

Clinical Evaluation of Sensorineural Hearing Loss in Patients with Diabetes Mellitus

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Original Research Article

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Abstract: Diabetes mellitus (DM) is a disease known since antiquity. Hearing impairment is one of the known complications of DM. The relationship between SNHL and DM has been studied since 1857, when Jordao [1] reported one case of hearing impairment associated with incipient diabetic coma. This study was done to evaluate the relation of SNHL with duration of DM, sexual preponderance of SNHL in DM and SNHL in familial DM. This study aims at knowing the prevalence of SNHL in DM and its relation to age, sex, and duration of DM. In this study a total of 140 patients presenting with diabetes mellitus during one year study period from January 2016 to December 2016 were studied. Hearing loss was assessed by pure tone audiometry this study was done in the department of otorhinolaryngology, Adichunchanagiri Institute of Medical Sciences, Karnataka. Of the 140 cases, 58.27% of the patients were males. The male to female ratio was 1.41:1. The mean age of the study population was 39.85 ± 9.25 years. Majority (75%) of the patients presented with duration of five years or less and the mean duration was 4.91 ± 3.44 years. Family history of diabetes was present in 32.86% of the patients. The mean fasting and postprandial blood sugar levels were found to be 124.6 ± 37.88 mg/dl and 188.24 ± 53.78 mg/dl respectively. In this study the prevalence of SNHL was 40% with maximum number of patients (20%) having minimal hearing loss. SNHL in diabetes was significantly associated with advancing age, duration of diabetes and family history of diabetes but association of SNHL with sex of the patient was not statistically significant.

Keywords: Sensorineural hearing loss, Diabetes mellitus, hearing impairment, Pure tone audiometry, Tuning fork tests.

INTRODUCTION

Hearing is integral part of speech; it helps us to lead our lives happily without any restrictions. Hearing impairment will hamper one's personal and social life and hence quality of life. Our ability to hear has a very great impact on almost every aspect of our lives. Hence hearing impairment is not a trivial consideration. Diabetes mellitus is a common non-communicable metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both[2]. Diabetes is a chronic and potentially disabling disease which is reaching an epidemic proportion in many parts of the world. It is a major and growing threat to global public health. The vast majority of cases of diabetes fall into two broad categories: those having little or no endogenous insulin secretory capacity (Insulin Dependent Diabetes Mellitus) or type 1 DM and those who retain endogenous insulin secretory capacity but have a combination of insulin resistance and an inadequate compensatory insulin secretory response (Non-Insulin Dependent Diabetes Mellitus or

Type 2 DM)[2,3]. The prevalence of diabetes mellitus and its adverse health effects have increased more rapidly in South Asia than in any other region of the world [4]. Furthermore, DM is associated with several complications, which include retinopathy, nephropathy, and neuropathy (both peripheral and autonomic). The risk for atherosclerotic vascular disease is also increased in persons with DM. The risk for microvascular and neuropathic complications is related to both duration of diabetes and severity of hyperglycemia [4]. In patients with DM all the cells of the body are exposed to high levels of plasma glucose but it is observed that symptoms of complication are arising only in few cell types. This may be because many of such complications are unrecognized or only particular cells are affected by hyperglycemia. The sense organ of hearing- the organ of Corti has complex components and arrangement which makes it a potential target for hyperglycemic damage. Microangiopathy is the basic lesion and is considered to be the most important factor in long term complication of diabetes [5]. Microangiopathic changes in retina, skin and renal vessels are very well documented. As microangiopathy

affects almost all parts of the body, its effect on the vessels of the inner ear may lead to impairment on hearing.

The typical hearing loss in diabetes is described as a progressive, bilateral, sensorineural type deafness of gradual onset which affects predominantly higher frequencies and elderly patients. There is decrease in auditory acuity which is similar to that due to presbycusis, but those affected show a hearing loss greater than could be expected at that age. Exceptions to this pattern have been reported. These have included acute onset of hearing loss [6] or associated with Meniere like attacks [7], unilateral deafness with or without vestibular symptoms and low frequency involvement. Edgar in 1915 was the first to report a high-frequency SNHL in a diabetic patient[8]. Conflicting results on hearing function in diabetic patients are described in medical literature. Hence the present study was planned to evaluate the relation of SNHL with duration of DM, sexual preponderance of SNHL in DM and SNHL in familial DM.

MATERIALS AND METHODS

The present study was a time bound descriptive study conducted in the department of otorhinolaryngology, Adichunchanagiri Institute of Medical Sciences, Karnataka during the period from January 2016 to December 2016. So far, limited data is available on prevalence of SNHL in DM and very few

studies have been performed in the past. Hence all the eligible patients presenting with diabetes mellitus during the period of study were taken up in the study. Patients with symptoms and signs of diabetes mellitus confirmed by; Fasting blood sugar level more than 100mg%, post prandial blood sugar level of more than 200mg%, Random blood sugar level of more than 200mg% in patients with symptoms of diabetes mellitus. History of noise exposure, ototoxic drug intake, hearing difficulty caused by other diseases and debilitating patients with diabetes mellitus were excluded from the study. All the patients fulfilling the selection criteria were explained about the nature of the study and a written informed consent was obtained. After the enrollment, demographic data such as age and sex were obtained through the interview. The history pertaining to the diabetes mellitus such as duration of diabetes, type and family history, history of other comorbid conditions were assessed. Thorough clinical examination was carried out followed by ENT examination. Patients were subjected to the following blood investigations; fasting blood sugar (FBS), Post prandial blood sugar (PPBS). To assess the hearing loss patients were subjected to tuning fork tests with 256, 512 and 1024 frequencies and Pure tone audiometry which was done by Alps pure tone audiometer for pure tone air conduction(AC) threshold, pure tone Bone conduction(BC), Speech reception and Tests for recruitment. The hearing impairment was interpreted as below [9].

Degree of hearing loss	Hearing loss range (db)
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+

The data obtained was coded and entered into Microsoft Excel Worksheet. The categorical data was expressed as rates, ratios and proportions and continuous data was expressed as mean \pm Standard deviation (SD). The comparison was done using chi-square test and unpaired student 't' test. A probability value (p value) of less than 0.050 was considered as statistically significant.

RESULTS

This descriptive study included a total of 140 patients presenting with diabetes mellitus during the study period. In this study 58.27% of the patients were males and 41.43% were females. The male to female ratio was 1.41:1. The commonest age group was 40 to

50 years comprised of 55% of patients followed by 20 to 30 years (24.29%) and 31 to 40 years (20.71%). The mean age of the study population was 39.85 ± 9.25 years. In the present study maximum (75%) patients presented with duration of 5 years or less. In the remaining, the duration was 6 to 10 years (18.57%), 11 to 15 years (5%) and more than 15 years (1.43%). The mean duration of the study population was 4.91 ± 3.44 years. Family history of diabetes was present in 32.86% of the patients. In this study, the prevalence of SNHL in patients with diabetes mellitus was found to be 40%. In the present study the severity of hearing loss was minimal in 20%, mild in 14.29%, moderate and moderately severe in 2.86% each (Table 1).

Table-1: Severity of hearing loss

Severity	Distribution (n = 140)	
	Number	Percentage
Normal	84	60.00
Minimal	28	20.00
Mild	20	14.29
Moderate	4	2.86
Moderate to Severe	4	2.86
Total	140	100.00

In this study 36.59% of the males had SNHL compared to 44.83% of females but the difference was statistically not significant (p=0.327).

In the present study the prevalence of SNHL increased with age that is 55.84% of patients aged

between 41 to 50 years had hearing loss compared to 11.76% of patients who were aged between 20 to 30 years. This difference was statistically significant (p<0.001). Patients aged between 31 to 40 years had 31.03% hearing loss (Table 2).

Table-2: Association of age with SNHL

Age group(years)	SNHL			
	Present		Absent	
	No	%	No	%
20 - 30	4	11.76	30	88.24
31 - 40	9	31.03	20	68.97
41 - 50	43	55.84	34	44.16
Total	56	40.00	84	60.00
P<0.001				

In this study the prevalence of SNHL was high in those patients who presented with duration of more than 10 years (77.78%) while it was less in those who

had duration of 5 years or less (33.33%). This difference was statistically significant (p=0.009) (Table 3).

Table-3: Association of duration of diabetes with SNHL

Duration (Years)	SNHL			
	Present		Absent	
	No	%	No	%
5 or Less	35	33.33	70	66.67
6 to 10	14	53.85	12	46.15
>10	7	77.78	2	22.22
Total	56	40.00	84	60.00
P = 0.009				

In the present study the prevalence of SNHL was significantly high in patients with family history of diabetes (58.70%) compared to those who did not have the family history of diabetes (30.85%) (p=0.002).

DISCUSSION

Diabetes mellitus is a non-communicable chronic disease with numerous neurological, cardiovascular, infectious and other complications. One of the known complication of DM is hearing impairment which leads to a decreased quality of life among those affected[10]. There have been various studies regarding the incidence of hearing impairment in diabetes[11]. Despite several studies of this topic, the effects of different variables such as age, sex family history of diabetes and duration of diabetes on SNHL have not been clarified leading to conflicting results.

The present study was aimed to evaluate the relation of SNHL with duration of DM, sexual preponderance of SNHL in DM and SNHL in familial DM. Perusal of the literature reveals conflicting reports regarding exact pathophysiological mechanism leading to hearing loss in diabetics. Most of the workers believe it to be due to microvascular lesion [12] analogous to that seen in other organs. The inner ear is affected by a microangiopathic process is strongly suggested by the studies of Jorgenson and Buch [13] Jorgenson *et al.* [14] Kakarlapudi[15]and Costa[16] who showed histopathological evidence similar to that observed in diabetic retinopathy, nephropathy and angiopathy of lower limbs. This further supports the suggestion that the underlying pathology is a microvascular one. Malicka *et al.* [17] have attributed the hearing impairment to be the function of increased levels of

mucopolysaccharides in the walls of internal auditory artery. The hallmark of the underlying pathophysiological mechanism for the long term complications of diabetes is a microvascular lesion. On the contrary peripheral neuropathy as the most important factor causing hearing loss has been suggested by Naufal[18]. Makishima and Tanaka [19] described atrophy of spiral ganglion neurons and demyelination of auditory nerve in four diabetic subjects.

In reviewing the literature it becomes clear that the site of lesion in diabetic hearing loss is still debatable. A sensorineural deafness can be caused by a lesion in the inner ear, auditory nerve, brainstem or auditory area of the cerebral cortex. The absence of other associated findings seems to rule out a central nervous system origin. In this present study exact pathophysiological mechanism leading to deafness could not be ascertained; however there is evidence to suggest that most probably it is because of microangiopathy of inner ear vessels of stria vascularis. This finding is in accordance with Jorgenson [20] who also reported that deafness in diabetic cases is generally because of thickening of vessels of stria vascularis. The hearing impairment in diabetics is similar to that of presbycusis. We eliminated the interplay of presbycusis with our findings by eliminating patients over 50 years of age. Thus it can be reasonably concluded that the hearing impairment in diabetics is akin to accelerated presbycusis. When sex was taken into consideration the present study revealed that it had no significant relationship with hearing impairment. This study reveals that the impairment in hearing in diabetics had a linear relationship with the duration of the disease. Increasing duration of the disease resulted in increasing hearing impairment. Increasing duration of diabetes mellitus is expected to result in increasing microangiopathy and neuropathy. In our study we correlated the hearing impairment with severity of diabetes. A significant correlation ship was evident between the severity and hearing impairment. Patient who had higher fasting blood sugar levels had a greater impairment of hearing.

CONCLUSION

Our study evidently demonstrated the association between sensorineural hearing loss and diabetes mellitus. Advancing age was found to correlate well with increasing hearing impairment. No correlation could be derived between sex and degree of hearing impairment. Duration of diabetes mellitus correlated significantly with increasing hearing impairment. In the present study the prevalence of SNHL was significantly high in patients with family history of diabetes. Severity of the diabetes was found to be important determining factor in hearing impairment. More severe the disease, greater was the hearing impairment.

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The results obtained in this study support the existence of a relationship between SNHL and DM. Hence the auditory status of DM patients should be thoroughly screened.

Conflict of interest

Authors declare that they have no conflicts of interest.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and /or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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