Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

A Comparative Study of Brainstem Evoked Response Audiometry in Patients with Diabetic Neuropathy and Retinopathy.

M. Vijayalakshmi[1], Heber Anandan[2]

[1]Associate Professor, Thoothukudi Government Medical College, Tamilnadu, India.
[2]Senior Clinical Scientist, Dr.Agarwal's Healthcare Limited, Tamilnadu, India.

Received: February 2018
Accepted: February 2018

Copyright: © the author(s), publisher. It is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Diabetes mellitus (DM) causes pathophysiological changes at multiple organ system. With evoked potential techniques, the brain stem auditory response represents a simple procedure to detect both acoustic nerve and central nervous system pathway damage. Aim: To find the evidence of neuropathy and retinopathy in diabetes patients by analyzing brainstem audiometry electric response obtained by auditory evoked potentials. **Methods:** The study was carried out on 28 diabetic patients both insulin requiring and oral hypoglycemic agents. Patients were divided into 2 groups, with neurological disorder and without neurological disorder. **Results:** 14 patients were male (Mean age: 45 yrs) and 14 female (Mean age: 41.2 yrs). The duration of illness since diagnosis, ranged from 5 years – 20 years. There was no significant change in nephropathy whereas in patients without retinopathy the amplitude and interpeak latency in wave III and V showed significant change. **Conclusion:** BERA is a simple, non-invasive procedure to detect early impairment of acoustic nerve, and CNS pathways, even in the absence of specific symptoms. This study suggests that if BERA is carried out in diabetic patients; involvement of central neuronal axis can be detected earlier.

Keywords: Auditory brainstem response, brainstem evoked response audiometry, diabetes mellitus.

INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia, resulting from defects in insulin secretion, (Type I) insulin action (Type II) or both. Diabetes mellitus has become a global epidemic. The chronic hyperglycemia of diabetes is associated with long term damage, dysfunction and failure of various organs.[1] Recognizing the earliest alteration of nerves, eyes, kidneys or blood vessels from diabetes may be important information useful for setting diagnostic criteria for diabetes and also to understand the pathophysiologic derangement of diabetes complications and adverse outcomes and developing preventive treatments. Although a connection between diabetes mellitus and peripheral nerve dysfunction has been recognized for hundreds of years, it is only since Marchal de Calvi's observations in 1864, that neuropathy was accepted as a consequence rather than a cause of diabetes.[2] Neuropathy is the most precocious and frequent large complication of diabetes mellitus, leading to great morbidity and mortality and resulting in a huge economic burden for care of the patient with diabetes mellitus. It is the most common form of neuropathy in the developed countries of the world, accounts for more hospitalizations than all the other diabetic complications combined, and is responsible for 50% to 75% of non traumatic amputation.[3-5] Diabetes affects nearly every organ system, and peripheral nerve involvement is common. Depending on the definition of neuropathy and the method of detection used, abnormalities in peripheral nerve are present in 20% to 67% of people with diabetes, though the prevalence of symptomatic neuropathy in people with diabetes is not well established. All the clinical and diagnostic studies on diabetic neuropathy have concerned only peripheral and autonomic nerve impairment very few data exist on the involvement of the central nervous system (CNS) in diabetics. All the clinical and diagnostic studies on diabetic neuropathy have concerned only peripheral and autonomic nerve impairment very few data exist on the involvement of the central nervous system (CNS) in diabetics.[7,8] The impact of the diabetes on the central nervous system (CNS) has gained much attention in the last few years. The clinical manifestations of central diabetic neuropathy are late in onset and non specific for example of the

Name & Address of Corresponding Author
Dr. M. Vijayalakshmi
Associate Professor,
Thoothukudi Government Medical College,
Tamilnadu,
India.

oculomotor nerve, facial nerve and sensory neural hearing loss. The exact evidence of central diabetic neuropathy in subclinical phase is unclear due to the difficulty in detecting latent electrophysiological disturbances in the central nervous system. Electro physiological studies are probably the most sensitive tools to detect sub clinical encephalopathy and describe early abnormalities. The early, short latency evoked potentials (Eps) obtained following the stimulation of the sensory modalities for vision (Visually Eps {VEPs}) and audio [Brainstem auditory Evoked potentials (BAEPs)] principally reflect activity generated in an afferent pathway and its primary receiving area in the brain.[9,10]

Aim

The objective was to find the evidence of neuropathy and retinopathy in diabetes patients by analyzing brainstem audiometry electric response obtained by auditory evoked potentials

MATERIALS AND METHODS

The study was carried out on 28 diabetic patients both insulin requiring and oral hypoglycemic agents. Informed consent was obtained from all participants. Patients were divided into 2 groups, with neurological disorder and without neurological disorder. Exclusion Criteria: Patients were excluded if they suffered from any concurrent disease that might affect the brain or the nervous system. Such as Uremia due to nephropathy; if they were on hemodialysis, If they showed ketoacidosis or hypoglycemia on the day of assessment, If they were judged at the clinic to be morbidly obese, If they had a positive pregnancy test, The patients in the sample were not on methyldopa, nitrofurantoin, reserpine, or any medication that might be expected to interface with the functioning of the central nervous system or to produce peripheral neuropathy, If the patient was febrile.

RESULTS

Their ages ranged from 30-60 years. 14 patients were male (Mean age: 45 yrs) and 14 female (Mean age: 41.2 yrs). The duration of illness since diagnosis, ranged from 5 years – 20 years. There is no significant difference between demographic characters of controls and cases. There was no significant change in nephropathy whereas in patients without retinopathy the amplitude and interpeak latency in wave III and V showed significant change. An evaluation of the extent and mechanism of damage of the central nervous system in diabetes mellitus is of high value in current neurological research. Electrophysiological abnormalities are frequently present is completely asymptomatic diabetes mellitus (DM) patients. Central and peripheral neuropathies in DM are not related to the duration of the disease or to the degree of hyperglycemia and metabolic control.

Table 1: Comparison between Results (BAER) With Nephropathy and Without Nephropathy.

Wave			Nephropathy		Without Nephropathy		P value
			Mean	SD	Mean	SD	
Amplitude	I	+	112.33	84.39	78.26	95.11	0.325
		-	72.97	88.20	144.42	129.50	0.099
	III	+	99.21	71.69	78.92	43.66	0.374
		-	80.30	59.96	156.44	71.91	0.005
	V	+	5.90	0.23	5.78	0.18	0.136
		-	248.79	125.31	24.33	81.86	<0.0001
Absolute Latency	I	+	1.77	0.24	1.75	0.08	0.769
		-	4.02	0.19	3.86	0.27	0.081
	III	+	3.81	0.31	3.87	0.30	0.607
		-	4.02	0.19	3.86	0.27	0.081
	V	+	5.90	0.23	5.78	0.18	0.136
		-	5.97	0.40	5.98	0.32	0.942
Interpeak Latency	I-III	+	2.05	0.13	2.05	0.34	1.000
		-	2.25	0.17	2.29	0.76	0.849
	III-V	+	2.09	0.22	1.91	0.30	0.081
		-	1.95	0.30	2.12	0.10	0.054
	I-V	+	4.14	0.15	4.03	0.22	0.134
		-	4.21	0.28	4.41	0.75	0.358

Table 2: Comparisons between Results (BAER) With Retinopathy and Without Retinopathy.

Wave			Retinopathy		Without Retinopathy		P value
			Mean	SD	Mean	SD	
Amplitude	I	+	93.78	67.71	112.30	106.79	0.588
		-	91.80	101.35	129.29	138.43	0.421
	III	+	114.28	71.92	103.07	36.91	0.608
		-	71.36	55.40	154.09	92.44	0.008
	V	+	257.48	59.03	263.31	138.33	0.885
		-	258.81	119.37	240.47	82.02	0.639
Absolute Latency	I	+	1.74	0.22	1.77	0.18	0.696
		-	1.79	0.21	1.74	0.26	0.580
	III	+	3.81	0.31	3.96	0.27	0.183
		-	4.00	0.22	3.78	0.25	0.020
	V	+	5.96	0.36	5.92	0.27	0.742
		-	5.92	0.31	5.90	0.32	0.867
Interpeak Latency	I-III	+	2.07	0.17	2.37	0.88	0.221
		-	2.21	0.19	2.04	0.18	0.022
	III-V	+	2.15	0.30	1.96	0.26	0.052
		-	1.92	0.20	2.13	0.12	0.00

							2
	I-V	+	4.22	0.27	4.39	0.89	0.500
		-	4.14	0.18	4.17	0.19	0.671

DISCUSSION

BAEP represents the electrical events generated along the auditory pathway. Thus, BAEP evaluation is able to detect the early impairment of brainstem function. Delay of BAEP waves in diabetic patients has been reported previously. Khardori et al.[11] and Parving at al.[12] found deviations in latency interval I-V but not in the latency of wave I. Other authors demonstrated that diabetic patients are characterized by an impairment in latency values of all major components of BAEP.[13,14] The amplitude values were generally, but not significantly , reduced.

Reske Neilson et al., and Makishima et al., showed degenerative abnormalities of the brain tissue and atrophy of the spiral ganglion of the cochlea in patients of DM,[15,16] thereby, suggesting the presence of central neuropathy. Based on histological findings, they concluded that microangiopathy of the stria vascularis was the main causative factor leading to central neuropathy in these patients.[17] Makishima and Tanaka had noticed that in patients with type-2 diabetics spiral ganglia in basal to middle turn of the cochlea tends to get atrophied along with the demyelination of the eighth cranial nerve.[16] Ren and Zhao reported hearing loss in middle aged diabetic patients.[18]

In diabetics, Martini et al., observed a significant correlation ($p<0.05$) between I-V interval shift and EMG proved reduction in motor conduction velocity of the peroneal nerve. They also found a high incidence of ABR impairment (53%) in diabetics with cardiovascular autonomic failure.[19] Martini A et al., observed a significant correlation between I-V interval shift and motor conduction velocity of peroneal nerve through our study did not show any correlation.[19]

CONCLUSION

BERA is a simple, non-invasive procedure to detect early impairment of acoustic nerve, and CNS pathways, even m the absence of specific symptoms. This study suggests that if BERA is carried out in diabetic patients; involvement of central neuronal axis can be detected earlier. So we strongly recommend that BERA should be done in all patients with diabetic mellitus.

REFERENCES

1. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus . Diabetes Care. 2009;32(Suppl 1):S62-S67. doi:10.2337/dc09-S062.
2. Marchal de, Calvi. Recherches sur les accidents diabetiques. P Asselin, Paris; 1864.
3. Sharma R, Gupta SC, Tyagi I, Kumar S, Mukherjee K, Brain stem evoked responses in patients with diabetes mellitus Indian J Otolaryngol Head Neck Surg 2000 52(3):223-29.
4. Alvin C Powers, Editors: Fauci AS, Braunwald E, Isselbacher KJ, Wilson JD, Martin JB, Kasper DL, et al. Diabetes Mellitus In Harrison's Principles of Internal Medicine 2005 vol 216th editionNew YorkThe McGraw-Hill, health professions division:2152-180.
5. Reske-Nielsen E, Lundbaek K, Rafaelsen OJ, Pathological changes in the central and peripheral nervous system of young long-term diabetics: I. Diabetic encephalopathy Diabetologia 1966 1(3-4):233-41.
6. Makishima K, Tanaka K, Pathological changes of the inner ear and central auditory pathways in diabetics Ann Otol Rhinol Laryngol 1971 80:218-88.
7. Durmus C, Yetiser S, Durmus O, Auditory brainstem evoked responses in insulin-dependent (ID) and non-insulin-dependent (NID) diabetic subjects with normal hearing International J of Audiology 2004 43(1):29-33.
8. Tóth F, Várkonyi TT, Kiss JG, Rovó L, Lengyel C, Légrády P, Brainstem auditory evoked potential examinations in diabetic patients Scandinavian Audiology 2001 30:156-59.
9. Virtanierni J, Laakso M, Nuutinen J, Karjalainens. Quoted by Booth JB Scott Brown's otolaryngology 1997 Vol 36th edButterworths, London:95
10. Verma A, Bisht MS, Ahuja GK, Involvement of central nervous system in diabetes mellitus Journal of Neurology, Neurosurgery and Psychiatry 1984 47:414-16.
11. Khardori R, Soler NG, Good DC, et al. Brainstem auditoryand visual-evoked potentials in type I (insulin-dependent) diabetic patients. Diabetologia 29:362-365 , 1986.
12. Parving A, Elberling C, Balle V, et al. Hearing disorders in insulin-dependent diabetes mellitus. Audiology 29: 113-121,1990.
13. Fedele 0, Martini A, Cardone C, et al. Impaired auditory brain stem-evoked responses in insulin-dependent diabetic subjects. Diabetes 33:1085- 1089, 1984.
14. Martini A, Fedele 0, Comacchio F, et al. Auditory brainstem-evoked responses in clinical evaluation of diabetic encephalopathy . In C Morocutti , PA Rizzo (eds), Evoked Potentials. Neurophysiological and Clinical Aspects. Amsterdam: Elsevier Science, 1985:231 - 235.
15. Reske-Nielsen E, Lundbaek K, Rafaelsen OJ, Pathological changes in the central and peripheral nervous system of young long-term diabetics: I. Diabetic encephalopathy Diabetologia 1966 1(3-4):233-41.
16. Makishima K, Tanaka K, Pathological changes of the inner ear and central auditory pathways in diabetics Ann Otol Rhinol Laryngol 1971 80:218-88.
17. Siddiqi SS, Gupta R, Aslam M, Hasan SA, Khan SA, Type- 2 diabetes mellitus and auditory brainstem response Indian J Endocrinol Metab 2013 17(6):1073-77.
18. Ren J, Zhao P, Chen L, Xu A, Brown SN, Xiao X, Hearing loss in middle-aged subjects with type 2 diabetes mellitus Arch Med Res 2009 40(1):18-23.
19. Martini, A., Comacchio, F., Fedele, D., Crepaldi, G., Sala, O. Auditory brainstem evoked responses in the clinical evaluation and follow-up of insulin-dependent diabetic subjects. Acta Otolaryngol. 1987;103:620–627.

How to cite this article: Vijayalakshmi M, Anandan H. A Comparative Study of Brainstem Evoked Response Audiometry in Patients with Diabetic Neuropathy and Retinopathy. Ann. Int. Med. Den. Res. 2018; 4(2):EN10-EN12.

Source of Support: Nil, **Conflict of Interest:** None declared