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# Comparative assessment of sensorineural hearing loss in patients suffering from diabetes in Bihar region

**Dr. Vandana Sharma[1], Dr. Rakesh Kumar Singh[2*]**
[1] Senior Resident, Department of ENT, Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, Bihar, India
[2] HOD, Department of ENT, Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, Bihar, India
[*] Corresponding author: Dr. Rakesh Kumar Singh

**Abstract**
Diabetes mellitus (DM) is a common systemic metabolic disease with increasing worldwide prevalence. DM is associated with multiple macro- and micro vascular complications, including thickening of the basal membrane of the stria vascularis is capillaries on the lateral wall of the cochlea and other micro vascular and neuropathic changes that could induce hearing loss. In view of contradictory results regarding hearing impairment in diabetic patients, the current study was planned with the objectives to assess the hearing threshold level in diagnosed patients of diabetes mellitus, to study the correlation between the degree of hearing loss and the duration, severity of hyperglycemia and its complications.
The present study was planned on 30 patients referred to Department of ENT in Indira Gandhi Institute of Medical Sciences from Jan 2018 to Jun 2018. A detailed history including hearing loss – duration, onset, associated symptoms and diabetes – duration, treatment taken was obtained from the patients who were selected on basis of the inclusion and exclusion criteria and was then subjected to a detailed ENT examination.
It is concluded that the incidence of sensorineural hearing loss is significantly high in Diabetes mellitus patients as compared to non-diabetic controls. However, there is a need for further studies with larger sample size in order to establish the observed SNHL in these patients. 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.

**Keywords:** diabetes mellitus, sensorineural hearing loss, deafness

## Introduction
Sensorineural hearing loss (SNHL) is a type of hearing loss, or deafness, in which the root cause lies in the inner ear or sensory organ (cochlea and associated structures) or the vestibulocochlear nerve (cranial nerve VIII). SNHL accounts for about 90% of reported hearing loss. SNHL is generally permanent and can be mild, moderate, severe, profound, or total. Various other descriptors can be used depending on the shape of the audiogram, such as high frequency, low frequency, U-shaped, notched, peaked, or flat.
Sensory hearing loss often occurs as a consequence of damaged or deficient cochlear hair cells. [disputed – discuss] Hair cells may be abnormal at birth, or damaged during the lifetime of an individual. There are both external causes of damage, including noise trauma, infection, and ototoxic drugs, as well as intrinsic causes, including genetic mutations. A common cause or exacerbating factor in sensory hearing loss is prolonged exposure to environmental noise, for example, being in a loud workplace without wearing protection, using headphones at high volume for a long period or being exposed to very loud recreational noise such as in clubs or concerts. Exposure to a single very loud noise such as a bomb blast can cause noise-induced hearing loss. Neural, or "retrocochlear", hearing loss occurs because of damage to the cochlear nerve (CVIII). This damage may affect the initiation of the nerve impulse in the cochlear nerve or the transmission of the nerve impulse along the nerve into the brainstem.
Most cases of SNHL present with a gradual deterioration of hearing thresholds occurring over years to decades. In some, the loss may eventually affect large portions of the frequency range. It may be accompanied by other symptoms such as ringing in the ears (tinnitus) and dizziness or light headedness (vertigo). The most common kind of sensorineural hearing loss is age-related (Presbycusis), followed by noise-induced hearing loss (NIHL). Frequent symptoms of SNHL are loss of acuity in distinguishing foreground voices against noisy backgrounds, difficulty understanding on the telephone, some kinds of sounds seeming excessively loud or shrill, difficulty understanding some parts of speech (fricatives and sibilants), loss of directionality of sound (especially with high frequency sounds), perception that people mumble when speaking, and difficulty understanding speech. Similar symptoms are also associated with other kinds of hearing loss; audiometry or other diagnostic tests are necessary to distinguish sensorineural hearing loss.
Identification of sensorineural hearing loss is usually made by performing a pure tone audiometry (an audiogram) in which bone conduction thresholds are measured. Tympanometry and speech audiometry may be helpful. Testing is performed by an audiologist.
There is no proven or recommended treatment or cure for SNHL; management of hearing loss is usually by hearing strategies and hearing aids. In cases of profound or total deafness, a cochlear implant is a specialised hearing aid which may restore a functional level of hearing. SNHL is at least partially preventable by avoiding environmental noise, ototoxic chemicals and drugs, and head trauma, and treating or inoculating against certain triggering diseases and conditions like meningitis.

A recent study found that hearing loss is twice as common in people with diabetes as it is in those who don't have the disease. Also, of the 86 million adults in the U.S. who have prediabetes, the rate of hearing loss is 30 percent higher than in those with normal blood glucose. It has not been established how diabetes is related to hearing loss. It is possible that the high blood glucose levels associated with diabetes cause damage to the small blood vessels in the inner ear, similar to the way in which diabetes can damage the eyes and the kidneys. Similar studies have shown a possible link between that hearing loss and neuropathy [1].

Very simply, diabetes inhibits the body's ability to produce and/or manage insulin appropriately, causing glucose to build up in the bloodstream instead of feeding hungry cells. The number of people diagnosed with this disease is on the rise, jumping more than 50 percent in the last decade, according to the Diabetes Research Institute Foundation.

**There are three types of diabetes**

- Those diagnosed with Type 1 diabetes are unable to produce the insulin required to move glucose into cells due to an autoimmune situation in which the body attacks the beta cells which produce the hormone.
- Those diagnosed with Type 2 diabetes are able to produce their own insulin; however, the quantity may not be sufficient or effective enough to move glucose into the cells.
- Some pregnant women develop gestational diabetes, a condition in which hormones make the body's cells more resistant to insulin. Gestational diabetes typically disappears once the baby is delivered.

In all three cases, the result is an elevation in blood sugar levels which must be managed. Diabetes is the leading cause of blindness, kidney failure, amputations, heart failure and stroke. Symptoms of the disease include frequent urination, increased thirst and/or hunger, sleepiness, weight loss, blurred vision, difficulty in concentrating and slow healing of infections. Scientists are not entirely sure why diabetes negatively impacts the sense of hearing; however, they suspect high blood glucose levels cause damage to the small blood vessels in the inner ear.

Like other parts of the body, the hair cells of the inner ear rely on good circulation to maintain health. These hair cells are responsible for translating the noise our ears collect into electrical impulses, which they send along the auditory nerve to the brain to interpret as recognizable sound. These sensory hair cells, known as stereocilia, do not regenerate. Once they are damaged or die, hearing is permanently affected. The resulting sensorineural hearing loss can often be treated with hearing devices such as hearing aids or cochlear devices. A hearing evaluation will determine the amount of hearing loss; a hearing healthcare professional can interpret those results to recommend appropriate treatment options [2].

Diabetes mellitus (DM) is a common systemic metabolic disease with increasing worldwide prevalence. DM is associated with multiple macro- and microvascular complications, including thickening of the basal membrane of the stria vascularis capillaries on the lateral wall of the cochlea and other microvascular and neuropathic changes that could induce hearing loss. The association of hearing loss with DM, however, is still controversial. Several studies have shown no or little association between DM and hearing loss and a longitudinal study reported that DM was associated with prevalent, but not with incident, hearing loss [3].

In view of contradictory results regarding hearing impairment in diabetic patients, the current study was planned with the objectives to assess the hearing threshold level in diagnosed patients of diabetes mellitus, to study the correlation between the degree of hearing loss and the duration, severity of hyperglycemia and its complications.

**Methodology**

The present study was planned on 30 patients referred to Department of ENT in Indira Gandhi Institute of Medical Sciences from Jan 2018 to Jun 2018. A detailed history including hearing loss – duration, onset, associated symptoms and diabetes – duration, treatment taken was obtained from the patients who were selected on basis of the inclusion and exclusion criteria and was then subjected to a detailed ENT examination. The approval of the institutional ethic committee had been taken before the study. All the patients were informed consent. The aim and the objective of the study are conveyed to all patients.

Following was the inclusion and exclusion criteria for the present study.

**Inclusion criteria**

1. Patients with high blood sugar level (fasting blood sugar, PP2BS, random blood sugar),
2. Known case of DM at least for 3 years,
3. Both the TM must be intact and normal, and
4. Age 30–59 years.

**Exclusion criteria**

1. Family history of deafness,
2. History of chronic suppurative otitis media (CSOM), meningitis, head or ear trauma,
3. History of chicken pox, smallpox, malaria, jaundice, typhoid,
4. History of ear surgeries performed in the past, and
5. History of ototoxic drug intake, chronic smoking, alcohol, radiotherapy.

**Results & Discussion**

The present study has revealed hearing loss as an important consequence of diabetes associated with the metabolic syndrome and can be used as a tool for diagnosing patients presenting hearing loss. Diabetes mellitus is an incurable disease and its management should be focused on preventing chronic complications associated with diabetes. Although, hearing loss is usually recognized complication of diabetes. Therefore, effective control of diabetes is essential to reduce the incidence of hearing loss in the middle age group and may affect the quality life.

DM can cause complications to any part of the body to any extent. Hence knowledge about these complications is mandatory for all of us to know so that necessary precautions can be taken to prevent it and help diabetes subjects to lead comparatively satisfactory life.

**Table 1:** Age & number of Patients

| Age group | No. of Patients |
|---|---|
| 20 - 30 years | 3 |
| 31 - 40 years | 7 |
| 41 – 50 years | 11 |
| 51 – 60 years | 6 |
| 60 years and above | 3 |
| Total | 30 |

**Table 2:** Hearing loss at Different Blood Glucose levels

| Diabetes Type | Glucose Level | Total Diabetic patients | Sensorineural Hearing Loss |
|---|---|---|---|
| Controlled Diabetes | 80-140mg/dl | 15 | 7 |
| | 140-200mg/dl | 6 | 2 |
| Uncontrolled Diabetes | 201-300mg/dl | 3 | 1 |
| | 301mg/dl &above | 6 | 2 |
| Total | | 30 | 12 |

**Table 3:** Hearing loss in accordance with duration of Diabetes

| Duration of diabetes in year | Total Diabetic patients | Sensorineural Hearing Loss |
|---|---|---|
| Less than 5 years | 13 | 7 |
| 5-10 years | 10 | 4 |
| More than 10 years | 7 | 1 |
| Total | 30 | 12 |

Hearing is one of the important special sensations which gives us and enriches our day to day life. Hearing enables us to interact with people, work and earn. Hearing is integral part of speech. It helps us to lead our lives happily without any restrictions. Hearing impairment will hamper ones personal and social life and hence quality of life.

Diabetes mellitus is one of the most common metabolic disorders, which affects both the older as well younger individuals and is associated with hearing impairment. Kurien [4] and Cullen [5], stated that there is no correlation between age of the patient and occurrence of SNHL in diabetes mellitus.

Kurien *et al*. [4] conclusively demonstrated that poorly controlled diabetics have significant hearing loss in all frequencies. This could be explained by the cumulative effects of advanced glycation end products and their effects on the inner ear [6]. Many studies have been done by various authors to find out the association between Fasting blood sugar and post prandial blood sugar, with that of SNHL [7-8]. Screening of all patients with diabetes for hearing loss in a multicentre longitudinal study in future may provide a clearer understanding of the relationship between diabetes and hearing loss. Diabetic patients can be advised to keep their glycemic levels under good control to prevent hearing loss.

It is evident from a review of otolaryngology literature that the relationship between diabetes and SNHL is complex. In our study, hearing status in patients with DM was evaluated. It was observed that 73% diabetics had SNHL which is similar to study by Taylor and Irwin in 1978 who reported that almost 70% of their adult diabetics had hearing impairment [9] and also similar to study by Rajendran in 2011 who observed 73% diabetic patients having SNHL [10], However, in 1975, Friedman *et al*. observed a 55% incidence of hearing loss in diabetic patients [11]. Age could play a role in hearing loss. Age-related hearing loss was defined as mid to late adult onset, bilateral, and progressive sensory neural hearing loss where underlying causes have been excluded [12]. This excludes hearing loss caused by primary factors including loud noise exposure, underlying medical conditions (diabetes, atherosclerosis, hypertension), intrinsic otological disease (otosclerosis, CSOM), head injury, and ototoxic drug therapies [12].

Most previous surveys on this subject have been carried out among patients of all ages, whereas our study was performed only in non-elderly subjects aged < 60 years. Sakuta *et al*. reported a statistically significant higher prevalence of hearing loss among diabetic and non-diabetic middle-aged men (60.2% and 45.2% respectively) [13]. Dalton *et al*. showed a higher incidence of hearing loss among diabetic subjects compared with a control group, but they reported no significant association between hearing loss and DM type 2 [14].

Control of blood sugar levels and their association with sensorineural hearing loss has been debated since long and in this study glycosylated haemoglobin was taken into consideration for assessing the diabetes control and we found a statistically significant correlation between the HbA1C levels and the severity of sensorineural hearing loss and our results are in par with the studies done by Cullen R [5], Kurien M [4] and Tay H L [15].

Since many people worldwide are living in communities with a high rate of undiagnosed DM [16] and since hearing loss can be considered to be a consequence of diabetes, a metabolic assessment may be useful for patients presenting with hearing loss. On the other hand, routine screening for hearing loss in diabetic patients may also be helpful to diminish comorbidities among these patients, with a consequent improvement in their quality of life. Determiningthecause of SNHL in diabetic patients may lead to development of better treatment options for both conditions [17].

Diabetes mellitus is a common metabolic disease affecting almost all age groups which is frequently associated with hearing loss. The hearing loss associated with diabetes mellitus is characteristically bilaterally symmetrical, gradual in onset and progressive in nature. The relationship between diabetes mellitus and sensorineural hearing loss is complex and not well explained. The two factors that is found to affect hearing in diabetic patients are diabetic angiopathy and diabetic neuropathy [18]. In addition to increased formation of advanced glycation products in collagen, DNA also contributes to tissue damage leading to cellular hypertrophy and hyperplasia.

## Conclusion

It is concluded that the incidence of sensorineural hearing loss is significantly high in Diabetes mellitus patients as compared to non-diabetic controls. However, there is a need for further studies with larger sample size in order to establish the observed SNHL in these patients.

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.

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