

ORIGINAL ARTICLE

Assessment of Auditory and Visual Reaction Time in Type 2 Diabetics –A Case Control Study

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Abstract: *Background:* Focussing on Type 2 diabetes a worldwide epidemic, we used visual and auditory reaction time as a tool to detect neuropathy a common complication of diabetes so that we could prevent further damage to nerves. *Material and Methods:* cases and controls were enrolled based on detailed questionnaire and informed consent was obtained. The study was conducted at Salem in the month of July 2010 which included 40 type 2 diabetic subjects from a private hospital in Salem. 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, visual and auditory disturbance. *Exclusion Criteria:* Alcoholics, subjects on insulin, diabetes with complication, subjects with auditory and visual disturbances. PC1000Hz reaction timer was used to measure auditory and visual reaction time. *Results:* paired t- test was applied for two groups for significance difference. The visual reaction time was significant with p value = .001 and for auditory reaction time p value = .000. *Conclusion:* Auditory and visual reaction was prolonged in type 2 diabetics on oral medication when compared with non diabetics of same age group. It could be because of the neuropathic changes in diabetes. This can be routinely applied to monitor neuropathic changes in diabetes and its prognosis with treatment.

Keywords: diabetic neuropathy, auditory and visual reaction time.

Introduction

Type 2 diabetes has become a worldwide epidemic and created a need to reduce the morbidity and mortality due to it from various causes like visual and auditory disturbances. Need has arisen 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 severity is related to duration and degree of glycemic control. 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. [3-4]. 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 behavioural response to occur. It is considered to be an index of speed of processing. The behavioural response is typically a button press but can also be an eye movement, a vocal response, or some other observable behaviour [5]. In this era we under took this study as there is paucity of data correlating auditory & visual reaction time

among type 2 diabetes on oral medication and to highlight the importance of auditory visual reaction time in routine examination of type 2 diabetic subjects and to reduce the neuropathy related morbidity.

Aim: This case-control study was to measure and compare visual and auditory reaction time between type -2 diabetics on oral medication and non-diabetics.

Material and Methods

Study Design: Case – control study.

Age group - 40-60 yrs. control and cases were age matched.

All participants gave a written informed consent to participate in this study. Information details about family history (Diabetes, Hypertension), alcohol consumption, cigarette smoking, drug intake, diet history, visual and auditory disturbances, occupational history and history of recent illness were obtained by a structured questionnaire. [6-8].

Controls: 40 healthy volunteers with no history of diabetes (fasting blood sugar < 100mg %), hypertension, visual and auditory disturbances, alcohol intake, and no history of recent illness from any diseases.

Cases:

- 40 Type 2 diabetic subjects were selected from *M.G. Diabetic Hospital & Research Centre in Salem* (fasting blood sugar < 100mg %, duration of diabetes less than 10 years).
- Inclusion criteria: Type 2 diabetics on oral medication.
- Exclusion criteria : subjects on insulin, complicated cases of diabetes , alcoholics , smokers , subjects with visual and auditory disturbances and subjects with any illness other than diabetes.

PC 1000 Hertz's Reaction Timer: We used an in house build add on device called PC 1000 [9], to measure auditory and visual reaction time. PC 1000 is a 1000 hertz square wave oscillator which has a soft key for start and stop function. PC 1000 Reaction timer instrument has two components (A &B) connected to each other.

- First component (A) has a start button and it is handled by the examiner only. Second component (B) has a stop button which will be handled by the subject alone and also it has a small red LED and head phone (1000 hertz's tone) which receives the visual and auditory stimulus respectively. Red light is selected for the experiment as it persists for a long time in retina. Component A and component B is in turn connected to a personal computer which has audacity software installed in it. Audacity city software records the reaction time in 0.001sec accuracy in wave format.

Visual Reaction Time (VRT) Measurement : Examiner presses the START button in first component(A) which will be out of the view of the subject .Subject is instructed to press the STOP button in second component(B) as soon as he/she sees the red light in the instrument. Reaction time is recorded in audacity software.

Auditory Reaction Time (ART) Measurement: Examiner presses the start button (A) which will be out of the view of the subject and the subject is instructed to press the stop button (B) as soon as he/she hears the sound (1000 hertz's tone) through the headphone connected to it. Reaction time is recorded in audacity software.

Minimum five trials are given for both VRT and ART measurement. Minimum time recorded is calculated as final VRT and ART (Figure-1).

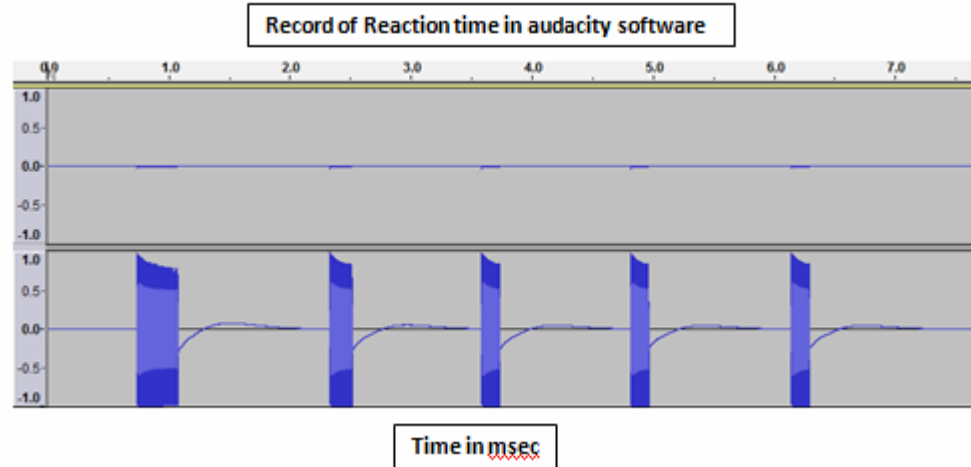


Figure-1

Statistical analysis was done using SPSS software 16.0 version and paired t- test applied between two groups (type 2 diabetics and controls) for significance difference.

Results

Mean age of 40 type 2 diabetic subjects was 49.8 years and 40 non diabetic subjects was 44.48 years. Mean values of both visual reaction time (VRT) and auditory reaction time (ART) in type 2 diabetic group were greater than controls and the difference was statistically significant (p<0.05) (Table -1).

Table 1 - Description of age, visual reaction time, auditory reaction time for controls and diabetes.			
	Age Mean ±SD (in years)	Visual reaction time Mean ±SD (m sec)	Auditory reaction time Mean ±SD (m sec)
Controls	44.4	207.63± 46.2	174.13±30.7
Type 2 diabetics	49.8	256.38±79.5	251.25±77.8
Statistical significance P value		0.001**	0.000 **
P value < .05 statistically significant, ** highly significant.			

Discussion

High blood sugar levels in individuals with type 2 diabetes often have neurological side effects that affect both peripheral and central nerves [10]. In our study we found that visual reaction time is longer than auditory reaction time [11-12]. 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 [13].

Reaction time is a measure of function of sensorimotor association [14] and performance of an individual [15]. It has physiological significance and is a simple and non-invasive test for peripheral as well as central neural structures [12].

Subjects with type II diabetes on oral medication all had mild, but measurable peripheral neuropathies. Diabetes has also been shown to affect peripheral nerves in the somatosensory [16] and auditory system [17], slows psychomotor responses [18], and has cognitive effects, all of which may affect reaction times. In our study that patients with near-normal blood glucose control were recruited and they exhibited slowed simple attention, whether information presentation is visual or aural [19].

The possible mechanism for this finding could be due to increased blood glucose associated with diabetes that causes chemical changes in the nerves and damages blood vessels that carry oxygen and nutrients to the nerves. Excessive glucose metabolism causes decrease in 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. 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 both myelinated and unmyelinated fibres, axon shrinkage, axonal fragmentation, thickening of basement membrane and microthrombi are responsible for the delayed motor nerve conduction velocity [20-21] and hence, the increased reaction time.]

Implication The clinical significance of such subtle alterations is speculative. Probably such alterations might prove deleterious in subjects required to take instantaneous decisions like drivers and sports persons on oral medication for type 2 diabetes before clinical neuropathy sets in. Since diabetes involves both central and peripheral nerves, clinicians can apply this simple non invasive test in their daily practice to detect neuropathy and supplement them with neurotropic agents to prevent further damage to nerves and monitor their prognosis with treatment.

Conclusion

We conclude from our present study that, for subjects with Type -2 diabetic on oral medication visual and auditory reaction time is prolonged compared to normal individuals.

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