



ORIGINAL RESEARCH PAPER

Physiology

ASSESSMENT OF AUDITORY EVOKED POTENTIAL IN TYPE II DIABETES MELLITUS INDIVIDUALS –A CASE CONTROL STUDY.

KEY WORDS: Brainstem auditory evoked potentials, type 2 diabetes mellitus, auditory nerve, central neuropathy.

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ABSTRACT

Background: Diabetes mellitus(DM) is a metabolic disease that produces vascular and neurological complications. In type 2 diabetes mellitus, resistance to insulin is accompanied by an insufficient recompense in the secretion of insulin. Due to metabolic dysregulation many pathophysiological changes are seen. Brainstem auditory evoked potentials(BAEP)are the potentials recorded from the ear and vertex in response to a brief auditory stimulation to assess the conduction through auditory pathway up to the midbrain and it produces wave I to wave V. The eighth cranial nerve and brain functions are impaired in type II Diabetic patients.

Aim&Objective: To study the Brainstem auditory evoked potential in type II diabetic patients and to compare it with normal individuals.

Materials and Methods: In this study 30 type 2 diabetes mellitus subjects were selected from department of diabetology OPD, Stanley medical college and Control group of 30 were selected from master health check up.BERA recording was done in Neurophysiology laboratory, Department of physiology, Stanley medical College using POLYRITE MEDICAID –Neuroperfect plus.

Results: There was a significant increase in latencies of waves I,III,V and interpeak latencies of waves I-V&III-V of diabetics when compared with controls (p < 0.01).

Conclusion: BERA is a simple and non invasive procedure to detect early impairment of acoustic nerve damage and CNS pathways. Hence it can be used even in the absence of specific symptoms.This study suggests that if BERA is carried out in diabetics, involvement of central neuronal axis can be detected earlier.

I. Introduction

Diabetes mellitus (DM) is a chronic metabolic and genetically inherited disease, due to the insufficient production of insulin in the pancreas or from the ineffective use of available insulin⁽¹⁾.It is characterized by increased blood sugar levels It has been estimated that by 2025 there will be around 300 million diabetic individuals in the world.The pathological changes which occurs in the auditory system of diabetics are,spiral ganglion atrophy, myelin sheath degeneration of the vestibulocochlear nerve, reduction in the number of nerve fibers in the spiral lamina,and thickening of the capillary walls of the striavascularis⁽¹⁾Neuropathy is a late complication of DM.Many studies have described about the peripheral and autonomic nerve involvement but with the introduction of evoked potential techniques the exploration of sensory pathway of auditory system was possible⁽²⁾.Brainstem auditory evoked potential is a simple, noninvasive tool to detect changes in the auditory nerve. In this study we want to evaluate the brainstem auditory response and the absolute and interpeak latencies in type 2 DM individuals and to compare it with age and gender matched controls.

II. MATERIALS AND METHODS

Ethical clearance was obtained from Institutional Ethical Committee. Informed consent was obtained from all subjects.This is a cross sectional study.BERA recording was done in Neurophysiology laboratory of research wing,department of physiology, Stanley medical college using POLYRITE MEDICAID –neuroperfect plus.30 subjects of both male and female selected from the department of diabetology who were around 30-45 years of age group,5 years duration of diabetes,on oral hypoglycemic drugs,with good glycemic control and normal hearing were included in the study. Smokers,alcoholics,external or middle ear diseases,ear surgery,systemic diseases,like hypertension, drugs acting on central nervous system (methyl dopa, nitrofurantoin, reserpine),neuromuscular disorders, subjects with cochlear implants,head injury or cerebrovascular accidents and many other diseases were excluded for selecting the subjects. The study was conducted from April 2012 to October 2012.

The participants are relaxed and comfortable prior to the tests.

Clinical history about diabetes was collected. Written and Informed consent obtained. Pure tone audiometry done prior to the recording .Complete external ear examination was done for both ears. Wax removed. The basic parameters of subjects height weight, age, pulse and BP were recorded. Several repetitions of auditory evoked potential recordings were done for the reliability of the method. The laboratory temperature was maintained uniformly. Recordings were done in the forenoon 10.00 am to 12 p.m. in sitting posture after a light breakfast.Subjects were informed to avoid beverages, to take shampoo bath of scalp and strictly oil free, and to remove ornaments on the day of recording.

Brainstem auditory evoked potential were recorded in type 2DM individuals of both the genders in Neurophysiology laboratory of research wing, department of physiology,Stanley medical college using POLYRITE MEDICAID –Neuroperfect plus. Disc electrodes placed on scalp by 10-20 standard system with conducting jelly. This provides stability of electrodes and prevents infection. The reference electrode was placed on the vertex (Cz) and active electrode on the side of mastoid on which side of ear stimulated. Ground electrode connected on the right forearm(Fz)⁽³⁾ Electrode impedance was checked.Click acoustic stimuli at a rate of 11 pulse per second at an intensity of 90dB hearing level to the ear stimulated and masking sound of 40dB in non stimulated ear was given through head phone supplied by Medicaid.

Results:

Table :1 Anthropometric measurements of type 2 Diabetes with controls.

	Cases n=30 Mean ±SD	Controls n=30 Mean±SD	p value
Age(yrs)	36.97±3.04	37.27±3.59	0.72
Height(cm)	157.77±6.93	156.73±6.40	0.77
Weight(kgs)	57.37±6.06	57.87±6.49	0.38
BMI(Kg/m ²)	23.04±1.96	23.56±2.42	0.36

BMI – Body Mass Index

The parameters were analyzed using Student independent' t'test. p < 0.05 is taken as significant

Table :2 Comparison of blood sugar type 2 dm with controls

Type2DM	143.20	10.27	145.53	15.71	<0.00**
Control	96.00	3.93	113.60	7.11	

The parameters were analyzed using Student independent' t'test. p < 0.05 is taken as significant.

Table :3 Absolute latencies of type 2 diabetes with controls

LATENCIES (L)ms	Cases n=30 Mean ±SD	Controls n=30 Mean±SD	P value
L1	1.84±0.09	1.76±0.69	t=2.67 p=0.001
L2	2.58±0.15	2.4±0.05	t=-6.18 p=0.00
L3	4.42±0.22	3.73±0.07	t=16.52 p=0.00**
L4	5.32±0.20	5.27±0.07	t=2.37 p=0.04
L5	6.50±0.14	5.79±0.09	t=25.97 p=0.00**

p < 0.01** is taken as highly significant

Table :4 Inter Peak latencies of type 2 diabetes with controls

LATENCIES(L) ms	Cases n=30 Mean ±SD	Controls n=30 Mean±SD	Student independent t test
IPL1-III	2.17±0.12	1.95 ±0.03	t=3.2 p=0.02
IPL 1-V	4.34±0.12	2.09±0.04	t=-48.90 p=0.00**
IPL III-V	4.07±0.143	2.79±0.14	t=78.42 p=0.00**

p < 0.01** is taken as highly significant.

There was no statistical difference between the Type 2 DM and controls with regards to age, height, weight and BMI (p > 0.05).

There was a highly significant increase in fasting and post-prandial blood sugar and significant increase in latencies of wave I, II, III, V and interpeak latencies (IPL) I-V, III-V in cases when compared with controls. (p < 0.01). Statistical Package for Social Sciences (SPSS) software 11.5 version was used for statistical analysis. The Student independent' t'test was used to compare cases and controls.

Discussion

Type 2 DM is a most common endocrine and metabolic disorder leading to hyperglycemia which in turn leads to multi organ dysfunction and one of the lesser known consequences of diabetes is hearing disorder. Altered hearing function is found in diabetics⁽⁴⁾. Metabolic disorders of carbohydrates and lipids affecting the vestibulocochlear system is the main etiologic factors related to hearing loss. Diabetic microangiopathy and neuropathy is the cause for vestibulocochlear disorders as they affect the vessels in the inner ear and stria vascularis. Derangements that may be involved in the development of diabetic neuropathy is the accumulation of alcohol sugars sorbitol and fructose, with increased free radical production, activation of the polyol and protein kinase C (PKC) pathways⁽⁵⁾. Symmetric Bilateral and progressive high frequency sensorineural hearing loss with gradual onset is found in patients with diabetes⁽⁶⁾.

Though peripheral neuropathy in DM has been investigated in detail the term "central neuropathy" was not known until recently. Electrophysiological investigations are sensitive in finding peripheral and central neuropathy in diabetic patients. Therefore the diabetics must be considered at risk for auditory conditions. Hearing loss is usually fluctuating with reduced endocochlear potentials. In our study there is prolongation of absolute latencies of I, II, III, IV. This suggest that eighth nerve transmission time is delayed. The delay in interpeak latencies I-V and III -V, shows the

evidence of a central conduction delay at the brainstem-to-midbrain level. This shows that the subjects may have central neuropathy. Toth et al proved that the waves III and V, IPL I-III and I - V were prolonged. G. Pozzessere et al⁽⁹⁾ showed increase in IPL of III- V and I- V Md. Noorain Alam et al, Grazyna Lisowska showed similar results that central conduction timings in the brainstem could neither be related to age of the patient nor to severity of diabetes.

Donald et al⁽⁷⁾ showed increase in latency of the waves V and I – III. Durmus et al⁽⁸⁾ evaluated the absolute latencies and interpeak latencies of I-V and III-V are prolonged without correlation to duration of disease ,gender and neuropathy. Pessin et al⁽¹⁰⁾ found that IPL of I – III is prolonged. The above studies are in favour of our study. Hyperglycemia causes widespread tissue damage, most specifically injuring endothelial (Vaughan, et al) neural tissue (Cameron et al.)

CONCLUSION :

It is concluded that type 2 diabetes mellitus patients have central neuropathy involving the auditory nerve and has prolonged delay in the latencies indicating more involvement of the nerve. So, this study suggests that early screening by electro physiological test may preferably be done to prevent the hearing impairment at an early stage. BERA is a simple and non invasive test to detect the early impairment of the nerve and CNS pathways even in the absence of symptoms. So we recommend that BERA should be performed as an investigatory procedure in all diabetics.

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