

Correlation of Diabetes and Hearing Impairment

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ABSTRACT

Introduction: Diabetes mellitus is a disease characterized by alteration in the glucose metabolism, resulting in elevated blood glucose levels. Diabetes mellitus continues to pose a serious threat to human society. More so because it is considered to be a lifestyle disease. Sedentary habits coupled with day to day stress and heredity do play the devil's advocate. The study was done with the prime objective of establishing a relationship between diabetes mellitus and its adverse affects on the hearing system.

Material and methods: The present study was done at the department of ENT at the government medical college Kathua, J and K, India. The study was an observational study based on the data base of the both diabetic and non diabetic patients who had walked into our outpatient department with hearing impairment complaints between February 2020 up to July 2020. Our study included 100 diabetics and 100 non diabetic patients with hearing loss as their presenting complaints. They were subjected to audiometric evaluation. Only patients with sensorineural hearing loss were included in the study. A total of 100 diabetic patients were subjected to audiometric evaluation.

Results: After going through our collected data, we discovered that diabetes most certainly has its adverse affect on hearing system. But then how badly it affects the auditory senses and an individuals hearing is debatable. More so when we are aware of the fact that compromised hearing of the patient is more often than not multifactorial in origin with more than one factor contributing to its occurrence. In our present study it was observed that 75% of diabetic patients had some degree of sensorineural hearing loss.

Conclusion: ENT specialists seeing middle aged patients with unexplained hearing loss should try and rule out diabetes mellitus and its family history. A regular monitoring of hearing with the help of audiometry is most certainly required in diabetics. Patients with diabetes mellitus should be motivated in their efforts to maintain their blood glucose levels. Family members of patients who are diabetics should be counseled about the adverse effects of diabetes and also their increased likelihood of developing diabetes. Their blood sugar monitoring should be done wherever it's possible.

Keywords: Diabetes Mellitus, Sensorineural Hearing Loss, Pure Tone Audiometry, Blood Sugar Levels

INTRODUCTION

Diabetes mellitus is a disease characterized by alteration in the glucose metabolism, resulting in elevated blood glucose levels. Diabetes mellitus continues to pose a serious threat to human society. More so, because it is considered to be a lifestyle disease. Sedentary habits coupled with day to day stress and heredity does play the devil's advocate.

Diabetes mellitus essentially represents metabolic disorders

wherein elevated blood sugar levels remain the common denominator. Depending on the basis of the underlying pathological phenomenon that leads to raised blood glucose, diabetes mellitus is at present classified as Type 1 and Type 2 DM. Type 1 DM is characterized by the deranged insulin producing capacity of the beta cells of pancreas resulting in insulin deficiency. Whereas in type 2 DM the pancreas continues to make insulin but a cellular impairment in sensitivity to insulin results in raised blood glucose levels.

Type 2 diabetes mellitus comprises of a diverse bunch of disorders that are represented by varying degrees of resistance to the insulin, a faulty insulin secretion, and an exaggerated hepatic production of glucose. The other varieties that are included under the diabetes mellitus type2 umbrella include MODY (maturity-onset diabetes of the young [MODY]). In this variety the diabetes mellitus is caused by genetic defects. Diseases of the exocrine pancreas (chronic pancreatitis, cystic fibrosis, hemochromatosis), endocrinopathies (acromegaly, Cushing's syndrome, glucagonoma, pheochromocytoma, hyperthyroidism), drugs (nicotinic acid, glucocorticoids, thiazides, protease inhibitors), and pregnancy (gestational DM) are also included in the type2 diabetes mellitus group of disorders. The phenotype of these monogenetic and secondary types of DM typically resembles type 2 DM; its severity depends on the degree of beta cell dysfunction and prevailing insulin resistance. Type 1 DM usually results from autoimmune destruction of pancreatic beta cells is the common causative factor in case of type1 diabetes. Since its commonly found in the adolescents and children it is often called juvenile-onset diabetes.

The prevalence of this disorder seems to be on a rapid rise. Infact it is the type 2 diabetes mellitus that is on a significant increase almost comparable with obesity which is also posing a huge threat and is often closely associated with the diabetes mellitus.

As per Harrison, between 1985 and 2013, the worldwide prevalence rate of diabetes mellitus across the globe increased by well over 10-folds. With the number rising from 30 million in 1985 to a humongous 382 million affected in 2013. In the USA, the rate of prevalence is more than 8%

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of the population, with an increasing trend towards the older age group. One needs to keep in mind a conspicuous group of patients who suffer from diabetes for some reasons remain undiagnosed. This disease is often accompanied by morbidity and significant mortality. Diabetes ranks 5th amongst the various leading causes of mortality globally.

In our nation India, there are an estimated 77 million people who are affected by diabetes mellitus. India ranks second amongst the countries worst affected by this disorder with China being number one. India has 17% of the world diabetic population. One in every six individuals who have diabetes is Indian.

Hearing impairment exists when there is reduced sensitivity to the sounds normally heard. Sensorineural hearing loss is caused by lesions of either the inner ear (sensory), the auditory (8th) nerve, or central auditory pathways¹

The World Health Organization (WHO) defines Hearing impairment as pure-tone thresholds of more than 25 dB hearing loss in the better ear, above which the hearing impairment makes it difficult to hear lower than normal voices and may cause individuals to miss parts or all of words in ordinary communication. Hearing impairment has a variety of causative factors. The most common being presbycusis, noise induced, intake of ototoxic drugs, and also viral infections. Also the relationship of auditory loss and diabetes mellitus is speculative and controversial. And there is insufficient evidence to support significant relationship between diabetes and hearing impairment from the epidemiological perspective.

National Institute on Deafness and Other Communication Disorders data suggest that among persons with diabetes between the ages of 50 and 69 years, more than 70% have a hearing loss at higher frequencies and one third have low- or mid-frequency hearing loss. The data also suggests that persons with diabetes may experience hearing loss at earlier ages.

Epidemiological evidence demonstrating a relationship between diabetes and hearing impairment is just emerging and needs to be confirmed by an extensive research work on the subject. Most evidence comes from cross-sectional analyses in which the ascertainment of diabetes and hearing impairment has been done at the same point in time. Studies designed to test whether hearing impairment has an earlier onset among persons with diabetes than among persons without diabetes would help establish the temporal relationship and give weight to the argument that diabetes precedes and it accentuates the hearing disabilities.

Diabetes mellitus has a deleterious effect on various vital organ systems like the cardiovascular, renal, immune system, eyes and the nervous system. Diabetic neuropathies also affect GI, bladder and erectile function. Because diabetes is a systemic disease with accompanying pathology affecting multiple organ systems, it sounds same enough to investigate and study as to whether diabetes affects the hearing mechanism. And if so how severely and also the

likely patterns that ought to be expected while evaluating hearing compromise in diabetic individuals.

MATERIAL AND METHODS

With the prime objective of establishing a relationship between diabetes mellitus and its adverse effects on the hearing system, we decided to take up this study at our institute. The study was conducted at the department of ENT at the government medical college Kathua, J and K, India. The study was an observational study based on the data base of the both diabetic and non diabetic patients who had walked into our outpatient department with hearing impairment complaints between February 2020 up to July 2020.

Our study included 100 diabetics and 100 non diabetic patients with hearing loss as their presenting complaints. A total of 100 diabetic patients were subjected to audiometric evaluation. These included twenty patients each belonging to age groups- 30-39, 40-49, 50-59 and 60-69. Likewise for the sake of comparison and analysis, twenty non diabetic patients belonging to age groups 30-39, 40-49, 50-59 and 60-69 were also included in the study.

These patients had presented to us with hearing impairment complaints, and had also been subjected to audiometric evaluation. In the present study only patients with sensorineural hearing loss were included in the study. Patients suffering from ear pathologies like CSOM, ASOM, and otosclerosis were excluded from the study. The reason being to exclude the various pathologies that could infringe upon the aim of the study which was to establish a relation between diabetes mellitus and its adverse effects on auditory apparatus. The patients were subjected to pure tone audiometry (PTA). The PTA test was done on 250Hz, 500Hz, 1KHz, 4 KHz, and 8 KHz.

The degree of auditory impairment was assessed on the basis of the WHO classification. This was based on the PTA findings, by taking the average of the thresholds of hearing for frequencies of 500 Hz, 1000Hz, and 2000Hz. Accordingly the degree of hearing loss was classified as mild when 26–40 dB, moderate when it was 41–55 dB, moderately severe when the average pure tone threshold was 56–70 dB, severe when 71–90 dB, and profound when the mean pure tone threshold exceeded 90 dB.

An informed written consent was obtained from the patients who were included in the study. The ones who were unwilling to give consent were excluded. In the present study we also tried to establish as to whether patients presenting to our outpatient department with hearing complaints had undiagnosed diabetes. Such patients who had a pure sensorineural hearing loss and had never got their blood sugar levels checked were sent for a random blood sugar level evaluation.

All the patients who were a part of this study were sent for random blood sugar levels and they were also sent for a post prandial and fasting blood sugar level testing the next day. This was followed up by a review checkup along with the blood sugar level reports on the next OPD day of our unit.

The patients with elevated fasting, post prandial and random blood sugar levels were included in the diabetic study group. The patients in the diabetic group also included known diabetics for the last 3 years. Only patients with a normal ear drum were included in this study.

RESULTS

After going through our collected data, we discovered that diabetes most certainly has its adverse affect on hearing system. But then how badly it affects the auditory senses and an individuals hearing is debatable. More so when we are aware of the fact that compromised hearing of the patient is more often than not multifactorial in origin with more than one factor contributing to its occurrence.

In our present study it was observed that 75% of diabetic patients had some degree of sensorineural hearing loss. This was similar to the study conducted by Taylor and Irwin 1978.² They reported a sensorineural hearing loss amongst 70% of their diabetic patients. On the contrary Friedman et al. 1975³ noted a 55% incidence of hearing loss in diabetic patients.

Underlining the proposition that the age of the person and onset age of diabetes also appear to play an important role to find out its exact effect on hearing system of people with Diabetes. In our study we also observed that the longer the duration of diabetes in the patients, the higher was the severity of hearing loss. This was more pronounced in the 60-69 year age group. However the fact as to whether the increased hearing loss was due to diabetes alone or multifactorial remains a subject of debate.

Age Group 30-39		
	Mean Threshold	
Frequency	Non-Diabetic	Diabetic
3000 Hz	40 dB	50dB
4000 Hz	45 dB	60 dB
5000 Hz	50 dB	65 dB
6000 Hz	50 dB	65 dB
8000 Hz	45 dB	60 dB

In our study we also found that with a wide gamut of competing factors that gather over a lifetime resulting in age-related hearing loss, the difference in prevalence between adults with diabetes and those without diabetes mellitus does appear to diminish with increasing age.

In our study this idea is supported when the mean pure-tone thresholds are analyzed for each age group. Among persons aged 30-39 years, mean thresholds at frequencies of 3000-8000 Hz were found to be 10-15 dB HL higher among persons with diabetes in comparison to the non diabetic individuals. (Table1)

It was also observed that in every following age group, hearing thresholds in both groups increased. This however at the same time was accompanied by narrowing of the difference between the hearing thresholds of the diabetic group and those of the non-diabetic group. Among those 50-59 years old and among those 60-69 years old, the average thresholds at frequencies 3000-8000

Hz were only 4-6 dB HL higher for those with diabetes. Diabetes may be prematurely aging the ear, Bainbridge et al., 2008.⁴

The pathophysiological basis that can explain hearing impairment that is diabetes-related is mostly speculative. The long term complications of diabetes including retinopathy, nephropathy, and peripheral arterial disease are basically vascular in origin. Diabetes is known to cause peripheral neuropathies. These neuropathies affect peripheral sensation and various autonomic functions. Similarly the pathological changes that are seen in diabetes may also cause injury to the cochlear vasculature or even the neural components of the inner ear. Histopathological evidence of vascular or neurological involvement obtained from autopsied patients with diabetes includes sclerosis of the internal auditory artery, thicker vessel walls of the stria vascularis and of the basilar membrane, demyelination of the cochlear nerve, and atrophy of the spiral ganglion, Makishima & Tanaka, 1971.⁵ Fukushima et al., 2006⁶ in their observation had reported a loss of outer hair cells among patients with diabetes.

Age Group 40-49		
	Mean Threshold	
Frequency	Non-Diabetic	Diabetic
3000 Hz	50 dB	55dB
4000 Hz	60 dB	60 dB
5000 Hz	60 dB	65 dB
6000 Hz	55 dB	65 dB
8000 Hz	50 dB	60 dB

Age Group 60-69		
	Mean Threshold	
Frequency	Non-Diabetic	Diabetic
3000 Hz	60 dB	60dB
4000 Hz	65 dB	70 dB
5000 Hz	65 dB	65 dB
6000 Hz	70 dB	75dB
8000 Hz	70 dB	75 dB

In our study we also observed that the longer the duration of diabetes in the patients, the higher was the severity of hearing loss. This was more pronounced in the 60-69 year age group. However the fact as to whether the increased hearing loss was due to diabetes alone or multifactorial remains a subject of debate.

The study also suggests a significant increase in speed at which the deafness progress post 60years. Marlow et al⁷ had observed that the age-related changes in the PTA were more severe at higher frequencies. Axelsson et al⁸ who observed that hearing loss increases with age in diabetics.

In the present study 15 of the patients who had presented to our OPD with sensorineural deafness had never got their blood sugar levels tested. Such patients were sent for getting their random blood sugar levels checked. Amongst these 6 such patients were found to have an elevated blood glucose levels.

Age Group 50-59		
Frequency	Mean Threshold	
	Non-Diabetic	Diabetic
3000 Hz	55 dB	60dB
4000 Hz	60 dB	65 dB
5000 Hz	65 dB	65 dB
6000 Hz	65 dB	70 dB
8000 Hz	70 dB	70 dB

CONCLUSION

ENT specialists seeing middle aged patients with unexplained hearing loss should try and rule out diabetes mellitus and its family history. Those patients who plead ignorance with respect to having gotten their blood sugar levels checked must be investigated and diabetes mellitus ruled out. A regular monitoring of hearing with the help of audiometry is most certainly required in diabetics. Patients with diabetes mellitus should be motivated in their efforts to maintain their blood glucose levels. A regular visit to the treating physician/ endocrinologist must be encouraged. Family members of patients who are diabetics should be counseled about the adverse effects of diabetes and also their increased likelihood of developing diabetes. Their blood sugar monitoring should be done wherever it's possible. A regular track of the hearing status of diabetic patients must be maintained. A regular Pure tone audiometry must be performed in order to compare the auditory function of diabetic patients by comparing with older audiometry records. An awareness programme at a national level with the sole objective being to highlight the deleterious effects of diabetes on the ears needs to be envisaged and the government agencies need to be sensitized and apprised of its urgent need. Lifestyle modification remains a cornerstone in management of diabetes and therefore its adverse effects on various organ systems too, which includes the ears. Patients need to be encouraged to lead an active life in order to check the disease and its side effects.

REFERENCES

1. Dhingra PL. Disease of Ear, Nose and Throat. 5th ed. ch. 5. 2010. p. 37.
2. IG, Irwin J. Some audiological aspects of diabetes mellitus. *J Laryngol Otol* 1978;92:99-113.
3. SA, Schulman RH, Weiss S. Hearing and diabetic neuropathy. *Arch Intern Med* 1975;135:573-
4. Bainbridge KE, Hoffman HJ, Cowie CC. Diabetes and hearing impairment in the United States: audiometric evidence from the National Health and Nutrition Examination Surveys, 1999 to 2004. *Annals of Internal Medicine*. 2008; 149:1-10.
5. Makishima K, Tanaka K. Pathological changes of the inner ear and central auditory pathway in diabetics. *The Annal of OtologyRhinology & Laryngology*. 1971;80:218-28.
6. Fukushima H, Cureoglu S, Schachern PA, Kusunoki T, Oktay MF, Fukushima N. et al. Cochlear changes in patients with type 1 diabetes mellitus. *Journal of Otolaryngology Head & Neck Surgery*. 2005; 133:100-6.

7. Marlow ES, Hunt LP, Marlow N. Sensorineural hearing loss and prematurity. *Arch Dis Child Fetal Neonatal Ed* 2000;82:F141-4.
8. Axelsson A, Sigroth K, Vertes D. Hearing in diabetics. *Acta Otolaryngol Suppl* 1978;356:1-23.
9. Fukushima H, Cureoglu S, Schachern PA, Paparella MM, Harada T, Oktay MF. Effects of type 2 diabetes mellitus on cochlear structure in humans. *Archive of Otolaryngology &Head Neck Surgery*. 2006; 132:934-8.
10. Duck SW, Prazma J, Bennett PS, Pillsbury HC. Interaction between hypertension and diabetes mellitus in the pathogenesis of sensorineural hearing loss. *Laryngoscope*. 1997; 107:1596-605.

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