

Research Article**Comparative Study of Reaction Times in Type 2 Diabetics and Non-Diabetics****Joginder Sidhu^{1*}, Sameer Mittu², Hasrat Sidhu³**¹Associate Professor, Dayanand Medical College and Hospital, Ludhiana, Punjab, India²Intern, Dayanand Medical College and Hospital, Ludhiana, Punjab, India³Final year student, Dayanand Medical College and Hospital, Ludhiana, Punjab, India***Corresponding author**

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Abstract: Reaction time is a reliable indicator of processing of sensory stimulus by central nervous system and its execution in the form of a motor response. There are very few studies showing the effects of diabetes on the processing of signals and also on peripheral nerves. Keeping this in mind, the present study was planned. This study was conducted on 50 subjects. Twenty –five were patients of Diabetes Mellitus of more than 5 years duration and between 30-50 years of age who presented to the Endocrinology unit of a tertiary care teaching hospital. The controls (n= 25) were non –diabetic but age matched. After taking written consent from all the subjects the procedure was explained to them. The auditory and visual reaction time was recorded using Digital Display Response Time Apparatus (Model no. 608 Medicaid: Ambala). Three auditory (low, medium, high pitched sounds) and three visual stimuli (red, green, yellow) were recorded. The mean and standard deviation were computed and comparison was done using unpaired t- test. There was marked increase in auditory reaction time values (p=0.000) and visual reaction time values (p=0.000) in patients. These findings reveal that reaction time is delayed in Diabetes Mellitus as it affects the nerve conduction velocity, information processing, speed, working memory. Our study highlights that reaction time measurement can be taken as a non-invasive, low cost indicator of early nerve damage especially without clinical neuropathy.**Keywords:** Cognitive functions, Diabetes Mellitus, Nerve conduction, Neuropathy, Reaction time, Signal processing.

INTRODUCTION

Diabetes Mellitus is a group of metabolic diseases in which a person has high blood sugar [1] either because the body does not produce enough insulin or because cells do not respond to the insulin that is produced [2]. Diabetes Mellitus affects the peripheral nerves in the somatosensory and auditory system, slows psychomotor responses and has cognitive effects all of which may affect reaction times [3]. A reaction time measurement is a reliable indicator of processing of sensory stimulus by central nervous system and its execution in the form of a motor response [4]. It is an important method used for central information processing, speed and co-ordinated peripheral movement responses [5]. The aim of the present study was to review the affects Diabetes Mellitus has on the reaction times and on nerve conduction. The study was approved by the institutional ethics committee.

MATERIALS AND METHODS

The study was conducted on fifty subjects. Twenty five were patients of Type 2 Diabetes Mellitus of duration more than 5 years who presented to the Endocrinology unit of a tertiary care teaching hospital. Twenty five were age matched controls. The aim was to

determine the reaction time both auditory and visual in Type 2 Diabetics and compare the values with those of the controls. Subjects suffering from any disease affecting the vision or hearing were excluded. A written informed consent was taken from all the subjects. Then the subjects were thoroughly acquainted with the apparatus. Three practice sessions were given to every subject. Auditory and visual reaction times were recorded using digital display response time apparatus (Model no 608: Medicaid: AMBALA). Three auditory stimuli (low, medium, high pitched sounds) were presented and three light stimuli (red, green, yellow) were presented. The reaction times of both were recorded in milliseconds and the lowest of the three readings was considered. The mean and standard deviation was computed. The comparison of means was done using the unpaired t –test.

RESULTS

Fifty subjects were included in this study. Twenty –five were patients of Type 2 Diabetes Mellitus of duration more than 5 years and twenty –five were age matched controls. Fifteen were males and ten were females in group I (Type 2 Diabetics) and in group II (controls) eighteen were males and seven were females .

Table 1: Gender Distribution in Group I and Group II

Gender	No. of Controls	No. of Patients
Male	18 (72%)	15 (60%)
Female	7 (28%)	10 (40%)

Auditory reaction time was recorded in all fifty subjects. The lowest values were considered and comparison between values of group I (Type 2 Diabetics) and group II (controls) were done, the values were recorded in milliseconds. The mean and standard

deviation was computed for all three values. The p values were also calculated and are shown in table II. There is seen a significant increase ($p = 0.000$) in auditory reaction time values in the Diabetic group .

Table 2: Auditory Reaction Time Values in Group I and Group II

Reading	Control Group Mean (Standard Deviation)	Study Group Mean (Standard Deviation)	T-Value	p-Value
Sound I	0.957133 (0.467631)	1.71656 (0.913174)	3.615259	0.000*
Sound 2	0.786307 (0.258654)	1.4774 (0.793132)	3.930987	0.000*
Sound 3	0.927147 (0.350004)	1.709373 (1.159469)	3.111321	0.000*

$p= 0.000$ Significant

Visual reaction time was recorded in both groups. The lowest of the three values was considered, values recorded were in milliseconds. Comparison between the values of the control group and diabetic group was

done, the p and t values were also analysed and all these parameters have been shown in table III. The P –value ($p= 0.000$) shows a significant increase in visual reaction time values of the diabetic group.

Table 3: Visual Reaction Time Values in Group I and Group II

Reading	Control Group Mean (Standard Deviation)	Study Group Mean (Standard Deviation)	T-Value	p-Value
Red	0.615507 (0.146439)	1.003733 (0.590622)	3.062292	0.003*
Green	0.578427 (0.183259)	0.916973 (0.604042)	2.671765	0.012*
Yellow	0.549133 (0.168918)	0.849867 (0.399709)	3.36406	0.001*

$p=0.000$ Significant

DISCUSSION

It is clear that Diabetes Mellitus affects the peripheral nerves, slows psychomotor responses and has cognitive effects on those individuals who do not have a proper metabolic control. Individuals with long standing Type 2 Diabetes Mellitus may develop signs of autonomic dysfunction [6-8], affects somatosensory and auditory system, slows psychomotor responses affect reaction times [3]. In our study, there was seen an increase in auditory reaction time measurement. There was a significant increase ($p=0.000$) for all three sound stimuli. Similar studies found a 30 milliseconds difference in auditory reaction time values between diabetics and the control group [9]. Diabetes Mellitus is reported to affect peripheral nerves in the somatosensory and auditory system [10]. Studies have shown that short term hyperglycemia with physiological hyperinsulinemia was associated with increased sensory

nerve conduction velocity and decreased motor latency in non-diabetic subjects [11, 12].

A significant increase in visual reaction time values was also seen in our subjects of group I i.e. ($p=0.000$) for all three colours i.e. red, green, yellow. Similar studies show doubling of visual reaction time in Diabetics versus that measured in healthy individuals [13]. In one study twenty five subjects with Type 2 Diabetes Mellitus of duration 5.9 years were studied. Tests of information processing, immediate and delayed memory, working memory and attention were administered. During acute hyperglycemia, cognitive functions were impaired and mood state was deteriorated [14]. Some authors have published data on the effects of acute hyperglycemia on cognitive functions and found them to be contradictory [14]. Controversy over the relationship between Diabetes Mellitus and reaction time still exists [3]. Some authors

believe that it could be due to axonal degeneration of both myelinated and unmyelinated fibres, axon shrinkage, axon fragmentation, thickening of basement membrane and micro thrombi which are responsible for delayed motor nerve conduction velocity and hence the reaction time is delayed in the Diabetic group [15].

CONCLUSION

In conclusion, the cognitive domains which were the most adversely affected in patients of Type 2 Diabetes Mellitus were information processing speed and working memory. Delayed reaction time in diabetics without clinical neuropathy can be taken as a non-invasive, low cost, sensitive indicator of early nerve damage without clinical signs or symptoms and can be performed as an outdoor procedure. Further research needs to be done to establish a relationship between neural processing deficits and the pathologic processes produced by long standing Diabetes Mellitus.

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