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Original Article

Physiology Section

Study of Auditory, Visual Reaction Time and Glycemic Control (HBA1C) in Chronic Type II Diabetes Mellitus

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ABSTRACT

Background: Diabetes mellitus is a disease of insulin deficiencyleads to micro and macro vascular disorder. Neuropathy is one of the major complication of chronic uncontrolled Diabetes affecting the Reaction time.

Objectives: To study the correlation between the glycosylated HbA1C and Auditory, visual Reaction time in chronic Type II diabetes (40-60y) of on oral hypoglycemic drugs of>10 y duration in two groups (n-100 in each group , both Males & females) and compared within the study groups and also with the age matched control group (100).

Materials and Methods: HbA1C–Glycosylated HbA1C was measured by Particle enhanced immunoturbidimetric test method. Auditory and visual reaction time (ART, VRT) were measured by PC 1000 Reaction timer for control & study groups i.e. Group-I – Chronic Type II DM for >10 y with HbA1c < 7.0, and Group II - chronic Type-IIDM for >10 y with HbA1c > 7.0 ie impaired glycemic control.

Exclusion Criteria- Subjects with Auditory and visual disturbances, alcoholism and smoking.

Statistical Analysis – One-way ANOVA. Using SPSS 21 software.

Result: Both the groups had prolonged ART and VRT than controls. Among the study group, G-II (DM with HbA1C >7) had increased Auditory & Visual Reaction time than Group I which is statistically significant p-value <0.05.

Conclusion: Impairment of sensory motor function of peripheral nervous system is more in chronic diabetic with less glycemic control ie., HbA1C>7 who have shown increased Auditory and Visual Reaction time than chronic DM with HbA1C<7.Severity of Peripheral neuropathy in Type II Diabetics could be due to elevated HbA1C.

Keywords: Auditory reaction time, Type-II diabetes mellitus, Visual reaction time

INTRODUCTION

Diabetes mellitus (DM) is an endocrine disorder in which high blood glucose either due to deficiency of insulin or its resistance which is the leading causes of mortality and morbidity. According to International Diabetic Federation, the current Diabetic capital of world, our India will be having 101.2 million Diabetic patients by 2030. Impaired glucose metabolism affects the micro and macrovascular systems, Kidney, Eyes & Nervous system. Neuropathy is one of the microvascular complications of diabetes and its severity of which is related to duration and degree of glycemic control which can be assessed by Blood level of glycated Heamoglobin (HbA1C) [1]. Auditory and visual Reaction time is considered as an ideal tool for measuring sensory motor association and performance of an individual. There is a direct relationship between elevated levels of HbA1C & Diabetic Neuropathy has been reported in Type-II DM [2,3]. 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. Screening for Neuropathy earlier before it manifests clinically by assessing the relationship between the HbA1C& Reaction time becomes mandatory. So this study aims to find out the relationship between glycosylatedHbA1C & Auditory and visual Reaction time in chronic Type II Diabetes.

OBJECTIVES

- Estimation of HbA1C in chronic Type-II Diabetics & controls.
- To measure Auditory reaction time and visual reaction time in two groups of chronic Type II-Diabetics (G-I, G-II) and controls.
- To compare Auditory reaction time and visual reaction time in Group 1 and Group 2 diabetics.
- To correlate Auditory reaction time with HbA1C levels and Visual reaction time with HbA1c levels in Chronic Type-II Diabetics.

MATERIALS AND METHODS

After getting approval from Institutional Ethical committee & obtained the written consent from the patients, this cross sectional study was conducted in Chennai medical college Hospital & Research centre, Department of Physiology within a period of six months.

Inclusion criteria: Chronic Type-II Diabetes mellitus(n-100, age 40-60 y, males-52 & females 48) on oral Hypoglycemic agents were divided in to two groups. The chronic Type-II Diabetic patients (with>10 y) with glycemic control i.e., HbA1C - <7 are grouped as Group-1(n=100), and those of without glycemic control i.e., with elevated HbA1C >7 are grouped as Group-II(n=100).

Healthy volunteers (100) in the age group of 40-60 y(males 52 and females48) with no history of Diabetes, Hypertension auditory & visual disturbance and without alcoholic habits were included as control in this study. Mean age of the study group in Group-I is 48±5, Group II is 47±4 & the mean age of control group is 47±3.

Exclusion criteria: Type-I DM, Type –II Diabetics on Insulin, DM with visual or Auditory disturbances, Alcoholics, Hypertensive, smokers, cases of peripheral neuropathy, Muscle weakness, severe anemia, subjects with psychological disorders &Neurovascular complications.

Reaction time is a non- invasive tool can be measured as the interval between the applications of stimulus like, light, sound. etc., and appearance of appropriate voluntary response in a subject[4,5].

Methodology for (HbA1C): HbA1C (Glycated hemoglobin) is estimated by Particle enhanced immunoturbidimetric test. Three Reagents are used; RI (750 µL) Buffer & latex, R2 (250 µL)-buffer and Mouse antihuman HbA1C monoclonal antibody, R3 (125 µL).

Assay Procedure: Whole blood specimen of 20 µl(collected with EDTA) is mixed with 1 ml of hemolyzing solution and allowed to stand for 5 min. To the above solution buffer and mouse antihuman

	CONTROL (n=100)	GROUP-I (n=100)	GROUP-II (n=100)
HbA1C Mean SD	5.5±45	6.45±32	9.1±56
Age Mean SD (in years)	47±3	48±5	47±4
Auditory reaction Time mean SD(msec)	198±32	225±45	291±14
Variance	13.07	456.16	186.95
Visual reaction time MeanSD(msec)	221±1	257±88	356±13
variance	102.07	217.46	77.88

[Table/Fig-1]: Level HbA1C,Auditory &Visual Reaction Time in control & the study Subjects

	SEX		Sex ratio
	Male	Female	
Control(100)	51	49	1.04
Group I(100)	52	48	1.08
Group II(100)	59	41	1.43
Total	162	138	

[Table/Fig-2a]: Sex ratio between the study & control groups

Age (years)	G-I	G-II	G-III
40-50	87	85	91
51-55	13	14	9

[Table/Fig-2b]: Classification of groups based on age

One Way Anova					
		Control (n=100)	Group -I (n=100)	Group- II (n=100)	p-value
HbA1c	Mean	5.5	6.45	9.1	
ART	Mean	198.31	225.17	291.35	p<0.01*
	Variance	13.07	456.16	77.88	
VRT	Mean	221	257.66	356.19	p<0.01*
	Variance	102.32	217.46	186.95	

[Table/Fig-3]: Comparison of ART,VRT with HbA1C among control& G-I&G-II., P<0.05 significant

Age (years)		Group		
		Control	Group 1	Group 2
		HbAIC	HbAIC	HbAIC
		Mean	Mean	Mean
sex	Male	5.58	6.49	9.24
	Female	5.51	6.42	9.01

[Table/Fig-4]: Mean HbA1C in study & control groups in males & females

HbA1C monoclonal antibody and Goat anti-mouse IgG polyclonal antibody are added and readings are taken in fully automated analyser.

In normal persons level of HbA1C is <7 [6]. In uncontrolled diabetes the percentage will be increased. HbA1C is an indicator of the average blood glucose concentrations over the previous three months & most widely accepted and reliable test to assess the blood glucose.

The auditory & visual reaction time reaction time was measured in the control and study groups (G-I,G-II) in a quiet secluded room, whose ambient temperature was about 27°C, using the PC1000Hz reaction timer with their right upper limb, at 10am -12 noon for the study group subjects. Care was taken to avoid the effect of menstruation on reaction time in female subjects; the tests were done during postmenstrual period [7].

Reaction Timer: The device is a PC1000 reaction timer [8] to measure Auditory and visual reaction time. PC1000 is a 1000 hertz square wave oscillator which has a soft key for 'start 'and 'stop' function. This instrument has two components (A&B) connected to each other. Component (A) has a start button and it was handled by the examiner only, second component (B) has a stop button which was handled by the subject small red LED since Red light persists for a long time in retina& head phone(1000Hz tone)which receives the Visual &Auditory stimulus respectively. These two components are connected to a Personal computer which has audacity software installed in it. Audacity software records the reaction time in 0.001sec accuracy in wave format.

Visual Reaction Time(VRT)Measurement: when the Examiner pressed the 'start' button in the component (A) which was out of the view of the subject and the subject was instructed to press the 'Stop' button in component (B) with the right index finger first as soon as he/she sees the red light in the instrument. Reaction time was recorded in audacity software.

Auditory Reaction Time (ART) Measurement: When the Examiner pressed the 'start' button which was out of the view of the subject and the subject was instructed to press the stop button with the right index finger first as soon as he hears the sound (1000 hertz's tone) through the head phone connected to it. Reaction time is recorded in Audacity software.

All subjects were right handed and used their right hand to press the switch to stop the quartz clock of the apparatus. When compared to left hand values before measuring VRT, each subject was asked to identify the flashing of yellow light. Each Subject was instructed to press the switch as soon as she/he saw the light. Minimum five trials are given for both VRT and ART measurement. Minimum time recorded is calculated as final VRT and ART.

RESULT

One-way Anova test was used to analyse the data for comparison of control and two study groups. Statistical analysis by SPSS 21was used. The level of significance was set as p ≤0.01 for comparison. The parameter ART,VRT are shown in [Table/Fig-1]. The sex ratio between three groups was shown in [Table/Fig-2a]. The study and control groups were classified based on the age which is shown in [Table/Fig-2b].

Both the study groups i.e. chronic Type-II DM has prolonged Auditory and visual reaction time than the controls. Group-II has shown more prolonged reaction time than the control and Group-I [Table/Fig-3] which is statistically significant. There is no significant difference of Mean in study and control groups in males and females [Table/Fig-4].

DISCUSSION

complications like Nephropathy, Retinopathy, ischemia due to Hyperglycemia [9]. Reaction time is the time interval between a stimulus (auditory /visual) to a subject and the subject's response, which is a sensitive indicator of the sensory motor association. In the present study, the ART and VRT are delayed in both the study groups (GI&GII) than the controls and VRT is more delayed which is similar to the findings of previous studies [10-13] have shown that chronic hyperglycemia favours glucose oxidation and free radical release like peroxynitrite leading to the axonal fragmentation & degeneration of both myelinated and unmyelinated fibres, axon shrinkage, finally impair the signal transmission of Nerves & delayed motor nerve conduction velocity [14-16] and hence the delayed reaction time. Studies supporting that more delayed VRT than ART in chronic Type-II DM may be due to the involvement of many collateral pathways in the Visual pathway & the difference in the type of stimulation of the Rods and cones than the Organ of corti [17-18].

The present study also states that there is more delayed Auditory and Visual reaction time in Group II (without glycemic control) than the Group I among the study population i.e., chronic Type II Diabetes, which can be due to lowering of HbA1C results in reduction in the microvascular complication like Neuropathy [2,3]. Delayed reaction

time (ART & VRT) can be taken as a sensitive indicator of severity of nerve damage prior to clinically manifestation of Diabetic neuropathy. It is mandatory to screen for neuropathy in chronic Type II DM patients, earlier before it manifest, by measuring reaction time and correlate it with HbA1C to assess the severity [19,20].

CONCLUSION

There is significant relationship between the Reaction time & glycemic control, in chronic Type-II DM. This can create an awareness of glycemic control & its importance in early screening for severity of sensory motor impairment before its clinical manifestation, among chronic Type-II Diabetes mellitus.

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