RESEARCH ARTICLE

Diabetes mellitus: A substantial factor of hearing loss in adults

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ABSTRACT

Background: Diabetes mellitus is considered as most prevalent non-communicable disease throughout the world. It is associated with many complications. Hearing loss among diabetics is a recent concern, its magnitude and pathophysiology are not yet clearly defined. Aim and Objectives: The present study aimed to determine the relation between diabetes and hearing loss. Materials and Methods: The present study was conducted with 200 diabetes mellitus patients aged between 20 and 50 years, selected from endocrinology outpatient department, SCB Medical College and Hospital, Cuttack. Participants were subjected to pure tone audiometry at the department of ENT. Two hours PGBS (75 g) value was collected. Results: About 58% of the participants were detected with sensorineural hearing loss. There was a significant association of hearing loss with the duration of diabetes and glycemic status (with \( P < 0.05 \)). Conclusion: The hearing loss found among diabetics showed strong association with the duration of the disease and the glycemic status. If detected earlier in its course, long-term complications of hearing can be avoided.

KEY WORDS: Hearing Loss; Audiometry; Diabetes

INTRODUCTION

Diabetes mellitus is one of the most common endocrinological disorders caused by insufficiency of insulin. It is a hyperglycemic state with derangement in metabolism of carbohydrate, protein, and fat.¹,² Type 1 diabetes is an autoimmune disease of pancreas but type 2 diabetes is a disorder of insulin resistance of peripheral tissues. Risk factors of type 2 diabetes include genetic predisposition, insufficient exercise, improper diet, smoking, and environmental factors.¹ The highest number of diabetic patients is found in India thus being called as the “the diabetic capital of the world.” It is estimated that presently, 19.4 million people in India are affected in diabetes, which may go up to 57.2 million by 2025.³

Type 2 diabetes contributes about 90% of diabetes patients and traditionally it is a disease of middle and older age group population. Since the 1990s, the onset has become apparent among the young adults and children too.¹,² This trend is a serious threat because diabetes leads to fatal complications and comorbidities such as neuropathies, visual abnormality, cardiovascular diseases, and kidney diseases.³ Many a times, the morbidities of many such complications limit the working capacity, absenteeism, and premature loss of employment.¹,² In this way, many complications of diabetes are already established and have been dealt with bulk of studies, trials, and researches. Still, some newer and less studied complications are emerging nowadays. One of such is hearing loss associated with diabetes. Hearing plays a potential role in speech development, cognitive function, and social and emotional development of human being. Impaired hearing...
becomes a hindrance in the development of an individual.1,3,4 According to the World Health Organization (WHO), in 2017, over 5% of the population of the world (around 360 million) suffer from hearing loss. The WHO also suggests that half of all the cases of hearing loss are preventable.1,5 Hearing loss or auditory organ dysfunction is one of the lesser established complication of diabetes. This issue has to be dealt with rigorously as the prevalence of diabetes is touching horizon with enormous speed. Over years diabetes has been implicated as an independent cause hearing loss.4,6

Given the scenario of increasing incidence of preventable hearing loss and the indefinite results of association between hearing loss and diabetes, it is of paramount significance to work on this issue and factors associated with it. In comparison to researches on other complications of diabetes, the research work on hearing loss is very sparse and inconsistent all over the globe. In India, some handful of studies have been conducted in recent past. Almost no research study had been done in the eastern part of India. Hence, our present study tried to explore the linkage between diabetes and hearing loss and certain factors associated with it, such as the glycemic control, the duration of diabetes, age, and gender.

MATERIALS AND METHODS

The study was conducted in SCB Medical College and Hospital. This was a hospital-based cross-sectional and observational study accomplished between February 2020 and July 2020. The Institutional Ethics Committee of SCB Medical College and Hospital approved this study. Study participants were diagnosed diabetic patients aged between 20 and 50 years who were selected from outpatients department of endocrinology. Participants with history ear discharge, perforated tympanic membrane, chronic exposure to noise, ear discharge, using ototoxic drugs in the past 2 months, and family history of deafness were excluded from the study. Participants were explained well about the study protocol and its output. Written consent was taken from each participant. Detailed history was taken by the principal investigator and the coinvestigator. Age of onset of diabetes was noted to calculate the duration of the disease (diabetic age). Laboratory parameter (2 h PGBS – 75 g) was collected from the patient’s prescription at endocrinology outpatient department (OPD). Rinne’s test, Weber’s test, and absolute bone conduction test of all participants were done.

Pure tone audiometry (PTA) was done in the Department of ENT, SCB Medical College, Cuttack. PTA was done in ALPS advanced digital dual channel diagnostic pure tone audiometer. Model AD2000 with TDH-39 headphones. However, if the degree of loss is 20 dB, adjacent frequencies were tested. The reference intensity level, designated as “X” decibel at particular frequency, was the mean of minimal audible threshold of pure tones in every healthy individuals. Hearing threshold was taken as the least intensity of pure tone audible to the subject. The subject was advised to signal on hearing the least sound of any sort till it ceases. The subject was presented with various selected tones for 1–3 s and for a minimum gap of 1–3 s between successive presentations. Air conduction threshold is repeated for 1000 Hz to assess the reliability of the procedure.

Principle of PTA

Audiometer is an electronic device which produces pure tones. Thresholds for air conduction were measured for tones 250, 500, 1000, 2000, 4000, and 8000 Hertz and for bone conduction up to 4000 Hz. The level of intensity to be raised above the normal denotes the degree of hearing deficit at that particular frequency. The graphical representation in a standard chart is called “AUDIOGRAM.” The threshold for bone conduction signifies the cochlear function. Conductive deafness is measured as the difference in thresholds of air and bone conduction (A-B gap). The audiometer is calibrated such that there is no A-B gap in normal person.7

The age of the patients was grouped into three groups: Group 1 (20–30 years), Group 2 (31–40 years), and Group 3 (41–50 years). The duration of the disease was divided into four groups, that is, Group 1 (<1 year), Group 2 (1–5 years), Group 3 (5–10 years), and Group 4 (>10 years). The glycemic status (2 h PGBS) was divided into three groups, that is, (1) <200 mg/dl, (2) 200–300 mg/dl, and (3) >300 mg/dl.

Statistical Analysis

Statistical analysis was done by statistical software SPSS 20. Chi-square test was used to find the association of different parameters. Chi-square and P-value were determined in various comparisons to find the strength of association. P < 0.05 was considered to be statistically significant.

RESULTS

Duration of diabetes, age of the diabetic patient (diabetic age), and glycemic status (2 h PGBS) were compared with the presence of sensorineural hearing loss (SNHL). The presence of SNHL in diabetic individuals among different gender was studied.

Table 1 represents the age and gender distribution among study participants. From the total of 200 participants, 20 were 20–30 years (12 males and 8 females), 58 were 31–40 years (40 males and 18 females), and 122 were 41–50 years (72 males and 50 females).

Table 2 represents percentage of participants detected with hearing loss. Among the 200 diabetic individuals, 84 were
found with normal hearing and 116 were diagnosed to have SNHL, which is 58%. Table 3 compares the duration of diabetes with hearing loss. Eighteen out of 71 with duration of the diabetes 1–5 years were found with hearing loss. In this study, 68 cases were having diabetes for more than 10 years. Among them, 63 cases were detected with some degree of hearing loss. Positive result of hearing deficit was also found in the middle group with 5–10 years of diabetes. In this group, 35 out of 49 were found with some hearing loss. Twelve diabetics with onset of the disease <1 year were not detected with any hearing impairment.

Table 4 represents the comparison between the age of the participants and hearing loss. Among the 20 cases in the age range 20–30 years, only two were found to have hearing impairment. Sixteen out of 58 were detected with the same in the age range 31–40 years. However, while checking the hearing status of cases in the group of 41–50 years, 98 out of 122 were found to have some degree of hearing impairment.

Table 5 compares the glycemic status (2 h PGBS) with hearing loss. In this study, 80 cases were having the 2 h PGBS more than 300 mg/dl and all of them were detected with some degree of hearing impairment. Twenty-five out of 26 cases with 2 h PGBS in the range 200–300 mg/dl were found with hearing loss, while only 11 out of 94 with 2 h PPBS <200 mg/dl showed audiometric findings of hearing impairment.

Table 6 gives the gender-wise findings of hearing loss among participants. From the 124 males recruited diabetics in this study, 74 (59%) were found with hearing loss. Forty-two out of 76 females (55%) with diabetes were detected with some degree of hearing loss.

**DISCUSSION**

After analysis, this study came to the result that the hearing of the diabetics was significantly impaired. Duration of diabetes, age, and the glycemic status of subjects were the factors which influenced the acuity of hearing. Most of the available studies in the recent times have agreed with the association of SNHL and diabetes, although some studies could not find any
positive association between the two. In our study, 116 out of 200 diabetic cases were found out to have some degree of SNHL, which comes out to be 58%, with \( P = 0.001 \), which is statistically very much significant. This result approximates with that of Meena et al.,\(^7\) (58%), Bhaskar et al.,\(^2\) (78.2%), and Sachdeva and Azim\(^5\) (33.7%). Strauss et al.,\(^1\) in 1982 and España et al.,\(^1\) in 1995 did not find any association between hearing loss and diabetes. The audiograms recorded in our study were having no air bone gap which confirmed the sensorineural type of hearing loss. These findings go in accordance with all the studies referred above. In our study, as age of the cases advances, the prevalence of SNHL increases. About 80.3% of diabetics of age group 41–50 years were detected with SNHL, while only 10% in the age group of 20–30 years. \( P \)-value came out to be 0.0001, which is statistically significant. The finding goes similar with that of Aziz et al.,\(^1\) Saini et al.,\(^9\) and Jankar et al.,\(^10\) However, some studies could not establish a correlation of SNHL with age of the diabetics. The reason might be the small number of subjects with which the studies were performed by Friedman et al.,\(^11\) (20 cases) and Cullen and Cinnamon\(^1\) (44 cases). The SNHL in diabetes is gradual and progressive. With increase in duration of the disease, the prevalence of SNHL increases. In our study, 92.6% of cases with disease more than 10 years were detected with SNHL, while only 25.4% were found with disease duration of 1–5 years. All the cases with diabetes <1 year were found to have normal hearing thresholds at all frequencies. The comparison of duration of diabetes with SNHL gives a positive association in our study with \( P = 0.0001 \). This outcome goes in similarity with Srinivas et al.,\(^13\) Ozkurt et al.,\(^14\) Rajendran et al.,\(^15\) and Aziz et al.,\(^3\) The indicator of glycemic status considered in our study was 2 h PGBS (75 g). Eleven out of 94 cases (11.7%) with blood sugar <200 mg/dl showed SNHL, while almost all cases with blood sugar more than 200 mg/dl were found with some degree of hearing loss. This comparison in this study was significant with \( P = 0.0001 \). Thus with increase in glycemic parameter, the prevalence of SNHL rises very high. These results approximate with the finding of Thimmasettaiah et al.,\(^16\) Sachdeva and Azim,\(^6\) and Aziz et al.,\(^3\) Mozaffari et al.,\(^17\) and Kakarlapudi et al.,\(^18\) did not find a significant association with glycemic status. This study did not show any strong association between SNHL and gender of the patients. This goes in accordance with that of Bhaskar et al.,\(^2\) Saini et al.,\(^9\) and Meena et al.,\(^11\) Aziz et al.,\(^3\) and Cullen and Cinnamon\(^12\) found statistically significant association among males than females, while Taylor and Irwin\(^19\) showed that the female diabetics were more prone to hearing loss than males. Hearing loss in diabetics is progressive, bilateral sensorineural type, affecting the higher frequencies.\(^14\)

Strength and Limitations of the Study

The present study explored the hearing status of diabetics due to age, gender, and glycemic status. Higher tests of hearing such as impedance audiometry, BERA, and speech audiometry could not be done. The glycemic status correlation can be minutely operated in long run studies. More number of cases if studied can give more pinpoint clues on the association.

CONCLUSION

Incidence of hearing loss was common among diabetics. The duration and glycemic status of diabetes were the significant factor of hearing loss. Any gender specificity was not detected in this study. Hearing loss is strongly associated with diabetes. Irrespective of the mechanisms behind this issue, the involvement is gradual and progressive, hence may be preventable to some extent. Till date, routine hearing assessment is not a protocol in managing diabetes and its comorbidities. This present study suggests to consider this underrated complication of diabetes with all importance and to perform routine hearing assessment in clinical set up. PTA is a less expensive procedure and almost available in all fast referral units and tertiary centers. Hence, this can be advised in the OPDs on regular interval while managing patients of diabetes. By this approach, we can prevent a person to proceed toward permanent disability and the global burden of hearing loss can be lessened.

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