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Original Research Article

Comparative Study of Auditory and Visual Reaction Time in Patients of Type 2 Diabetes Mellitus on Allopathic Treatment and in Healthy Controls

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Abstract: Diabetes is a worldwide epidemic also having high prevalence in Indian population. It leads to peripheral neuropathy affecting somatosensory and auditory system. It slows psychomotor responses, and has cognitive effects on those individuals without proper metabolic control, all of which may affect reaction times. We used visual and auditory reaction time as a tool to early detect neuropathy so that we could prevent further damage to nerves. The aim is to measure and compare visual and auditory reaction time between type-2 diabetics on oral medication and healthy volunteers. Subjects and controls were enrolled based on detailed questionnaire and informed consent was obtained. The mean age of type 2 diabetic subjects was 49.8 years and that of control 44.8 years. Cases and controls were age matched. Inclusion Criteria: AGE 40- 60 Years. Cases: Type 2 Diabetics under control. Control: Healthy subjects without Diabetes, Hypertension, no visual and auditory disturbance. Exclusion Criteria: Alcoholics, hypertension, subjects on insulin, diabetes with complication, subjects with auditory and visual disturbances Human reaction time apparatus was used to measure auditory and visual reaction time. Unpaired `t` test has been used for statistical analysis. Auditory reaction time for both high frequency and low frequency sounds are more in type 2 diabetic patient as compared to normal. Visual reaction time for red and green colour is also more in type 2 diabetic patient as compared to normal control group. This study concludes that type 2 diabetes mellitus leads to neuronal changes which leads to delayed reaction time.
Keywords: reaction time, Type 2 Diabetes

INTRODUCTION

Reaction time (RT) is the time between the application 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. Reaction time is considered to be an index of speed of processing. It gives an idea about the ability of the person to concentrate and co-ordinate the response. Thus, it helps to analyze the cognitive ability of the person

Nowadays Type 2 diabetes is considered as a worldwide epidemic and created a need to reduce the morbidity and mortality due to it from various causes like visual and auditory disturbances. It is better to detect neuropathy earlier before it is clinically visible. One of the micro vascular complications of diabetes, include neuropathy is a major contributor to morbidity and mortality. Neuropathy progression preferentially affecting nerve fiber subtypes may explain some clinical heterogeneity, but different neurophysiologic tests are required to identify dysfunction of different nerve in diabetes [1-2]. Auditory and visual reaction time is considered as a ideal tool for measuring sensory motor association [3]. Motor response is typically a button press but can also be an eye movement, a vocal response, or some other observable behavior [4].

Reaction time estimation is a noninvasive procedure and can be easily done. Nervous system is associated with various body maintenance functions including walking, posture maintenance, sensation of pain, temperature and appropriate withdrawal functions. Disturbance in this peripheral nervous system leads to neuropathy which can lead to various traumas, injuries and may lead to ulcers. So, it is necessary to diagnose neuropathy at its early stage. Now a day from the available tests it is quite difficult to diagnose neuropathy at its early stage. Type 2 diabetes is one of the leading causes, leads to such peripheral

neuropathies [5]. Delay in reaction time can be used as an early sign for developing neuropathy. It is necessary to test its validity in case of type-2 Diabetic patients. So, hereby in this study we will compare reaction times of diabetic patients with that of normal individuals from the same age group. Also, we can compare age related deranged in reaction time in diabetic patient to evaluate progress related to age and also progress related to duration of diabetes.

MATERIAL AND METHODS

This cross-sectional study was to measure and compare visual and auditory reaction time between type -2 diabetics on oral medication and non-diabetics. Ethical permission was taken from Institutional Ethics Committee (IEC), Seth G. S. Medical College & KEM Hospital, and Mumbai.

The study was an observational study. The study continued for 3 months till all patients are recruited. The study population included 40 type 2 Diabetic patients from Outer Patient Department (OPD), Endocrine department of KEM Hospital. The sample size of 40 is selected according to admission rate, inclusion and exclusion criteria and duration of the study as well as feasibility. Control group i.e. normal individuals will be recruited from voluntary staff members from our institute, patient's relatives, workers from hospitals who will be selected as per given inclusive and exclusive criteria and willing to participate by giving their written informed consent.

Human reaction time apparatus:

This apparatus consists of inbuilt electronic circuits. It has two parts, one operational side for examiner and other for the subject to be tested. There is a partition in the middle so that the activities of the examiner will not interrupt the subject and be useful for avoiding faulty readings. On the examiner's side, there are various switches (opening switches) to set the instrument ready for visual or auditory responses. On the other side, there are closing switches for right hand and left hand separately and red and green bulb to see the light when they glow after switching on by the examiner. Auditory stimuli are heard aloud by both examiner and the subject. For recording reaction time, subjects were asked to sit comfortably on the stool or chair with an appropriate height so that the examiner's side of the instrument was not visible to the subject. Examiner set the instrument to glow red or green light for visual reaction time or send a high pitch or low pitch sound stimuli for auditory reaction time on the instrument. As soon as the examiner switched on the button for a particular stimulus, the stimulus appeared on the subject's side after a particular interval as set by the examiner of which subject was not aware. The subjects were instructed to press the closing button on his side when he saw or heard the stimulus. The reading was recorded in seconds on the digital screen on the examiner's side.

The whole procedure of the study was explained to the subjects (patients) and informed consent of the subjects, willing to participate in the study was taken. Complete medical history of the patients and control were taken and also the reports of all investigations, which are done as routine, were checked. (These investigations were a part of the treatment that the patients receive here and no other investigations were advised to the patients as a part of this study). Patients and control that were eligible according to the inclusion and exclusion criteria were included.

Inclusion Criteria:

1) Age: 40- 60 Years.
2) Cases: Type 2 Diabetics under control.
3) Control: Healthy subjects without Diabetes, Hypertension, No visual and auditory disturbances

Exclusion Criteria*:*

1) Alcoholics, hypertension, subjects on insulin, diabetes with complication, subjects with auditory and visual disturbances

The patient and control were demonstrated and made to practice the whole procedure for recording reaction time for both auditory and visual stimuli separately. Final readings were taken. Three readings were taken and lowest of the three was taken as final reading.

Unpaired't' test has been used for statistical analysis. For comparing data, software Graphpad Instat (version 3.1) was used. The level of significance was set as $p < 0.005$ for all comparisons.

RESULTS

The results of visual reaction time for red and green colour and auditory reaction time for low and high frequency sounds are shown in following tables.

Table 1: Comparison of visual reaction time in type 2 Diabetes and control group

	Stimulus	Age (yrs.)	Type 2 Diabetes	Control group	P value
Visual reaction time	Red light	40- 50	0.2109+ 0.0275	0.1759+ 0.0128	**0.009**
		50- 60	0.2930+ 0.0752	0.2297+ 0.0485	**0.019**
	Green light	40- 50	0.2387 + 0.0397	0.1884 + 0.0103	**0.001**
		50- 60	0.3071+ 0.0632	0.2459+ 0.0642	**0.023**

Table 2: Comparison of auditory reaction time in type 2 Diabetes and control group

	Stimulus	Age (yrs.)	Type 2 Diabetes	Control group	P value
Auditory reaction time	High pitched	40- 50	0.2221 + 0.0278	0.1732+ 0.0198	**0.003**
		50- 60	0.2887+ 0.0783	0.2115+ 0.0408	**0.013**
	Low pitched	40- 50	0.1915+ 0.0249	0.1561+ 0.0204	**0.003**
		50- 60	0.2317+ 0.0246	0.1946+ 0.0397	**0.022**

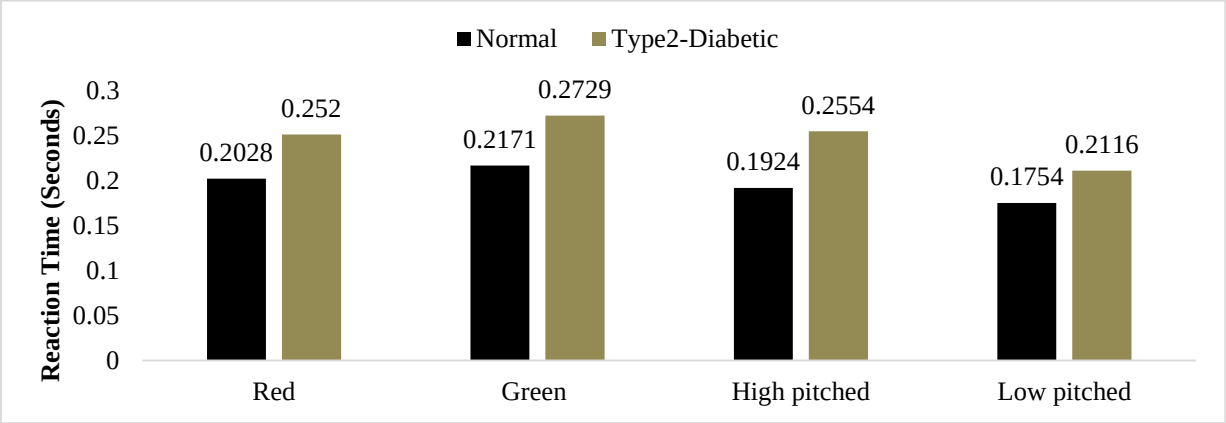

Fig. 1: Comparison of visual and auditory reaction time between type2 diabetes and control group

DISCUSSION

Important finding of the study was performance shown by diabetic patients as compared to normal control group. Findings of the study revealed that both visual as well as auditory reaction time were significantly prolonged in diabetic patients as compared to normal control group. The possible mechanism for this finding could be due to increased blood glucose associated with diabetes that causes axonal degeneration of myelinated and unmyelinated fibers, axon shrinkage, axonal fragmentation, thickening of basement membrane and damages blood vessels that carry oxygen and nutrients to the nerves [6-7].

Also, we have compared reaction time according to age group of 40-50 years and 50-60 years. We found that in old age reaction time is prolonged in normal individuals also. So, we can consider there are many factors like lifestyle changes, radical injuries which leads to neuropathic changes with age [8-9].

Delayed reaction time in diabetics without clinical neuropathy can be taken as a sensitive indicator of early nerve damage without clinical signs or symptoms. Since diabetes shows significantly prolonged reaction time, physician can give neurotropic supplements along with antidiabetic drugs to reduced morbidity of central and peripheral neuropathy in diabetic patients.

Most likely cause of visual reaction time being greater than auditory reaction time is due to the fact that the visual reaction time involves chemical changes in its occurrence. Also, the visual pathway involves many collateral pathways to various association areas and hence a greater delay in comprehension of visual stimulus as it is interpreted in a more complex and elaborate fashion. Some degree of difference in type of receptor and the manner in which the receptor gets stimulated i.e. the retina versus the organ of corti [10]. In future, prospective study can be done based on duration of onset of Diabetes and changes in reaction time for early diagnosis of Diabetic Neuropathy.

CONCLUSION

This study concludes that type 2-Diabetes mellitus increases visual reaction time and auditory reaction time as compared to normal individuals.

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