

Sensorineural hearing loss in Type 2 diabetes mellitus

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Abstract: The relationship between diabetes and sensorineural hearing loss has been highly controversial and debatable since a long time. The hearing loss is characteristically bilateral and progressive typically affecting higher frequencies. This study was aimed to evaluate the prevalence of sensorineural hearing loss in type 2 diabetics and to establish a relationship between age, gender, duration and diabetic control. **METHODS:** This study was conducted in 83 patients and were subjected to pure tone audiometry and evaluation of random blood sugar, glycosylated haemoglobin and serum creatinine. The prevalence of sensorineural hearing loss with relation to age, gender, duration and control of diabetes were analysed. **RESULTS:** A prevalence of sensorineural hearing loss was found in 62.65% of type 2 diabetic patients. Diabetic duration and long term diabetic control had a significant effect on the hearing threshold of the subjects. **CONCLUSION:** The hearing threshold is increased in diabetics mainly in the higher frequencies. There is a strong association between hearing loss, duration of diabetes and long term diabetic control.

Keywords: Type 2 diabetes mellitus, sensorineural hearing loss, pure tone audiometry.

I. Introduction

Hearing is considered one of the important factor involved in development of human skills which has been known to be hindered by many diseases since early days. The available records suggest that hearing loss has been identified around 1550 BC in ancient Egypt. It was reported by Jardao, 1857 that diabetes mellitus causes hearing loss in a case series study of diabetic coma⁽¹⁾. It is considered almost 278 million people around the world have hearing loss ranging from moderate to profound hearing loss and more than half of them is preventable by early diagnosis and treatment, of which diabetes mellitus takes a major part. India has a diabetic population around 50 million people which is expected to be doubled by 2030⁽²⁾. Various studies has shown that diabetes mellitus causes sensorineural hearing loss (SNHL), but the relationship between the two has been highly controversial. This study aims at evaluating the prevalence of sensorineural hearing loss in type 2 diabetes mellitus and to figure out a relation between age, sex, duration of diabetes and diabetic control.

II. Aims & Objectives

- To find out the prevalence of sensorineural hearing loss in type 2 diabetes mellitus
- To evaluate the association of hearing loss of following factors in type 2 diabetes mellitus
 - Age
 - Gender
 - Duration of diabetes
 - Diabetic control

III. Materials & Methods

This cross sectional study was done in 83 patients attending Yenepoya Medical College Hospital, Deralakatte, Mangalore in patients with type 2 diabetes mellitus during the period of September 2014 to September 2015. The sample size was calculated on the basis of previously conducted study results using the statistical formula:

$$N = \left\{ \left[\alpha \sqrt{P_0(1 - P_0)} + \alpha \sqrt{P_a(1 - P_a)} \right] \div [P_a - P_0] \right\}^2$$

P₀ - population proportion

P_a - sample proportion

α - significance level

Written informed consent was taken from all the participating patients. Ethical clearance was obtained from institutional ethical committee for conducting the study.

Inclusion criteria:

- Type 2 diabetic patients on oral hypoglycemic agents
- Patients of both gender in age group 30-55 years
- Without any other systemic illness (hypertension, coronary artery disease, thyroid disorders)
- Willing to undergo investigations

Exclusion criteria:

- Patients with type 2 diabetes less than 30 years and more than 55 years of age
- Patients on insulin treatment
- Patients on dialysis
- History of hearing loss prior to onset of diabetes
- History of ear discharge
- Patients with history of head trauma, radiotherapy, ototoxic drug intake, noise exposure

A detailed history including hearing loss – duration, onset, associated symptoms and diabetes – duration, treatment taken was obtained from the patients who were selected on basis of the inclusion and exclusion criteria and was then subjected to a detailed ENT examination including otoscopic examination and tuning fork tests. Patients further underwent audiometric assessment – Pure tone audiometry (PTA) and blood investigations – random blood sugar (RBS), glycosylated haemoglobin (HbA1c) and renal parameters like blood urea and serum creatinine.

The hearing threshold was graded as per World Health Organization (WHO) guidelines⁽³⁾,

- 0 – 25 dB - hearing within normal limits
- 26 – 40 dB - mild hearing loss
- 41 – 55 dB - moderate hearing loss
- 56 – 70 dB - moderately severe hearing loss
- 71 – 90 dB - severe hearing loss
- > 90 dB - profound hearing loss

IV. Results

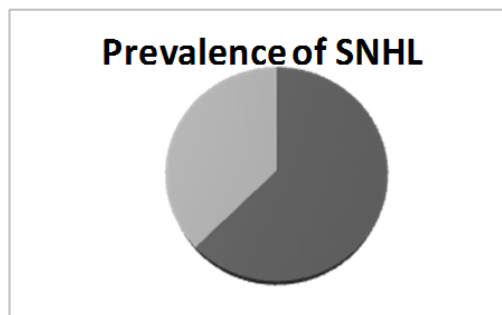
Taking into consideration on various factors involved in sensorineural hearing loss in patients with type 2 diabetes, evaluation was done on

- Prevalence of sensorineural hearing loss
- Age of the patient
- Gender of the patient
- Duration of diabetes
- Random blood sugar level
- Diabetic control
- Creatinine levels

PREVALENCE OF SNHL:

In this study of 83 type 2 diabetic patients, 52 had sensorineural hearing loss – 62.65% and the rest 31 patients had hearing within normal limits – 37.34%. Of the patients with sensorineural hearing loss only 31 patients complained of hearing loss – 59.6%

	SUBJECTS	PREVALENCE (%)
SNHL	52	62.65%
NORMAL	31	37.34%



AGE and SNHL:

The patients involved in the study was divided into three groups based on age

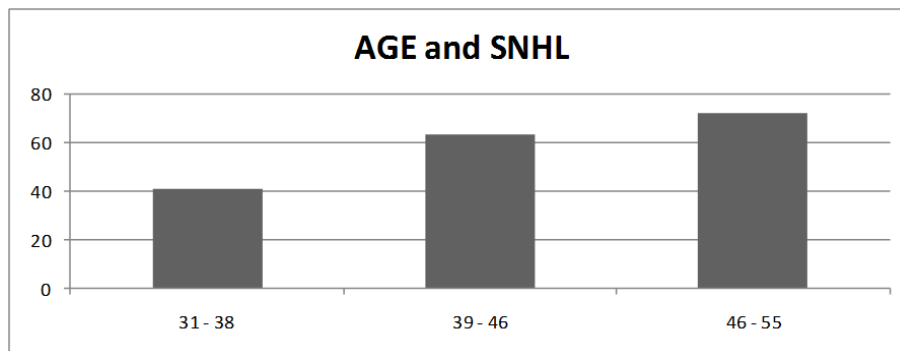
Group I 31 – 38 years of age

Group II 39 – 46 years of age

Group III 46 – 55 years of age

In group I, there were 17 patients out of which 7 was found to have sensorineural hearing loss. Out of 30 patients in group II 19 had sensorineural hearing loss. And in group III, out of 36 patients 26 was found to have sensorineural hearing loss.

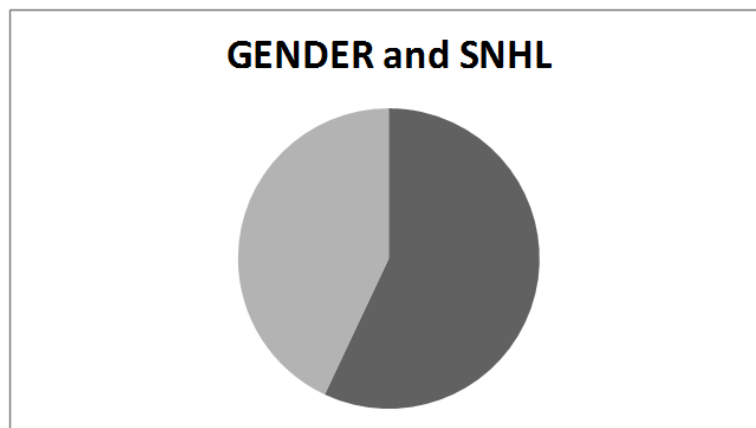
GROUP	AGE (years)	SUBJECTS	SNHL	PREVALENCE (%)
I	31 – 38	17	7	41.1
II	39 – 46	30	19	63.3
III	46 - 55	36	26	72.2



GENDER and SNHL:

In this study of 83 patients with type 2 diabetes mellitus, 54 were males and 29 females. In the 54 males, 37 patients was found to have sensorineural hearing loss – 68.5% and among the 29 females, 15 patients had sensorineural hearing loss – 51.7% The incidence of SNHL, male : female is 1.3:1

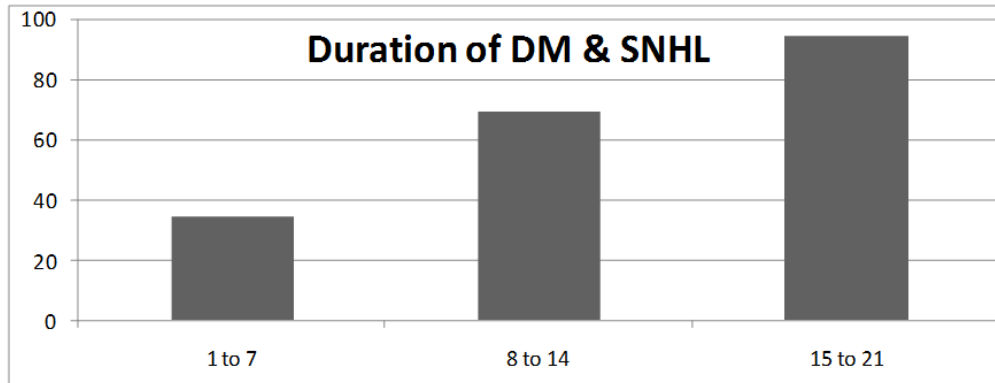
GENDER	No. of patients	SNHL	PREVALENCE (%)
MALE	54	37	68.5
FEMALE	29	15	51.7



Duration Of Diabetes And SNHL:

Based on the duration of diabetes three groups each of seven years duration was made. It was found that the incidence of sensorineural hearing loss was increased with duration of diabetes.

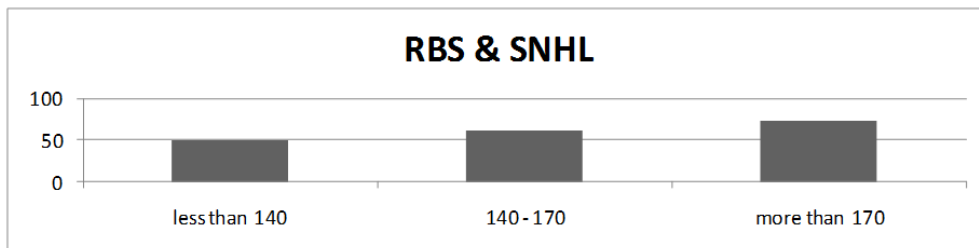
DURATION (years)	No of patients	SNHL	PREVALENCE (%)
1 – 7	29	10	34.4
8 – 14	36	25	69.4
15 – 21	18	17	94.4



Random Blood Sugar And SNHL:

In this study, patients with uncontrolled sugar levels had higher incidence of sensorineural hearing loss when compared with patients with moderately controlled and well controlled sugar levels.

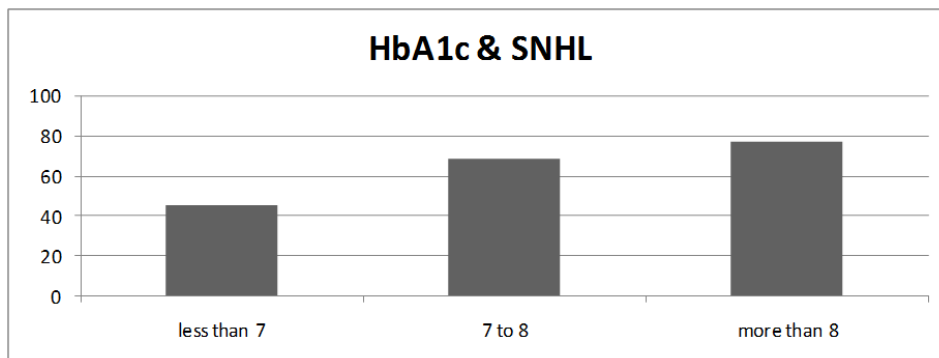
BLOOD SUGAR (mg/dl)	No of patients	SNHL	PREVALENCE (%)
< 140	28	14	50
140 – 170	21	13	61.9
>170	34	25	73.5



HbA1C and SNHL:

In the study done, showed that patients with uncontrolled sugar levels – 76.6% had more incidence of sensorineural hearing loss than patients with controlled sugar levels.

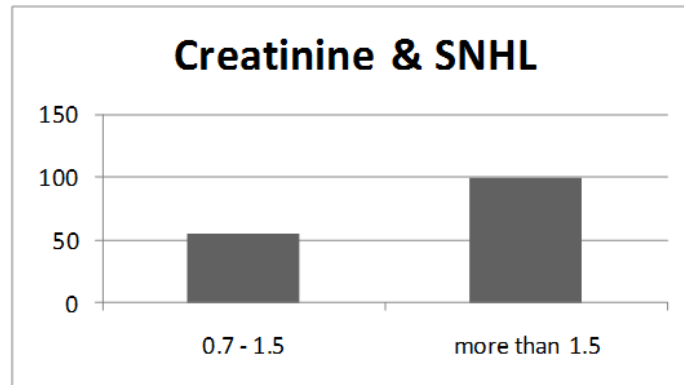
HbA1C (%)	No of patients	SNHL	PREVALENCE (%)
< 7	31	14	45.1
7 – 8	22	15	68.1
>8	30	23	76.6



Serum creatinine and SNHL:

In the study, patients with increased creatinine levels showed higher prevalence of SNHL

CREATININE (mg/dl)	No of patients	SNHL	PREVALENCE (%)
0.7 – 1.5	69	38	55.1
More than 1.5	14	14	100



V. Discussion

A Diabetes mellitus is a common metabolic disease affecting almost all age groups which is frequently associated with hearing loss. The hearing loss associated with diabetes mellitus is characteristically bilaterally symmetrical, gradual in onset and progressive in nature. The relationship between diabetes mellitus and sensorineural hearing loss is complex and not well explained. There also have been debatable opinion amongst various studies where some studies show strong association whereas some studies show no relation between diabetes mellitus and sensorineural hearing loss.

The two factors that is found to affect hearing in diabetic patients are - Diabetic angiopathy and diabetic neuropathy⁽⁴⁾.

Diabetes mellitus causes increased rate of triglyceride production due to insulin resistance. There is endothelial proliferation and accumulation of glycoproteins with thickening of the capillary vessels in basement membranes. This results in impaired nutrient transportation through these thickened vessels resulting in decreased blood flow through narrowed vessels leading to secondary degeneration of the vestibulocochlear nerve.

Activation of polyol pathway, causes accumulation of sorbitol within the neurons thereby reducing the myoinositol content and Na⁺/K⁺ + ATPase activity intracellularly leading to osmotic damage and swelling.

Protein kinase C is implicated in increased production of cytokines, regulation of vascular permeability, flow, and increased synthesis of basement membranes which is seen to increase in diabetes.

In addition to increased formation of advanced glycation products in collagen, DNA also contributes to tissue damage leading to cellular hypertrophy and hyperplasia.

This study showed a prevalence of sensorineural hearing loss in 62.65% of type 2 diabetics. This results were comparable with previous studies like to that of Friedman (55%), Aggarwal (64.86%), Rajendran (73.3%)⁽⁵⁾⁽⁶⁾⁽⁷⁾. Other studies also reveal low prevalence rates. The wide variation in prevalence of sensorineural hearing loss in diabetics may be due to difference in methodology including inclusion and exclusion criterias.

In the present study hearing loss was found to be typically bilateral symmetrical, progressive and gradual in onset, asymmetry was also noted in some of the patients. The hearing loss was more in higher frequencies 4 to 8kHz and approximately 5-30dB difference was noted in the hearing threshold. This results were comparable with that of studies by Cullen R, Kurien M and Tay H L⁽⁸⁾⁽⁹⁾⁽¹⁰⁾.

On comparing the sensorineural hearing loss in three age groups, the prevalence was found to be more in 46-55 years age group (72.2%) which shows association of advanced age in type 2 diabetics and sensorineural hearing loss. This was comparable with studies by Friedman, Cullen R.⁽⁵⁾⁽⁸⁾ However effects of age related cause for hearing loss – presbycusis was minimized as the patients included in the study was below 55 years of age.

An association between duration of diabetes mellitus and sensorineural hearing loss was made in this study showing patients with more than 15 years of diabetic duration had increased prevalence of hearing loss (94.4%) when compared to younger age groups. This results were comparable to that of study by Wilson et al.

Control of blood sugar levels and their association with sensorineural hearing loss has been debated since long and in this study both random blood sugar levels and glycosylated haemoglobin were taken into consideration. In this study showed diabetics with uncontrolled sugar levels had increased prevalence of sensorineural hearing loss when compared with diabetics of moderately and well controlled sugar levels. This results were comparable to that with studies published by Cullen R, Kurien M, Tay H L.⁽⁸⁾⁽⁹⁾⁽¹⁰⁾

Creatinine levels act as indicators of long term diabetic control and in this study high or borderline creatinine levels were found in increased hearing threshold patients. Almost all diabetic patients with high creatinine levels increased prevalence of hearing loss. This was supported by Kakarlapudi which shows strong association sensorineural hearing loss with microangiopathy⁽¹¹⁾.

VI. Conclusion

Prevalence of hearing loss was found to be increased in patients with type 2 diabetes (62.65%). Bilateral symmetrical progressive hearing loss was noted in all frequencies but characteristically hearing loss was found in higher frequencies in type 2 diabetic patients. There was also a increase in the prevalence of sensorineural hearing loss in type 2 diabetics as the age increases. Male type 2 diabetic patients were more affected with sensorineural hearing loss than their female counterparts. A strong association was found between blood sugar levels, glycosylated haemoglobin and severity of hearing loss which showed sensorineural hearing loss was more prevalent in patients with poor diabetic control.

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