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Heart Rate Variability as a Tool To Detect Cardiac Autonomic Neuropathy in Type 2 Diabetic Patients

Dr Prakash S B	Assistant Professor, Department of Physiology, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.
Dr Riyaz Ahamed S	Assistant Professor, Department of Community Medicine, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.
Dr Vaijyanath Itagi	Professor, Department of Physiology, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.
Dr Prashanth Dixit	Associate Professor, Department of Physiology, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.
Dr Subramanya B K	Associate Professor, Department of Pharmocology, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.

ABSTRACT

Background: Cardiac autonomic neuropathy in diabetic patients is a serious and common complication. Unrecognized cardiac autonomic neuropathy can prove fatal in them. The present study was done to evaluate efficacy of heart rate variability as a tool in diagnosis of cardiac autonomic neuropathy in diabetic patients. Methods: The study was carried out on 100 randomly newly detected cases of type 2 diabetic patients in a tertiary care hospital in Karnataka. Frequency domain analysis of heart rate variability of the selected cases was compared with 50 healthy individuals taken as controls. Niviqure software was used to analyze heart rate variability in terms of Low Frequency, High Frequency the ratio. Student T test is applied to find out the statistical significance. Results: Mean SD of low frequency, high frequency and ratio of low and high frequency was calculated and no significant change is noted among controls and cases.

Conclusion: The economic impact of testing is heart rate variability as tool for early detection of cardiac autonomic neuropathy is minimal along with physical examination.

KEYWORDS Cardiac autonomic neuropathy, heart rate variability, diabetes

INTRODUCTION

Diabetes mellitus can cause cardiovascular autonomic neuropathy and is associated with increased cardiovascular deaths. Diabetic Autonomic Neuropathy is among the least recognized and understood complications of diabetes despite its significant negative impact on survival and quality of life in people with diabetes.[1] One of the most overlooked complications of diabetes is Cardiac Autonomic Neuropathy.[2] Cardiac Autonomic Neuropathy results from damage to the autonomic nerve fibers that innervate heart and blood vessels and it causes abnormalities in the heart rate and control vascular dynamics.[3] Sub clinical autonomic dysfunctions can however occur within a year of diagnosis of type II diabetic patients and within two years in type I diabetic patients[4]. Various studies have demonstrated that unbalanced sympathetic or parasympathetic tone can be responsible for many cases of sudden death[5-8] in diabetic patients, despite the absence of documented pre-existing heart disease.[7] Early recognition and treatment is important, as the autonomic complications of Diabetes are potentially treatable. The present study therefore attempts to study the cardiac autonomic neuropathy in newly detected type 2 diabetic patients with the following objectives

1. To analyze short term frequency domain of Heart Rate Variability (HRV) in newly diagnosed diabetic patients with and without autonomic neuropathy and compare the results with controls.
2. To study the pattern of autonomic neuropathy in newly detected diabetic patients.
3. To assess the utility of heart rate variability as a tool for diagnosing cardiac autonomic neuropathy in newly detected diabetic patients

Methodology

This is a cross sectional study from December 2013 to May 2014 involving, 100 consecutive, newly diagnosed type 2 diabetic patients and 50 normal individuals attending medical out patients in tertiary care hospital in Karnataka. A pre tested structured proforma will be used to collect the relevant information regarding clinical findings, investigations such as HbA1c, FBS and PPBS. Newly diagnosed type 2 diabetic cases were included in the study with following criteria

Inclusion Criteria:

- Age 35 to 50 years
- Patients who are biochemically proved type 2 diabetes mellitus.
- Both male and female having NIDDM were included in the study group.
- Patients who were not on any drugs that would interfere with the autonomic functions like anti hypertensives, vasodilators, phenothiazines, TCA's, and β-Blockers.
- Patients on anti diabetic treatment for less than 3 Months
- Normal healthy control of both sexes between 35-50 years age.

Exclusion Criteria:

- Presence of hypertension
- Smokers
- Presence of ischemic heart disease.
- Valvular heart disease.
- Heart failure.
- Chronic alcoholic and alcohol dependent.
- Patients with acute complications of diabetes mellitus like diabetic ketoacidosis, non-ketotic hyperosmolar coma and

hypoglycemia.

These patients and normal individuals were subjected to heart rate variability after detail history regarding autonomic symptoms, peripheral neuritis and careful physical examinations. The patients were placed supine on an examination table and allowed to rest for 5 minutes; they were asked to breathe regularly at 6 breaths per minute using Metronome and connected to ECG machine. The ECG recording was done and resting heart rate was calculated. Frequency Domain analysis was done by using NIVIQURE soft ware. Analysis of Heart rate variability was assessed by spectral analysis of series of successive R-R interval (Frequency Domain Analysis) on 5 min ECG Recordings. Two major oscillatory components detectable in spectral analysis of which one synchronous with respiration is described as High Frequency (0.18 – 0.40 Hz) and is generally considered a marker of vagal activity, whereas the other, corresponding to the slow waves of arterial pressure, is described as Low Frequency (0.03 – 0.15 Hz).[9,10] The distribution of the power and the central frequency of Low frequency and High frequencies are not fixed but may vary in relation to changes in autonomic modulations of the heart period. The high frequency region is considered a marker of vagal activity whereas the low frequency component influenced by both sympathetic and vagal activity.

Results:
The study group (cases) consisted of 100 newly detected Type 2 diabetic cases with mean age 45 ± 8 years. The controls consisted of 50 healthy individuals with mean age 39 ± 7 years. Majority of the subjects in cases were from age group of 40-49 years (44%) followed by 50-59 years (32%). With respect to controls majority of the subjects were from 30-39 years of age group (58%).The results obtained were expressed as mean ± standard deviation (Table 1).

Table 1: Age wise distribution of subjects

Age group (yrs)	Control	Cases
30-39	29 (58%)	21 (21%)
40-49	16 (32%)	44 (44%)
50-59	3 (6%)	32 (32%)
60 +	2 (4%)	3 (3%)
Total	50 (100%)	100 (100%)
Mean age ± SD	39.3 ± 7.8	45.3 ± 8.3
Range	30-60	30-62

The heart rate variability parameters like low frequency, high frequency and ratio of low and high frequency are calculated for cases and controls. Table 2 depicts the Mean ± SD of low frequency, high frequency and ratio of low and high frequency. Statistical test like T test is applied to know the significance. In relation to heart rate variability (LH, HF and LH/HF ratio), there was no significant change is noted among controls and cases.

Table 2: Comparison of HRV between cases and controls

Groups		LF	HF	LF/HF
Controls (50)	**Mean ± SD**	0.11 ± 0.09	0.28 ± 0.08	0.39 ± 0.30
	Range	0.01 – 0.54	0.15 – 0.39	0.03 – 1.64
Cases (100)	**Mean ± SD**	0.10 ± 0.07	0.27 ± 0.08	0.37 ± 0.23
	Range	0.04 – 0.64	0.15 – 0.39	0.10 – 1.64
Cases Vs controls	t-value	0.5	0.49	0.44
	P-value	0.58	0.63	0.66

P value < 0.01 = Significant P value >0.05 = Not significant

Discussion:
Cardiac autonomic neuropathy is a common form of diabetic autonomic neuropathy and abnormalities in HR control contributes to morbidity, mortality and reduced quality of life for persons with diabetes.

Heart rate variability represents one of the most promising markers for cardiac autonomic neuropathy. The apparently easy derivation of this measure has popularized its use. Most routinely used tools like cardiovascular reflex test have limitations for early detection of cardiac autonomic neuropathy and are not quantifiable. [11] These limitations can be circumvented by measuring time and frequency domain variability in the heart rate. Frequency domain measurements can be used to quantify the sympathetic component of autonomic function in addition to the parasympathetic component. Various studies carried out to know the heart rate variability had shown that diabetes caused progressive autonomic dysfunction and decreased variability in heart rate. [12,13,14,15,16] Whereas in our study there was no significant changes in heart rate variability, which can be attributed to inclusion of only newly diagnosed diabetic patients with onset of less than three months.

Conclusion:
Despite research evidence that clinical observations should not be the sole basis for the diagnosis of cardiovascular autonomic dysfunction. Screening for abnormalities is infrequently done. Given the clinical and economical impact of diabetic complications, testing of diabetic individuals for cardiovascular autonomic dysfunction should be part of their standard of care

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