GYCOSYLATED HAEMOGLOBIN VERSES REACTION TIME IN DIABETICS – A CROSS SECTIONAL STUDY

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ABSTRACT

Background: Focussing on diabetes a worldwide epidemic, we used visual and auditory reaction time as a tool to detect neuropathy a common complication of diabetes in earlier stages so that we could prevent further damage to nerves.

Materials and Methods: Subjects 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 diabetic subjects was 47.8 years.

Inclusion Criteria: Cases; AGE 40-49 Years, Duration of diabetes less than 10 years, HBA1C value less than 7.5%.

Exclusion Criteria : Alcoholics, diabetes with complication, subjects with auditory and visual disturbances. PC1000Hz Reaction timer was used to measure auditory and visual reaction time.

Results: Pearson correlation was applied for two groups. The auditory reaction time showed linear correlation with HBA1C with r value = 0.406. The visual reaction time showed linear correlation with HBA1C with r value = 0.2OO.

Conclusion : Auditory and visual reaction time correlated linearly with glycosylated haemoglobin. It could be because of the neuropathic changes in diabetes. This can be routinely applied to monitor neuropathic changes and its prognosis with glycemic status. This device measures pshycomotor response of the individual.

Key Words : diabetic neuropathy, auditory and visual reaction time, glycosylated hemogobin.

INTRODUCTION

Microvascular complications of diabetes, which include retinopathy, neuropathy and nephropathy, are major contributors to morbidity and mortality. Although neuropathy severity is related to duration and degree of glycemic control, individual subjects may have widely disparate clinical presentations despite similar risk factors. 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. Nerve conduction studies are utilized both in clinical practice and as endpoints in longitudinal investigations of diabetic neuropathy[1,2] Diabetes being an worldwide epidemic, and neuropathy being common associated side – effect it becomes important to measure the sensory motor association in them. Reaction time (RT), which is an indicator of sensory motor association, 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. Reaction time is often used in experimental physiology to measure the duration of mental operations, an area of research known as mental chronometry. In psychometric psychology it is considered to be an index of speed of processing. That is, it indicates how fast the thinker can execute the mental operations needed by the task at hand. In turn, speed of processing is considered an index of processing efficiency. The behavioral response is typically a button press but can also be an eye movement, a vocal response, or some other observable behaviour[3]. We studied glycosylated haemoglobin a sensitive indicator of the glycemic status with auditory and visual reaction time so that we could reveal the sensorymotor and psycomotor association among diabetics. As there are few simpler non invasive tools available, we used an instrument PC 1000 reaction timer to measure the sensory motor association earlier in diabetics.

AIM

This cross sectional study was designed to measure and compare visual and auditory reaction time with glycosylated haemoglobin among type 2 diabetic subjects.

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MATERIAL AND METHODS

STUDY DESIGN: Cross sectional study.

Age- 40-49 yrs

All participants gave a written informed consent to participate in this study. Information details about socio demographic characteristics, 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.

CASES

- 40 Type 2 diabetic subjects were selected from M.G. DIABETIC HOSPITAL & RESEARCH CENTRE IN SALEM
- INCLUSION CRITERIA : Type 2 Diabetics under control (fasting blood sugar < 110mg % , duration of diabetes less than 10 years, glycosylated hemoglobin < 7.5%).
- EXCLUSION CRITERIA : complicated cases of diabetes, alcoholics, smokers, subjects with visual and auditory disturbances and subjects with any illness other than diabetes

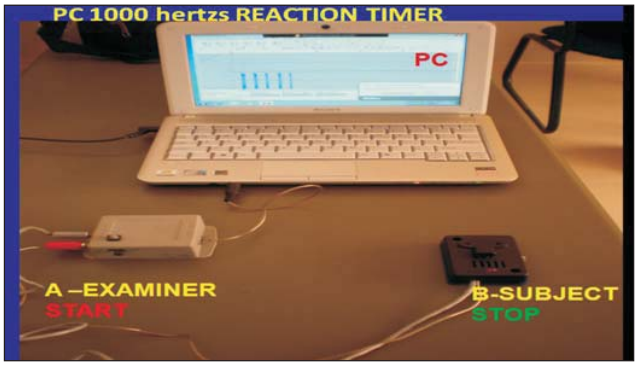
We used an in house build add on device called PC 1000 to measure auditory and visual reaction time. PC 1000 is a 1000 hertz square wave oscillator which has a soft key for start and stop function. (FIGURE-1)

- PC 1000 Reaction timer instrument has two components 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 which receives the visual stimulus. Red light is selected for the experiment as it persists for a long time in retina. Headphone (1000 hertz's tone) is also connected to the second component (B) for receiving auditory stimuli. Component A and component B is in turn connected to a computer which has Audacity software installed. Audacity city software records the Reaction time in msec. in wave format. (FIGURE-1)

VISUAL REACTION TIME (VRT) MEASUREMENT

Examiner presses the START button in first component which will be out of the view of the subject .Subject is instructed to press the STOP button in second component as soon as he/she sees the red light in the instrument. Reaction time is recorded in msec using audacity software.

Figure 1 - PC 1000 hertzs REACTION TIMER



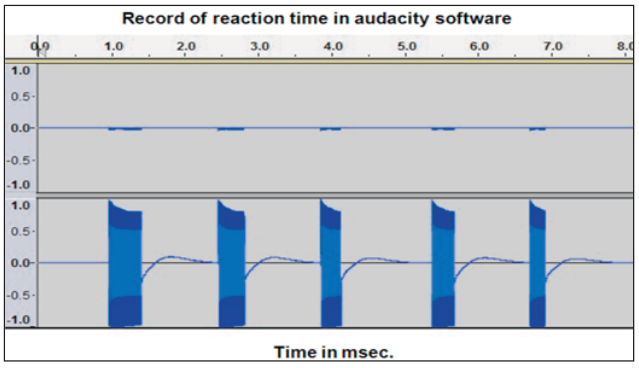
AUDITORY REACTION TIME (ART) MEASUREMENT

Head phone is connected to the second component. Examiner presses the START button which will be out of the view of the subject and the subject is instructed to press the STOP button as soon as he/she hears the sound (1000 hertz's tone) through the headphone. Reaction time is recorded in msec.

FIVE TRIALS are given for both VRT and ART measurement to eliminate the training effect. Minimum time recorded is calculated as final VRT and ART. (FIGURE-2)

STATASTICAL ANALYSIS was done using SPSS software 16.0 and Pearson correlation applied.

FIGURE-2



RESULTS

Mean age of 40 diabetic subjects was 47.8 years. Mean visual reaction time (VRT) values in diabetic group was 263 msec. Mean auditory reaction time (ART) values in diabetic group was 258.5msec.Mean value of glycosylated haemoglobin(hba1c)was7.2%. ART correlated linearly with HBAIC (r value =0.406. p value = 0.008). VRT correlated positively with HBAIC with less significance. (r value =0.200, p value =0.208). (TABLE -1) (FIGURE 3, 4)

Table 1 - Description of age, visual reaction time, auditory reaction time and Glycosylated haemoglobin (HBA1C) for diabetes.

	Age Mean ±SD (in years)	Auditory reaction time Mean ±SD (m sec)	Visual reaction time Mean ±SD (m sec)
Diabetics MEAN HBA1C in %: 7±60%	47.8	252.2±84	256.59±82
Correlation between Glycosylated hemoglobin(HBA1C) WITH VRT AND ART.		r value = 0.406 p value = .008	r value = 0.200 p value = .208

r value showed a statistically significant positive correlation.

FIGURE: 3

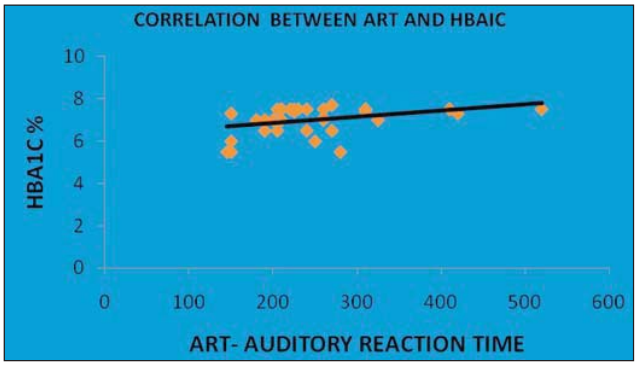
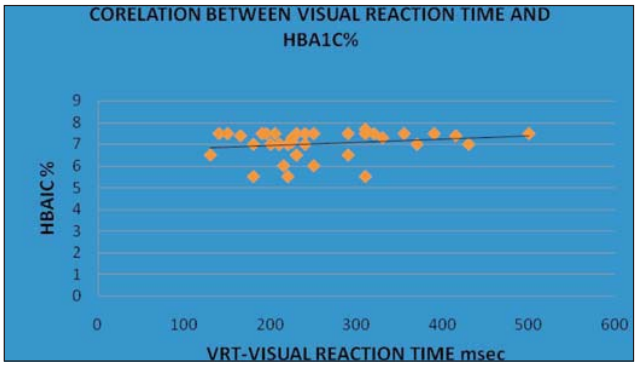


FIGURE: 4



DISCUSSION

High blood sugar levels in individuals with diabetes often have neurological side effects that affect both peripheral and central nerves[4]. In our study we found that visual reaction time is longer than auditory reaction time similar to previous studies[5]. The cause of visual reaction time being greater than auditory reaction time is not very clear though almost all of the research done in reaction time have reached similar conclusion. Most likely it 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[6].

Reaction time is a measure of function of sensorimotor association[7] and performance of an individual[8]. It has physiological significance and is a simple and non-invasive test for peripheral as well as central neural structures[9].

Glycated hemoglobin (glycosylated hemoglobin, hemoglobin A1c, HbA1c, A1C, or Hb1c; sometimes also HbA1c) is a form of hemoglobin used primarily to identify the average plasma glucose concentration over prolonged periods of time. It is formed in a non-enzymatic glycation pathway by hemoglobin's exposure to plasma glucose. Elevated intracellular levels of glucose cause a non-enzymatic covalent bonding with proteins which alters their structure and inhibit function - pathology of diabetic neuropathy (affect central and peripheral nerves), so we used glycosylated hemoglobin as a indicator of blood glucose. Monitoring the HbA1c in type-2 diabetic patients may improve treatment[10].

Subjects with controlled type II diabetes all had mild, but measurable peripheral neuropathies. Diabetes has also been shown to affect peripheral nerves in the somatosensory[11] and auditory system[12], slows psychomotor responses[13], 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[14].

The possible mechanism for this finding could be due to high blood glucose associated with diabetes as indicated by Hba1c, 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[15,16] and hence, the increased reaction time.

LIMITATION

1) Study population were limited.
2) Follow up of study subjects was not done.

IMPLICATION

The clinical significance of such subtle alterations is speculative. Probably such alterations might prove deleterious in subjects required to take instantaneous decisions (drivers, sportsperson etc..). Since it involves both central and peripheral nerves, we can detect neuropathy earlier and supplement them with neurotropic agents to prevent further damage to nerves.

This simple and non invasive device which is also cost effective can be routinely applied in clinical practice by clinicians to monitor prognosis of diabetics and neuropathic changes in them with treatment. This device can measure the psychomotor response of the individual.

CONCLUSION

Visual and auditory reaction time is prolonged in type -2 diabetes mellitus and correlated linearly with their glycosylated haemoglobin level.

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