

## A Hospital Based Prospective Study for Assessment of Sensorineural Hearing Loss (SNHL) in Type-II Diabetes Mellitus Patients

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### Abstract

**Background:** Diabetes mellitus is an increasing health problem worldwide and the prevalence is steadily increasing. The organ of Corti cells are important structures for hearing mechanism and turn out to be the potential target for damage, due to high glycemic levels, micro vascular compromise, their complex structure and arrangement. Thus, screening of these patients at a higher risk of developing sensory neural hearing loss, will aid in early diagnosis and management. The aim of this study to assess the sensorineural hearing loss in diabetes mellitus type II patients. **Materials & Methods:** This is a prospective study in which evaluation of 50 patients who were diagnosed with diabetes mellitus undergoing treatment on Out-Patient or In-Patient basis in department of E.N.T and Medicine at RVRS Medical College, Bhilwara, Rajasthan, India. All the patients were taken up for Otoscopic examination, in which the ear canal and status of tympanic membrane were assessed. Assessment of hearing loss in these patients is done using PTA. In this method, they are exposed to pure tones, the intensity of which can be increased or decreased in 5 dB steps. The amount of intensity that has to be raised above the normal level is a measure of the degree of hearing impairment at that frequency. Statistical Package of Social Sciences (SPSS) Trial Version 24.0 Significant level was  $p \leq 0.05$ . **Results:** The present study showed that mean age of patients was 56.43 years & male to female ratio was 1.5:1. The mean duration of diabetes was 12.36 years, the distribution among the study sample showed majority among  $\leq 15$  years duration of diabetes mellitus at 72% (36 out of 50) and shows significance among PTA results of hearing loss degree with P-value  $< 0.01$ . **Conclusion:** Hearing loss observed in diabetics is mostly bilaterally symmetrical, progressive, ranging from mild to severe.

**Keywords:** Diabetes Mellitus (DM), Sensorineural Hearing Loss (SNHL), PTA, Frequency.

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### Introduction

Hearing impairment is the most common sensory deficit in human beings. It affects more than 250 million people in the world. The consequences of hearing impairment include difficulty in interpretation of speech, often producing a decreased ability to communicate, delay in language acquisition, educational and economic drawbacks, social isolation and stigmatization. It may turn bad along with by medical conditions such as hypothyroidism, diabetes, and hyperlipidemia, among others [1].

Diabetes mellitus is an increasing health problem worldwide and the prevalence is steadily increasing. And it is more pronounced in India (an estimate total of about 40.9 million) [2]. The physiological basis of type 2 diabetes mellitus is a combined form of both impairment of beta cell function, with significant raise in peripheral levels of insulin resistance near the levels of receptor and post receptor.

The complex arrangement of inner ear makes it potential target of hyperglycaemic damage [3].

Diabetes Mellitus is the single most important metabolic disease which can affect nearly every organ system in the body. Almost all the macro and microvascular complications of diabetes have been studied extensively [4].

Diabetic patients are more prone to complications of hyperglycemia, as all body cells are exposed to high levels of plasma glucose. The organ of Corti cells are important structures for hearing mechanism and turn out to be the potential target for damage, due to high glycemic levels, micro vascular compromise, their complex structure and arrangement. Thus, screening of these patients at a higher risk of developing sensory neural hearing loss, will aid in early diagnosis and management [4].

Sensorineural hearing loss (SNHL) is a type of hearing loss, or deafness, in which the root cause lies in the inner ear (cochlea and associated structures), vestibule-cochlear nerve (cranial nerve VIII), or central auditory processing centers of the brain [5].

Hearing impairment is defined by the World Health Organization (WHO) as a hearing loss with thresholds higher than 25 dB in one or both ears. The degree of hearing loss is classified as mild, moderate, severe or profound. Early detection of hearing loss is possible with the help of high frequency pure tone audiometry which may be undetected

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by a conventional audiometry[5]. The aim of this study to assess the sensorineural hearing loss in diabetes mellitus type II patients.

### Materials & methods

This is a prospective study in which evaluation of 50 patients who were diagnosed with diabetes mellitus undergoing treatment on Out-Patient or In-Patient basis in department of E.N.T and Medicine at RVRS Medical College, Bhilwara, Rajasthan, India.

### Inclusion Criteria

1. Known cases of Diabetes mellitus
2. Age-group >30 years to <60 years
3. Both genders

### Exclusion Criteria

1. Individuals involved in occupations exposing to loud noise
2. Individuals with previous history of ear discharge/hearing loss/tinnitus/ear surgery
3. Otoscopic examination showing any ear pathology like wax, discharge, retracted tympanic membrane, perforated tympanic membrane or tympanosclerosis.
4. Patients unwilling to comply with the study.

### Methods

History of every patient was taken in detail and importance was given on their presenting complaints. Any significant past history of ear discharge, hearing loss or previous ear surgeries were elicited. History of duration of diabetes and mode of treatment were given importance. All the patients were taken up for Otoscopic examination, in which the ear canal and status of tympanic membrane were assessed. Data including age, sex, occupation, weight, history of smoking, alcoholism, diabetes, hypertension, and hypothyroidism

history are noted. Investigations such as level of Hemoglobin, FBS/ppBS and HbA1c are done as routine investigations.

Assessment of hearing loss in these patients is done using PTA. In this method, they are exposed to pure tones, the intensity of which can be increased or decreased in 5 dB steps. Air conduction thresholds are measured for tones of 125, 250, 500, 1000, 2000 and 4000 and 8000 Hz and bone conduction thresholds for 250, 500, 1000 and 2000 and 4000 Hz. The amount of intensity that has to be raised above the normal level is a measure of the degree of hearing impairment at that frequency. It is charted in the form of a graph called audiogram. The threshold of bone conduction is a measure of cochlear function. The difference in the thresholds of air and bone conduction (A-B gap) is a measure of the degree of conductive deafness.

The audiometer is so calibrated that the hearing of a normal person, both for air and bone conduction, is at zero dB and there is no A-B gap.

### Data Analysis

Statistical Package of Social Sciences (SPSS) Trial Version 24.0 Significant level was  $p \leq 0.05$ .

### Results

Among 50 subjects, as age and gender frequencies had comparability, following inferences were: Patient's ages were tallied to obtain mean of 56.43 with standard deviation of 10.25. Gender frequency distribution was slightly higher in males, 30(60%) as compared to females, 20(40%).

Duration of Diabetes Mellitus was grouped after obtaining mean of 12.36 with a standard deviation of 7.92 years. The grouping was approximated with respect to 15 year mark for better understanding of short and long-term affliction of diabetes mellitus. The distribution among the study sample showed majority among  $\leq 15$  years duration of diabetes mellitus at 72% (36 out of 50) (table 1).

**Table 1: Demographic profile of patients**

Demographic profile	No. of patients (N=50)	Percentage
<b>Age group (yrs)</b>		
30-50 yrs	19	38%
51-60 yrs	20	40%
>60 yrs	11	22%
Mean±SD	56.43±11.25	
<b>Gender</b>		
Male	30	60%
Female	20	40%
<b>Diabetes mellitus duration of year</b>		
≤15	36	72%
>15	14	28%
Mean±SD	12.36±7.92 yrs	

The frequency pattern for patients with hearing loss with diabetes was significant in the SNHL group with at 58% (29 out of 50) while normal and mixed hearing were 18 and 5 (36% and 10%) respectively (table 2).

**Table 2: Frequency Based on Hearing Loss Type:**

HEARING LOSS	No. of patients (N=50)	Percentage
<b>Type</b>		
NORMAL	16	32%
SNHL	29	58%
MIXED	5	10%
<b>HEARING LOSS DEGREE</b>		
Normal	18	36%
Mild	2	4%
Mild- Moderate	8	16%
Moderate	10	20%
Moderate- Moderately Severe	5	10%
Moderately Severe	1	2%
Moderately Severe- Severe	1	2%
Severe	5	10%

Duration of DM shows significance among PTA results of hearing loss degree with P-value <0.01. This helps to make relation with degree of hearing loss and diabetes duration (table 3 & 4).

**Table 3: Degree of Hearing Loss Degree InRt and Lt PTA Vs. DM Duration**

Rt PTA (dB)	Duration Of Diabetes Mellitus (inyears)				Total	Total PERCENT	
	≤15	PERCENT	>15	PERCENT			
≤25	17	34%	0	0%	17	34%	
26-40	10	20%	4	8%	14	28%	
41-60	8	16%	3	6%	11	22%	
61-80	0	0%	7	14%	7	14%	
>80	1	2%	0	0%	1	2%	
<b>Total</b>	36	72%	14	28%	50	100%	
<b>P-value</b>	0.005*						

Chi-square test

**Table 4: Degree of Hearing Loss Degree InRt and Lt PTA Vs. DM Duration**

Lt PTA (dB)	Duration Of Diabetes Mellitus (inyears)				Total	Total PERCENT	
	≤15	PERCENT	>15	PERCENT			
≤25	17	34%	0	0%	17	34%	
26-40	8	16%	1	2%	9	18%	
41-60	10	20%	5	10%	15	30%	
61-80	1	2%	8	16%	9	18%	
<b>Total</b>	36	72%	14	28%	50	100%	
<b>p-value</b>	0.01*						

Chi-square test

In present study to collect samples before performing PTA test on necessary study group, ABC test was conducted to confirm hearing loss, which lead to the results obtained the table no. 5, they were in coherence with the findings of PTA and also showed relation to diabetic duration (table 5).

**Table 5: ABC Test Degree Vs. DM Duration**

ABC TEST	Duration Of Diabetes Mellitus (in years)				Total	Total PERCENT	
	≤15	PERCENT	>15	PERCENT			
<b>NORMAL</b>	20	40%	4	8%	24	48%	
<b>MILD</b>	10	20%	0	0%	10	20%	
<b>REDUCED</b>	6	12%	10	20%	16	32%	
<b>Total</b>	36	72%	14	28%	50	100%	
<b>p-value</b>	0.01*						

Chi-square test

## Discussion

Audiological investigation, PTA was performed by the department audiologist in sound treated room after necessary clinical examination for hearing loss was undertaken. Clinical examination that aided to maintain inclusion criteria were local examination of ear, nose, throat and systemic examination for other co-morbidities and tuning fork test which helped attaining the focused group. After assessing and confirming the type and degree of hearing loss by PTA, confirmation and classification of degree of hearing loss was done with the help of WHO grades of hearing impairment[6].

In this study, SNHL comprised of majority at 58%. While comparing degrees of hearing loss, from bilateral mild to moderate comprised of 36%. In the past, studies gave outcomes ranging from 40% onwards. Friedman et al[7] incurred an average of 55% hearing loss in diabetic patients. Ren et al[8] and Kakarlaupadi et al[9] found that hearing loss in diabetics coincided with higher frequencies yielding to moderate degree of hearing loss. Celik o et al[10] compared age groups and gender similar to this study. Similarly, they also compared age groups with duration of diabetes and other diabetic related conditions, hence establishing relation of duration of diabetes with hearing loss.

Affection of bilateral SNHL was seen in study conducted by MeenaR et al[11] which showed near equal distribution in various frequency thresholds. SSNHL in diabetes may be a result of microangiopathy showed a study by Shikowitz MJ et al[5], while Friedman[7] and CullenA[12]. Showed SNHL on set in younger individuals.

Li et al[13] and Abdulbari Bener et al[14] found significant hearing loss with advancement of age an disease in diabetics. Therefore, to avoid large discrepancies in age related changes in hearing status, conducted study in DM patients were focused from 35-80 years age

group in comparison to their DM illness duration which was a maximum of 30 years and was included in DM duration of >15years which comprised of 57% of study subjects.

In this study, even though DM duration had comparative significance P-value= 0.011, ABC test showed better significance at P value = 0.001 which was further reconfirmed by PTA in relation to SNHL where 58% SNHL cases with 40% mild-moderate level of hearing loss were present.

## Conclusion

Hearing loss observed in diabetics is mostly bilaterally symmetrical, progressive, ranging from mild to severe. Even though clinical tests may help finding and proving hearing loss type and to a certain extent the degree as well, health care providers must take into account, the condition progression and refer to audiology for proper screening and evaluation for all diabetes mellitus cases, to have a better insight as well as preparedness for the outcome.

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