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Original Research Article

Comparative Study of Visual Reaction Time in Healthy Controls and Patients with Different Duration of Diabetes Mellitus

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ABSTRACT

Introduction: In chronic Type-II Diabetes Mellitus (T2DM) Peripheral Neuropathy (PN) is one of the most common complications. The severity of Diabetic Peripheral Neuropathy is related to the duration of diabetes and degree of glycemic control. Need has arisen to detect neuropathy earlier before it is clinically visible. Reaction Time has physiological significance and is a simple and non-invasive test for peripheral as well as central neural structures.
Materials and Methods- This study was conducted in Dr Shankarrao Chavan Govt. Medical College Nanded for a period of 6 months on a total of 90 male participants aged between 40-50 years. Among 90 participants, total of 60 type II diabetic male patients were grouped as the study group with a total of 30 male patients with the duration of diabetes from 1-5 years as group-D1 and 30 patients with the duration of diabetes from 5-10 years as group-D2. Remaining 30 non diabetic ages matched male participants were grouped as the control group and visual reaction time was recorded. Reaction time was taken as mean ± standard deviation (SD). Data was collected and statistically analyzed using Graphpad prism software the level of significance was tested by t-test. The observation was taken as significant with P value less than 0.05.
Results- We found that visual reaction time was significantly prolonged in diabetics ($P<0.0001$). The group-D1 diabetics performed significantly better than group-D2 diabetics ($P<0.05$).
Conclusion- We concluded that there is a significant difference in the visual reaction time of diabetics and normal healthy controls. We observed prolonged visual reaction time in diabetics, which increased with the duration of the disease.

Key words: Type II Diabetes Mellitus, Neuropathy, Reaction Time

INTRODUCTION

The number of people with type 2 diabetes is growing rapidly worldwide. India ranked second among top ten countries having highest number of adults with diabetes. [1] Diabetic Peripheral Neuropathy (DPN) is one of the most common complications associated with Diabetes Mellitus. [2] Many workers have demonstrated autonomic dysfunction in diabetic patients. [3-6] Chronic sensory-motor distal symmetric polyneuropathy is the most

common form of DPN. [7] DPN leads to a number of impairments and functional limitations including foot ulceration and subsequent lower-extremity amputation. [7] The severity of Diabetic Peripheral Neuropathy is related to the duration of diabetes and degree of glycemic control. [7,8]

Diabetes Mellitus has been shown to affect peripheral nerves in the somatosensory [9] and auditory system, [10] slows psychomotor responses, [11] all of which may affect reaction times. Reaction time (RT) is the elapsed time 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 response to occur. It is considered to be an index of speed of processing. [12]

In chronic Type-II DM, slowing of reaction time may affect balance leads to probability of slip, fractures, non-healing ulcer which ends in amputation of limbs and disability. [9-11] Need has arisen to detect neuropathy earlier before it is clinically visible. Reaction Time has physiological significance and is a simple and non-invasive test for peripheral as well as central neural structures. [6]

Hence we considered this study to correlate visual reaction time among type II diabetic patients to the duration of diabetes and also to emphasize the importance of assessing visual reaction time in routine clinical examination of type II diabetic patients to reduce the neuropathy related morbidity.

MATERIAL AND METHODS

This study was conducted in Dr Shankarrao Chavan Govt. Medical College Nanded for a period of 6 months on a total of 90 male participants aged between 40-50 years. After getting approval from Institutional Ethical committee & obtained the written consent from the patients, Visual reaction time was studied in patients suffering from type 2 DM and age matched normal control subjects. A total of 60 type II diabetic male patients were grouped as the study group with a total of 30 male patients with the duration of diabetes from 1-5 years as group-D1 and 30 patients with the duration of diabetes from 5-10 years as group-D2. A total of 30 non diabetic age matched male participants were grouped as the control group.

Inclusion Criteria

Study group: A total of 60 type II diabetic male patients with good metabolic control, without any complications. Study group was further divided into Group D1 and Group D2.

Group D1: 30 type II male diabetics, aged 40-50 years, with the duration of the disease 1-5 years.

Group D2: 30 type II male diabetics, aged 40-50 years, with the duration of the disease 5-10 years.

Control group: A total of 30 age matched healthy male participants from the non-teaching staff of our institute.

Exclusion Criteria for (Study Group)

1. Patients on insulin.
2. Duration of diabetes more than 10 years.
3. Alcoholics, smokers, history of hypertension.
4. Clinical evidence of peripheral neuropathy or myopathy.
5. Any pathology or injury to the upper limb.

Visual reaction time was measured by reaction time apparatus specially designed to measure response time in milliseconds. The reaction time was recorded for visual reaction time light stimuli. As soon as the stimuli was perceived by the participant, they responded by pressing the response switch. The display indicated the response time in milliseconds. After familiarizing the participant with the instrument and after repeated practice, three readings for each parameter were noted; the average of the three readings was taken as the value for reaction time task. Data was collected and was statistically analyzed using Graph pad prism software. Reaction time was taken as mean±standard deviation (SD). The level of significance was tested

by students t-test the observation was taken as significant with P value less than 0.05.

OBSERVATION AND RESULT

Table 1: Comparison of Visual Reaction Time in Control and Study Group (Group D1 and D2)

Visual Reaction Time (MSEC)	Control (n=30) (Mean ± SD)	Study Group D1+D2 (n=60) (Mean ± SD)	P value
	222.9 ± 7.968	271 ± 4.294	<0.0001 (Significant)

Table 2: Comparison of Visual Reaction Time in Study Group (Group D1 and D2)

Visual Reaction Time (MSEC)	Study Group D1 (n=30) (Mean ± SD)	Study Group D2 (n=30) (Mean ± SD)	P value
	258.9 ± 6.373	283 ± 4.939	0.0041 Significant

In comparison to the age matched non-diabetic control group, the diabetic subjects showed a significant increase in the RTs. We found that visual reaction time was significantly prolonged in diabetics (P<0.0001). The group-D1 diabetics performed significantly better than group-D2 diabetics (P<0.05).

DISCUSSION

Diabetic Neuropathy is one of the commonest causes of peripheral neuropathy. It accounts for hospitalization more frequently than other complications of diabetes and also is the most frequent cause of non-traumatic amputation. Diabetic autonomic neuropathy accounts for silent myocardial infarction and shortens the lifespan resulting in death in 25%–50% patients within 5–10 years of autonomic diabetic neuropathy. [18,19] In our study we found that the visual reaction time was delayed in the diabetes mellitus group. This finding of our study was in accordance with similar studies done in the past. Madanmohan et al studied Visual and auditory reaction times in patients suffering from diabetes mellitus and age matched normal control subjects. They found that in diabetic patients there was significant prolongation of visual as well as auditory reaction times. [6] Excessive glucose metabolism causes decrease in the Nitric Oxide in nerves that dilates blood vessels, and low levels of Nitric Oxide may lead to constriction of blood vessels supplying the nerves in diabetic patients. [13] Raised blood glucose affects many metabolic pathways in the nerves leading to an accumulation of sorbitol and depletion of myoinositol. These changes impair the nerve's ability to transmit signals. The axonal degeneration of myelinated and unmyelinated fibres, axon shrinkage, axonal fragmentation, thickening of basement membrane, and micro thrombi are responsible for delayed motor nerve conduction velocity and hence the reaction time is delayed in diabetes mellitus group. [14-16]

We also found that VRT in group-D1 diabetics (duration of diabetes 1-5 years) is faster than in group-D2 diabetics (duration of diabetes 5-10 years). Similar study was conducted by Gupta et al to correlate auditory and visual reaction time among type II diabetic patients to the duration of diabetes. They found that both auditory and visual reaction time was significantly prolonged in diabetics and derangements in reaction time are correlated with duration of diabetes. [2] The relation between hyperglycemia and development of severity of neuropathy has been shown in retrospective and prospective studies. A classic study on 4400 diabetic patients who were followed up over 25 years, showed an increase in clinically detectable DN from 12% at the time of diagnosis of diabetes to about 50% after 25 years and those with poorest diabetic control had the highest prevalence. [21] In another study conducted in the UK showed that Neuropathy was associated with duration of diabetes, and was present in 20.8% (19.1-22.5%) of patients with diabetes duration less than 5 years and in 36.8% (34.9-38.7%) of those with diabetes duration greater than 10 years. [22]

Similar study was conducted in Pakistan by Nisar M, Asad A et al they also

showed significant association of diabetic neuropathy and duration of diabetes. [23] Hyperglycemia causes depletion of nerve myoinositol through a competitive uptake mechanism. Moreover, activation of polyol pathway in the nerve through enzyme aldose reductase leads to accumulation of sorbitol and fructose in the nerve and induces non-enzymatic glycosylation of structural nerve proteins. Hyperglycemia also induces oxidative stress. Activation of protein kinase C has been linked to vascular damage in DN. These changes result in abnormal neuronal, axonal, and Schwann cell metabolism, which result in impaired axonal transport. Direct measurement of glucose, sorbitol, and fructose in nerves of diabetic patients showed correlation with the severity of neuropathy. Hyperglycemia also induces rheological changes, which increases endothelial vascular resistance and reduces nerve blood flow. Endoneural hypoxia is produced by increased vascular resistance and reduced blood flow in the nerve. Hypoxia leads to further capillary damage, which in turn aggravates disturbance in axonal transport and reduced Na-K ATPase activity leading to axonal atrophy and impairment of nerve conduction. [20] Due to these influences exerted by long-term hyperglycemia there is exaggerated peripheral nerve damage, resulting in distal-predominant nerve fiber degeneration. [17]

CONCLUSION

In our study we found that delayed visual reaction time in diabetics as compared to normal healthy controls. We also observed a prolonged visual reaction time in diabetics, which affected more as the duration of the disease and showed direct association with duration of diabetes. As derangements in reaction time appears early even without clinical signs and symptoms of diabetic peripheral neuropathy. We conclude that determination of Reaction time may prove a valuable method for determining the severity of neurological derangement and for assessing the effectiveness of therapy in diabetic patients.

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