



ORIGINAL ARTICLE

Analysis of Hearing Status in Patients with Type 2 Diabetes Mellitus

Dr. Sarmishtha De^{1*}

Assistant Professor , Department of ENT /Otorhinolaryngology, Mahatma Gandhi Institute of Medical Sciences , Sevagram, Wardha 442102 , Maharashtra, INDIA

Abstract

Introduction: The relation between hearing loss and diabetes mellitus appears as a controversial topic as different studies have given conflicting results. Present study aimed 1) To find the prevalence of SNHL in Type 2 DM 2) To study the association of hearing loss with the following factors among type 2 DM (a) Duration of DM , (b) Severity of hyperglycemia. 3) To evaluate the result of our study and to compare our data with similarly published studies.

Methods: This Retrospective Analytical study involved data of 100 of the randomly selected patients (candidates / study subjects) .) It was noted and observed that Hearing tests like Pure tone audiometry and tympanometry were performed for all patients. For pure tone audiometry, thresholds were obtained by using modified Hughson – Westlake procedure.

Results: . Prevalence of SNHL in type 2 DM was 79%. There was no association between SNHL and duration of DM but positive association was found between SNHL and severity of hyperglycemia.

Conclusion: . In all type 2 DM while examining them clinically due consideration may be given to hearing tests along with other tests like Fasting and post prandial blood glucose levels (FBS, PPBS) and HbA1C level to find out the glycemic control. Also it is mandatory for necessary follow ups to be done regularly.

Key Word : SNHL (Sensorineural hearing loss), Type 2 Diabetes Mellitus (DM), neuropathy, glucose levels.

1 | INTRODUCTION

Diabetes mellitus (DM) is a chronic multifunctional endocrine disorder that affects almost all parts of the body. In diabetes, type 2 is the most predominant one, making it one of the major non-infectious global health issues.[1]

Complications of diabetes are quite frequent and are responsible for high morbidity and mortality. Complications of diabetes affect almost all organs depending on the duration and its poor metabolic control over time.[1,2] This study was done to assess the hearing status in patients having type 2 diabetes and find out its association with the duration of diabetes. Type II DM, is the predominant form of diabetes worldwide accounting for 90% of cases [1]. It has reached an epidemic status in both developed and developing countries and has become one of the world's most important public health problems [2]. One of the main functions affected by it is hearing. Also incidentally hearing is one of the most important among the five senses gifted to mankind which plays an important role in the development of speech, communication and cognitive, emotional and social development of a human being [3]. Of late the incidence of DM has increased several folds and also though it was disease of old age, several cases are diagnosed in the earlier age sometimes as early as 30 years.

The relation between hearing loss and diabetes mellitus appears as a controversial topic as different studies have given conflicting results. Logically in patients aged above 50 years hearing loss due to DM may be additional to that due to age alone (ageing also causes SNHL). It is not aging of itself that causes the problem rather the effects accumulated from environmental noise toxicity and metabolic/ oxidative stress. Studies have shown it to be almost double. The exact damage because of diabetes cannot be assessed due to various factors. Type 2 DM in the age group of 30 -50 yrs (early onset) cannot be ignored in the present day scenario. Hence an attempt was made in our hospital to assess the increased prevalence of subclinical hearing loss in early onset / non elderly / middle aged (30 -50

years).

The effect of diabetes mellitus on hearing is known since 1857, when Jordao first showed hearing loss in a patient with incipient diabetic coma [4]. The typical hearing loss in diabetics is progressive, bilateral SNHL affecting the higher frequencies. But rarely, there are incidences where sudden onset, SNHL affecting lower frequencies is also noted. The type of hearing impairment noted, is similar to that of presbycusis, but those affected show a greater decrease in hearing than one would expect at that age. One of the studies compared the audiometric and clinical history with temporal bone histopathological findings of 8 diabetics and 10 controls matched for age and sex. The group with DM had significantly more hearing loss. The results suggest that diabetic SNHL results from microangiopathic involvement of the endolymphatic sac and basilar membrane vessels. They proposed that the significant vascular insult to the endolymphatic sac may cause the accumulation of toxic metabolic products which may result in hair cell dysfunction [5]. Certain studies state that increase in hearing threshold in diabetics is for low frequencies (500 Hz), but some authors say it is present only in high frequencies (6000Hz and 8000Hz) [6,7]. Lasisi et al (2003) found that the mean hearing thresholds in subjects with diabetes of less than 10 years duration was far better than those with greater than 10 years duration and other studies also supports that threshold becomes poorer as duration of diabetes increases [6, 7, 8], while others state that there is no relation between hearing threshold and diabetes mellitus [3, 4].

Supplementary information The online version of this article (<https://doi.org/10.15520/ijmhs.v5i6.3427>) contains supplementary material, which is available to authorized users.

Corresponding Author: Dr. Sarmishtha De Assistant Professor , Department of ENT / Otorhinolaryngology Mahatma Gandhi Institute of Medical Sciences Sevagram, Wardha 442102 Maharashtra, INDIA

Glycosylated hemoglobin (HbA1C) is also one of the indicators for control of diabetes. But its elevated levels were not systematically associated with increased thresholds of hearing. Thus, direct evidence that poor metabolic control in diabetes causing SNHL remains to be proven [7]. Even though studies have proved the occurrence of SNHL in DM, disagreement still exists among some about their relation [9, 10]. Present study aimed 1) To find the prevalence of SNHL in Type 2 DM 2) To study the association of hearing loss with the following factors among type 2 DM (a) Duration of DM, (b) Severity of hyperglycemia. 3) To evaluate the result of our study and to compare our data with similarly published studies.

2 | METHODOLOGY

The present study was conducted on diabetic patients selected randomly from hospitals. 100 individuals (200 ears) who have type 2 DM participated in the study. Informed consent was obtained from all the subjects enrolled in the study. This Retrospective Analytical study involved Prior Consent from Hospital Authorities / Medical Superintendents of the Local Randomly selected Secondary & Tertiary care Radio-diagnostic Centres / hospitals to see the records of the patients from Medical Records Department (MRD). The study was conducted within ethical standards. The Patients who were attending or admitted in randomly selected Diagnostic centres / hospitals including our Hospital in the city were selected for the study. Randomization was done using computer tables in selecting data. All Patients underwent standard clinical examinations, routine biochemical and haematological investigations with CT. Medical record numbers were used to generate the data for analysis.

For the purpose of the present study, data of 100 of the randomly selected patients (candidates / study subjects) who seek care for care were retrospectively identified.

Inclusion criteria

Known patients of Type 2 DM Aged between 30 to 50 years Willing to undergo investigations

Exclusion criteria

Patients with conductive hearing loss Patients with mixed hearing loss

Sensorineural hearing loss other than due to Type2 Diabetes, trauma due to head injury, congenital causes, family history of deafness, occupational noise exposure and presbycusis in otherwise normal will be excluded.

Not willing to undergo investigations
All the participants underwent following investigations:

a) Thorough ENT examination with case history
b) HbA1C level (Glycosylated Hemoglobin) to find out the glycemic control, if patients have HbA1C level between 6-8% they were labeled as controlled and those with HbA1C level > 8% were labeled as poorly controlled.

c) It was noted and observed that Hearing tests like Pure tone audiometry and tympanometry were performed for all patients. For pure tone audiometry, thresholds were obtained by using modified Hughson – Westlake procedure [11], for octave frequencies from 250Hz to 8 KHz for air conduction stimuli and from 250Hz to 4 KHz for bone conduction stimuli. For Tympanometry 226Hz probe tone was used to obtain ipsilateral and contralateral reflexes at 500Hz, 1000Hz, 2000Hz and 4000Hz.

Once the investigations are done and extent of disease is established, management was planned accordingly.

3 | RESULTS

a) The prevalence of SNHL in diabetic patients was studied under the following parameters: Whether SNHL has taken sudden or gradual onset.

b) whether the degree of SNHL is slight (16 – 25 dB) /mild (26 – 40 dB) /moderate (41-55 dB) / severe (56 – 70 dB) .

c) Descriptive statistics was done to measure mean and standard deviation. Inferential statistics was also carried out through independent t test to find out P value.

Total no of subjects with type 2 DM	With gradual SNHL	With sudden SNHL	Magnitude
100 cases	73	6	79%

Table 1: prevalence of SNHL among type 2 DM with details of gradual or sudden onset among them.

In our study, 100 aural symptomless type 2 DM patients (patients without symptoms of Hearing loss) underwent pure tone audiometry. Table 1 shows that out of 100 patients 79 had SNHL, that is magnitude of SNHL among type 2 DM is 79% and among SNHL cases, 73 of them developed gradual onset SNHL and 6 developed sudden onset SNHL. Degree of hearing loss among type 2 DM was also taken into account .21 cases had normal hearing, 42 had slight HL, 33 had mild SNHL, 04 cases had moderate SNHL and none of them had severe SNHL. Hearing loss was more common in high frequencies but in few cases there was loss in mid frequencies also. In the present study pure tone average of 500 Hz, 1000Hz and 2000Hz was taken to find out the degree of hearing loss.

Pure tone average	No of subjects with type 2 DM following under each category (%)
Slight hearing loss (16 - 25 dB)	42(53.1%)
Mild SNHL(26- 40 dB)	33(41.7%)
Moderate SNHL(41- 55 dB)	04(5.06%)

Table 2: Subjects with type 2 DM having different degree of hearing loss with mean and standard deviation

- Present study followed ASHA classification of hearing loss[12]
- Association of hearing loss with the following factors among type 2 DM i) Duration of DM ii) Severity of hyperglycemia was also studied.

Duration of diabetes in years	No. of cases	Cases with SNHL Number	Cases with SNHL Prevalence (%)
0-5	24	20	83.33%
6-10	37	32	86.48%
11-15	29	23	79.31%
16-20	10	04	40.0%

Table 3: Prevalence of SNHL considering duration of DM as factor

From the table 3, we can see that there are 24 cases with 0-5 years duration of diabetes, among which 20 (83.33%) had SNHL. Similarly, among 37 cases

with 6-10 years of duration,32 cases (86.48%) had SNHL but among 29 cases in 11-15 duration of diabetes 23 (78%) of them had SNHL and 10 cases in 16-20 years duration group wherein 4 (40%) had SNHL. It is clearly seen that there is no relation between duration of DM and SNHL. Independent t test shows no association between duration of diabetes and SNHL (P value >0.05).

Glycosylated Hb level	No. of cases	Cases with SNHL	prevalence (%)
Controlled HbA1C (6-8%)	62	43	69.35
Uncontrolled HbA1C > 8%	38	36	94.73

Table 4: Prevalence of SNHL considering severity of DM as factor

From the table 4, we can infer that among 62 controlled diabetics 43 (69.35%) had SNHL and out of 38 uncontrolled diabetes 36 (94.73%) had SNHL. Independent t test shows association between control of diabetes and SNHL (P value < 0.05) .

4 | DISCUSSION

Most of studies have supported association of SNHL with diabetes. The present study also supports the association of SNHL with diabetes with a prevalence of 79 %. The hearing loss is usually of gradually progressive type. But Shuen Fu in 2005 reported a series of 68 sudden onset of SNHL in diabetes [13]. Our study presents only 6 cases of sudden onset SNHL. So the results of the present study supports gradual onset of hearing loss. The hearing loss is more common in higher frequencies as stated by Kurien M in 1989 and Cullen R in 1993 [3, 4]. But Tay in 1995 stated that the hearing loss was in mid and low frequencies while Fangchao MA in 1998 found hearing loss in diabetics only in 500Hz frequency [14, 6]. Our study shows hearing thresholds to be increased in higher frequency but hearing loss in mid frequencies was also seen in few cases. Salvenelli et al (2004) did not find hearing loss in the diabetics included in his study.

The results of the present study do not match that of Salvenelli et al [10]. The possible pathophysiological basis for this reduction in auditory acuity may be; microangiopathy of the inner ear, neuropathy of the cochlear nerve, or a combination of both. Several studies have attempted to locate the site of any possible pathological processes causing hearing loss in diabetics. Microangiopathy of the small blood vessels to the inner ear has been commonly cited as the causative pathology. Some noted thickened capillaries in the stria vascularis, basilar membrane, and endolymphatic sac [5]. They also proposed that these changes were responsible for diabetic SNHL. Similar microangiopathic mechanisms were proposed by Kakarlapudi et al (2003) [15]; Zelenka et al (1965) who found sensorineural hearing loss in all the frequencies tested in their diabetic subjects [16].

Studies have found that there is no association between duration of diabetes and hearing loss [17, 18, 3, 9]. The present study supports the above conclusion. It can be concluded that not all the diabetic patients have uncontrolled hyperglycemia during their course of the illness. So rather than the duration of illness, the degree of hyperglycemia and the HbA1C levels are more important in determining the auditory acuity.

Occurrence of SNHL in diabetics depends on the control of the disease. Most of the studies have stated that a better control of diabetes delays or prevents the onset of SNHL in that person [3,4, 14]. Dalton et al (1998) [18] and Salvanelli et al (2004) [10] both do not show an association between glycosylated hemoglobin levels and hearing loss. Present study contradicts their findings.

5 | Conclusion

Hearing impairment is an under recognized complication of early onset type 2 DM. The relationship between diabetes and hearing loss is controversial. The present study was undertaken to better understand the disease and its influence on hearing acuity. It was found that there is association of SNHL in type 2 DM and prevalence of SNHL in poorly controlled diabetic patients was 94.73%.

Globalization is rapidly transforming India from a developing to a developed country. People have become more health conscious and they expect to add more socially and economically productive years to their life span. This disorder which was manifesting mainly in older years of life is now manifesting in earlier years hence it is advisable to screen for SNHL in all diabetics. In all type 2 DM while examining them clinically due consideration may be given to hearing tests along with other tests like Fasting and post prandial blood glucose levels (FBS, PPBS) and HbA1C level to find out the glycemic control. Also it is mandatory for necessary follow ups to be done regularly.

ACKNOWLEDGEMENTS

We would like to thank all the participants, Hospital Authorities & Dean sir for their always available guidance and support.

Funding: No funding sources

Conflict of interest: None declared

Ethical standards: Yes

REFERENCES

1. King H, Aubert RT & Herman WH. Global burden of diabetes 1995-2025: Prevalence, Numerical estimations and projections. *Diabetes care.* 1998;21: 1414-1431.
2. Harris M I. Undiagnosed NIDDM: Clinical and public health issues. *Diabetes care.* 1993; 16:642- 652.
3. Kurien M, Thomas K & Bhanu TS. Hearing threshold in patients with diabetes mellitus. *Journal of Laryngology and Otology.* 1989; 103(2): 164-168.
4. Cullen R & Cinnamond NJ. Hearing loss in diabetes. *Journal of laryngology and otology.* 1993;107: 179-182.
5. Wackym PA & Linthicum F H Jr. Diabetes mellitus and hearing loss: clinical and histopathological relationships. *The American journal of otology .* 1986;7(3): 176-182.
6. Fangcha MA et al. Diabetes and Hearing Impairment in Mexican American Adults:

a population-based study. *Journal of Laryngology and Otology*.1998;112: 835-839.

7. Virteniemi J et al. Hearing thresholds in Insulin dependent diabetes mellitus. *Journal of laryngology and Otology*.1994;108: 837-841.

8. Lasisi OA, Nwaorgu OGB & Bella AF. Cochleovestibular complications of diabetes mellitus in Ibedan, Nigeria. *International Congress Series 1240*. 2003: 1325-1328. International federation of otorhinolaryngological societies [IFOS].

9. Axelson A & Fagerberg SE. Auditory functions in diabetics. *Acta Otolaryngologica*.1968: 66:49-63.

10. Salvenelli F, Miele A, Casale M, Greco F, D'Ascanio L & Firrisi L et al. Hearing thresholds in patients with diabetes. *The internet journal of otorhinolaryngology* 2004: 3(1).

11. Carhart R & Jerger JF. Preferred Method for Clinical Determination of Pure tone Thresholds. *Journal of Speech and Hearing Research*. 1959: 24: 330.

12. Clark JG. Uses and abuses of HL classification, ASHA. 1981: 23:493-500.

13. Shuen-Fu, Yuh-Shyang & Chuan-Jen. Clinical Features of Sudden Sensorineural Hearing Loss in Diabetic Patients. *The Laryngoscope*. 2005: 11: 1676-1680.

14. Tay HL, Ray N & Ohri R. Diabetes mellitus and hearing loss. *Clinical otolaryngology*. 1995: 20: 130-134.

15. Kakarlapudi Venkata, Sawyer R & Staecker H. The effect of diabetes on sensorineural hearing loss. *Otology and Neurology* .2003: 24 (3): 382-386.

16. Zelenka J & Kozac P. Disorders in blood supply of the inner ear as early symptom of diabetic angiopathy. *J Laryngology and Otology* .1965: 79: 314- 319.

17. Taylor IG, Irwin J. Some audiological aspects of diabetes mellitus. *Laryngology and Otology* 1978: 92(2): 99-113.

18. Dalton SD, Cruickshanks KJ, Klien BEK & Wiley TL. Association of NIDDM and hearing loss. *Diabetic care*. 1988: 21(9): 1540-1544.

How to cite this article: Dr. Sarmishtha De , Analysis of Hearing Status in Patients with Type 2 Diabetes Mellitus, *Innovative Journal of Medical and Health Science*. 2015;971–976. <https://doi.org/10.15520/ijmhs.v5i6.3427>