

Case series: A retrospective study of sensorineural hearing loss in diabetes mellitus patients in Vindhya region

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Abstract

The aim of this study was to assess hearing threshold levels in patients with diabetes mellitus, correlate degree of hearing loss with duration and severity of hyperglycaemia and complications of diabetes mellitus. Retrospective study was carried out from Jan 2018 to Dec 2018. Patients of previously diagnosed cases of type 1 and type 2 diabetes mellitus aged less than 60 years were subjected to fasting, post prandial blood glucose levels and pure tone audiometry were evaluated and compared with age matched controls. The results showed significant difference in hearing threshold with mild to moderate sensorineural hearing loss in both type 1 and type 2 diabetes mellitus patients. Diabetics with poorly controlled blood sugar level have increased risk of hearing loss.

Keywords: diabetes mellitus, sensorineural hearing loss, audiological evaluation

Introduction

Diabetes is a metabolic disease where upon the body is unable to metabolize glucose. Insulin is the hormone which causes the cells to allow glucose through the cell membrane. Diabetes mellitus is a chronic metabolic disorder, due to relative or absolute lack of insulin, which results in elevated blood glucose levels. Morbidity in diabetes mellitus is mainly due to long term micro and macro vascular complications affecting blood vessels of eyes, kidneys, heart and nerves. The relationship between diabetes mellitus and hearing loss has been dated for many years. It has been postulated that the microvascular and neuropathic complications of diabetes do affect the hearing of individuals. Studies in diabetic animals have demonstrated thickening of basement membrane of capillaries of striae vascularis^[1], the diabetic hearing impairment can be termed as Hypoacusis diabetic neuro-sensorica or Diabetic Cochleopathy.

Diabetes mellitus has been implicated as independent causative factor for sensorineural hearing loss. Most audiometric studies of hearing in patients with diabetes showed a mild-moderate sensorineural hearing loss mostly in high frequency^[2], although Celik *et al*^[3] noted high threshold at all frequencies tested in diabetics.

It is a retrospective study carried out in previously diagnosed patients with type 1 & 2 diabetes mellitus, to assess their hearing threshold and to study the correlation between the degree of hearing loss and the duration, severity of hyperglycaemia and its complications.

Materials and Methods.

This was a retrospective study carried out from January 2018 to December 2018. 50 known cases of diabetes mellitus, both type 1 & 2 were included in the study. The hearing threshold was compared between test cases and 50 age and sex matched healthy controls.

A detailed history including age, sex, address, present &

previous occupation (for occupational noise exposure and exposure to ototoxic substances) was taken. History of hypertension, ear discharge, hypo & hyperthyroidism, head-injury, cerebro-vascular accident, radiotherapy was also obtained. Drug history regarding exposure to aminoglycosides, diuretics, beta-blockers, antidepressants, quinine and cis-platinum was obtained. Diabetic patients having other otological or systemic diseases (family history of deafness or middle ear abnormality, recent less than 1 month upper respiratory tract infection, autoimmune diseases, more than 60 years) were excluded from the study. Patients with conductive or mixed-type audiometric curves with an air-bone gap more than 20dB were also excluded.

A complete general and systemic examination was performed. A routine ear, nose & throat examination was carried out, blood sugar levels (both fasting and post-prandial) of all diabetic and controls were obtained. Pure-tone audiometry was performed using an Elkon 3n3 multiaudiometer calibrated to ISO standard in a soundproof room. Both air and bone conduction were tested at frequencies between 250 and 6000Hz. Special tests like, tone decay and SISI were also performed.

Type 1 diabetics were grouped into Group 1A and Type 2 diabetic patients were grouped into Group 1B. Patients were assessed according to following parameters:

1. Metabolic control (according to blood sugar fasting level with cut-off of 140 mg%)
2. Duration of disease (0-2 years, 3-10 years, 11-20 years and ≥ 21 years).

Audiometric results in diabetic patients were compared to those obtained in the control group (group 2) they were subgrouped into group 2A, group 1A age-matched controls and group 2B, group 1B age matched controls.

Results

A total of 50 cases with established diabetes mellitus (both type 1 and type 2) were taken in this study, 50 age and sex

matched controls were included for comparison. 13 cases were of type 1 Diabetes mellitus (26%) and 37 were of type 2 Diabetes mellitus (74%). 30 cases were males (60%) and 20 cases were females (40%) including both type 1 and type 2 Diabetes mellitus. 1 case (2%) was found in age group of 11-20 years, maximum number of 25 cases (50%) was

found in 51-60 years age group.

13 cases of type1 diabetes had poorer threshold by 13dB at 2000Hz, 16dB at 3000Hz, 18dB at 4000Hz & 21dB at 6000Hz suggesting auditory threshold was significantly higher in the diabetic patients in all middle and high frequencies when compared to the control group. (table 1).

Table 1: showing mean hearing threshold (bone) in type 1 diabetic patients (test) versus age matched control.

	Mean hearing threshold (dB)													
	250Hz		500Hz		1000Hz		2000Hz		3000Hz		4000Hz		6000Hz	
	T	C	T	C	T	C	T	C	T	C	T	C	T	C
Mean	8	5	7	3	9	4	16	3	21	5	25	7	30	9

37 cases of type2 diabetes had poorer threshold by 9dB at 2000Hz, 12dB at 3000Hz, 14dB at 4000Hz & 20dB at 6000Hz suggesting auditory threshold was significantly

higher in the diabetic patients in all middle and high frequencies when compared to the control group. (table 2).

Table 2: showing mean hearing threshold (bone) in type 2 diabetic patients (test) versus age matched control.

	Mean hearing threshold (dB)													
	250Hz		500Hz		1000Hz		2000Hz		3000Hz		4000Hz		6000Hz	
	T	C	T	C	T	C	T	C	T	C	T	C	T	C
Mean	11	6	9	4	9	3	15	4	20	6	23	8	29	10

A positive relationship ($p \leq 0.0001$) exists between blood glucose level and the hearing threshold. Diabetics with blood glucose level less than 200 mg%, their hearing threshold does not deteriorate below 25dB. Uncontrolled diabetes (fasting blood glucose level more than 300 mg%)

had mild SNHL at mid frequency and moderate SNHL at high frequencies. Thus it is clear that diabetes causes mid and high frequency loss and more deterioration occur in uncontrolled diabetes.

Table 3: Showing the effect of blood glucose level of diabetic cases (both type 1 & 2) on the hearing threshold.

S.No.	Fasting blood glucose level (in mg/100ml)	Number of cases	Percentage%	Hearing threshold (in dB) Mean \pm S.D.						
				250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz
1.	≤ 200	32	64%	6 \pm 1.2	6 \pm 1.1	6 \pm 1.2	11 \pm 1.4	15 \pm 1.1	20 \pm 1.5	23 \pm 1.6
2.	≥ 200	18	36%	15 \pm 1.4	14 \pm 1.2	13 \pm 1.5	17 \pm 1.2	24 \pm 2.1	25 \pm 2.2	33 \pm 2.8
				$p \leq 0.0001$						
Total		50	100%							

In our study we included 50 cases of both type 1 & 2 diabetes mellitus. Out of 50 cases only 10 patients had one or other complication of diabetes. The complications in our series were evident from the medical records and the clinical examination of the patients. The complications, patients were reported to have were, retinopathy, neuropathy (distal

sensory loss), nephropathy, coronary artery disease and peripheral vascular disease, diabetic foot ulcers and dermatologic complications of non-healing ulcers. There was significant difference in the hearing threshold between patients with complicated diabetes and without the complications of the disease.

Table 4: showing the difference in hearing threshold between patients with complicated diabetes and patients with uncomplicated diabetes (both type 1 & 2).

S.No.	Type	Number of cases	Percentage%	Mean hearing threshold (in dB)						
				250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz
1	Complicated diabetes	10	20%	21 \pm 2.4	20 \pm 2.1	26 \pm 2.5	28 \pm 1.9	35 \pm 2.4	32 \pm 2.1	45 \pm 2.9
2	Uncomplicated diabetes (both type 1 & 2)	40	80%	4 \pm 0.8	3 \pm 0.6	5 \pm 0.6	10 \pm 0.9	12 \pm 1.2	16 \pm 1.5	24 \pm 1.9
				$p \leq 0.0001$						

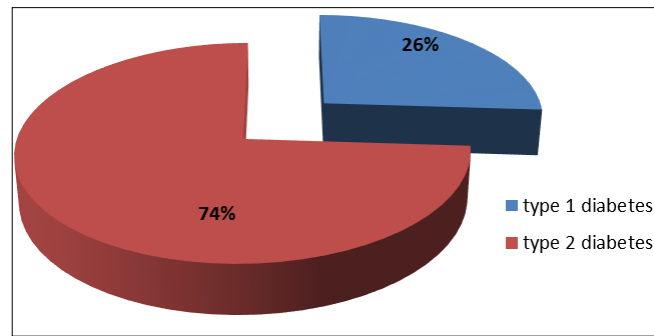


Fig 1: showing group distribution of diabetic patients Type 1 & Type 2 diabetes mellitus.

Discussion

It is evident from review of otolaryngology literature that relationship between diabetes and sensorineural hearing loss is complex. In the current study, evaluation of hearing threshold of previously diagnosed type 1 and type 2 diabetes mellitus patients and their comparison with age and sex matched controls was done. Type 1 & 2 diabetes patients had significantly higher threshold of hearing (table 1 & 2). Friedman *et al*^[4], showed a 55% incidence of hearing loss in diabetic patients. Weng *et al*^[5] noted that, 44.8% diabetic subjects had profound hearing loss, while Rajendran *et al*^[6] showed 73% diabetic patients having sensorineural hearing loss.

Age is another variable that could play a role in hearing loss. Axelsson *et al*^[7] showed that the incidence of pure tone hearing loss increases with age in patients with diabetes, even after correction for senile deafness. In the present study also incidence of sensorineural hearing loss was increased with the age of diabetics. However, there was no significant association between age and sensorineural hearing loss.

There was significant association between blood glucose level and diabetes mellitus in the current study. Diabetics with blood glucose level less than 200 mg%, their hearing threshold does not deteriorate below 25dB. Uncontrolled diabetes (fasting blood glucose level more than 300 mg%) had mild SNHL at mid frequency and moderate SNHL at high frequencies. Thus it is clear that diabetes causes mid and high frequency loss and more deterioration occur in uncontrolled diabetes. Kurien *et al*^[9] carried out the study on 30 diabetic cases & found that there was maximum incidence of sensorineural hearing loss of high frequency when blood glucose level was higher than normal.

There was strong association between diabetic complications and sensorineural hearing loss in our study. Out of 50 cases only 10 patients had one or other complication of diabetes. The complications in our series were evident from the medical records and the clinical examination of the patients. The complications, patients were reported to have were, retinopathy, neuropathy (distal sensory loss), nephropathy, coronary artery disease and peripheral vascular disease, diabetic foot ulcers and dermatologic complications of non-healing ulcers. There was significant difference in the hearing threshold between patients with complicated diabetes and without the complications of the disease. Kurien *et al*^[9] also found that patients without complications had relatively lower level of sensorineural hearing loss as compared to patients with diabetic complications. Taylor and Irwin^[10] reported that almost 70% of their adult diabetics had hearing impairment. This occurred more commonly when retinopathy was

present. Parving A^[11] in his study of 20 patients with diabetic micro angiopathy did not find correlation between hearing impairment and angiopathy as well as neuropathy.

Conclusion

The diabetic subjects had higher hearing threshold with bilateral mild to moderate degree sensorineural hearing loss. Age, gender of diabetic patient and duration of diabetes had no significant correlation with hearing loss. Since blood glucose level and diabetic complications had strong association with sensorineural hearing loss. Diabetic patients with poor control of blood glucose level have increased risk of hearing loss and may be an under diagnosed complication of diabetes. While considering sensorineural hearing loss to be a consequence of diabetes, a metabolic assessment may be useful for patients presenting with hearing loss so as to reduce the high rate of undiagnosed diabetes mellitus in the community. On the other hand, routine screening for hearing loss in diabetes patients may also be helpful to diminish co morbidities among them and improve their quality of life.

References

1. Jorgensen M B, Buch NH. Studies on inner ear function and cranial nerves in diabetics. *Arch Otolaryngol*. 1961; 74:373-381.
2. Harner SG. Hearing in adult onset diabetes mellitus. *Otolaryngol Head Neck Surg*. 1981; 89:322-7.
3. Celik O, Yalcin S, Celebi H, Ozturk A. Hearing loss in insulin- dependent diabetes mellitus. *Auris Nasus Larynx*. 1996; 23:127-32.
4. Friedman SA, Schulman RH, Weiss S. Hearing and diabetic neuropathy. *Arch Intern Med*. 1975; 135(4):5736.
5. Weng SF, Chen YS, Hsu CJ, Tseng FY. Clinical features of sudden sensorineural hearing loss in diabetic patients. *Laryngoscope*. 2005; 115(9):1676-80.
6. Rajendran S, Anandhalakshmi, Mythili B, Viswanatha Rao. Evaluation of incidence of sensorineural hearing loss in patients with type2 diabetes mellitus. *Int J Biol Med Res*. 2011; 2(4): 982-87.
7. Axelsson A, Sigroth K, Vertes D. Hearing in diabetics. *Actaotolaryngol*. 1978; 356 (Suppl):3-21.
8. Cullen JR, Cinnamon MJ. Hearing loss in diabetics. *J Laryngol Otol*. 1993; 107:179-82.
9. Kurien M, Thomas K, Bhanu TS. Hearing threshold in patients with diabetes mellitus. *J Laryngol Otol*. 1989; 103(2):164-68.
10. Taylor IG, Irwin J. Some audiological aspects of diabetes mellitus. *J Laryngol Otol*. 1978; 92:99-13.
11. Parving A. Hearing problems and hormonal

- disturbances in the elderly. *Act Otolaryngol Suppl* (Stockh). 1990; 476:44-3.
12. Fangchao Ma, Orlando Gomez-Marin, LeeDJ, Balkany T. Diabetes and hearing impairment in Mexican American adults: a population based study. *J Laryngol Otol*. 1998; 112:835-839.
 13. Harkare VV, Deosthale NV, Khadakkar SP, Dhoke PR, Dhote KS, Gupta A. A Prospective Study Hearing Status in Patients with Diabetes Mellitus. *PJSR*. 2014; 7(2):38-2.
 14. Meena R, Sonkhya D, Sonkhya N. Evaluation of hearing loss in patients with type 2 diabetes mellitus. *Int J Res Med Sci*. 2016; 4:2281-7.
 15. Dadhich S, Jha SG, Sinha V, Samanth TU. A prospective, observational study of incidence of sensory neural hearing loss in diabetes mellitus patients. *Indian J Otol*. 2018; 24:80-2
 16. Pemmaiah KD, Srinivas DR. Hearing loss in Diabetes Mellitus. *International Journal of Collaborative Research on Internal Medicine & Public Health*. 2011; 3(10):725-731.