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STUDY OF BRAINSTEM EVOKED AUDITORY RESPONSE IN TYPE 2 DIABETICS WITH NORMAL AND ELEVATED BODY MASS INDEX

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ABSTRACT

Background: Diabetes mellitus is a metabolic syndrome affecting many organs including the heart, kidneys, eyes and nerves

Aim: The study aims to understand the changes in brain stem evoked auditory response(BERA) in type 2 diabetics with normal and elevated Body mass index.

Materials And Methods: 60 individuals diagnosed with type 2 diabetes belonging to age group 30 - 50 years having normal and elevated BMI (Body Mass Index) were studied. Their Brainstem evoked auditory response was recorded and results were studied with the help of unpaired t test. The brainstem evoked auditory response(BERA) wave latencies I, II, III, IV, V and interpeak latencies I-III, III-V, I-V were recorded individually for left and right ear.

Result: Significant increase in latencies of waves I, III, V and interpeak latencies I-III, III-V, I-V were observed in diabetics with elevated BMI when compared with normal BMI. There was a positive association seen between BMI and wave latencies I, III,V and interpeak latencies I-III, III-V, I-V were also observed.

Conclusion: The study shows that type2 diabetic patients with elevated BMI can have subclinical hearing loss and impaired brainstem evoked auditory response. BERA is a simple non-invasive tool in early diagnosis. So management of diabetes along with maintaining ideal Body mass index will help in preventing early sensory neural hearing loss.

KEYWORDS : Brainstem Evoked Auditory Response, Diabetes, BMI, Interpeak Latencies.

INTRODUCTION

Diabetes mellitus is a non-communicable disease emerging as an epidemic in developing countries like India. The most common causes are sedentary life style, improper diet, lack of exercise and stress. It is characterized by raised blood sugar levels primarily due to impaired beta cell function of Pancreas [1]. International Diabetes Federation says that there are 463 million diabetics in the world. Among them, 79.4 million are there in India and it is expected to rise by 87 million in 2030[2]. The complications of diabetes are caused by microvascular and macrovascular pathology. Diabetes affects many organ systems like kidneys, heart, eyes, nerves [3].

Both central and peripheral neuropathy are common complications of type 2 diabetes mellitus. Sensory neural deafness due to diabetes mellitus is very common among them [5]. This is shown in a study funded by National Institutes of Health which says that deafness caused by auditory neuropathy is twice common in diabetic individuals when compared with normal people[6].The deafness seen in diabetes is a bilateral sensory neural deafness associated with micro vascular pathological changes in the cochlea, like vessel wall thickening, atrophy of stria vascularis and outer hair cell loss[7].

Auditory neuropathy due to diabetes may manifest clinically later, but it can be detected earlier with the help of electrophysiological tests [8]. These electrophysiological tests are non-invasive with no side effects and highly sensitive. Brainstem evoked auditory response one among them which reflects the bioelectrical responses of the auditory nerve to brief auditory stimulation that are recorded as potentials when it is conducted through auditory nerve up to midbrain. This is also used in the assessment of hearing impairment in uncooperative patient like children and in patients with brainstem dysfunction [9].

Typically, the Brainstem evoked auditory response consists of five waveforms (I, II, III, IV, V) that are recorded within 10msec of an acoustic stimulus. The waves I, II, III, IV, V are assigned from peripheral portion of auditory nerve, cochlear nucleus, superior olivary complex, lateral lemniscus, inferior colliculus of midbrain [10]. In auditory neuropathy due to diabetes there may be increase in latency and decrease in amplitude of the waves in response to auditory click stimulus.

The aim of this study was to compare the Brainstem evoked auditory response in type 2 diabetics with normal BMI and elevated BMI. This study helps to assess whether increased BMI is positively correlated with severity of sensory neural hearing loss and if it so, whether maintaining an ideal Body mass index(BMI) will help in prolonging the complications like sensory neural hearing loss in these individuals.

MATERIALS AND METHODS

This cross sectional study was carried out in the Department of Physiology, Government Medical College, Chennai from February 2017 to July 2017. The study subjects include 60 individuals of both gender in the age group of 30-50 years. They all diagnosed as type 2 diabetes for more than 5years and attending Medicine OP for treatment They were divided into two groups according to BMI as normal (18.50-24.99) and those with elevated BMI (25-40.00). After obtaining approval from the Institutional Ethics Committee, proper informed consent was taken from all the study individuals prior to the study. Those with history of trauma, occupational noise exposure, treatment with ototoxic drugs, familial deafness, history of alcohol, cigarette, tobacco use, or systemic diseases like uraemia, stroke, hepatic encephalopathy, multiple sclerosis, thyroid disorders, anaemia, meningitis were excluded from this study.

Medical And Biochemical Examination:

All the study individuals were subjected to the following prior to BERA:

Detailed medical history and life style

Body Mass Index(BMI) was calculated by Quetlet's index

General physical examination and systemic examination

Thorough ENT examination to rule out peripheral hearing loss

Blood urea, creatinine, FBS, HbA1C levels were taken.

BERA Study

The study was done as per the guidelines of American Clinical Neurophysiological Society. The recording of waves was carried out by RMS EMG EP Marc II Channel machine. BERA was done in a semi dark room with quiet environment. After masking the sounds from opposite ear, broad band click stimulus was given via headphones at a rate of 11.1Hz. The intensity of the clicks were 60dB above the individual perceptual hearing threshold. Percutaneous silver disc electrodes were used to record. To show replicability minimum two responses were obtained from both the ears separately. The latencies of waves I, III, V and interpeak latencies I-III, III-V, I-V were interpreted. Statistical analysis was done using SPSS software.

RESULTS:

Table 1: Comparison Of HbA1C Levels In Diabetic With Normal BMI And Diabetic With Elevated BMI

Study Group	Mean	SD	'P' value
Diabetic with normal BMI(n=30)	5.58	0.34	0.000
Diabetic with elevated BMI(n=30)	8.25	0.58	

Statistically significant 'p' value ≤ 0.05

The HbA1C levels were significantly increased ('p' value ≤ 0.05) in diabetics with elevated BMI when comparing diabetics with normal BMI.

Table 2: Comparison Of Right Ear Wave Latencies I, III, V& IPL I-III, III-V, I-V Between Diabetic With Normal BMI And Diabetic With Elevated BMI

BERA Latencies right ear	Diabetic with normal BMI (n=30) Mean+/- SD	Diabetic with elevated BMI (n=30) Mean+/- SD	'p' value
I	1.40+/- 0.12	1.86+/- 0.12	0.000
III	3.51+/- 0.25	4.70+/- 0.18	0.000
V	5.67+/-0.15	5.74+/- 0.14	0.006
I-III	2.79+/- 0.15	2.80+/- 0.14	0.007
III-V	1.99+/- 0.12	2.29+/- 0.18	0.000
I-V	4.12+/- 0.18	4.40+/- 0.11	0.000

Statistically significant 'p' value ≤0.05

Among diabetic individuals with elevated BMI, the latencies of wave I, III, V and IPL I-III, III-V, I-V were increased with significant 'p' value in comparison to diabetic with normal BMI

Table 3: Comparison Of Left Ear Wave Latencies I, III, V & IPL I-III, III-V, I-V Between Diabetic With Normal BMI Diabetic With Elevated BMI

BERA Latencies left ear	Diabetic with normal BMI(n=30) Mean +/- SD	Diabetic with elevated BMI(n=30) Mean+/- SD	'p' value
I	1.41+/- 0.10	1.82+/- 0.12	0.000
III	3.50+/- 0.24	4.72+/- 0.18	0.001
V	5.62+/- 0.14	5.76+/- 0.14	0.005
I-III	2.20+/- 016	2.32+/- 0.12	0.003
III-V	2.00+/- 0.12	2.30+/- 0.20	0.002
I-V	4.14+/- 0.12	4.42+/- 0.20	0.007

Statistically significant 'p' value ≤0.05

The latencies of wave I, III, V and interpeak latencies I-III, III-V, I-V were increased with significant 'p' value among diabetic with elevated BMI when compared to diabetic with normal BMI. For both the groups there was no significant difference between right and left ears in wave latencies I, III, V and interpeak latencies I-III, III-V, I-V.

DISCUSSION:

As like any other organ system, the auditory system also uses glucose for its energy demands. This explains that the cochlea may also be affected by diabetes and its complications. Exposure of cochlea to raised blood glucose levels, will initiate metabolic changes, that could disrupt it both anatomically and physiologically. In patients with sensory neural deafness due to diabetes, there is damage to the nerves and blood vessels of the inner ear [11]. In our study the mean HbA1C levels was significantly high in diabetic patients with elevated BMI (p value 0.00) when compared with normal BMI individuals. In diabetics with elevated BMI, the latencies of waves I, III, V were increased in both right and left ears significantly (p value of 0.00) in comparison to diabetic with normal BMI. This study correlates with the study conducted by Al-Azzawi[12].This shows delay in transmission of auditory stimulus in the auditory pathway of diabetics with elevated BMI and indicates sensory neuropathy at brainstem and midbrain level[13]. Also in this study, there was conduction delay through the auditory pathway as shown by increase in the interpeak latencies of both right &left ear in diabetic with elevated BMI ('p' value0.00) significantly. This was also seen by those conducted by Durmus[14].The sensory neural hearing loss in diabetes could be explained by various pathophysiological mechanisms. The electrolyte homeostasis in the endolymph may be altered due to increased permeability of endothelium of stria vascularis. This can interrupt the signal transduction and transmission.

Endolymph and perilymph micro haemorrhages, destruction of hair cells, and atrophy of the spiral ganglion was also observed in many histopathological studies [15]. The same changes may also be observed in cochlear tight junctions which act as anatomical barrier between perilymph and endolymph. This can produce cochlear ionic imbalance. Three main mechanisms have been proposed to explain pathogenesis of sensory neuropathy in patients with diabetes which may be the cause for hearing loss.

1. Structural abnormality of endo neural vessels causing multiple infarcts due to anoxia
2. Abnormalities in metabolism like reduction in free myoinositol, Na-K ATPase, and rate of protein synthesis
3. Non enzymatic glycosylation induced protein alteration

All these mechanisms will produce degeneration of axon by impairing transport across the axon 16]. Therefore, in diabetics with elevated BMI can have subclinical hearing loss & impaired brainstem auditory response, independent of peripheral neuropathy. In our study there was an increase in wave latencies of I, III, V and interpeak latencies I-III, III-V, I-V. There was also no significant difference between right and left ears.

CONCLUSION:

By this study, we understood that even though earlier in the course of diabetes a person might be unaware of any hearing loss, yet degenerative changes start appearing at various levels. BERA which is a simple, non-invasive test can detect this subtle degenerative changes in the auditory nerve. Therefore, considering the prevalence of diabetes in India and its long term complication on an individual's hearing, it is recommended that BERA testing may be carried out in diabetics particularly in those with elevated BMI and increased HbA1C levels.

This was the most important clinical implication of this study. So diabetic patients should maintain an ideal BMI by regular exercise and proper diet. This will help in keeping the HbA1C level within normal limits and prolonging complications of diabetes such as sensory neural hearing loss.

Limitations Of The Study:

Relatively smaller sample size, duration of diabetes and BERA latencies by gender were the limitations of this study.

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Conflict Of Interest: Nil

REFERENCES:

1. Umegaki H. Neurodegeneration in diabetes mellitus. Adv Exp Med Biol 2012;724:258-65.
2. Latest diabetes figures paint grim global picture. International diabetes federation 2019. Available at www.idf.org
3. Girling J, Dornhost A. Pregnancy and Diabtes Mellitus. In:Pickup JC, Williams G, editors. Textbook of Diabetes. 3rd ed. Oxford: Blackwell Publishing Company; 2003. P. 65-66.
4. Jali MV, Kambar S, Jali SM, Gowda S, Familial early onset of type 2 diabetes mellitus and its complications. N Am J Med Sci 2009;1; 377-80.
5. Mala CA, Campos CA. Diabetes mellitus as etiological factor for hearing loss. Braz J Otorhinolaryngology 2005; 71:208-14.
6. Diabetes and hearing loss. American Diabetes Association Alert Day. Healthy hearing your complete hearing aids information source. Available at; www.diabetes.org
7. Fukushima J. Cureolglu S, Schachern PA, Paperella MM, Harada T, MechetbOF. Effects of type 2 diabetes on cochlear structure in humans. Arch Otolaryngeal Head and Neck Surg 2006; 132:934-938.
8. Imam M Shehata OH. Subclinical central neuropathy in type 2 diabetes mellitus. Bull Alex Fac Med 2009; 45;65-73.
9. Misra UK, Kalita J. Brainstem auditory evoked potentials. In;Misra UK, Kalita J, editors. Clinical Neurophysiology, 2nd ed. NewDelhi: Elsevier Publications; 2006. P329-45.
10. Biacabe B, Chevallier JM, Avan P, Bonfils P. Functional anatomy of auditory brainstem nuclei: Application to the anatomical basis of brainstem auditory evoked potentials. Auris Nasus Larynx 2001;28:85-94
11. de la Monte SM, Longatop L, Tong M, Wands JR. Insulin resistance and neurodegeneration: Roles of obesity, type 2 diabetes mellitus and non alcoholic steatohepatitis, Curr Opin Investig Drugs 2009; 10:1049-60.
12. Al-Azzai LM, Mirza KB. The usefulness of brainstem auditory evoked potential in early diagnosis of cranial neuropathy associated with diabetes mellitus. Electromyogr Clin Neurophysiol2004;44:387-94
13. Chi-Ren Huang, Chen-Hsein Lu, Heueh-Wen Tsai, Wen-Neng Chang,. Brainstem auditory evoked potentials study in patients with Diabetes Mellitus. Acta Neurologica Taiwanica March 2010;19(1):33-40.
14. Durmus C, Yetiser S, Durmus O. Auditroy evoked responses in insulin dependent(ID) and non insulin dependent(NID) diabetic with normal hearing. Int J Audiol 2004;43:29-33.
15. Dhanraj GA. A one year care control study to know the association between sensorineural hearing loss and diabetes mellitus in KLES, Hospital and medical research center. District Hospital Belgaum. Department of otorhinolaryngology. Jawaharlal Nehru medical college. Belgaum. Karnataka. September 2006;103-13.
16. Resella Medori, Herman Jenich, Lucila Autilio Gambetti, Pierluigi gambetti. Experimental Diabetic Neuropathy Similar changes of Slow Axonal Transport and axonal size different Animal Models.The journal Neuroscience. May 1988;8(5):1814-21.