

Study of brainstem auditory affection in Diabetic Patients

Thesis

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دراسة تمهيدية توطئة للحصول علي درجة الماجستير في الأمراض العصبية والنفسية

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Abstract

Diabetic community is vast enough, giving researchers a very good reason to explore more in their world. One of their rarely probed complications is brainstem dysfunction. In this study, we investigated brainstem auditory evoked potential studies (BAEPs) in diabetic patients, as well as its associations with diabetic complications, especially diabetic microangiopathy. Our study was conducted on 40 diabetic patients having type I or type II. They were classified into two groups; group I (< 5 years duration of illness) and group II (> 5 years duration of illness). Their ages ranged from 20 to 59 years. The patients were examined clinically, neurologically and electrophysiologically. Brainstem auditory evoked potential studies, nerve conduction studies and flash electroretinography were performed to all patients. Urine analysis, instantaneous random blood sugar and funduscopy were also performed for patients. The brainstem auditory evoked potential studies of patients were compared to values of 30 normal subjects and their ages ranged, also, from 20 to 59 years. The diabetic patients experience brainstem dysfunction early in their disease course (before 5 years duration of the illness) that is increased as the disease duration increases. This dysfunction is evident by significant delay of wave V in diabetic patients as compared to normal individuals. Later, after 5 years duration of the illness, delay of wave III, further delay of wave V, prolongation of I-V IPL and decrease in amplitude of wave V occur. Diabetes type, I or II, has no different effect on BAEPs results.

Microangiopathic complications (retinopathy and nephropathy) are associated with increasing hearing threshold in diabetic patients, mainly after 5 years duration of the illness. Wave III is significantly delayed in presence of diabetic retinal affection; functionally and by funduscopy. Also, wave V is significantly delayed, in patients

with abnormal skin and peripheral nervous system manifestations. In addition, wave V latency and III-V IPL are prolonged in patients having cardiovascular affection symptoms and postural hypotension. Finally, in patients with sweating abnormalities, wave I amplitude is significantly increased.

So brainstem dysfunction occurs early in the course of diabetes (type I and II similarly) and it is further affected by its duration. It starts by affection at the midbrain level (inferior colliculus) then proceeds by time to lower levels; caudal pons (cochlear nucleus). Also, as diabetic microangiopathic complications occur, hearing threshold increases. Retinopathy is accompanied with brainstem disintegration, at the caudal pons level. In three situations, we questioned the occurrence of similar pathogenesis theories, intracranially and extracranially. First, diabetic patients, with abnormal skin or peripheral nervous system manifestations, experience midbrain dysfunction (in the vicinity of the inferior colliculus) as well. The presumed theory is microvascular or, less likely, autoimmune affection. Second, diabetic patients with cardiovascular affection symptoms and postural hypotension show retrocochlear dysfunction. The doubted theory is macrovascular affection.

Finally, diabetic patients with sweating abnormalities show evidence of affection of olivocochlear bundle. The probable theory is small fiber neuropathy.

Keywords: Microangiopathic – Retinopathy – Nephropathy – Diabetic community

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List of abbreviations

ABR	Auditory Brainstem Response
ADP	Adenosine Di-Phosphate
AGEs	Advanced Glycation Endproducts
ATP	Adenosine Tri-Phosphate
AST	Aspartate transaminases
BAEP	Brainstem Auditory Evoked Potentials
CMAP	Compound Motor Action Potential
CTT	Central Transmission Time
DCCT	Diabetes Control and Complication Trial
dB	deci-Bels
DKA	Diabetic Ketoacidosis
DM	Diabetes Mellitus
DNA	Deoxy Ribo Nucleic acid
FPG	Fasting Plasma Glucose
GAD	Glutamate Decarboxylase
GAPDH	Glut-Amide Phosphodehydrogenase
HbA1c	glycoselated Heamoglobin A1c
IAA	Insulin Autoantibodies
IC	Inferior Colliculus
ICA	Islet Cell Antibodies
IDDM	Insulin Dependent Diabetes Mellitus
IPL	Inter Peak Latency
LADA	Latent Autoimmune Diabetes of the Adult
LL	Lateral Leminscus
MGB	Medial Geniculate Body
MI	Myocardial Infarction
MNCS(s)	Motor Nerve Conduction Study (ies)
MODY	Maturity Onset Diabetes of the Young
msec	Milli second
NAD	Nicotine-Amide Adenine Di-nucleotide
NCS(s)	Nerve Conduction Study(ies)
NCV(s)	Nerve Conduction Velocity(ies)
nHL	normal Hearing Level
NOS	Nitric Oxide synthase

PTN	Posterior Tibial Nerve
PTT	Peripheral Transmission Time
SD	Standard Deviation
SNAP	Sensory Nerve Action Potential
SNCS(s	Sensory Nerve Conduction Study(ies)
SNCV	Sensory Nerve Conduction Velocity
SOC	Superior olivary complex
μV	Micro-Volt

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Introduction

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia, which is a result of alteration in the secretion and or action of insulin Type 1 DM is due to pancreatic islet Beta cell destruction predominantly by an autoimmune process, and these patients are prone to ketoacidosis (DKA). Type 2 DM is the more prevalent form and results from insulin resistance with a defect in compensatory insulin secretion (**Tahrani et al.,2011**).

Neuropathy is one of the most frequent complications of DM. Diabetic neuropathy can usually be detected as autonomic and peripheral nerve impairment in the early period of DM (Clements et al, 2008); however, data in the literature have demonstrated the involvement of the central nervous system in diabetic patients (**Donald et al., 2002**).

Brainstem auditory evoked potentials (BAEPs) or auditory brainstem response (ABR) are small electrical voltage potentials which are recorded in response to an auditory stimulus from electrodes placed on the scalp. They reflect neuronal activity in the auditory pathway. ABR can be used to trace the signal generated by a sound through the ascending auditory pathway. The evoked potential is generated in the cochlea, goes through the cochlear nerve, through the cochlear nucleus, superior olivary complex, lateral lemniscus, to the inferior colliculus in the midbrain, on to the medial geniculate body, and finally to the cortex. (**Baran., 2007**) .

BAEPs is a simple, non-invasive procedure for detecting subclinical impairment of the auditory pathway and can be used for analyzing the influence of diabetic neuropathy on the auditory system.

Aim of the study

The aim of this study is to evaluate the hearing function in homogenous group of diabetic patients:-

- 1- To assess the usefulness of auditory brainstem response (ABR) in the early detection of subclinical pathological changes in the auditory pathway in diabetic patients.
- 2- To detect possible correlation between alteration of the auditory brainstem function and peripheral neuropathy as other clinical manifestations of DM.

Review of Literature