Research Paper Physiology

The effect of Duration of Diabetes Mellitus on Choice Reaction Times (Visual and Auditory) in adults as a measure of Neurological Deficit

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ABSTRACT

Background: Diabetes mellitus is the most common endocrine disorder. Neurological complications of diabetes are manifold .It is found that sensory perception and motor nerve conduction velocity reduced with increasing duration of diabetes. Reaction time is a simple, non- invasive test to measure the function of sensorimotor association and its measurements might be useful in studying the neurological deficit in diabetics (1). Aim: To study the effect of duration of diabetes on reaction times (visual and auditory).Method: 58males and 42 females aged 30 to 80 years visiting endocrinology OPD formed the study group. Depending upon the duration of diabetes, 3 groups [Group 1(<10yrs), group 2 (10-20yrs) and group 3(>20yrs)] were identified and reaction time measurements taken. Result: A significant increase in reaction times was found with duration of diabetes between 10-20years as compared to other two groups. Conclusion: This study suggests that the reaction times increases with duration of diabetes.

KEYWORDS : Choice reaction time, Diabetes mellitus, Neurological deficit.

INTRODUCTION:

Type II diabetes has become a worldwide epidemic leading to visual and auditory disturbances. The nervous system is so frequently involved in diabetes mellitus that it has been included in the triad of neuropathy, retinopathy and nephropathy. Diabetic neuropathies comprise a polymorphous group of disorders ranging from those characterized by acute onset and reversibility to those characterized by insidious onset, continuous progression and complete irreversibility. Therefore, a need has arisen to detect neuropathies before they are clinically diagnosed. Severity of diabetic neuropathy is related to duration of diabetes and degree of glycemic control [(2)].

Diabetes has also shown to affect peripheral nerves in the somatosensory [(3)] and auditory system [(4)], slowing of psychomotor responses [(5)], and cognitive effects, all of which affecting reaction times [(6)].

While it has been demonstrated that affection of the eyes and kidneys are due to a specific vascular disorder closely correlated with the duration of the disease, the pathogenesis of the neurological disorders has always been questionable[(7)] . With the aid of neurophysiological investigation methods, it has been possible to obtain quantitative expressions of the nerve functions and in numerous cases to reveal sub- clinical signs of nervous disorder.

Reaction time (RT) is the time that elapses between the presentation of a stimulus which can be of any modalities of sensory input like visual, auditory, pain, touch or temperature and the subsequent behavioral motor response. Auditory and visual reaction times is considered as an ideal tool for measuring sensory motor association and is considered as an indirect index of processing capability of the CNS (speed and accuracy)[(8)]. The aim of the present study is to review the effects of duration of Diabetes Mellitus on the reaction times as a measure of degree of damage to nervous functioning.

AIM: To establish the relationship between the duration of Type II diabetes Mellitus and Choice Reaction times (visual and auditory) in adults as a measure of affliction of nervous system.

MATERIAL AND METHODS: The study was conducted in a tertiary care teaching hospital with approval from the institutional ethics committee.100 patients (58males and 42 females aged 30 to 80 years) confirmed to be suffering from Type II Diabetes Mellitus (DM) visiting Endocrinology OPD formed the study group. An informed written consent was taken from all patients. Depending upon duration of diabetes, males and females were divided into 3 groups separately;
Group 1: Duration of diabetes<10years
Group 2: Duration of diabetes between 10 to 20 years and
Group 3: Duration of diabetes >20years.

These patients were screened to rule out the presence of affective disorders like depression and manic state and any other condition that can lengthen the reaction time.

Choice reaction times (visual and auditory) were performed on all the patients with reaction time apparatus (RTM-608). The tests were carried out in a secluded room under similar conditions in sitting position.

To record visual reaction time (VRT), 2 stimuli green and red lights were used. The subjects were not aware of the colour of the light being switched on by the examiner. The examiner switched on the lights randomly and the lights glowed on the subject's side of the panel. The subjects responded by quickly pressing the corresponding button in front of the light. The reaction time was directly read from the digital display in seconds. Three trials were given to each subject and the average of three values was taken for statistical analysis.

To record the auditory reaction time (ART), subjects were trained to differentiate between high and low frequency sounds by placing earphones. Procedure similar to the recording of VRT was followed.

The statistical significance was determined by students unpaired "t" test. p value=0.02 was taken to be statistically significant.

RESULTS:

TABLE NO. 1: CORRELATION OF REACTION TIMES WITH DURATION OF DIABETES IN MALES AND FEMALES.

		Males						Females					
Duration of Diabetes (years)		<10 (n=32)	10-20 (n=18)	Res.	10-20 (n=18)	>20 (n=8)	Res.	<10 (n=23)	10-20 (n=13)	Res.	10-20 (n=13)	>20 (n=6)	Res.
VRT(G)	Mean	0.6924	0.8787	S	0.8787	0.9131	NS	0.6651	0.8919	S	0.8919	0.8828	NS
	SD	0.1122	0.1204		0.1204	0.1998		0.1086	0.1253		0.1253	0.2269	

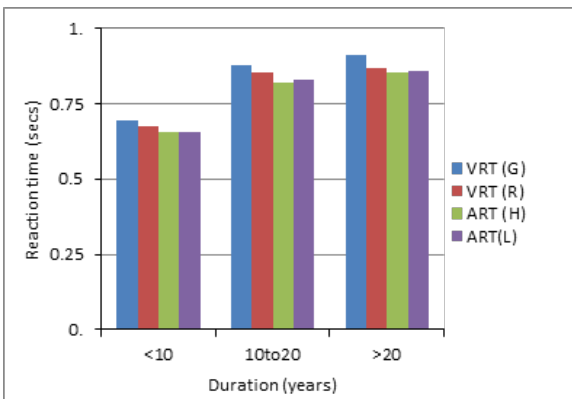
Duration of Diabetes (years)		Males <10 (n=32)	10-20 (n=18)	Res.	10-20 (n=18)	>20 (n=8)	Res.	Females <10 (n=23)	10-20 (n=13)	Res.	10-20 (n=13)	>20 (n=6)	Res.
VRT(R)	Mean	0.6739	0.8533	HS	0.8533	0.8699	NS	0.6496	0.8735	HS	0.8735	0.8226	NS
	SD	0.0114	0.0935		0.0935	0.1662		0.1088	0.1248		0.1248	0.1722	
ART(H)	Mean	0.6533	0.8217	S	0.8217	0.8523	NS	0.6320	0.8514	HS	0.8514	0.7911	NS
	SD	0.1120	0.0839		0.0839	0.1698		0.1099	0.1085		0.1085	0.1557	
ART(L)	Mean	0.6572	0.8285	S	0.8285	0.8578	NS	0.6351	0.8487	HS	0.8487	0.7987	NS
	SD	0.1135	0.0835		0.0835	0.1663		0.1089	0.1128		0.1128	0.1521	

NS- Not Significant, S-Significant, HS-Highly significant.

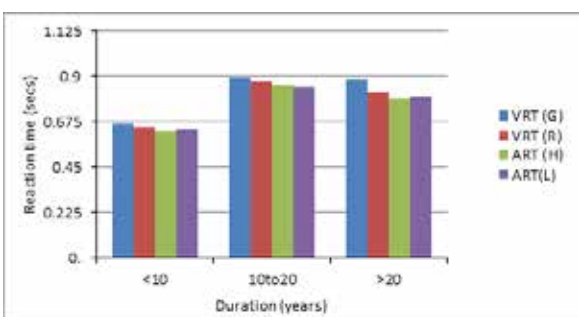
VRT (G) =Visual reaction time (green), VRT(R) =Visual reaction time (red).

ART (H) =Auditory reaction time (high frequency), ART (L) = Auditory reaction time (low frequency).

GRAPH NO. 1: CORRELATION OF REACTION TIMES WITH DURATION OF DIABETES IN MALES



GRAPH NO. 2: CORRELATION OF REACTION TIMES WITH DURATION OF DIABETES IN FEMALES.



DISCUSSION:

This present study was carried with the objective of assessing the effect of the duration of diabetic process on reaction times (auditory and visual). Table 1 showed the comparison of duration of diabetes in males and females and the changes in reaction times. It is seen that duration between 10-20 years of diabetic process significantly increases reaction time as compared to less than 10years of the same. Also more than 20 years of diabetes does not contribute significantly to any further deterioration of reaction time. Probably, this is due to the fact that 20 years of diabetes must have damaged auditory and visual processes to the point that any further damage may not contribute any more to further increase in the reaction times.

The findings of the present study correlate well with the study of Gregerson 1967[7]. He obtained the following results: a) Motor conduction velocity was slower in diabetics than in non-diabetics for every age group. b) Motor conduction velocity decreased with the increasing duration of diabetes, but the change was statistically significant in young patients only.

The findings of our study are in agreement with the investigation on vibration sense by Steiness [9], and the correlation between the duration of diabetes and electromyographic abnormalities as shown by Fagerberg and associates [10]. It was observed that motor conduction velocity was distinctly reduced as easily as the first year after the onset of diabetes.

Thus the above findings suggest that the diabetic disease processes definitely increase the audiovisual reaction time. The probable mechanism leading to this increase is increased oxidative stress, defective myelination, reduced neurotransmitters and involvement of the central neuraxis which in turn is due to association of diabetes with cerebrovascular disease leading to loss of cognitive functions and development of dementia [11, 12].Segmental demyelination is the basic pathological lesion present in the diabetic nerve. This change results in delayed electrical conduction leading to a reduction in motor conduction velocity [13]. As a consequence of longstanding hyperglycemia, a downstream metabolic cascade leads to peripheral nerve injury through an increased flux of the polyol pathway, enhanced advanced glycation end products formation, excessive release of cytokines, activation of protein kinase C and exaggerated oxidative stress [14]. Sparse vascular supply with impaired auto regulation is likely to cause hypoxic damage in the nerve. Such dual influences exerted by long-term hyperglycemia are critical for peripheral nerve damage, resulting in distal-predominant nerve fibre degeneration. The axonal degeneration of both the myelinated and unmyelinated fibres, axonal shrinkage, thickening of the basement membrane and microthrombi formation are responsible for delayed motor nerve conduction and hence, the increased reaction time [15]. Diabetes being a chronic disease may be leading to various types of immune complex related damage to the tissues like the nervous tissue, vascular endothelium, sense organs, glomeruli and tubules of the kidneys etc. This would be an adjuvant mechanism to several other concurrent damaging mechanisms.

CONCLUSION: It is clear that the diabetic process is lengthening the reaction time significantly, beyond whatever the ageing process would, in males and females irrespective of the modality being tested (visual or auditory) affecting the overall working of the various neural pathways. Reaction times may provide additional measures of cognitive functions and increase the accuracy of decisions concerning the extent and presence of brain dysfunction [16].Thus, the reaction times tasks can be used to diagnose and determine the severity of brain damage.

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