Original Article

A COMPARATIVE STUDY OF BRAINSTEM EVOKED RESPONSE AUDIOMETRY IN DIABETIC AND NON-DIABETIC SUBJECTS

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ABSTRACT

INTRODUCTION:

The prevalence of diabetes mellitus is increasing all over the world particularly in the developing countries. Diabetes is associated with hearing impairment which has been described as sensorineural in origin, but evidence favoring a specific mechanism is insufficient. Brainstem evoked response audiometry is a simple, non invasive procedure to detect early impairment of acoustic nerve and auditory pathway, even in the absence of specific symptoms. The present study is under taken to evaluate the impact of type 2 diabetes mellitus on BERA parameters.

OBJECTIVES:

To analyze and compare the brainstem evoked response audiometry in diabetic patients and age and gender matched controls.

METHODS:

40 type 2 diabetic patients attending outpatient department of Otorhinolaryngology and Medicine, C.S.S.Hospital, Meerut and 40 non diabetic age and gender matched subjects from general population were selected randomly, with none of them having complains of hearing loss and were subjected to Brainstem evoked response audiometry (BERA). BERA parameters such as latency of wave I, II, III, IV, and V; inter-peak latencies I-III, I-V and III-V were analyzed. BERA parameters were also assessed according to the duration of diabetes and fasting blood glucose levels.

RESULTS:

Patients with type 2 Diabetes mellitus were found to have subclinical hearing impairment as revealed by impaired auditory brainstem response. In this study diabetic patients showed a statistically significant (pvalues0.05) delay in the latency of waves I, III and V and Inter-Peak Latency of waves I-III, I-V and III-V when compared to controls. There was a positive correlation between prolongation of latencies and duration of diabetes mellitus. The latencies were also found to be prolonged with altered blood glucose levels.

CONCLUSION:

The present study correlates with earlier findings that impaired BERA response in diabetic patients is a consequence of microangiopathy. Meticulous control of blood sugar levels is a must to prevent the early complications of diabetes, so that further damage to auditory pathway can be prevented.

KEY-WORDS:

Diabetes mellitus; Hearing; Brainstem evoked response audiometry (BERA).

INTRODUCTION:

Brainstem evoked response audiometry (BERA) is a non invasive procedure that helps in far field recording of the synchronized response of a large number of neurons in the lower portion of auditory pathway. It helps to detect early impairment of acoustic nerve and auditory pathway, even in the absence of specific symptoms.[1]

India is currently, the world leader in terms of diabetic population, earning the dubious distinction of being

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termed as the "Diabetic capital of the world" and it is anticipated that the number diabetic patients in India will reach 79.4 million by the year 2030.[2]

Type 2 Diabetes is associated with hearing impairment in population based studies. Diabetesrelated hearing impairment has been described as sensorineural in origin, implying that the lesion may be cochlear or of the eighth cranial nerve, but evidence favoring a specific mechanism is insufficient.[3] It is suggested that BERA can demonstrate electro-physiologically, any lesions from acoustic nerve to the brainstem and can be used in diabetics to show subclinical variances and central neuropathy.[4]

In the recent past, studies similar to our own have been done worldwide, but the results reported by these, with respect to the BERA changes in type 2 diabetic patients, have been quite variable. The objective of this study was to analyze and compare the brainstem evoked response audiometry in diabetic patients and age and gender matched controls.

MATERIALS AND METHODS

In this study, type 2 diabetic patients between 30 -70 years, attending outpatient department of ENT and Medicine of Subharti Hospital and normal age matched subjects from general population were included. Patients who were biochemically proved type 2 diabetes mellitus (fasting blood glucose levels more than 126 mg/dl) with >2 years of duration of type 2 diabetes mellitus with no hearing impairment were included in this study. Patients with any complications of type 2 diabetes mellitus; patients who had history of ear discharge or associated endocrine disorder; head injury, neurological deficit, cerebrovascular accident or noise trauma in past, history of taking ototoxic drugs were excluded from the study. Diabetic patients presenting with complaint of hearing loss were also excluded.

After giving consent, a brief history, general physical examination followed by an otological examination with fasting blood glucose levels and pure tone audiometry were done. These patients were then subjected to Brainstem Evoked Response Audiometry on RMS MEDULLA AD machine. BERA potentials were recorded in every patient and were then analyzed between the type 2 Diabetics and non diabetics. The results were expressed as mean and standard deviation. Unpaired t-test was used for intergroup comparisons, p-value of 0.05 or less was considered as statistical significant.

RESULTS

A total of 80 patients were evaluated with 40 in each group. The age range in our study was 30-70 years. In the control group, the mean age was 47.18 ± 7.78 years and for the type 2 diabetic group, the mean age was 47.4 ± 7.64 years. There were a total of 24 males (60%) and 16 females (40%) with male to female ratio of 1.5:1 in both the groups.

In our study, the mean duration of type 2 diabetes mellitus was 6.13 ± 2.30 years in the diabetic group. Minimum duration of diabetes mellitus was 3 years and the maximum duration was 12 years. In our study, the mean fasting blood glucose level was 145.05 ± 30.79 mg/dl in the diabetic group.

All patients had normal hearing thresholds (WHO criteria), as analyzed by the pure tone audiometry.

Table-I Comparison between the WAVE Latencies in Diabetic Patients and Controls

VARIABLE			DIABETIC PATIENTS		CONTROLS		t-VALUE	p-VALUE	
			MEAN	SD	MEAN	SD			
LEFT EAR	WAVE LATENCY (ms)	WAVE I	1.69	0.21	1.55	0.11	3.597	0.001	SIG
		WAVE II	2.63	0.27	2.65	0.19	0.31	0.758	NS
		WAVE III	3.83	0.21	3.33	0.18	11.548	0.001	SIG
		WAVE IV	5.02	0.30	4.95	0.35	0.38	0.12	NS
		WAVE V	6.1	0.53	5.30	0.17	9.022	0.001	SIG
RIGHT EAR	WAVE LATENCY (ms)	WAVE I	1.72	0.19	1.57	0.1	4.605	0.001	SIG
		WAVE II	2.68	0.20	2.64	0.25	0.778	0.439	NS
		WAVE III	3.79	0.23	3.42	0.21	7.329	0.001	SIG
		WAVE IV	4.83	0.29	4.73	0.25	1.661	0.101	NS
		WAVE V	5.89	0.39	5.31	0.18	8.537	0.001	SIG

Table-II Comparison between the Inter-Wave Latencies in Diabetic Patients and Controls

VARIABLE			DIABETIC PATIENTS		CONTROLS		t-VALUE	p-VALUE	
			MEAN	SD	MEAN	SD			
LEFT EAR	INTER PEAK LATENCY (ms)	I - III	2.15	0.25	1.77	0.21	7.341	0.001	SIG
		I - V	4.41	0.47	3.75	0.16	8.406	0.001	SIG
		III - V	2.25	0.48	1.97	0.21	3.378	0.001	SIG
RIGHT EAR	INTER PEAK LATENCY (ms)	I - III	2.1	0.3	1.86	0.23	4.003	0.001	SIG
		I - V	4.17	0.33	3.75	0.19	7.015	0.001	SIG
		III - V	2.11	0.41	1.89	0.27	2.836	0.001	SIG

CORRELATION OF BERA PARAMETER BETWEEN THE DIABETICS AND CONTROLS

In our study we found that there was lengthening in latencies of the wave I, III and V, and inter-peak latencies between waves I-III, I-V and III V in type 2 diabetic patients in both the ears, when compared to controls ($p<0.05$).

CORRELATION BETWEEN BERA RESPONSES AND DURATION OF DIABETES

In our study we found that absolute latencies of waves I, III and V were prolonged in type 2 diabetic patients with duration of type 2 diabetes mellitus more than 5 years when compared to short term type 2 diabetic patients with 2 5 years of type 2 diabetes mellitus. Also absolute latencies of waves III and V were significantly prolonged in both these groups i.e. in type 2 diabetic patients with duration of illness more than 5 years and short term diabetic patients with 2 5 years of duration, when compared to controls ($p<0.05$). Also type 2 diabetic patients with more than 5 year duration of illness showed significant delay in IPL III-V and I-V when compared to controls and with type 2 diabetics of 2 5 year duration.

CORRELATION BETWEEN BERA RESPONSE AND FASTING BLOOD GLUCOSE LEVELS IN DIABETIC PATIENTS

We found that absolute latencies of wave I, III and V in both ears were delayed in type 2 diabetics with increased blood sugar levels (>126mg/dl) when compared to controls. Inter-Peak Latency of waves IIIV and IV were also delayed in both ears in diabetics with increased blood sugar levels ($p<0.05$). Similar results were obtained when the type 2 diabetics with fasting blood sugar levels more than 140 mg/dl were compared to those with fasting blood sugar levels between 126-140mg/dl ($p<0.05$).

DISCUSSION

Central diabetic neuropathy is a newer concept and it can be detected by simple and non-invasive methods. One of these methods is BERA. By this method, functional and autonomic pathologies, from the acoustic nerve to the upper part of the brainstem can be demonstrated at an early stage. Lesions at these levels results in changes in BERA latencies. Evaluation of these changes might help to determine early sub-clinical neurological dysfunctions in type 2 diabetes mellitus.[5]

In our study we found that there was lengthening in latencies of the wave I, III and V and inter-peak latencies between waves I-III, I-V and III V in type 2 diabetic patients in both the ears, when compared to controls. The delay in latencies signifies conduction delay from the peripheral parts of the auditory pathway which may be due to demyelination which results in delay of the wave components.[6] Similar findings were reported by Sharma R et al[7] and Al-Azzawi et al[8] who conducted similar studies and obtained similar results.

One thing to be concluded is that the subjects included in this study had a normal pure tone audiogram suggesting that subclinical involvement of auditory pathway can be detected earlier in the course of disease by BERA and thus BERA can be a diagnostic test for analyzing early impairment of the auditory function.

There is a positive correlation between the duration of type 2 diabetes and lengthening of latency of BERA parameters. This can be explained due to sub-clinical ischemia, which can develop during diabetic process like atherosclerosis and sorbitol accumulation.[9]

Micro-angiopathy too has been implicated to cause diabetic neuropathy, which is a long term complication and this explains a higher incidence of abnormal BERA responses in patients with prolonged illness.[10]

The present study concurs with findings of Naini et al[9], which showed that short term diabetes mellitus patients

have minor abnormality in their BERA response, while those having diabetes for > 5 years, the duration of absolute latency in wave III and V had increased by 0.3 ms, as compared to the control group.

On analysis of BERA parameters according to level of fasting blood glucose in patients with type 2 diabetes mellitus, a positive correlation between the fasting blood glucose levels and lengthening of latency in BERA was observed. Similar findings were reported by Pessine et al[11] and Chaudhary S et al[12] who also deduced to the same conclusion. In contrary to our findings Sharat Gupta et al[13] and Donald MW et al[14] found no correlation between the fasting blood glucose levels and BERA parameters. Thus from the above mentioned findings, we would recommend further evaluation by similar trials.

Though our study is by no means exhaustive, it does provide a glimpse about the effect of type 2 diabetes mellitus on hearing, which brings about changes in BERA parameters.

Thus BERA can be of clinical importance for the type 2 diabetes, as it may reflect the degree of neural affection in the auditory pathway and may alert the patients for adequate glycemic control, which can resist the neuropathic progression any further.

As diabetes is rampant in our country, it is necessary to consider the "hearing status as a long term complication of diabetes". It is recommended to perform an audiometric test initially on all the diabetic patients and to keep this as an "initial record of auditory examination of patients".

Also, performing this test on a regular basis could help the physician to up-date their record of the hearing status of the patients as well as to give the necessary guidance in regard to the control of diabetes to them.

CONCLUSION

Our study indicates that it is important to have a good glycemic control in patients with diabetes, in order to avoid involvement of auditory nerve and further ascending auditory pathways resulting in hearing impairment. In our opinion, BERA is an important investigation and it should be included in the protocol for evaluation of a patient having type 2 diabetes mellitus. This will further help in understanding the progression and reducing the morbidity of diabetic patients.

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