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Comparison of Brainstem Evoked Potential between Type 2 Diabetic Females and Controls

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Abstract

Background and objective: Diabetes mellitus is a world wide problem with multiorgan involvement. Peripheral neuropathy is a known complication and is widely investigated. Auditory nerve involvement is a new area of research in diabetes. Most of the work in this area has been done on mixed population or male diabetic patients only. Exclusive work on female diabetic patients is lacking. Therefore, the present study was undertaken.

Methods: 57 diabetic females (comprising of recently diagnosed and established cases) were subjected to brainstem evoked potential studies (BAEP) and compared with 38 nondiabetic control females. The absolute latency (AL) and interpeak latency (IPL) of the three groups were compared.

Results: The results revealed that there is prolongation of all latencies in both ears in diabetic females than the control ones. However, the changes were rapid in newly diagnosed diabetics and thereafter slow down in established diabetic ladies.

When the two groups of diabetic females were compared, there was variable response in all the latencies. There is possibility of some adaptative changes later on.

Conclusion: Central auditory pathways seem to be involved in diabetes. BAEP may be used as a prognostic tool and patient awareness programs. More research is needed in this area.

Key Words: Braistem auditory evoked potential (BAEP), Central neuropathy, Diabetes mellitus (DM).

Introduction

Diabetes mellitus (DM) is a chronic multifactorial syndrome comprising of a group of common metabolic disorders that share the phenotype of hyperglycaemia[1]. The metabolic dysregulation associated with DM causes secondary pathophysiological changes in multiple organ systems. Nervous system involvement in diabetes mellitus has been amply documented[2-4]. Electrophysiological studies have objectified the peripheral nervous system and central venous system damage caused by diabetes, both in patients and experimental models. There are few reports that document central nervous system dysfunction in diabetes mellitus suggesting central neuropathy. Cranial nerve involvement has also been reported in this disease[2-4].

Evoked potentials represent an obligate neuronal response to a given stimulus. It was reported that early involvement of the central auditory pathway can be detected with fair accuracy with auditory evoked potential studies.

Many workers[5-7] found a delay in all latencies of diabetics when compared to healthy individuals, demonstrating a defect at the level of brainstem and midbrain in long-standing type 2 DM subjects. This effect was more pronounced in those with pre-existing neuropathy.

However, some researchers found either no change[8] or a decrease in the latencies[9] of BAEP in diabetics. Therefore, there are conflicting reports about the effect of DM on BAEP. Most studies on BAEP were performed either on mixed population or in males only. There is lack of exclusive work done on female diabetics. Therefore the present study was planned with a view to observe the central neuropathy, if any, in ladies with diabetes.

Material and method

The study was conducted in the Department of Physiology, LLRM Medical College over a period of 15 months, following approval from institutional ethical committee. 57 female diabetic patients (comprising of twenty-seven recently diagnosed in past six months and thirty established patients) between 30 - 70 years of age were taken from the OPD of Department of Endocrinology of associated SVBP Hospital. Random blood glucose of each patient was done prior to BAEP procedure by Glucose Oxidase Method[10]. Thirty-eight age and sex-matched non-diabetic female patients were also selected and served as controls. Patients having history

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of diabetes related complications, deafness, known ear pathology and ototoxic drugs were excluded. All subjects had no complaint of hearing loss which was further confirmed by otoscopic and tuning fork tests. BAEP was conducted in all subjects after getting a written and informed consent, using the software Neurostim NS-4 (Medicaid, Chandigarh). The procedure and purpose of BAEP was fully explained to each patient. It was carried out with the subject lying in supine position comfortably on a wooden couch. Active electrodes were placed behind each of the ear lobes, ipsilateral and contralateral respectively. Grounding was done by placing en electrode on subject's forehead. Reference electrode was placed over the vertex. All electrodes were finally plugged into the electrode box and the appropriate channels were switched on, skin to electrode impedance was maintained below 5 ohms. The signals were then picked up by these electrodes from the scalp after standard click stimuli and then were filtered, amplified, averaged and displayed on the screen of Neurostim NS-4 Evoked Potential Recorder.

For recording of the BAEPs, 2,000 click stimuli having intensity 30 - 40 dB above threshold level were given to each ear independently at the rate of 11/sec and duration of 1 msec.

During testing of one ear, the other was masked with a white noise of 40 dB. These clicks were generated by passing 1 msec squared pulses through shielded headphones with alternating polarity. Each ear was tested twice. After filtration, amplification and averaging the waves in the first 10 msec of latency were considered for auditory brainstem responses.

Absolute latencies of waves I, III and V and interpeak latencies between waves I-V, I-III and III-V were noted for each ear.

At the end of the study, the intergroup comparison was done by unpaired student t test and intragroup comparison by one way ANOVA .

Results

Table I shows the anthropometric parameters of all females. They are comparable in diabetics as well as non diabetic ladies except that the former was mildly obese and there was significant difference in height as well. However, the difference in height would not affect the BAEP, hence ignored. All diabetic females had significant high blood glucose levels and taken as uncontrolled diabetics.

Table I: Base line parameters of all female subjects.

S N	Parameter	Controls (38) mean ± sd	Newly diagnosed diabetics (27) mean ± sd	Established diabetics (n = 30) mean ± sd	F	P
1	Age (year)	50 ± 12.27	45.22 ± 10.08	46.53 ± 10.50	1.63	0.20
2	Height (m)	1.57 ± 0.06	1.56 ± 0.06	1.60 ± 0.06	3.54	0.03†
3	Weight (Kg)	61.47 ± 10.44	62.48 ± 11.30	64.70 ± 9.18	0.84	0.43
4	BMI (Kg/m^2)	24.95 ± 3.57	25.70 ± 4.13	25.25 ± 3.29	0.33	0.72
5	Random blood sugar (mg/dl)	89.05 ± 9.95	301.96 ± 76.72	259.73 ± 114.75	72.97	0.00'

† <0.05 significant value, ' 0.001 highly significant value.

Table II: Comparison of absolute and interpeak latencies between control (n = 38) and newly diagnosed diabetic females (n = 27).

S N	Parameters	Right ear		Left ear		P value	
		Control	New cases	Control	New cases		
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Right ear	Left ear
1	I*	1.09 ± 0.28	1.22 ± 0.34	1.20 ± 0.36	1.25 ± 0.35	0.127	0.604
2	III*	3.46 ± 0.38	3.56 ± 0.29	3.54 ± 0.34	3.4 ± 0.33	0.279	0.164
3	V*	5.26 ± 0.34	5.60 ± 0.29	5.53 ± 0.38	5.56 ± 0.34	0.002†	0.759
4	I-III*	2.34 ± 0.54	2.36 ± 0.47	2.34 ± 0.57	2.38 ± 0.52	0.884	0.787
5	I-V*	4.49 ± 0.51	4.53 ± 0.33	4.37 ± 0.49	4.38 ± 0.49	0.732	0.94
6	III-V*	2.17 ± 0.49	2.21 ± 0.49	2.06 ± 0.53	2.17 ± 0.51	0.763	0.437

**milliseconds, † <0.05 significant value.*

Table III: Comparison of absolute and interpeak latencies between controls (n = 38) and established diabetic females (n = 30).

S N	Parameters	Right ear		Left ear		P value	
		Control	Established DM	Control	Established DM		
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Right ear	Left ear
1	I*	1.09 ± 0.28	1.32 ± 0.41	1.20 ± 0.36	1.21 ± 0.33	0.007†	0.907
2	III*	3.46 ± 0.38	3.53 ± 0.35	3.54 ± 0.34	3.65 ± 0.35	0.040†	0.239
3	V*	5.26 ± 0.34	5.60 ± 0.34	5.53 ± 0.38	5.53 ± 0.38	0.040†	0.087
4	I-III*	2.34 ± 0.54	2.24 ± 0.56	2.34 ± 0.57	2.52 ± 0.47	0.459	0.168
5	I-V*	4.49 ± 0.51	4.11 ±0.55	4.37 ± 0.49	4.25 ± 0.55	0.004†	0.346
6	III-V*	2.17 ± 0.49	1.87 ± 0.46	2.06 ± 0.53	1.69 ± 0.41	0.012†	0.002†

**milliseconds, † < 0.05 significant value.*

Table IV: Comparison of absolute and interpeak latencies in new (27) and established diabetic (30) females.

S N	Parameters	Right ear		Left ear		P value	
		New DM	Established DM	New DM	Established DM		
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Right ear	Left ear
1	I*	1.22 ± 0.34	1.32 ± 0.41	1.25 ± 0.35	1.21 ± 0.33	0.330	0.664
2	III*	3.56 ± 0.29	3.53 ± 0.35	3.4 ± 0.33	3.65 ± 0.35	0.731	0.008†
3	V*	5.60 ± 0.29	5.60 ± 0.34	5.56 ± 0.34	5.53 ± 0.38	0.052	0.955
4	I-III*	2.36 ± 0.47	2.24 ± 0.56	2.38 ± 0.52	2.52 ± 0.47	0.394	0.010†
5	I-V*	4.53 ± 0.33	4.11 ± 0.55	4.38 ± 0.49	4.25 ± 0.55	0.717	0.090
6	III-V*	2.21 ± 0.49	1.87 ± 0.46	2.17 ± 0.51	1.69 ± 0.41	0.203	0.140

**milliseconds, † < 0.05 significant value.*

Table II shows that there was rise in all absolute and IPL in both ears of recently diagnosed diabetic females than controls. A significant increase in absolute latency of wave V was found in right ear but increase in other latencies were not significant in either ear.

Table III shows that all the absolute latencies were also increased in both ears of established diabetic females similar to new diabetic females but significantly in right than left ear. In contrast the IPLs in established diabetics were found to be lower than the non diabetic females and some of them were decreased significantly in one or both ears.

Table IV compares the absolute and interpeak latencies between newly diagnosed and established diabetic female patients. It shows a variable pattern of absolute and IPLs with either increase or decrease or same in one or other ear. The increase in AL III and IPL I-III was found to be significant in left ear.

Discussion

Peripheral neuropathy is a well known complication in long standing diabetes mellitus, especially if there is poor glycaemic control. Both – somatic and autonomic nerves are involved. Sensorineural hearing loss is also a common observation in diabetics especially with uncontrolled glycaemic level though it may be more in one ear than the other. It is slow but progressive with more severe loss to higher frequencies. Therefore the possibility of central neuropathy also exists and is a new research area. There are different views about involvement of central auditory pathways. BAEP is a non invasive electrophysiological device to detect the involvement of the auditory pathways. It gives information of peripheral as well as central auditory pathways. Most researchers have done studies on mixed population of diabetics to evaluate the extent of central neuropathy.

The present study shows a delay in most of the absolute and interpeak latencies in both ears in elderly diabetic females either recently diagnosed or established ones in comparison to non diabetic females. The changes in BAEP latencies were non-significantly increased in both ears in newly diagnosed diabetic ladies but in established cases,

these changes were significant in right ear than left. Moreover, in established diabetic females, the IPLs were found to be significantly decreased as compared to non diabetic ladies. Similar findings are also found when we compared the BAEP latencies between newly diagnosed and established diabetic women. Therefore, diabetic related changes in auditory pathways may start rapidly with the onset of diagnosis of the disease but slow down later with increase in duration of the disease. It might be possible that there is some adaptation in auditory pathways with increase in duration of disease which may account for slow progression of changes or even may reverse them for which no definite cause can be ascribed. It was said that diabetic neuropathy is confined to peripheral nerves only and degenerative changes in CNS are unimportant[11]. Even the major text books disregard or minimise its existence[8]. The subclinical sensorineural hearing loss in DM has been reported[12]. The neural tissue involvement may be due to microangiopathies which lead to defective energy utilisation by the neural tissue. Deficiency of myoinositol in the nerve may also contribute to central neuropathy[13,14]. The atrophy of spiral ganglion and defect in myelin sheath of VIII nerve with lack of degenerative changes are the main pathological findings observed in DM.

Therefore, there is a distinct possibility of involvement of central auditory pathways in uncontrolled diabetic females though the adaptative response in longer duration diabetes need to be explored with extent of such adaptation in male diabetics. In view of increasing global incidence of DM, routine BAEP studies may be used as a diagnostic tool and to generate awareness among patients about possible future hearing loss.

Limitations

1. The glycaemic level in the present study was determined by random sugar testing prior to BAEP but estimation of HbA1c would be a better parameter We could not do it being of its high cost as we took OPD patients in our study.
2. We did not assess the correlation of BAEP latencies with duration of disease or random blood sugar as we had diabetics of two populations – one group having been diagnosed of DM in past six months and the other group of established cases ranging from 2 to 12 year.

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