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Original Research

Assessment of prevalence of sub-clinical hearing loss in children with type 1 diabetes

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ABSTRACT:
Background: Eye, kidney, cranial nerve, peripheral nerve, ear, and vascular system disorders reside among the chronic complications of diabetes mellitus. The relationship between Diabetes mellitus and hearing impairment remains controversial. Hence; the present study was undertaken for assessing prevalence of sub-clinical hearing loss in children with type 1 diabetes. **Materials & methods:** A total of 35 subjects with between age group of 6-17 years with confirmed diagnosis of Type 1 Diabetes with average disease duration of more than 2 years were included as study group. Another set of 35 age and gender matched subjects were enrolled as healthy controls. Complete audiological assessment was done in all the patients by pure tone audiometry (PTA) and otoacoustic emission (OAE). Data of study were analysed statically and compared with literature. Detailed demographic and clinical details of all the patients were obtained. Audiological assessment was done in a sound proof room. All the results were compiled in Microsoft excel sheet and were analysed by SPSS software. **Results:** Subclinical hearing loss was found to be present in 16.67 percent of the patients (5 patients) of the study group. None of the patients of the control group presented with sub clinical hearing loss. Non-significant results were obtained while assessing the correlation of sub-clinical hearing loss with duration of diabetes in diabetic patients. Significant results were obtained while comparing the glycaemic profile of the patients with and without subclinical hearing loss. **Conclusion:** Diabetic children are associated with significantly higher risk of hearing loss.
Key words: Diabetes, hearing loss.

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INTRODUCTION

India currently faces an uncertain future in relation to the potential burden that diabetes may impose upon the country. The aetiology of diabetes in India is multifactorial and includes genetic factors coupled with environmental influences such as obesity associated with rising living standards, steady urban migration, and lifestyle changes. Yet despite the incidence of diabetes within India, there are no nationwide and few multi-centric studies conducted on the prevalence of diabetes and its complications.[1, 2]
Eye, kidney, cranial nerve, peripheral nerve, ear, and vascular system disorders reside among the chronic complications of diabetes mellitus. Today the association between DM and hearing loss is being given a lot of attention. Otoacoustic emissions can record the acoustic energy produced by the cochlea in the outer ear canal, reflecting active mobility of the outer hair cells and revealing early or subclinical cochlear damage. Studies indicate that DPOAE intensity was significantly lower in T1DM patients but there PTA was normal suggesting possible subclinical cochleopathy.[3]
It is recognised that evoked OAEs are more sensitive in revealing early or subclinical cochlear damage. The variants of OAE are spontaneous, stimulus frequency, transient evoked and distortional product otoacoustic emission. DPOAE are best investigation to evaluate cochlea function. The absence of distortion product otoacoustic emissions with normal middle ear function is an indication of audiometric threshold greater than 30-35 dB hearing loss. The relationship

between Diabetes mellitus and hearing impairment remains controversial.[4-6] Hence; the present study was undertaken for assessing prevalence of hearing loss in children with type 1 diabetes.

MATERIALS & METHODS

The present study was conducted in the department of paediatrics of the medical institute and it included evaluation of prevalence of subclinical hearing loss in children with type 1 diabetes. A total of 35 subjects with between age group of 6-17 years with confirmed diagnosis of Type 1 Diabetes with average disease duration of more than 2 years were included as study group. Another set of 35 age and gender matched subjects were enrolled as healthy controls. Complete audiological assessment was done in all the patients by pure tone audiometry (PTA) and otoacoustic emission (OAE). Data of study were analysed statically and compared with literature. Detailed demographic and clinical details of all the patients were obtained. Audiological assessment was done in a sound proof room. All the results were compiled in Microsoft excel sheet and were analysed by SPSS software. Chi- square test and student t test were used for assessment of level of significance. P- value of less than 0.05 was taken as significant.

RESULTS

In the present study, a total of 35 healthy children and 35 children with type 1 diabetes were enrolled. Mean age of the diabetic subjects and controls was found to be 11.2 years and 11.5 years respectively. There were 18 males and 17 females in study group while 15 males and 20 females in control group. Subclinical hearing loss was found to be present in 16.67 percent of the patients (5 patients) of the study group. None of the patients of the control group presented with sub clinical hearing loss. In the present study, among the 5 patients with sub-clinical hearing loss, duration of diabetes was between 1 to 3 years in 2 patients while it was more than 3 years in 3 patients. Non-significant results were obtained while assessing the correlation of sub-clinical hearing loss with duration of diabetes in diabetic patients.

In the present study, mean RBS value among diabetic patients with subclinical and patients without subclinical hearing loss was found to be 192.4 mg/dL and in diabetic patients with without subclinical hearing loss was found to be 181.4 mg/dL. Mean HbA1c levels among the patients with and without subclinical hearing loss was found to be 9.8% and 8.4% respectively. In the present study, significant results were obtained while comparing the glycaemic profile of the patients with and without subclinical hearing loss.

Table 1: Age-wise distribution

Age group (years)	Study group (n= 35)	Control group (n= 35)
6 to 9	7	9
10 to 12	18	18
13 to 17	10	8
Total	35	35

Table 2: Gender-wise distribution

Gender	Study group (n= 35)	Control group (n= 35)
Males	18	15
Females	17	20
Total	35	35

Table 3: Sub-clinical hearing loss

Sub-clinical hearing loss	Study group		Control group	
	n	%	n	%
Present	5	16.67	0	0
Absent	30	83.33	35	100
Total	35	100	35	100

Table 4: Correlation of sub-clinical hearing loss with duration of diabetes in diabetic patients

Duration of diabetes	Sub-clinical hearing loss present		Sub-clinical hearing loss absent		Chi-square value	p- value
	Number of patients	Percentage (%) of patients	Number of patients	Percentage (%) of patients		
1 to 3 years	2	40	13	43.33	0.001	0.741 (Non-significant)
More than 3 years	3	60	17	56.67		
Total	5	100	30	100		

Table 5: Correlation of sub-clinical hearing loss with glycaemic profile in diabetic patients

Mean Glucose profile	Sub-clinical hearing loss present	Sub-clinical hearing loss absent	p- value
RBS (mg/dL)	192.4	181.4	0.005 (Significant)
HbA1c (%)	9.8	8.4	0.000 (Significant)

DISCUSSION

Diabetes mellitus (DM) is a chronic disease derived from the inadequate production of insulin in the pancreas or from the ineffective use of available insulin. It is characterized by increased blood sugar levels1 and is a genetically inherited disease. It has been reported that in patients with "diabetes in situ" (when routine workup cannot diagnose diabetes) hearing loss is usually fluctuating, as characterized in hydrops secondary to altered sodium/potassium gradients and reduced endocochlear potentials. As the disease progresses, microangiopathy and diabetic neuropathy assist in the progression of dysacusis.[7, 8]

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. Glucose metabolism significantly affects the inner ear. Both low and high sugar levels may alter inner ear function. Patients with glucose metabolism disorders may have auditory, vestibular, or mixed symptoms as seen in diabetes.[9- 11] Hence; the present study was undertaken for assessing prevalence of subclinical hearing loss in children with type 1 diabetes.

In the present study, a total of 35 healthy children and 35 children with type 1 diabetes were enrolled. Subclinical hearing loss was found to be present in 16.67 percent of the patients (5 patients) of the study group. None of the patients of the control group presented with sub clinical hearing loss. In a previous study conducted by Fukuda Cet al, authors evaluated the effect on the inner ear affection by diabetes mellitus in children. Thirty type I diabetic and thirty non-diabetic children with ages ranging from 7 to 12 years old, perfectly paired regarding sex, age, cultural and social-economic status, were evaluated by pure tone audiometry, speech audiometry, high frequency audiometry and distortion product otoacoustic emissions (DPOAE). Diabetic children exhibited slightly elevated thresholds in pure tone audiometry at 250, 2,000, 3,000, 4,000, 6,000 and 8,000 Hz frequencies. No statistical difference was found between results of speech discrimination, high frequency audiometry or DPOAE. Diabetic children hear slightly less than non-diabetic children, and this does not seem to be related to impaired function of outer hair cells.[11]

In the present study, among the 5 patients with sub-clinical hearing loss, duration of diabetes was between 1 to 3 years in 2 patients while it was more than 3 years in 3 patients. Non-significant results were obtained while assessing the correlation of sub-clinical hearing loss with duration of diabetes in diabetic patients. In another study conducted by Akinpelu OV et al, authors reviewed the available evidence on the effects of type 2 diabetes mellitus on hearing function. Eligible studies were identified through searches of eight different electronic databases and manual searching of references. It was concluded that type 2 diabetic patients had significantly higher incidence for at least the mild degree of HL when compared with controls. Mean PTA thresholds were greater in diabetics for all frequencies but were more clinically relevant at 6000 and 8000 Hz. Prolonged ABR wave V latencies in the diabetic group suggest retro-cochlear involvement. Age and duration of DM play important roles in the occurrence of DM-related HL.[12]

In the present study, mean RBS value among diabetic patients with subclinical and patients without subclinical hearing loss was found to be 192.4 mg/dL and in diabetic patients with without subclinical hearing loss was found to be 181.4 mg/dL. Significant results were obtained while comparing the glycaemic profile of the patients with and without subclinical hearing loss. Botelho CT et al, in a previous study, evaluated the hearing of adolescents with diabetes mellitus type 1(DM1) by otoacoustic emissions (OAEs), and by comparing different tests with pure-tone audiometry to identify potential early cochlear impairments. Pure-tone audiometry, transient evoked otoacoustic emissions (TEOAEs), and distortion product otoacoustic emissions (DPOAEs) were performed in a group of adolescents with and without DM1. Clinical characteristics, disease duration, and glycated haemoglobin levels were studied. Participants were 40 adolescents with DM1 and 40 healthy subjects. Sensorineural hearing loss, affecting frequencies of 6000 and 8000 Hz, was found only in DM1 subjects when compared to the controls. A higher prevalence of cochlear damage was detected by DPOAE responses, 32% belonging from the diabetic group, vs. 3.7% in the control group. They concluded that early evidence of cochlear damage was detected in adolescents with DM1 leading to hearing loss at high frequencies.[13]

CONCLUSION

From the above results, the authors concluded that diabetic children are associated with significantly higher risk of hearing loss. However; further studies are recommended.

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