'. By measuring HbA1C, clinicians can get average blood sugar levels have been over a period of weeks/months. Normal level of HbA1C fall in between 4 to 5.6%. Level between 5.7 to 6.4% shows that person is prediabetic. Level equal to or more than 6.5% shown that person is diabetic. If person having more than 6.5% HbA1C constantly for subsequent regular checkup will lead to uncontrolled diabetes. Uncontrolled diabetes leads to so many complications like microangiopathy, macroangiopathy, neuropathy, nephropathy, retinopathy. Microangiopathy is considered as most important factor that causes long-term complication of diabetes.[5]

In uncontrolled diabetes mellitus due to high insulin resistance there will be increased triglyceride production which will lead to damage inner wall of blood vessel, which will lead to endothelial proliferation and accumulation of glycoprotein which will lead to thickening of basement membrane in capillary vessel and reduce blood flow through narrow vessel which will lead to secondary degeneration of vestibulocochlear nerve. Uncontrolled diabetes mellitus will lead to long-term microvascular and macrovascular complications which affect blood vessels of almost all parts of the body. Its effect on the vessels of the inner ear may lead to impairment on hearing. These vascular changes act as an important causative factor, leading to degeneration of neurones in the auditory system.[6] Uncontrolled diabetes having high blood glucose levels will affect outer hair cells. Outer hair cells become potential target for hyperglycaemic damage.[7][8] Once these outer hair cells are damaged, they cannot be regenerated, and hearing loss is permanent.

AIM & OBJECTIVES

To compare sensorineural hearing loss in well controlled & uncontrolled diabetics and to explore correlation between control of

diabetes & hearing defects and frequencies of hearing get affected by uncontrolled diabetes mellitus.

MATERIAL & METHOD

A comparative cross-sectional study on 30 well controlled diabetics and 30 uncontrolled diabetics without any comorbidity are selected based on inclusion & exclusion criteria. Subjects of both the groups are taken from society and their pure tone audiometry was done in a soundproof room at Asian speech and hearing clinic, Ashram Road, Ahmedabad, Gujarat with HERMES D Digital audiometer by modified Hughson-Westlake procedure (Carhart and Jerger, 1959).

Prior informed consent was taken from all the subjects participating in the study & Ethical clearance was also obtained from institution for conducting the study. The minimum hearing thresholds were taken at all frequencies including 250, 500, 1k, 2k, 4k, 8k Hz, in air conduction and only till 4 kHz in bone conduction.

The average pure tone threshold was taken at 500, 1k Hz & 2k Hz frequencies and calculated & compared between well controlled and uncontrolled diabetics groups. Patient's control of diabetes is measured with the help of HbA1C investigation. First detailed history was taken regarding duration of diabetes and treatment, then participants underwent routine general physical examination. After overnight fasting investigation for fasting blood glucose, postprandial blood glucose and HbA1c were done.

The categories of glucose tolerance based on the levels of fasting and HbA1c. (G. K. Pal chapter-60 Endocrine Pancreas, pg. no: 542)[9]

	Fasting Blood Glucose (FBS) (mg/dl)	HbA1C (%)
Normal blood glucose	60-99	4 to 5.6%
Impaired glucose tolerance (Prediabetes)	100-125	5.7 to 6.4%
Diabetes	126 or more	6.5% or high

The severity of hearing loss was graded according to the ASHA. (American Speech-Language-Hearing Association)[10]

Degree of Hearing Loss	Hearing loss range (dB HL)
Normal	-10 to +15
Minimal	+16 to +25
Mild	+26 to +40
Moderate	+41 to +55

Moderately Severe	+56 to +70
Severe	+71 to +90
Profound	91+

Inclusion criteria:

- Subjects with well controlled type 2 diabetes mellitus.
- Subjects with uncontrolled type 2 diabetes mellitus.
- Age of subjects between 30 – 60 years.
- All subjects are of same age & gender.

Exclusion criteria:

- Age: <30 years & >60 years.
- Patients having Conductive or Mixed hearing loss.
- Patients having known cause of SNHL.
- Past history of head/ear trauma.
- Past history of ear surgery.
- Patient with middle ear pathology.
- Past history of occupational noise exposure.
- Patients with history of ototoxic drugs.

4. RESULT AND DISCUSSION:

Increased cases of uncontrolled diabetes also increase risk of hearing loss. Table:1 & Fig:1 it is seen that SNHL is more in uncontrolled diabetics than controlled diabetics.

Table:1 Comparison of SNHL among controlled diabetics and uncontrolled diabetics

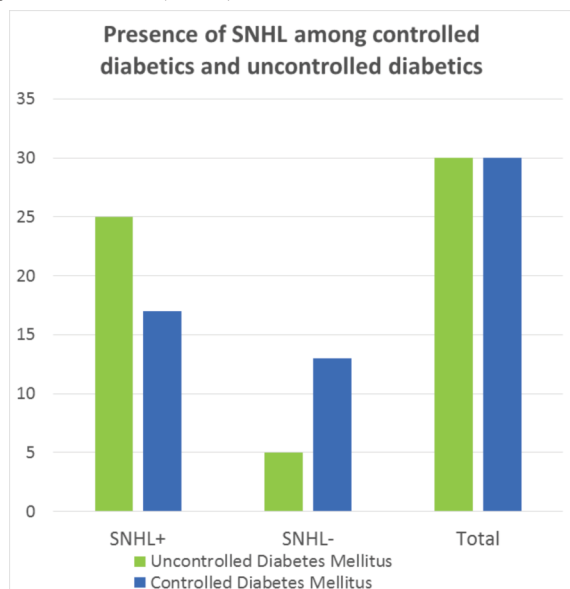
	SNHL present	SNHL Absent	Total
Uncontrolled Diabetes Mellitus	25	5	30
Controlled Diabetes Mellitus	17	13	30

ODDS RATIO = $25 \times 13 / 17 \times 5 = 325 / 85 = 3.82$

SNHL among uncontrolled diabetics is 3.82 times higher than controlled diabetics.

Chi square test = 3.8889

p value = 0.048607 (≤ 0.05)

**Fig:1: Presence of SNHL among controlled diabetics and uncontrolled diabetics**

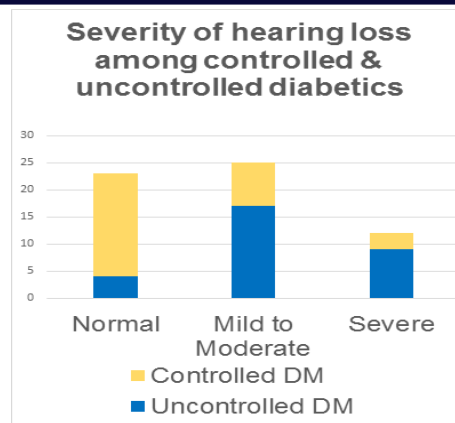
As shown in Table:2 and Fig:2 it is seen that uncontrolled diabetes is known to cause bilateral progressive SNHL with most of them have mild to moderate degree of hearing loss.

Table:2 Comparison of severity of SNHL among controlled & uncontrolled diabetics

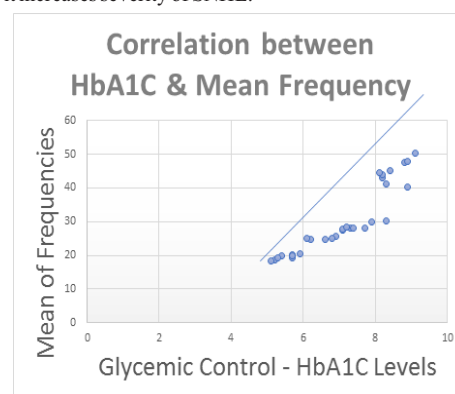
	Normal	Mild to Moderate	Severe
Uncontrolled Diabetes Mellitus	4	17	9
Controlled Diabetes Mellitus	19	8	3

χ^2 test = 16.0226

p value = 0.000332 (Highly significant as it is < 0.001)

**Fig:2: Severity of hearing loss among controlled & uncontrolled diabetics**

As shown in Fig:3 our study shows that as control of diabetes become poorer it increases severity of SNHL.

**Fig: 3 Correlation between severity of SNHL and control of diabetes.****Statistical analysis**

It is comparative cross-sectional study. Here, Chi square test is done to compare the loss of hearing among well controlled diabetics and uncontrolled diabetics, with a confidence interval of 95%. A p-value is 0.048607 which is less than 0.05 considered statistically significant. Here, with the help of Chi square test, comparison of severity of SNHL among well controlled diabetics & uncontrolled diabetics also done with a confidence interval of 95%. A p value is 0.000332 which is less than 0.001 considered statistically highly significant.

CONCLUSION

Diabetes mellitus occurs due to modern lifestyle & genetic activation, leads to increase in sensorineural hearing loss which is bilateral & progressive in nature. [11][12] Most of them have mild to moderate degree of hearing loss at higher frequencies than lower frequencies. Study also shows that as glycaemic control of diabetes – HbA1C levels become poorer, there is increased sensorineural hearing loss. [11][12]

Acknowledgment

I acknowledge the able guidance of Dr Rajendra Amin under whom this study was conducted. We also acknowledge the kind co-operation of all the participants. I also want to thank my senior Dr Nilu Chaudhari & audiologist Mayanta Chaudhari for great support during my study. I would like to express my sincere gratitude to my mother for great support during study. I also acknowledge Asian speech and hearing clinic, Ahmedabad for allowing me for their soundproof room for my study.

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