ORIGINAL RESEARCH

Evaluation of Hearing Loss in Patients of Insulin Dependent Diabetes Mellitus at a Tertiary Care Hospital

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ABSTRACT
Background: Cross-sectional studies consistently suggest that the prevalence of hearing loss is higher in persons with diabetes compared with those without diabetes, especially among younger persons. Hence, the present study was conducted to assess hearing loss in patients of insulin dependent diabetes mellitus.**Materials &Methods:**A total of 100 patients with presence of insulin dependent diabetes mellitus were enrolled. Complete demographic and clinical details of all the patients were obtained. All the patients belonged to less than 18 years of age. The concentration of hemoglobin A1C (HbA1C) was also documented. In the diabetic cohort, HbA1C levels were measured quarterly, and the average of these measurements was utilized to assess glycemic control. Hearing thresholds were evaluated using pure tone audiometry. Both bone and air conduction thresholds were assessed across frequencies ranging from 250 to 4000 Hz and 250 to 8000 Hz, respectively. The average air conduction thresholds for both ears at each frequency were recorded as the subject's hearing threshold. Hearing loss was classified as a hearing threshold exceeding 25 dB.**Results:**A total of 100 patients with presence of juvenile insulin dependent DM were evaluated. The mean age of the patients was 15.3 years. Among them 61 patients were boys while the remaining were females. Incidence of hearing loss was 29 percent. While assessing the correlation of occurrence of hearing loss with HbA1c concentration, significant results were obtained. **Conclusion:**Significant proportion of patients with insulin dependent diabetes mellitusare affected by hearing loss. This correlates significantly with HbA1c levels.
Key words: Diabetes, Insulin Dependent, Hearing Loss.

INTRODUCTION

Since the publication of the Position Statement "Care of Children and Adolescents with Type 1 Diabetes" by the American Diabetes Association (ADA) in 2005, significant advancements have reshaped the management of type 1 diabetes. These innovations include the identification of novel autoantibodies, the development of advanced insulin delivery systems and glucose monitoring devices, as well as the establishment of diabetes registries. Despite these advancements, effective strategies for the prevention or delay of type 1 diabetes in the pediatric population remain elusive, and the incidence of the disease continues to rise. The SEARCH for Diabetes in Youth (SEARCH) study reported a 21.1% increase in the prevalence of type 1 diabetes among individuals aged 0 to 19 years from 2001 to 2009, with increases noted across all sex, age, and racial/ethnic groups, with the exception of those with the lowest prevalence (specifically, children aged 0–4 years and American Indians).[1,2] Furthermore, the incidence of type 1 diabetes has also escalated, with an adjusted annual risk increase of 1.4% from 2002 to 2012, affecting all age groups except for those aged 0–4 years. A key theme of this Position Statement emphasizes that "children are not little adults." Pediatric-onset

diabetes presents unique characteristics that differentiate it from adult diabetes, including distinct epidemiological patterns, pathophysiological mechanisms, developmental factors, and therapeutic responses.[3] Therefore, diabetes management strategies for children should not be derived from adult care models. Clinicians must consider the evolving developmental stages of children and adolescents, tailoring care to meet their specific needs and circumstances. Providing timely anticipatory guidance and ensuring coordinated care will facilitate a smooth transition for both the developing patient and their family as they progress into young adulthood.[4, 5]

Cross-sectional studies consistently suggest that the prevalence of hearing loss is higher in persons with diabetes compared with those without diabetes, especially among younger persons. Furthermore, longitudinal studies have demonstrated a higher incidence of hearing loss in persons with diabetes compared to those without diabetes. These findings seem to hold for both type 1 and type 2 diabetes, although considerably more population-based evidence is available for type 2 diabetes.[6, 7]Hence; the present study was conducted to assess hearing loss in patients of insulin dependent diabetes mellitus.

MATERIALS & METHODS

The present study was conducted to assess hearing loss in patients of insulin dependent diabetes mellitus. A total of 100 patients were enrolled. Complete demographic and clinical details of all the patients were obtained. All the patients belonged to less than 18 years of age. Patients with a documented family history of hearing impairment, previous incidents of head trauma resulting in loss of consciousness, complex otitis media, surgical interventions on the ear, or prior exposure to ototoxic drugs were excluded from this investigation. The collected data encompassed variables such as sex, age, insulin dosage, and the duration of diabetes. Additionally, the concentration of hemoglobin A1C (HbA1C) was also documented. In the diabetic cohort, HbA1C levels were measured quarterly, and the average of these measurements was utilized to assess glycemic control. Hearing thresholds were evaluated using pure tone audiometry. Both bone and air conduction thresholds were assessed across frequencies ranging from 250 to 4000 Hz and 250 to 8000 Hz, respectively. The average air conduction thresholds for both ears at each frequency were recorded as the subject's hearing threshold. Hearing loss was classified as a hearing threshold exceeding 25 dB. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.

RESULTS

A total of 100 patients with presence of juvenile insulin dependent DM were evaluated. The mean age of the patients was 15.3 years. Among them 61 patients were boys while the remaining were females. Incidence of hearing loss was 29 percent. While assessing the correlation of occurrence of hearing loss with HbA1c concentration, significant results were obtained.

Table 1: Incidence of hearing loss

Hearing loss	Number	Percentage
Present	29	29
Absent	71	71
Total	100	100

Table 2: Correlation with occurrence of hearing loss with HbA1c concentration

Variable	r-value	p-value
Hearing loss correlation with HbA1c concentration	1.339	0.001 (Significant)

DISCUSSION

Initially, the pathophysiology and management of type 1 diabetes may appear to be a straightforward subject; however, as research progresses, it becomes increasingly evident that our understanding of the disease is limited. Enhanced insights into the disease's pathogenesis have not culminated in a singular, comprehensive application of Koch's postulates across all instances. What was once perceived as a uniform autoimmune condition, primarily driven by T-cell mediated destruction of insulin-secreting β cells, is now acknowledged to arise from a multifaceted interaction among environmental influences, the microbiome, genetic factors, metabolic processes, and immune responses, all of which exhibit considerable variability among individuals. Despite the established genetic factors associated with type 1 diabetes, a significant proportion of individuals diagnosed do not have a family history of the disease nor do they possess the highest risk combinations of HLA alleles, complicating efforts toward primary prevention. While advancements in patient survival and health outcomes have been notable, particularly over the last quarter-century, a definitive cure for type 1 diabetes remains unattained. Furthermore, despite technological progress, optimal glycaemic control is not achieved for many individuals with type 1 diabetes, and access to modern treatment options is often hindered by the prohibitive costs associated with even basic healthcare.[7-10]

Apart from the well-described association between congenital deafness and the maternally inherited type of diabetes mellitus in the Wolfram syndrome, the relationship between type 1 diabetes mellitus and hearing impairment has been a subject of debate since Jordao reported a case of hearing loss with incipient diabetic coma almost 150 years ago. Previous studies have reported contradicting results regarding hearing impairment in diabetic patients and its relationship to other diabetic complications and to metabolic control. Several earlier studies have documented presence of bilateral sensori-neural hearing loss affecting mainly

the high and middle frequencies, quoting widely different incidence ranging from 15 to 85 percent.[8, 9] Hence; the present study was conducted to assess hearing loss in patients of insulin dependent diabetes mellitus.

A total of 100 patients with presence of insulin dependent diabetes mellituswere evaluated. The mean age of the patients was 15.3 years. Among them 61 patients were boys while the remaining were females. Incidence of hearing loss was 29 percent. While assessing the correlation of occurrence of hearing loss with HbA1c concentration, significant results were obtained. Teng et al. showed that the pooled odds ratio (OR) of the prevalence of deafness in patients with T1DM versus non-diabetics was 49.08 (95%CI 12.03–200.31) (Teng et al. 2017), while Mujica-Mota et al. calculated an OR of 7.73 (95%CI 3.32–17.98) (T1DM patients) (Mujica-Mota et al. 2018). Compared with Teng et al., the results reported by Mujica-Mota et al. may be more realistic because of the larger sample size this study included. In a study on T2DM, Horikawa et al. and Akinpelu et al. (2014, 2013).[12- 15]

Okhovat SAet al evaluated hearing loss patterns in young children suffering from IDDM and define risk factors for this complication. Their study includes 200 youngsters divided into two groups: 100 patients in diabetic group and 100 healthy individuals in control group. Hearing thresholds are determined in 250, 500, 1000, 2000, 4000 and 8000 Hz and metabolic controls are evaluated as average of one year HbA1C, dividing diabetic group into well control and poor control subgroups.Twenty one out of 100 patients in diabetic group showed significant hearing loss. Hearing loss is correlated with metabolic control, showing less loss in patients with HbA1C less than 7.5%. Results showed that hearing loss is not related to sex of patients but duration of disease (more or less than 5 years) affects degree of hearing loss in some frequencies.Hearing loss in children suffering from IDDM is sensorineural, bilateral and symmetrical and is related to the duration of disease and state of metabolic control (HbA1C).[16]Elamin A et al examined the auditory function in a group of children with type 1 diabetes. Sixty-three diabetic patients below the age of 18.The hearing acuity was lower in the diabetic patients than in the control subjects in all tested frequencies, but the differences achieve statistical significance only at middle and high frequencies. The hearing loss was symmetrical, generally mild, and affects both sexes equally. Duration of diabetes, HbA1c concentration, and angiopathic complications showed positive correlation with the increased hearing thresholds; while age at onset, insulin dose per day, presence of neuropathy, and frequency of DKA and hypoglycaemic episodes were not associated.Hearing loss occurs early in diabetic children and is related to the duration of the disease and the degree of metabolic control.[17]

CONCLUSION

A significant proportion of patients with insulin dependent diabetes mellitus are affected by hearing loss. This correlates significantly with HbA1c levels.

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