A Comparative Study Of Autonomic Functions Between The Patients Of Diabetes Mellitus And Controls

Morker B*, Patel R, Rajdeep P*****

**Associate professor, ***Tutor,*M.Sc. student, Department of physiology, Medical College, M.S.University, Vadodara-390001,

Abstract: Background: Autonomic failure is encountered in many clinical conditions as primary or secondary disorders. Amongst all, Diabetes mellitus is most common systemic disease causing autonomic dysfunctions, whose severity is related to duration of diabetes and the degree of the metabolic control. While the degree of loss of autonomic functions can be assess by series of autonomic tests. The aim of the present study was to find out the effects of diabetes mellitus on autonomic functions. Method: In this cross sectional study, 30 diabetics were compared with 30 non-diabetics (plasma glucose level between 80-120 mg %) for their autonomic functions. Their autonomic functions were counted as per the protocol of 'Autonomic Function Lab', AIIMS, New Delhi. Statistical analysis was performed using Medcalc 11.1.0.0 statistical software. Result: All the autonomic tests- Deep breathing test, Valsalva maneuver, Sustain hand grip test & Lying to standing test has shown significantly altered autonomic functions amongst diabetics than non diabetics. Conclusion: Diabetes mellitus is one of the systemic disease which leads to autonomic dysfunctions when compared to non diabetes which may be because of increased blood glucose.

Key words: Diabetes mellitus, Autonomic neuropathy, Autonomic function tests

Author for correspondence: Bhavna morker, Department of physiology, Medical college of baroda, M.S.University, Vadodara-390001, Gujarat, India. E-Mail: morker.bhavna@yahoo.com M.9726054684

Introduction: Autonomic system is the part of peripheral nervous system and subdivided into the sympathetic and the parasympathetic nervous system. It controls the most visceral functions of the body. When these functions are compromised, it results into "Autonomic malfunction". Autonomic malfunctions are also known as "Autonomic Neuropathy".

Autonomic failure results in mild-to-severe degree of life threatening conditions depending on the degree of dysfunction. In neuropathy nerve fibers of different size and of different types may be variably involved.[1, 8]Autonomic failures is encountered in many clinical conditions as primary disorder or secondary disorder such as diabetes mellitus, alcoholism, amyloidosis etc. Diabetes mellitus is most common systemic disease causing neuropathy. It occurs secondary to metabolic disturbance, and prevalence is related to duration of diabetes and the degree of the metabolic control. In such conditions, clinical assessment may not be sufficient to assess the degree of autonomic failure. Clinical symptoms of autonomic failure may appear late in the course of disease. In these conditions and assessment of degree of loss of autonomic functions can be done by series of autonomic tests.

Material And Method: This cross sectional study was designed as per the protocol of autonomic function lab, AIIMS, New Delhi. Participants were recruited from Medicine OPD of SSG Hospital and were enrolled after taking informed written consent.

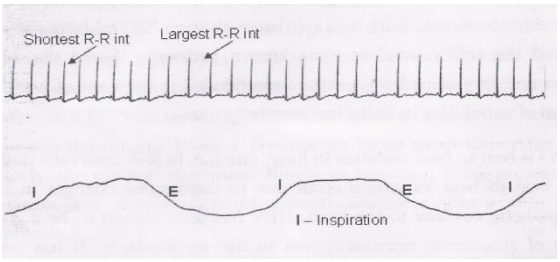
All Participants were free of hypertension or any other systemic disease. In our study, two different categories of participants are, non-diabetic control subjects (n=30), whose plasma glucose level remain within normal range i.e. between 80-120mg%, and second category is diabetes subjects (n=30, under medical treatment and has diabetes[1,2] for more than 5 years as referred from hospital case paper). At the time of participation plasma glucose level of all the participants were taken by digital glucometer (GLUCOCHECK).[4, 5]

Autonomic functions of 30 diabetics and 30 non-diabetics making a total of 60 voluntary participants were compared on the bases of the following tests-

Deep breathing test: Procedure Continuous ECG and Respiration of a supine participant is recorded by Schillers Multipara Monitor for six cycles per minute (which was guided by a hand

signal to get a smooth, slow & deep breathing) and E:I ratio is measured.

Fig 1: Tracing of deep breathing test with three respiratory cycles

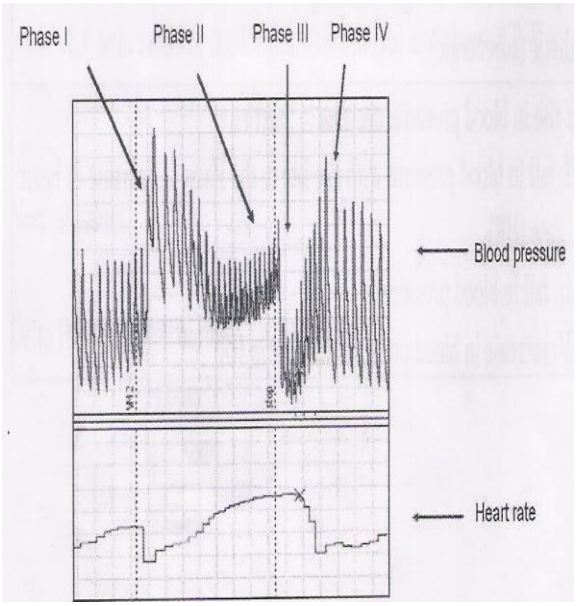


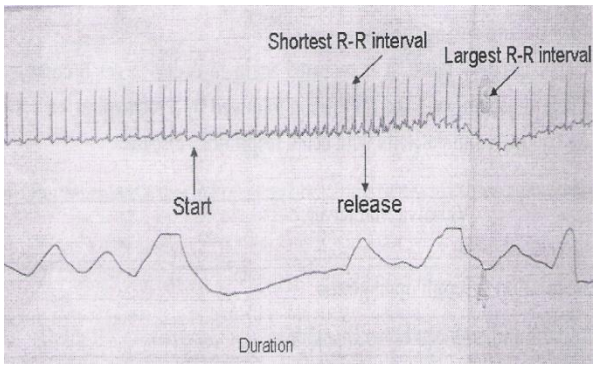
E ratio = Longest R-R interval during expiration / Shortest R-R interval during inspiration
I

(Averaged over 6 cycles) Normally during breathing test E : I ≥ 1.21

Valsalva maneuver: Procedure Participant in supine position is asked to expire into mouthpiece attached to sphygmomanometer. The participant has to maintain the expiratory pressure at 40 mmHg for 15 seconds. Their ECG, Respiration and BP are recorded as ab

Fig 2: Tracing of Valsalva Maneuver record with different phases





Valsalva ratio = Longest R-R interval in phase IV / Shortest R-R interval in phase II

Normally valsalva ratio is more > 1.2

Sustained handgrip test: Procedure After taking baseline blood pressure the participant is asked to maintain a handgrip of 30% of their maximum voluntary contraction for 4 min in handgrip dynamometer and blood pressure is measured during the test. Normal increase in diastolic blood pressure is ≥ 16 mm Hg.

Lying to standing test: Procedure The base line blood pressure and heart rate is taken during resting condition in supine position. After 10 minutes of rest the participant was told to attain standing posture within 3 seconds and recordings are taken immediately.

Normally fall in systolic blood pressure ≤ 10 mm Hg.

Result: In our study, demographic characteristics (age, height, weight), diastolic blood pressure and basal heart rate has shown no significant difference in their distribution amongst the two groups while FBS, PP2BS and basal systolic blood pressure has shown a significant difference. This provides the most suitable background to carry out the comparison amongst the diabetics and non-diabetics.

Table 1: It is showing age, height, weight, FBS, PP2BS, duration of diabetes, systolic blood pressure, diastolic blood pressure, heart rate in diabetes mellitus group and non-diabetes group i.e. control subjects

No	Parameters	Diabetic (n=30)		Non-diabetic (n=30)	
		Mean	SD	Mean	SD
1	Age (Years)	49.47	13.35	49.57	14.17
2	Height (cm)	158.97	9.11	171.26	6.10
3	Weight (kg)	62.3	11.45	71.1	8.58
4	FBS (mg/dl)	156.3*	55.19	94.43	13.54
5	PP2BS (mg/dl)	219.93 *	72.90	151.7	10.36
6	Systolic B.P. (mm of Hg)	137.13 *	17.50	120.67	6.86
7	Diastolic B.P. (mm of Hg)	78.37	8.88	78.3	7.25
8	Basal H.R./min	80.47	12.18	80.87	12.36

*Statistically significant.

Table 2 : Comparison of autonomic functions in diabetes mellitus group and non-diabetic group based on mean values

No	Test	Group	Mean	SD	'p' Value
1	Deep breathig	Control	1.525	0.266	<0.0001
		Diabetic	1.109	0.148	
2	Valsala maneuver	Control	1.734	0.320	<0.0001
		Diabetic	1.107	0.081	
3	Sustained handgrip	Control	22.2	6.375	<0.0001
		Diabetic	10.6	5.411	
4	Lying to Standing	Control	3.8	2.537	<0.0001
		Diabetic	13.9	5.352	

While comparing both the groups for autonomic functions it shows statistically significant differences which indicates diabetes as the main culprit in causing autonomic dysfunctions.

Discussion: The activity of the autonomic nervous system is of crucial importance in moment to moment regulation of heart rate and blood vessels resistance, thereby controlling arterial pressure, cardiac output and tissue perfusion[3]. Assessment of cardiovascular autonomic nerve damage can be made from the combined results of simple non-invasive cardio-autonomic tests[4]. From the above result, it can be explained that diabetes mellitus affect the autonomic system.

Duration of diabetes had a significant correlation with the degree of cardiac autonomic dysfunction detected by all the studied tests. Schnell et al[1] and Nsimies et al[2]showed the passive effect of the disease duration on all the tests results.

The mean value of heart rate response to E:I ratio in diabetes and control group were(1.109±0.148) and (1.525±0.266) respectively, they show statistically significant difference. Samy m. makary and associates[5] found statistically significant (p=0.02) difference of mean values of HR response to E:I ratio in diabetics(1.13±0.18) and control(1.37±0.18) group, when carried out study on 77 diabetic subjects and 23 control subjects. The mean values of heart rate response to valsalva ratio in diabetic and control group were (1.107 ± 0.081) and (1.734 ± 0.320) respectively. The differences of mean values were statistically significant (P< 0.0001).Didangelos and associates (2003)(6) found statistically significant (P< 0.001) difference of mean values of HR response to valsalva ratio in diabetics with DAN (1.38 ± 0.26) and controls i.e. diabetics without DAN (1.78 ± 0.29) which shows association of diabetes with diabetic auto neuropathy.

The mean values of increase in diastolic blood pressure (mmHg) during sustained handgrip test in diabetic and control group were (10.6 ± 5.41) and (22.2 ± 6.37) respectively. The mean difference in diastolic blood pressure was statistically significant P< 0.0001. May O and associates[7] reported impaired diastolic blood pressure increase during sustained handgrip test which is statistically significant i.e. P=0.037.

The mean values of decrease in systolic blood pressure (mmHg) during postural change from lying to standing in diabetic and control group were (13.9 ± 5.35) and (3.8 ± 2.53) respectively. The mean difference in systolic blood pressure was statistically highly significant (P< 0.0001). Didangelos and associates[6] also found statistical significant difference (P< 0.001) in mean values of decreased systolic blood pressure in group with diabetic autonomic neuropathy (20.6 ±

13.6) group without diabetic autonomic neuropathy (1.67 ± 4.08).

As very few studies were undertaken amongst the Indians, the above results is very valuable inindicating that there must be some co-relationship between blood glucose level and development of neuropathies and hence autonomic dysfunctions. Specific investigative studies will better able to explain patho-physiological changes which are resulting in these dysfunctions.

Conclusion: Diabetes mellitus is one of the systemic disease which leads to autonomic dysfunctions, which may be because of interactions between increased blood glucose and neuronal tissues. Autonomic dysfunction is a prevalent and serious complication for individuals with diabetes.

References:

1. Schnell O KC, Stemplingec J, Haslbeck M. Scintigraphic evidence for cardiac sympathetic dysfunction in long term IDDM patients with and without ECG based autonomic neuropathy. Diabetologia. 1995;38(11):1345-52.
2. Nsimies EA UM, Mtysarra MJ, Niskamen LK. Occurrence, predictors, and clinical significance of autonomic neuropathy in NIDDM. . Ten years follow up from the diagnosis Diabetes 1996;45(3):304-8.
3. Braunwald, editor. Text book of cardiovascular medicine. Philadelphia, W. B. Saunders Co.1988.
4. Ewing. Aurtonomic neuropathy. Chronic complication of Diabetes 1994:p. 124-35.
5. Samy M. Makary HAS, Yasser M. El-Wazir, Abd El-Ariz Mahmoud. Physiological Assessment of Cardiac Autonomic Reflexes in Diabetics. Suez Canal Univ Med J 1999 March;Vol. 2(No. I):61-72.
6. Triantaffilos P. Didangelos M, Georgios A. Arsos, MD2, Dimitrios T. Karamitsos, MD1, Vasilios G. Athyros, MD1,Nikolaos D. Karatzas, MD2. Left Ventricular Systolic and Diastolic Function in Normotensive Type 1 Diabetic Patients With or Without Autonomic Neuropathy. Diabetes Care 2003;26:1955-60.
7. May O AH. Long-term predictive power of simple function tests for cardiovascular autonomic neuropathy in diabetes: a population-based study. ActaDiabetol. 2011;48(4):311-6.

Source Of Financial Support-Nil
Conflict Of Interest-None