The Effect of Type 2 Diabetes Mellitus on Cardiac Autonomic Function Tests in recently diagnosed Diabetes Mellitus

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ABSTRACT

Introduction: Diabetes is a lifelong metabolic disorder and is becoming an epidemic in the poorly developed countries. Micro vascular complications leading to cardiac Autonomic neuropathy can be present even at the time of diagnosis which indicates its early onset. HRV is a gold standard for autonomic variability measured as standard deviation of normal to normal RR intervals [SDNN]) in milliseconds and mean heart rate are the markers of autonomic functions. Higher SDNN is healthier than a lower value. **Objectives:** (1) To determine the Heart Rate, Systolic Blood Pressure & Heart Rate Variability in Supine and Standing postures in recently diagnosed diabetics. (2) To compare the values with a healthy control group. **Materials and methods:** 20 recently diagnosed [< 1yr duration], male Type2 Diabetic patients in the age group of 45 to 55yrs were selected. Apparently healthy males of the same age group were the controls. The HR, SBP and mean of SDNN in the supine and in standing were recorded for 5 minutes in both the groups. **Results:** The results statistically analyzed using 'Independent Sample Students t Test' showed that the effect of diabetes on the HR and SDNN [HRV] were statistically significant with a p value <0.001, both in supine and standing postures. The association with SBP in supine was significant but that in standing was not statistically significant. **Conclusion:** Cardiac autonomic neuropathy starts very early in Type2DM that is evident by the reduced HRV warrants early diagnosis and stringent glycemic control to reduce sudden cardiac deaths.

Keywords: Autonomic neuropathy, Glycemic control, Heart Rate Variability, RR intervals,Type 2 Diabetes Mellitus

Introduction

Diabetes, one of the oldest diseases known affects 422 million people in the world, as per the latest WHO review [1]. Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder and its prevalence has been increasing worldwide. It is almost becoming an epidemic in some countries especially in poorly developed countries, which adds on to the burden on healthcare system[2]. Diabetes is a lifelong metabolic disorder that affects almost all systems of the body. Patients with type 2 DM develop complications in the course of the disease resulting in increased morbidity and mortality[2]. Micro vascular complications affecting the cardiovascular system are one of the

earliest complications which can be present even at the time of diagnosis which indicates that the disease process began much earlier. Autonomic neuropathy is an important cause for the cardiovascular effects of diabetes [3]. Early diagnosis and management with stringent glycemic control and life style modifications can delay the onset and retard the progress of the complications. Here lies the importance of Autonomic Function Tests to detect the cardiovascular effects of DM[4]. Apart from the usual diagnostic methods like postural hypotension, recently the tests for alteration in the Heart Rate variability(HRV) is being used. In this study the changes in Systolic Blood Pressure, Heart Rate and Inter beat interval (RR or NN intervals) were used as parameters to assess the cardiac autonomic functions in the short time domain in the recently detected diabetics [5].

Aim and Objectives

1. To determine the Heart Rate, Systolic Blood Pressure & Heart Rate Variability in Supine and Standing postures in recently diagnosed diabetics.

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2. To compare the values of the mean heart rate, Systolic Blood Pressure & Average RR intervals with a healthy control group.

Materials and Methods

After obtaining the Ethical Committee clearance and the written informed consent from each participants, 20 recently diagnosed[less than 1yr duration], male Type2 Diabetic patients in the age group of 45 to 55yrs were selected. A control group was selected after obtaining written informed consent individually, consisting of apparently healthy volunteers of the same age group [45-55yrs]. Both the groups were instructed to have good sleep in the night before and the tests were done in the morning hours for all of them to avoid the effect of diurnal variation. They were advised to refrain from smoking, alcohol or any other stimulants and antihistamines for two days prior. The lighting was kept optimal and undue noises were avoided in the recoding room. After allowing a sufficient relaxation in the supine position, the resting heart rate, SBP and beat to beat variability of heart beat from the RR intervals were recorded continuously for 5 minutes using the Power lab of AD Instruments 16/35 version. The subjects were instructed not to speak or sleep during the recording. The same parameters were recorded in the standing posture, for 5 minutes continuously. The mean HR, SBP and SDNN [standard deviation of the mean NN intervals] were obtained and tabulated in excel. Statistical analysis was done by running 'Independent Sample Students t Test' on the data.
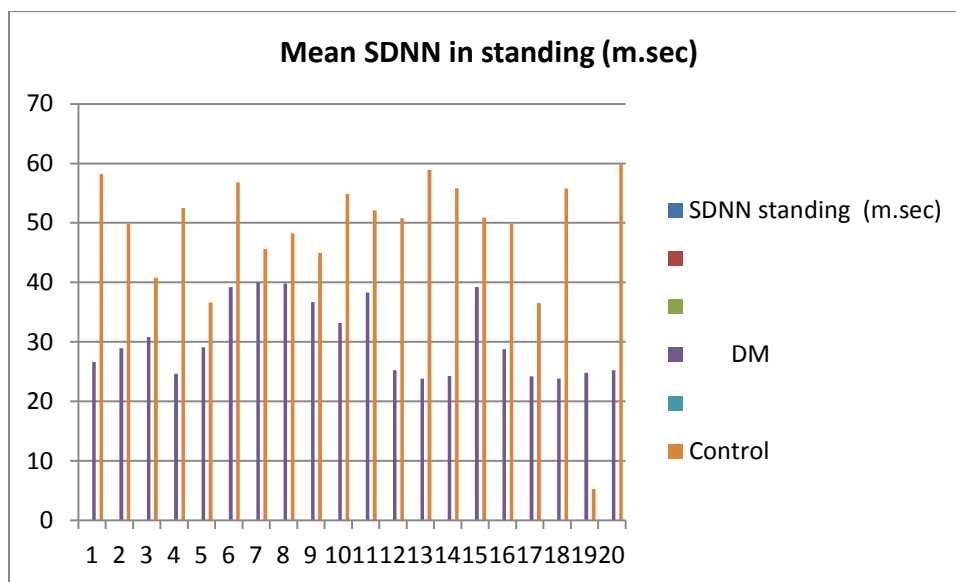
Results

The results showed that the (mean± SD)of resting heart rate[HR] in the supine position was (71.14 ± 1.67) in the study group and (67.86± 0.80) in the control group respectively with a p value <0.001. The mean SDNN [Standard Deviation of the RR (denoted as NN being the normal RR) intervals] in the Study group was (31.39± 4.11) and (44.48 ± 6.54) in the controls with a p value < 0.001. The Mean (mean± SD) of Systolic Blood Pressure [SBP] in the supine posture was (115.90± 14.77) and (107.93± 7.32) in standing and the p value was 0.039. The (mean± SD) of HR in the standing posture was (82.14 ± 6.68) in the study group and (71.42± 1.99) in the control group respectively with a p value < 0.001. The (mean± SD) of SDNN were (30.34± 6.27) and (48.22 ± 12.19) in the two groups having a p value of < 0.001. The (mean± SD) of SBP in the Type2DM was (117± 16.41) and (109.12±8.06) in the control group with a p value 0.062

Table 1: Comparison of Heart rate, SDNN & SBP in supine and standing with controls

		Group	N	Mean	Std. Deviation	p-value
Supine	HR(bpm)	DM	20	71.14	1.67	**<0.001**
		Control	20	67.86	0.80	
	SDNN(m.sec)	DM	20	31.39	4.11	**<0.001**
		Control	20	44.88	6.54	
	SBP(mm. Hg)	DM	20	115.90	14.77	0.039
		Control	20	107.93	7.32	
Standing	HR(bpm)	DM	20	82.14	6.68	**<0.001**
		Control	20	71.42	1.99	
	SDNN(m.sec)	DM	20	30.34	6.27	**<0.001**
		Control	20	48.22	12.19	
	SBP(mm. Hg)	DM	20	117.08	16.41	0.062
		Control	20	109.12	8.06	
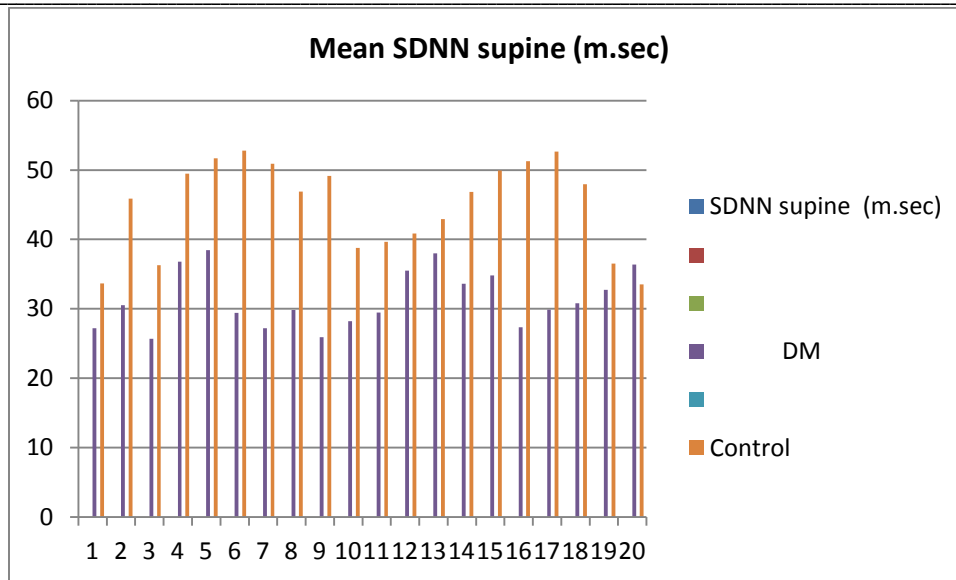
Graph 1: comparison of HRV (Mean SDNN) in supine posture

Graph 2: comparison of HRV (Mean SDNN) in standing posture

Discussion

Autonomic neuropathy resulting in cardiovascular complications is a common complication in diabetes [3]. This is one of the leading causes of death in diabetics and is the reason for silent myocardial infarction which warrants the need for early diagnosis and management [8]. The blood pressure response to sustained handgrip, orthostatic hypotension and the Valsalva ratio are dependable indicators of autonomic dysfunction [6]. Changes in the systolic blood pressure (SBP) and decrease in heart rate variability (HRV) are the recent parameters [5]. HRV is the beat to beat variation in the RR intervals in a continuous recoding using a 24 hours long term or 5 minutes short term recording. HRV is a gold standard for autonomic variability [7] which is an invasive measure of the cardiac autonomic tone, measured as standard

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deviation of normal to normal RR intervals [SDNN]) [8] in milliseconds (ms). SDNN and mean heart rate are considered as the markers of autonomic functions in which higher SDNN is healthier than a lower value[7]. Decreased HRV common in diabetic patients without any obvious heart disease is a risk factor for sudden death[9,10]. HRV can be assessed in time domain and in frequency-domain to quantify the severity of autonomic dysfunction[11,12]. In my study the Mean HR, SDNN and SBP of the study group (Recently detected Type2DM male patients) were compared with that of the control group (apparently healthy men of the same age group), both in supine (resting) and standing postures. The influence of age, sex, time of the day etc. on HRV were nullified in selecting the control group and the recording time [13,14, 15]. The statistical analysis was done by running 'Independent Sample Students t Test' on the data. This showed that the effect of recently detected DM on the Mean HR and the mean SDNN in the supine position was statistically significant and the p value was <0.001 for both the parameters. The p value for the effect of DM on the same 3 parameters in standing posture was also <0.001, indicating that the association was statistically significant. This proves that there is decrease in the HRV (mean SDNN) in the recently detected DM patients both in supine and standing postures. This study also proves that the resting HR is increased in the Type2DM patients, indicating their increased sympathetic tone. The p value for the mean SBP in the supine posture was 0.039 showing that the effect of diabetes on the resting SBP was statistically significant, probably due to the sympathetic dominance [17]. However, the p value for the mean SBP in standing posture was only 0.062, indicating that the effect of recently detected Type2DM on the standing SBP was not statistically significant[5]. Hence HRV can be used as an important indicator of autonomic dysfunction that has already started in these patients [8, 16].

Conclusion

This study concludes that the cardiac autonomic neuropathy starts very early in Type 2 DM which is evident by the reduced HRV in recently diagnosed patients. This warrants early diagnosis and stringent glycemic control to reduce cardiac complications and sudden death in diabetics.

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