Original Research Article

Assessment of brainstem auditory evoked potential in patients with type 2 diabetes mellitus and its correlation with glycemic control

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Abstract

Background: In this study we tried to assess the effect of type II diabetes mellitus on brainstem by recording brainstem auditory evoked potential and compare these findings with age and sex matched healthy individuals. Apart from this, we tried to assess the effect of glycemic control over brainstem in type II diabetic patients. **Materials & Methods:** It was a hospital based descriptive cross sectional study. In this study 50 diabetic subjects of more than 30 year age group were selected from the Diabetic Clinic of Medicine OPD of Bankura Sammilani Medical College from November 2017 to August 2018 by using convenience sampling. The age & sex matched 50 healthy individuals were also selected from hospital and departmental staffs and from the people attending general Out Patient Department (OPD) of Bankura Sammilani Medical College as control subjects. HbA1C level were measured once in diabetic group during this study. The HbA1C level was used for determination of correlation of HbA1C level with different parameters of BAEP in diabetic group. The HbA1C level was also used for determination of efficacy of diabetic control over brainstem involvement, for that reason the subjects in the diabetic group was divided into two sub- groups: HbA1C level < 7 % and HbA1C level > 7%. **Results:** Latencies of different waves are more in Diabetic patients than control, though significant differences were present in latencies of wave III and V. Interpeak latencies are more in diabetic patients than control group and significant differences are present in interpeak latencies of I –III and I –V. Latency of wave I is more in diabetic on OHA than Diabetics on Insulin and OHA, though there was no significant difference between two. Inter-peak latencies of I-III and I-V are more in diabetic on OHA and the results were significantly different. **Conclusion:** BAEP is non-invasive method of detection of CNS involvement even without symptoms. It can be used as screening of all type 2 DM patients to detect neuropathy even before appearance of symptoms. Insulin may have a role in prevention of CNS involvement

Keywords: Diabetes mellitus, brainstem auditory evoked potential (BAEP), glycemic control

Introduction

Diabetes Mellitus (DM) is one of the most frequent metabolic diseases which cause major and minor complications in many organs of different systems of human body like – cardiovascular system, eye and central nervous system. Brainstem is one of the most important part of central nervous system as it consists of different cranial nerve nuclei & several pathways of sensory and motor tracts, therefore early detection of its involvement in a diabetic individual may lead to early treatment & less subsequent morbidity and mortality. The integrity of neuronal brainstem and eighth nerve activity can be easily judged by assessment of brainstem auditory evoked potential (BAEP) as it is a simple, non-invasive and less expensive test [1, 2]. Many studies have been performed on this similar topic but none of these were able to give authentic & original result regarding the effect of glycemic control over the brainstem involvement in a diabetic individual.

Aims: In this study we tried to assess the effect of type II diabetes mellitus on brainstem by recording brainstem auditory evoked potential and compare these findings with age and sex matched healthy individuals. Apart from this, we tried to assess the effect of glycemic control over brainstem in type II diabetic patients.

Objectives

- To assess different BAEP waves in patient of Type II DM
- To compare the different waves in patient of type II DM with age and sex matched healthy control
- To assess the effect of glycemic control on different BAEP waves

Materials & Methods

It was a hospital based descriptive cross sectional study. In this study 50 diabetic subjects of more than 30 year age group were selected from the Diabetic Clinic of Medicine OPD of Bankura Sammilani Medical College from November 2017 to August 2018 by using convenience sampling.The age & sex matched 50 healthy individuals were also selected from hospital and departmental staffs and from the people attending general Out Patient Department (OPD) of Bankura Sammilani Medical College as control subjects. The study was carried out after receiving ethical clearance from Institutional Ethics Committee and written informed consent from each subject in Bengali language.

Inclusion Criteria: Age more than 30yrs, duration of diabetes mellitus more than 5 yrs from the time of diagnosis, fasting blood sugar (FBS) more than 126 mg/dl according to American Diabetes

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Association (ADA) and 2 hrs plasma glucose during and oral Glucose tolerance test (GTT) more than 200 mg/dl[3]

Exclusion criteria: History of ear disease, stroke and head injury, exposure to prolonged loud noise, and intake of ototoxic drugs

Measurement of Blood parameters: HbA1C level were measured once in diabetic group during this study. The HbA1C level was used for determination of correlation of HbA1C level with different parameters of BAEP in diabetic group. The HbA1C level was also used for determination of efficacy of diabetic control over brainstem involvement, for that reason the subjects in the diabetic group was divided into two sub- groups: HbA1C level < 7 % and HbA1C level > 7%. In Pathology Lab the value of HbA1C level were measured by IEC methods (Immuno electro chromatographic method).

Recording of Brainstem Auditory Evoked Potentials:The evoked potential (EP) recordings from the scalp of the subjects were done using RMS EMG EP MK 2 equipment. Silver- silver chloride disk electrodes were used to record the EP from standard scalp locations of the 10-20 international system. Cz (Active Electrode), Fz (Ground Electrode) & A1, A2 electrodes were placed (Reference Electrode) after cleaning the scalp or skin site with alcohol followed by use of skin preparation gel & EEG paste Elefix TM. Electrode impedance was set at less than 5 KΩ [4].The subjects were instructed to close their eyes to avoid blink artifacts. All subjects & controls were tested under similar Laboratory conditions. They were made familiarized to the experimental & environmental conditions of the laboratory.

About 1000 click stimuli at the rate of 10 Hz with duration of 0.1 ms were delivered through shielded headphones. Stimulus intensity was kept at 65dB above hearing threshold. White noise at 40dB was given for masking to the contralateral ear was given. Signals were filtered with band pass 100 Hz and 3 KHz & averaged to 1000 stimuli. Peak latencies of all the waves, inter-peak latencies of I-III, III-V & I-V & Amplitudes of wave I, V was determined for each ear separately with the help of digital cursor. The amplitude was measured as the maximum height of the peak from the succeeding trough [5, 6].

Statistical Analysis: The data obtained were analyzed using SPSS 17th version software. The average of Left & Right ear were taken & analyzed. The statistical analysis for the comparison between Diabetic & control group was done using Unpaired 't' test. Results are expressed as mean ± SD.

Results

Table 1: Comparison of anthropometric parameters between Diabetic and control group

Different categories	Diabetic (50)	Control (50)	P value
	Mean ± SD	Mean ± SD	
Age	43.8± 10.73	35.4 ±10.33	0.199
Height	155 ± 7.48	164.2 ± 9.75	0.189
Weight	58 ± 12.51	73 ±10.05	0.130

In this study a total 50 type II diabetic subjects were included [Table 1].

Table 2: Comparison of absolute latencies of different waves of BAEP between diabetic and control group

Absolute latency	Diabetic group [Mean ± SD]	Control group [Mean ± SD]	P value
Wave I	1.92 ± 0.22	1.79 ± 0.23	0.544
Wave II	2.88 ± 0.15	2.80 ± 0.20	0.540
Wave III	4.05 ± 0.17	3.62 ± 0.17	0.026*
Wave IV	4.75 ± 0.17	4.81 ± 0.26	0.621
Wave V	5.89 ± 0.19	5.64 ± 0.27	0.039*

Latencies of different waves are more in Diabetic patients than control, though significant differences were present in latencies of wave III and V [Table 2].

Table 3: Comparison of Inter peak latencies of BAEP between Diabetes mellitus patients and control group

Inter peak latency	Diabeteics Mean ± SD	Control Mean ± SD	P value
I - III	2.28 ± 0.22	1.82 ± 0.17	0.042
I -V	4.73 ± 0.39	3.79 ± 0.10	0.008
III - V	1.87 ± 0.19	1.87 ± 0.16	0.984

Interpeak latencies are more in diabetic patients than control group and significant differences are present in interpeak latencies of I –III and I –V [Table 3].

Table 4: Comparison of latency of different waves and level of HbA1C

Waves	Correlation of different wave latency with HbA1C (r)
Wave I Latency	-0.49376
Wave I Latency	0.339479
Wave III Latency	-0.65384
Wave IV Latency	0.195725
Wave V Latency	0.674018
Wave I-III IPL	-0.27237
Wave I-V IPL	-0.36431
Wave III-V IPL	0.291828

Table 5: Comparison of latencies between Diabetic on oral hypoglycemic agents (OHA) and diabetics on insulin and oral hypoglycemic agents (OHA)

Latency	Diabetics on OHA	Diabetics on insulin and oral hypoglycemic agents (OHA)	p
III	4.14 ± 0.16	3.61 ± 0.53	0.216
V	5.4 ± 0.24	5.77 ± 0.32	0.851
I – III IPL	2.39 ± 0.14	1.54 ± 0.31	0.013
I – V IPL	4.97 ± 0.26	4.38 ± 0.23	0.027

Latency of wave I is more in diabetic on OHA than Diabetics on Insulin and OHA, though there was no significant difference between two. Inter-peak latencies of I-III and I-V are more in diabetic on OHA and the results were significantly different [Table 4, 5].

Discussion

The study was conducted between 50 diabetic patients of age range of 35 to 52 (43.8± 10.73) , having history of diabetes for more than 5 years and fasting and post-prandial blood glucose of 126 and 200

mg/dl respectively and 50 age and sex matched control subjects (35.4 ± 10.33) maintaining inclusion and exclusion criteria. In this study latencies of different waves were more in Diabetic patients than control, though significant differences were present in latencies of wave III and V (0.026 and 0.039 respectively).Inter-peak latencies were more in diabetic patients than control group and significant differences were present in inter-peak latencies of I –III and I –V (0.042 and 0.008 respectively).In this study latencies of all waves except wave IV were more than control group and significant differences were present in latencies of wave III and V (0.026 and 0.039 respectively). This is also supported by a study conducted by Zehra Abdülkadiro¤lu where they found significant differences in latencies of wave I, III and V [2]. Rahul Gupta et al also found significant difference in wave III and V latencies in their study [7]. Sharat Gupta et al showed significant differences in latencies of wave III and V of diabetics and control group [8].There was a meaningful association between latency of wave III (p=0.012), IV (p=0.023), V (p<0.0001) as shown by Mahnaz Talebi et al in 2008 [1]. In a study by Li Chen et al, increased wave V latency was observed along with increased inter-peak latency of I-V [9]. Our study showed significant difference in inter-peak latency of I-III (p=0.035) and III-V (p=0.003) in the diabetic when compared to control group which was supported by findings of a study by Mahnaz Talebi et al in 2008 [1]. Rahul Gupta et al showed a significant difference in I-III, III-V and I-V inter-peak latencies[7].Zehra Abdülkadiro¤lu et alshowed significant difference in inter-peak latencies of I-III, I-V and not of III-V in their study and control group[2]. Fidele D et al showed significant difference in I-V latency in diabetic patients than control group which we did not observe [10]. The prolongation of I, III and V wave latencies. Inter-peak latencies of I-III prolongation indicate disturbance in pathway from VIIIth nerve to Superior Olive nucleus and prolonged I-V indicate brainstem involvement. There was no change in inter-peak latency of III-V which is also supported by other study [2]. So, these BAEP findings of our study might indicate involvement in peripheral as well as central pathway of VIIIth nerve due to diabetes. Diabetic neuropathy could be the reason for this finding. Our study revealed a positive correlation (+0.67) of HbA1C level with only wave V latency and with no other waves. This is also supported by previous studies by DPG Purwa Samatra et al and Mahnaz Talebi et al [1, 11]. The study also revealed that there were significant difference of inter peak latencies of wave I-III (0.013) and I-V (0.027) among patients treated with only oral hypoglycemic agent and patient on OHA and Insulin therapy. 80% of cases were on OHA only and 20% were on both OHA and Insulin. There is practically no data available in this aspect. A study M. Vijaylakshmi and Sarat Gupta et al showed that no significant difference in BAEP findings exist in patients with duration and blood sugar level in diabetic patients but there is no study regarding the effect of insulin on control of blood sugar level and prevention of neuropathy [8, 12]. So from above findings it can be said that lengthening of different waves and inter-peak latencies found in this study could be due to diabetic involvement of peripheral as well as central neural pathway of hearing even in absence of any clinical signs.

Conclusion

To conclude it can be said that BAEP is non-invasive method of detection of CNS involvement even without symptoms. It can be used as screening of all type 2 DM patients to detect neuropathy even before appearance of symptoms. Insulin may have a role in prevention of CNS involvement

Limitations

Sample size was small in our study. BAEP study findings could have been correlated with MRI and peripheral nerve conduction velocity findings to get better results.

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