ASSOCIATION OF TYPE 2 DIABETES MELLITUS AND HEARING LOSS

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ABSTRACT
Diabetes mellitus is one of the common metabolic disorders. The relationship between hearing loss (HL) and type two diabetes mellitus (T2DM) remains unclear despite the vast volume of research conducted in this topic. Microvascular abnormalities complicating DM have been proposed to affect the auditory system and ultimately hearing. In this study presence of hearing loss is determined by using pure tone hearing thresholds (measured in decibels, dB; HL) with 25-dB HL as the typical cutoff. Therefore based on the above statements our study had assessed the relationship between severity of hearing loss (HL) and duration of diabetes mellitus. Objective: The objective of this study is to compare severity of hearing loss (HL) and duration of diabetes mellitus and to study the relationship between severity of HL and HbA1c levels. Material and method: In this cross sectional study, participants were selected on the basis of inclusion criteria. Only patients visiting the ENT department with diabetes mellitus were considered. Pure tone Audiometry (PTA) was done to assess the extent and type of hearing loss (HL), if present. Hearing assessment was determined at 1 kHz, 2 kHz, 4 kHz, 8 kHz, 0.5 kHz and 0.25 kHz in similar order. Testing of both ear and bone conduction was done. The audiogram chart results were classified based on hearing threshold (in dB) as mild, moderate, moderately severe, profound and total deafness. Statistical analysis of collected data has been determined by using SPSS (16.0). P value < 0.05 was considered as statistically significant. Result: out of 200 patients visiting ENT department 89 patients had issue of hearing loss. After applying Pearson’s correlation coefficient it was found that there is positive correlation between HbA1c and mild hearing loss, moderate hearing loss and severe hearing loss (r=0.35) (p=0.01), (r=0.31) (p=0.03) and (r=0.13) (p=0.23) respectively at a significant level of (0.05) except HbA1c and severe hearing loss. Severe hearing loss in relation to HbA1c indicate slight positive co-relation but not at the significant level of <0.05. The result of our study indicates patient of diabetes are more prone to suffer from mild to moderate hearing loss but may not suffer from complete hearing loss. Conclusion: The findings of this study suggest that participants diagnosed with diabetes had higher chances of developing hearing loss. Also, the likelihood of hearing loss presence was associated with diabetes duration and also the age factor of participants. In this study no difference was seen between males and females. The findings of the current study indicate that healthcare providers should include, as part of diabetes patient management, a referral for hearing screening for early detection of hearing loss. The current study highlights the need for an audio logistical test in diabetes patient care profile.

Key words: Diabetes Mellitus, Hearing loss, Pure tone Audiometry.

INTRODUCTION
Diabetes mellitus is one of the common metabolic disorders characterized by chronic hyperglycemia and disturbances in carbohydrate, fat, and protein metabolism due to absolute or relative deficiency of insulin secretion or its action. People with diabetes mellitus are at an increased risk of chronic complications which affect many organ systems. Chronic complications of diabetes mellitus include microvascular complications (Nephropathy, Retinopathy, and Neuropathy) and macrovascular complications (coronary artery disease and cerebral vascular disease). It has been estimated that by 2025 there will be around 300 million diabetic individuals in the world, twice as many as in 2000. Patients of diabetes mellitus having chronic complications occur as a result of pathological changes affecting the lens, skin, nerves and vascular system; therefore, the disease is not confined to a single organ system rather it affects
multiple systems. The relationship between hearing loss (HL) and type two diabetes mellitus (T2DM) remains unclear despite the vast volume of research committed to this topic. Microvascular abnormalities complicating DM have been proposed to affect the auditory system and ultimately hearing. On the other hand, few studies have also reported no correlation between hearing loss (HL) and DM whereas, other studies have found a positive correlation between the variables. While, limited research has also been conducted on this topic in India, which is known to be the diabetic capital of the world. More recently, the highest prevalence was reported in a study from India with 78.2% prevalence of sensori neural hearing loss in uncontrolled diabetes patients. Hearing loss is already a major public health issue globally with adult-onset hearing loss ranked second highest contributor to years lost to disease. In this study presence of hearing loss is determined using pure tone hearing thresholds (measured in decibels, dB; HL) with 25-dB HL as the typical cutoff used to differentiate between presence and absence of hearing loss. Complaints related to the auditory and vestibular systems and metabolic disorders affecting glycides and lipids have been pointed out as the main etiologic factors related to hearing loss, tinnitus, and dizziness. Therefore, the diabetic population must be considered at risk for auditory conditions. It is known that in order for the inner ear to function properly there has to be a good balance between insulin and glucose levels. DM patients have glucose in their blood, but it cannot enter the cells of the inner ear because of the lack of insulin thus producing functional disorders. Genetic syndromes have also been considered by many authors, once more cases of hypacusis have been observed in diabetic individuals with diabetic mothers in an inheritance pattern connected to mitochondrial DNA, which can also be the main reason for hearing loss. Therefore based on the above statements our study had assessed the relationship between severity of HL and duration of DM, and to study the relationship between severity of HL and HbA1c levels.

MATERIAL AND METHODS

In this cross sectional study, participants were selected on the basis of inclusion criteria. This study was conducted for 1 year. Only patients visiting the ENT department with different complication were considered. In this study total number of 200 participants of both sexes had participated out of which 130 were male and 70 female were known cases of diabetes mellitus. Patients were identified by the principal investigator at ENT OPD only. Complete history and physical examination were taken to confirm diagnosis of diabetes mellitus. If participant met the inclusion criteria, informed consent was sought from the patients after explaining to him or her about the study. Pure tone Audiometry (PTA) was done to assess the extent and type of hearing loss (HL), if present. Hearing assessment was determined at 1 kHz, 2 kHz, 4 kHz, 8 kHz, 0.5 kHz and 0.25 kHz in that order. Testing of both ear and bone conduction was done. The audiogram chart results were classified based on hearing threshold (in dB) as mild, moderate, moderately severe, profound and total deafness. Statistical analysis of collected data has been determined by using SPSS (16.0). P value < 0.05 was considered as statistically significant.

Inclusion Criteria

1. Patient having diabetes for more than 5 years.
2. Patients having HbA1c level >7%.
3. Patient with fasting blood glucose level more than 170 mg/dl.
4. Patient with no history of hyperlipidemia.
5. Patient with no history of any ear problems.

Exclusion Criteria

1. Hypertension
2. Chronic noise exposure
3. History of smoking
4. Ototoxicity
5. Patient with no history of hearing loss.

RESULTS

1. Table showing total number of patient in different age groups with its percentage

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Age group (40-50)</td>
<td>45</td>
<td>34.6</td>
</tr>
</tbody>
</table>

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Table representing total number of participants in different age groups with percentage.

### 2. Table showing total number of patient having hearing problem in different age groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
<th>Total number of hearing Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(40-50)</td>
<td>45</td>
<td>11</td>
</tr>
<tr>
<td>(51-60)</td>
<td>65</td>
<td>23</td>
</tr>
<tr>
<td>(61-70)</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>Female</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(40-50)</td>
<td>23</td>
<td>09</td>
</tr>
<tr>
<td>(51-60)</td>
<td>29</td>
<td>16</td>
</tr>
<tr>
<td>(61-70)</td>
<td>18</td>
<td>14</td>
</tr>
</tbody>
</table>

Table indicating total number of patient having problem of hearing loss respective to their age groups.

### 3. Table showing hearing loss patient with association to HbA1c

<table>
<thead>
<tr>
<th>Hearing Loss</th>
<th>HbA1c Level</th>
<th>&lt;7.0%</th>
<th>&lt;8.0%</th>
<th>&lt;8.5%</th>
<th>&lt;9.0%</th>
<th>&gt;9.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td></td>
<td>03</td>
<td>09</td>
<td>09</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td>02</td>
<td>04</td>
<td>07</td>
<td>09</td>
<td>09</td>
</tr>
<tr>
<td>Severe</td>
<td></td>
<td>00</td>
<td>01</td>
<td>01</td>
<td>03</td>
<td>08</td>
</tr>
</tbody>
</table>

Our study shows 45 patients were suffering from mild hearing loss, 31 patients were suffering from moderate hearing loss and 13 patients had severe hearing loss in respect to level of HbA1c.

### 4. Tabular representation showing Pearson correlation coefficient (r) and p-value

<table>
<thead>
<tr>
<th>Parameters</th>
<th>r-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c and Mild hearing loss</td>
<td>0.35</td>
<td>0.01</td>
</tr>
<tr>
<td>HbA1c and Moderate hearing loss</td>
<td>0.31</td>
<td>0.03</td>
</tr>
<tr>
<td>HbA1c and severe hearing loss</td>
<td>0.13</td>
<td>0.23</td>
</tr>
</tbody>
</table>

After applying Pearson’s correlation coefficient it was found that there is a positive correlation between HbA1c and mild hearing loss, moderate hearing loss and severe hearing loss (r= 0.35) (p=0.01), (r=0.31) (p=0.03) and (r=0.13) (p=0.23) respectively at a significant level of (0.05) except HbA1c and severe hearing loss. Severe hearing loss in relation to HbA1c indicate slight positive co-relation but not at the significant level of <0.05. The result of our study indicates patient of diabetes are more prone to suffer from Mild hearing loss to moderate hearing loss but may not suffer from complete hearing loss.

**DISCUSSION**

Diabetes mellitus (DM) is a metabolic disorder known to enable several disease processes. The relationship between hearing loss (HL) and type 2 DM (T2DM) remains unclear despite the vast volume of research devoted to this topic. Chronic complications occur as a result of pathological changes affecting the lens, skin, nerves and vascular system; therefore, the disease is not confined to a single organ system rather it affects multiple systems. Microvascular abnormalities complicating DM have been proposed to affect the auditory system and ultimately hearing. Many studies have proposed that DM may exacerbate HL and extensive investigations have been conducted in order to identify the
cause. The proposed mechanisms of HL in DM reported in literature include microangiopathy of the inner ear, neupath of the cochlear nerve, outer hair dysfunction and disruption of the endolymphatic potential. In this study we found 89 patients out of 200 were suffering from hearing abnormalities. Among them patient with mild hearing loss was a big concern having highest number of patients with age group range from (51-60 years). Tay et al. also reported a similar result that shows higher incidence of HL among DM patients as compared to non-diabetics. Karkarlapudi et al. also stated that HL was seen more often in DM cases than the subjects without DM. Alvarenga et al. reported high incident of hearing loss among cases of diabetes mellitus as compared to the non-diabetics. The reason for hearing loss among diabetes patients can be due to vestibular systems and metabolic disorders affecting glycosides and lipids have been pointed out as the main etiologic factors related to hearing loss, tinnitus, and dizziness. Therefore, the diabetic population must be considered at risk for auditory conditions. While after applying Pearson's correlation coefficient it was found that there is a positive correlation between HbA1c and mild hearing loss, moderate hearing loss and severe hearing loss (r= 0.35) (p=0.01), (r=0.31) (p=0.03) and (r=0.13) (p=0.23) respectively at a significant level of (0.05) except HbA1c and severe hearing loss. Severe hearing loss in relation to HbA1c indicate slight positive co-relation but not at the significant level of <0.05. however, contradictory result has been shown in the study of Rajendran et al. who reported glycaemic control and duration of DM did not affect the incidence of HL. In this study we also observed no gender differences in regards to hearing loss. However, our study was having 200 patients out of which 89 were only having hearing issue, so to make any decision a more extensive study including a larger sample size and wide geographical area may help in generalizing the results. PTA was utilized to determine and quantify the HL among DM patients; however, this test is subjective in nature. Thus, usage of more objective tests would have given more reliable results.

**CONCLUSION**

The current study had provided a broad description of hearing loss in patients with diabetes mellitus. The findings of this study suggest that participants diagnosed with diabetes had higher chances of developing hearing loss. Also, the likelihood of hearing loss presence was associated with diabetes duration and also the age factor of participants. In this study no difference was seen between males and females. The findings of the current study indicate that healthcare providers should include, as part of diabetes patient management, a referral for hearing screening for early detection of hearing loss. The current study highlights the need for an audio logistical test in diabetes patient care profile.

**REFERENCES**


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