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The Hospital Based Study of Autonomic Disparity of Heart Rate in Middle Aged Diabetics Patients

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Abstract **Original Research Article**

Introduction: The Back ground of this study is increasing number of patients with diabetes in India is currently around 40.9 million and is expected to rise to 101 million by 2030. It is estimated that almost one in six people are currently at risk of developing diabetes related complications. Cardiovascular disease (CVD) is the leading cause of mortality and morbidity in patients with diabetes. ***Materials and methods:*** The present study was conducted on 100 middle aged Diabetics attending department of cardiology S.P. Medical College, Bikaner Rajasthan. The patients were divided into two groups, based on age, 36-45yrs and 46-55yrs. Parameters: Resting pulse rate, Deep breathing test, Heart-Rate variation to Valsalva Manoeuver, Heart rate response to standing - Postural Tachycardia Index (PTI) were measured. ***Results:*** The mean ± SD of all the parameters above are de-termined and results were analyzed. 1) Changes within the groups before and after the tests were analyzed by paired 't'. test. 2) Inter group changes were analyzed by unpaired't' test. Discussion: Involvement of nervous system is a well-known complication of diabetes. Neuropathy is one of the most com-mon complications of diabetes. At an early stage autonomic dysfunction may be asymptomatic or mildly symptomatic. Symptomatic autonomic neuropathy carry worst prognosis, so early diagnosis is essential for maximum benefit. ***Conclusion:*** More sympathetic tests have shown significant abnormal responses in diabetics compared to parasympathetic tests.

Keywords: Autonomic variation, Heartrate, Middle aged Di-abetics.

INTRODUCTION

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia [1]. NIDDM occurs mainly in middle aged and elderly, and is much more common than IDDM.2 Diabetes mellitus (DM) is a global epidemic affecting at least 8.3% of the global population and 371 million people worldwide with a significant proportion (50%) remaining undiagnosed. The number of patients with diabetes in India is currently around 40.9 million and is expected to rise to 101 million by 2030. Cardiovascular disease (CVD) is the leading cause of mortality and morbidity in patients with diabetes and subsequently the primary goal of diabetes treatment is to reduce the burden of CVD as well as the vascular complications associated with diabetes [2].

Autonomic neuropathies affecting the cardiovascular system cause a resting tachycardia and orthostatic hypotension. Quantitative Autonomic Function Tests consists of a series of simple noninvasive tests for detecting cardiovascular autonomic neuropathy. Autonomic function tests are considered reliable, reproducible, simple and quick to carry out and all of them are non – invasive. The present study is undertaken to assess the severity of adverse effects of diabetes on autonomic functions of CVS which helps in early detection of CAN (Cardiovascular Autonomic Neuropathy) in asymptomatic diabetic and there by promotes timely diagnostic and therapeutic intervention [3].

MATERIALS AND METHODS

Selection of Subjects

100 diabetic patients who belong to the middle age group of 35-55years attending the diabetic outpatient department in King George Hospital, Visakhapatnam are selected.

Inclusion Criteria

- Cases of already diagnosed Type II Diabetes.
- Cases who are in the age group of 35-55 years
- Cases who are attending the diabetic outpatient department in King George Hospital, Visakhapatnam.

Exclusion Criteria

- Patients suffering from cardiac, neuronal and other endocrinal disorders.
- Patients under medications other than oral hypoglycemics

Methods to Collect the Data

The protocol was explained to the subjects and patients, who volunteered for the present study and informed consent was obtained from each of the participant. The subjects were asked to have light breakfast two hours before the tests and were instructed not to have coffee, tea or cola 12 hours prior to the tests.

Materials

Autonomic function tests can be carried out by using Electrocardiograph, recording of pulse and thermometer.

Deep Breathing Test

In the sitting position subject was asked to breathe quietly and deeply at the rate of 3 breaths per 30sec. A continuous ECG was recorded for 3 cycles with marker to indicate the onset of each inspiration and expiration. The maximum and minimum R-R intervals were measured during each breathing cycles and converted to beats per minute. The result was then expressed as mean of the difference between maximum and minimum heart rate for 3 measured cycles in beats per minute. Deep breathing difference (DBD) = mean of heart rate differences in 3 breath cycles. A normal response was a difference of 15beats/min or more, 11-14 beats/min borderline and less than 10 beats/min was considered abnormal

Heart-Rate variation to Valsalva Manoeuver

The subject was seated comfortably and was asked to blow into a mouthpiece connected to a mercury sphygmomanometer and holding it at a pressure of 40 mm of mercury for 15 seconds, while a continuous ECG was being recorded. The ECG was continued to be recorded after release of pressure at the end of 15 seconds for 30seconds. The change in heart rate induced by the Valsalva maneuver is expressed asthe ratio of the maximal tachycardia during the manoeuvre to the maximal bradycardiaafter the manoeuvre. This ratio was defined as the Valsalva ratio and was calculated asthe ratio of maximum R-R interval after the maneuver to minimum R-R interval duringthe manoeuvre.Valsalvaratio (VR) = maximal tachycardia/maximum bradycardia = maximum R-R interval/minimum R-R interval.A value of 1.10 or less is defined as an abnormal response, 1.11-1.20as borderline, and 1.21 or more as a normal response.

Heart rate response to standing - Postural Tachycardia Index (PTI)

The subjects were asked to lie on the examination table quietly while heart rate is being recorded on ECG. They were then asked to stand-up unaided and ECG was recorded for 1minute. The shortest R-R interval at or around 15th beat and longest R-R interval at or around 30th beat was measured. The result was expressed as ratio of 30/15.

PTI= Longest R-R interval at 30th beat / shortest R-R at 15th beat.

A ratio of 1.00 or less was defined as an abnormal response, 1.01-1.03 as borderline and 1.04 as normal response.

RESULTS

The mean ± SD of Age of the groups 36-45yrs and 46-55yrs were found to be 41.125 ± 2.95 and 51.51 ± 2.78 respectively. The mean ± SD of Body Temperature of the groups 36- 45yrs and 46-55yrs were found to be 96.74 ± 1.01 and 96.64 ± 2.48 respectively The mean ± SD of Resting Pulse Rate of the groups 36-45yrs and 46-55yrs were found to be 82.63 ± 11.14 and 75.20 ± 9.65 respectively. Results were analyzed and expressed in the following ways:

- Changes within the groups before and after the tests were analyzed by paired ‘t’ test.
- Inter group changes were analyzed by unpaired ‘t’ test

Table-1: Heart rate response to Deep Breathing response and Valsalvamenoeuver in 36-45yrs.

	Deep breathing difference (bpm)	Valsalva ratio	Postural tachycardia index
Mean	13.38	1.21	1.05
SD	6.31	0.13	0.09
SEM	1.29	0.03	0.02

Table-2: Showing Heart rate response to Deep Breathing response and Valsalvamenoeuver in 46-55yrs

	Deep breathing difference (bpm)	Valsalva ratio	Postural tachycardia index
Mean	12.42	1.17	1.04
SD	7.75	0.12	0.08
SEM	0.89	0.01	0.01

Table-3: Percentage distribution of cases according to age groups in normal, border line and abnormal patterns in deep breathing difference

Age group (Yrs)	Total (%)	Normal (%)	Borderline (%)	Abnormal (%)
36-45	24(100)	10(41.7)	2(8.3)	12(50.0)
46-55	76(100)	22(28.9)	17(22.4)	37(48.7)

Table-4: Percentage distribution of cases according to age groups in normal, border line and abnormal patterns invalsalva ratio

Age group (Yrs)	Total (%)	Normal (%)	Borderline (%)	Abnormal (%)
36-45	24(100)	12(50.0)	8(33.3)	4(16.7)
46-55	76(100)	35(46.1)	13(17.1)	28(36.8)

Table-5: Percentage distribution of cases according to age groups in normal, border line and abnormal patterns postural tachycardia index

Age group (Yrs)	Total (%)	Normal (%)	Borderline (%)	Abnormal (%)
36-45	24(100)	15(62.5)	2(8.3)	7(29.2)
46-55	76(100)	42(55.3)	3(3.9)	31(40.8)

DISCUSSION

Heart Rate Response to Deep Breathing

Percentage distribution of cases according to age groups in normal, borderline & abnormal patterns is given in Table-3. England JD, Gronseth GS, Franklin G, Carter GT *et al*., in 2009 in their study titled "Evaluation of distal symmetric polyneuropathy: the role of autonomic testing, nerve biopsy, and skin biopsy" stated that heart rate variability with deep breathing is the most widely used test of cardiovagal function and has about _80% specificity [4]. Christopher H. Gibbons, Roy Freeman, Aristidis Veves, in the year 2010 recruited 130 individuals: 25 healthy subjects and 105 subjects with diabetes. Heart rate response is significantly lesser in diabetics (8.2±5.0 bpm) when compared with that of normal subjects (16.3±6.7 bpm) [5].

Sixty diabetic patients were taken against age matched controls by Fareeda banu AB, Gorkal AR, Narsimha Setty KR in 2011 in their study 'a simple test of one minute heart rate variability during deep breathing for evaluation of sympathovagal imbalance in patients with type 2 diabetes mellitus'. Statistically significant decrease in mean minimal heart rate and 1 minute HRV (16.30±6.42 vs 29.33±8.39) was observed during deep breathing among Type 2 Diabetic patients on comparison with that of healthy controls [6].

S Sucharita, Ganapathi Bantwal, JyothiIdiculla, VageeshAyyar, and Mario Vaz in their study in 2011, recruited 23 diabetic subjects and their age matched controls. Test of cardiac parasympathetic activity ie timed deep breathing was significantly lower in patients with diabetes compared to the controls (P<0.05) [7].

In a study titled Autonomic changes in preoperative uncomplicated diabetic patients with postural changes by Yun WH *et al.*, in 2010, heart rate variability during deep breathing of diabetics and healthy normal subjects were matched in different postures. HRV in diabetic patients was lower than in controls at all positions [8].

Heart Rate Response to Valsalva maneuver

The abnormal Valsalva response (Table-4) in the subjects may be due early parasympathetic damage involving vagal nerve.

Prakash S B, Asmita S. Nene, Kalpana M in 2014 studied 100 diabetic patients matched against 50 normal healthy controls in their study titled 'A cross sectional study for the evaluation of autonomic nervous system functioning in type 2 diabetes mellitus patients'. The Valsalva ratio was decreased in diabetics (1.24±0.03) as compared to controls (1.27±0.02) which was statistically significant (p< 0.01) [9].

Lata Patil *et al*., in 2013 in a study entitled AComparative study of heart rate variability during Valsalva maneuver in healthy, hypertensive and diabetic subjects, VR was significantly reduced (1.1883+0.1302) statistically highly significant, which may be because of sympathetic dominance and due to parasympathetic dysfunction [10].

S Sucharita, GanapathiBantwal, JyothiIdiculla, VageeshAyyar, and Mario Vaz in their study in the year 2011, recruited 23 diabetic subjects and their age matched controls. Tests of cardiac parasympathetic activity such as timed deep breathing and Valsalva ratio were significantly lower in patients with diabetes compared to the controls (P<0.05) [7].

Fisher BM *et al.*, in their study found 5 patients out of 115 of asymptomatic diabetic patients showed abnormal response to Valsalva ratio and 6 out of 9 patients of symptomatic diabetics showed abnormal response to this test [15]. Christopher H. Gibbons, Roy Freeman, Aristidis Veves, in the year 2010 recruited 130 individuals: 25 healthy subjects and 105 subjects with diabetes. Valsalva ratio was significantly less in diabetics (1.26 ±0.21) when compared with normal subjects (1.54±0.23) [5].

In a study on Influence of cardiovascular diseases upon the results of the cardiovascular reflex tests in diabetic and non diabetic subjects by Kronert *et al*., have opined that, in the old non diabetic and

diabetic patients, cardiovascular reflexes were generally impaired but did not show any difference between subjects with and without cardiovascular diseases. In young diabetic patients suffering from cardiovascular diseases, the diagnostic value of cardiovascular reflex tests is reduced as far as cardiac autonomic neuropathy is concerned. The older patients, the tests are not suitable for the diagnosis of diabetic autonomic neuropathy. More specific methods are required [11].

Heart rate response to standing

The abnormal heart rate response (Table-5) to standing in the subjects may be due to vagaldamage as a part of diabetic autonomic neuropathy. In 2014, Prakash S B, Asmita S. Nene, Kalpana M studied 100 diabetic patients matched against 50 normal healthy controls in their study titled 'A cross sectional study for the evaluation of autonomic nervous system functioning in type 2 diabetes mellitus patients'. Ratio of heart rate on standing decreased in cases as compared to controls ($p < 0.05$) [9].

A study titled 'Cardiac Autonomic Neuropathy (CAN) in Type-1 Diabetes Mellitus Patients and its Association with the Duration of Disease and Glycemic Control' by Haji Khan Khoharo, Shuaib Ansari, Imran Ali Shaikh and Fatima Qureshi in 2009, 24% of the subjects showed borderline response whereas 10% of them showed abnormal heart rate response to standing [12].

Chugh SN *et al.*, in their study in 2011, titled 'QT Dispersion in Patients of Diabetes Mellitus without Manifest Cardiac Dysautonomia' consisted of 50 diagnosed cases of diabetes mellitus. Of them 13 subjects showed abnormal response and 14 subjects were found to have borderline response of heart rate to standing [13].

In a study titled 'Determination of sensitivity among various cardiovascular autonomic function tests in diabetic patients of Bijapur' done by Chavan NR, Dhundasi SA, Das KK in 2009 recruited eleven diagnosed diabetic patients and fifteen healthy age-matched control subjects were subjected to six standardized cardiovascular autonomic reflex function tests. Only two subjects have shown abnormal response and one subject has shown borderline response of heart rate to standing [14].

CONCLUSION

Involvement of nervous system is a well-known complication of diabetes. Neuropathy is one of the most common complications of diabetes. At an early stage autonomic dysfunction may be asymptomatic or mildly symptomatic. Symptomatic autonomic neuropathy carry worst prognosis, so early diagnosis is essential for maximum benefit.

In conclusion, our present study indicates that:

- More sympathetic tests have shown significant abnormal responses in diabetics compared to parasympathetic tests.
- Probably no single test suffices indicating normality or autonomic neuropathy in diabetics and a battery of tests reflecting both parasympathetic and sympathetic functions is preferable.

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