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A Comparative study of Audio Visual Reaction Time Variability in Controlled and Uncontrolled Type II Diabetes Mellitus Patients

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Abstract

Background: Neuropathy is one of the major microvascular complications of Diabetes Mellitus. Auditory (ART) and visual (VRT) reaction time were used in this study as diagnostic and prognostic tools for Diabetic Neuropathy.

Objective: To measure ART and VRT among type II DM patientsand to compare the ART and VRT among Group 1 (HbA1C < 7%) and Group 2 (HbA1C >7%) Type II DM patients.

Materials and Methods: 60 Type II DM patients aged between 40-60 years attending the OPD of Dept. of Medicine, RRMCH, Bangalore were selected as Subjects. The Patients were divided into 2 groups: Group 1 includes Type II DM patients with HbA1C < 7% and Group 2 includes Type II DM patients with HbA1C > 7%.Type II DM patients with HbA1C < 7% were taken as Controlled and Type II DM patients with HbA1C > 7% were taken as Uncontrolled patients. The results were compiled and statistically analysed for significant differences.

Results: It was found that the values of both ART and VRT were significantly increased ($p \leq 0.05$) in Group 2(HbA1C > 7%) Type II DM patients in comparison with Group 1(HbA1C < 7%) Type II DM patients.

Conclusion: Results of the study conclude that both ART & VRT were significantly prolonged in Group 2 Type II DM patients. Glycemic axonal degeneration slows nerve conduction and increases reaction time. ART and VRT reaction time may be routinely used to detect and monitor prognosis of Diabetic Neuropathy.

Key words: Auditory Reaction Time; Visual Reaction Time; Type II Diabetes mellitus; HbA1C.

Introduction

Diabetes mellitus is one of the most common endocrine disease worldwide. Indian has the largest number of diabetic subjects compared to total world diabetic population. The number of diabetic subjects which was 40.9 millions in 2007 is expected to rise to 69.9 million by 2025.[1]

One of the major microvascular complication of diabetes is neuropathy, which leads to a significant morbidity. Neuropathy being common side effect of diabetes, it becomes essential to study the sensory motor association in them.[2]

Though many neurophysiological tests are in clinical use to diagnose sensory motor association or neuropathy, but are all complicated. Nerve conduction studies are used in clinical practice to diagnose diabetic neuropathy[3]. A simpler non-invasive test to diagnose early neuropathy or sensory motor association is the reaction time. Not many studies have used reaction time to assess the sensory motor association in diabetes mellitus.

Reaction time is the elapsed time between the presentation of a stimulus and the subsequent behavioural response. Reaction time is often used in experimental physiology to measure the duration of mental operations in area of research known as mental chronometry.[2]

Processing efficiency of CNS can also be assessed by reaction time which includes stimulus processing, decision making and response programming. Reaction time can also be used to estimate the sensory motor performances in a simpler way.[4]

One of the largest implications that an increased reaction time may have is in the area of slips, falls and accidents. Falls are incurred by one third of the elderly population and are common source of morbidity and mortality.[5]

Glycosylated haemoglobin is an effective tool in monitoring long term blood glucose control in patients with type 2 diabetes mellitus. Glycosylated hemoglobin reflects the average plasma glucose levels over the previous 8 to 12 weeks. More recently there has been a substantial interest in using it as a diagnostic test for diabetes and

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as a screening test for persons at high risk for diabetes mellitus[6]. Because of all these factors glycosylated hemoglobin becomes an important marker of metabolic control in diabetes mellitus.
HbA1c testing is a measure of diabetic glycemic control. Diabetes control is categorized as poor control (HbA1c levels > 9%), moderate control (HbA1c levels between 7% and 9%) and good or desired control (HbA1c levels < 7%).[7]
According to a study both auditory and visual reaction time are prolonged in type 2 diabetes mellitus and correlated linearly with their glycosylated haemoglobin level[2].Mohan et al found a 30 ms difference in auditory reaction times between those with diabetes (approximately 210 ms) and a control group (180 ms).[8]
The aim of this study is to determine, if there is any alteration of simple auditory and visual reaction time in type II diabetes mellitus.

MATERIALS AND METHODS

Source of data

60 type II diabetes mellitus patients, 30 patients with HbA1c< 7% and 30 patients with HbA1c>7% are taken from the outpatient department of medicine, Rajarajeswari Medical College and Hospital. Type II DM patients with HbA1C < 7% were taken as Controlled and Type II DM patients with HbA1C > 7% were taken as Uncontrolled patients.

Method of collection of data

Diagnosed type II diabetes mellitus patients will be identified and referred to the Department of Physiology. Reaction time will be analysed by using the in house build reaction time apparatus.

Before analysing the reaction time the subject is asked to fill a questionnaire. Anthropometric measurements will be taken from the subject and filled in the subject questionnaire form. Blood pressure and Heart rate will be recorded in the subjects. Auditory and Visual reaction time will be assessed by making use of an in-house built add on device called PC 1000. PC 1000 is a thousand Hz square wave oscillator which has a soft key for start and stop function.[3]
The stimulus is a red LED light. The peak wavelength of the LED was 625nm. The circular stimulus is 5mm in diameter. The stimulus is kept at a working distance of 38 cm. The LED mean luminance is 513 cd/m^2 with the surrounding luminance being around 100 cd/m^2. The LED light was mounted at the center of a white square screen 15X15 cm. Two diagonal red lines which crossed at the LED were fixed to the screen. A control knob is provided which can increase or decrease the frequency of flicker of the LED light.
Measurements will be taken separately in each eye with any refractive error corrected.

Inclusion Criteria

1. Diagnosed Type II diabetes mellitus patients attending OPD of RRMCH.
2. Age group between 40yrs to 60yrs.

Exclusion criteria

1. Patient suffering from any other microvascular or microvascular complications.
2. Diagnosed Hypertensive patients.
3. Any patient not willing to give consent for the study.

Ethical Clearance: Permission was taken from Institutional Ethics Committee.

Statistical analysis

The data was entered into an excel sheet and analysed using SPSS software version 20.0. Mean and standard deviations were calculated for quantitative variables. Frequencies and proportions were used for qualitative variables. Unpaired student's t test was applied to compare the reaction time between the two groups, i.e., Type II DM patients with HbA1C < 7% and Type II DM patients with HbA1C > 7%.

RESULTS

Table 1: Age distribution of Subjects

	Age(years)

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	Gp I	GpII
Males	53.05±8.8	55.9 ±7.46
Females	50.38± 9.96	51.3± 11.23

Values are Mean±SD

Table 2: Gender distribution of Subjects

	Type 2 Diabetes mellitus	
	Gp I	GpII
Males	17	20
Females	13	10
Total	30	30

Table 3: Anthropometry

	Height (cms)	Weight (Kg)	BMI (Kg/m2)
Gp I	162.56±7.56	61.7± 10.7	23.17± 2.628
GpII	161.1 ±9.39	62.3± 6.81	24.09± 2.733
P value	0.50	0.79	0.19

Table 3 shows that both the Groups (Group I and Group II) were matched for Height, Weight and BMI (that is the difference between the two groups is statistically insignificant with P>0.05).

Table 4: Reaction Time

	ART (msec)	VRT (msec)
GROUP I (n=30)	194 ± 35	215 ± 41
GROUPII (n=30)	215 ± 33	254 ±41
P value	0.027*	0.0006*

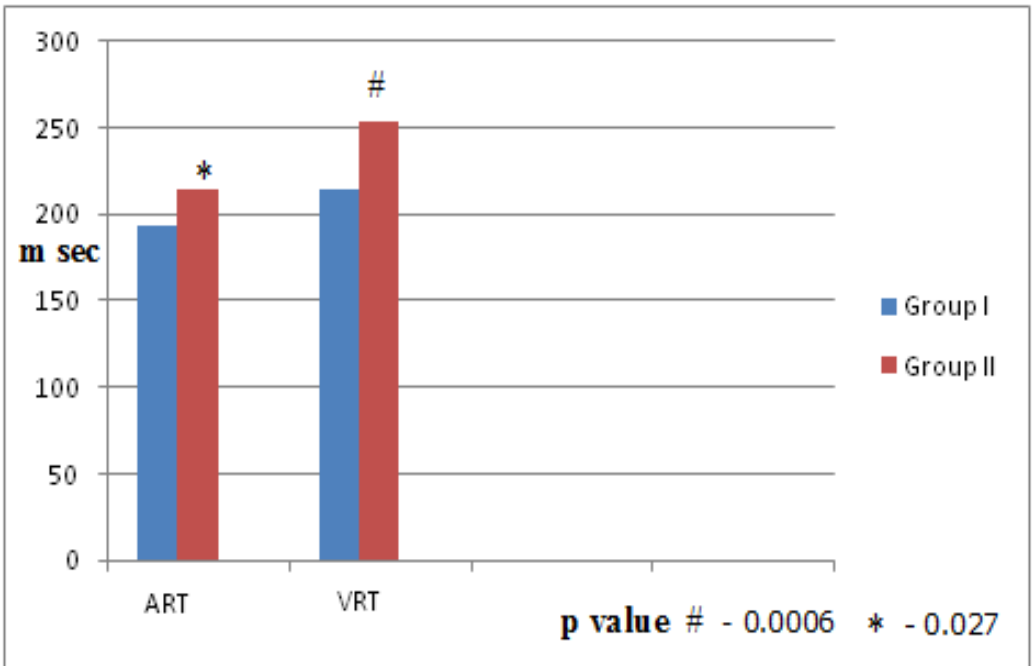

Figure 1: Comparisons of ART and VRT between the Groups

P value ≤0.05 - Statistically significant

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Table 4 and Figure 1 shows that the values of both ART and VRT are significantly increased(P value<0.05) in Group II in comparison with Group I Type II DM individuals.

DISCUSSION

In the present study there was a significant increase in both Auditory Reaction Time and Visual Reaction Time in Group 2 (HbA1C >7%) Type II DM patients.

The study is in accordance with the study done by Muhil M et al "Study of Auditory, Visual Reaction Time and Glycemic Control (HBA1C) in Chronic Type II Diabetes Mellitus" who found that there was statistically significant increase in Auditory & Visual Reaction time in Group II (DM with HbA1C >7) than Group I (DM with HbA1C<7).

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 and hence the delayed reaction time.[9]

The chronic complications of DM can be divided into vascular and nonvascular complications. The vascular complications of DM are further subdivided into microvascular (retinopathy, neuropathy, nephropathy) and macrovascular complications [coronary heart disease (CHD), peripheral arterial disease (PAD), cerebrovascular disease]. Nonvascular complications include problems such as gastroparesis, infections, and skin changes. Long-standing diabetes may be associated with hearing loss.

The risk of chronic complications increases as a function of the duration and degree of hyperglycemia; they usually do not become apparent until the second decade of hyperglycemia. Since type 2 DM often has a long asymptomatic period of hyperglycemia, many individuals with type 2 DM have complications at the time of diagnosis.

The microvascular complications of both type 1 and type 2 DM result from chronic hyperglycemia. Large, randomized clinical trials of individuals with type 1 or type 2 DM have conclusively demonstrated that a reduction in chronic hyperglycemia prevents or delays retinopathy, neuropathy, and nephropathy.[10]

Limitations:

In the present study ART & VRT was done only on Type II DM patients and was not done on Type I DM patients and non-diabetics. ART & VRT on Type I DM patients and non-diabetics would have provided more information and also resulted in better comparison of ART & VRT among Type I DM patients, Type II DM patients and non-diabetics.

Conclusion

Results of the study conclude that both ART & VRT were significantly prolonged in Group II DM patients. Glycemic axonal degeneration slows nerve conduction and increases reaction time. ART and VRT reaction time may be routinely used to detect and monitor prognosis of Diabetic Neuropathy.

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Conflict of Interest: The Authors declare that there is no conflict of interest.

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