

## Effect of supine rest on cardiac autonomic tone in type 2 diabetes mellitus

Farhana Rahman<sup>1</sup>, Sultana Ferdousi<sup>2</sup>

### Abstract

**Background:** Autonomic nerve dysfunction has been noted in type 2 diabetes mellitus (T2DM). Regular practice of supine rest (SR) may cause improvement of this impaired autonomic nerve function. **Objective:** To observe the effect of SR on the autonomic nerve activity by analysis of heart rate variability (HRV) in patients with T2DM. **Methods:** This prospective interventional study was carried out in the Department of Physiology, Bangabandhu Sheikh Mujib Medical University (BSMMU) during 2016 on 30 female diagnosed T2DM patients aged 50-55 years with duration of diabetes of 5-10 years. They performed SR (20 minutes twice daily) for 3 months. The diagnosed patients were selected from the Out Patient Department of Endocrinology, BSMMU, Dhaka. Thirty age matched apparently healthy females who did not perform regular SR, were control. To assess the cardiac autonomic nerve function, HRV parameters of all subjects were recorded by PowerLab. HRV data of all subjects were collected at baseline and also after 3 months follow-up. In addition, urinary level of Vanillyl Mandelic acid (VMA) of all subjects were measured at baseline and at post intervention period for patients. For statistical analysis, paired and independent sample t-tests were done, as applicable. **Results:** The pre-intervention values of LF normalized unit (LF nu), LF/HF ratio ( $p < 0.01$ ) and urinary VMA were significantly higher ( $p < 0.001$ ) and HF normalized unit (HF nu) was significantly ( $p < 0.01$ ) lower in all diabetic patients compared to control. The post-intervention data showed LF nu, LF/HF ratio and urinary VMA were reduced and HF nu was increased but these changes were not statistically significant ( $p > 0.05$ ) in diabetic patients. **Conclusion:** This study concluded that parasympathetic activity decreased, increased sympathetic activity with higher sympathovagal balance indicating autonomic dysfunction in patients with T2DM, which was shown with trend of improvement after regular practice of supine rest of 3 months though statistically not significant.

**Key words:** type 2 diabetes mellitus, supine rest, heart rate variability, vanillyl mandelic acid.

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For Authors Affiliation, see end of text.

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### Introduction

**T**ype 2 diabetes mellitus (T2DM) is the most common form of diabetes.<sup>1</sup> Diabetic autonomic neuropathy (DAN) is a serious and common complication of T2DM, associated with increased mortality<sup>2</sup>. Features of

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DAN are manifested in functional disorder of various organ systems such as cardiovascular, gastrointestinal, genitourinary system<sup>2</sup>. Cardiac autonomic neuropathy (CAN) is a subtype of the diabetic autonomic neuropathy classified into a subclinical autonomic dysfunction and clinically overt stage<sup>3-4</sup>. Clinical CAN or late stage

CAN occurs due to both parasympathetic and sympathetic denervation of heart which may present with resting tachycardia, orthostatic hypotension, exercise intolerance and silent myocardial ischemia<sup>2, 4-6</sup>. In the scientific literature, multi-factorial treatment strategy and life style modification have been suggested for prevention of autonomic dysfunction in patients with type 2 DM<sup>7</sup>. Despite this report, no ideal or effective therapy specific for improvement of autonomic impairment in T2DM are suggested in clinical practice except symptomatic treatment<sup>7,8</sup>.

In recent days, relaxation technique has been popularly claimed to be effective in the prevention, management and cure of many kind of diseases<sup>9-11</sup>. Yoga is the most common form of relaxation technique adopted in Indian culture since ancient time.<sup>12</sup> Among the yoga based relaxation techniques, deep relaxation technique (DRT), supine rest (SR) or shavasana, cyclic meditation (CM) has become topic of research focus, studied by several investigators in both health & diseased condition<sup>13-20</sup>. SR has been described as relaxation & awareness on the border between sleep and wakefulness, allowing contact with the sub conscious and unconscious mind<sup>13</sup>.

Various investigators investigated the effect of relaxation response on cardiac autonomic nerve function by assessment of heart rate variability (HRV) which is more sensitive, non invasive procedure to quantify cardiac parasympathetic and sympathetic activity<sup>18,20-23</sup>.

Among the different HRV outcome measures frequency domain measures of HRV include high frequency (HF) norm which determines vagal modulation & low frequency (LF) norm represents sympathetic modulation on heart and also LF/HF reflects sympathovagal balance of cardiac autonomic control<sup>23,24</sup>. Reduced HRV was reported in T2DM by several studies<sup>17,25-28</sup>.

Several studies observed the relation of HRV measure to catecholamines in plasma and in urine<sup>5,29-30</sup>. Furthermore, urinary excretion of vanillyl mandelic acid (VMA) which is a metabolic end product of released catecholamines in circulation has been measured as a marker for sympathetic activity<sup>31-33</sup>.

In healthy subjects irrespective of sex, significant higher values of HF norm and lower values of LF norm and LF/HF has been reported after practicing relaxation technique. But they failed to show any significant change of these parameters after practicing SR<sup>2,21,34-35</sup>.

There are reports of investigation on the effect of relaxation technique including supine rest on HRV in sedentary female subjects<sup>16</sup>. But the effect of SR on HRV in T2DM has not been investigated yet. Therefore, the aim of this study was to investigate the impact of SR on cardiac autonomic nerve function activity by analyzing HRV in patients with T2DM so that it can be used as an adjunct to treatment of T2DM to improve the cardiac autonomic dysfunction and also to reduce cardiovascular and cardiac autonomic neuropathy and long term complications.

## Methods

This prospective interventional study was conducted during 2016 in the Department of Physiology, Bangabandhu Sheikh Mujib Medical University, Dhaka. The protocol of this study was approved by the institutional review board of BSMMU. This study enrolled to 30 diagnosed female patients of T2DM following criteria of WHO<sup>37</sup> (age: 50 to 55 years; HbA1C: 5-10%; 5 to 10 years duration of DM) as study group by purposive sampling from the Endocrinology out patient department, BSMMU, after taking their written informed consent. All these patients were only under oral hypoglycemic agents in addition to lifestyle modification. All patients were studied

at baseline before beginning SR and same patient was studied after performing SR for 3 months. Age and physical activity matched 30 apparently healthy female previously never exposed to relaxation technique were recruited as control among the relatives and attendants of patients, hospital staffs and also through personal contacts. HRV data of all patients were recorded once before SR then once after completion of 3 months of SR. Similarly, data of healthy subjects were recorded at baseline and after 3 months. History of DAN, T1DM, diabetic retinopathy, nephropathy, hypertension, coronary artery diseases, epilepsy, migraine, psychiatric disorders, respiratory disorders, hypo & hyperthyroidism, consuming drugs with effect on autonomic nervous system function, yoga practitioners and athletes were excluded. A thorough clinical examination of all subjects were done and a detail family and medical histories and also physical activity status were recorded in a prefixed data schedule.

For HRV recording, the finally selected subjects were prepared from one day prior to the test. They were advised to take their meal by 9.00 p.m. and have sound sleep and avoid any physical or mental stress and also sedative medications. In addition, they were advised to take light breakfast in the morning without tea and coffee and to attend at the Autonomic Nerve Function Test Laboratory in the Department of Physiology of BSMMU between 9.00 a.m. to 11.00 a.m. on the day of examination. For HRV measurement, the room temperature of the Autonomic Lab was maintained around 25°C-28°C and the subject was allowed to sit for 15 minutes to adjust with the lab conditions. Then, ECG was recorded on Lead II for 5 minutes, by Power Lab 8/35 (ADInstrument, Australia) from which measures of HRV was analysed by Lab chart software.

24 hour urine of all patients and control group were collected randomly for determination of

VMA using autoanalyzer in the immunological lab of Department of Endocrinology of BIRDEM. The patients were asked to perform SR twice daily for 3 months. For this purpose, patients were trained by demonstrating the procedure of SR for twenty minutes by the researcher. During this session, the participants lay supine in the corpse posture (shavasan) with eyes closed, legs apart and arms away from the body.<sup>2,37</sup> They were requested to practice the steps twice daily in peaceful, lighted and well ventilated room for 20 minutes at home.

Data were expressed as mean and SE. SPSS for windows, version 22.0 was used for statistical analysis. Independent sample t-test was done to compare the mean values between control and T2DM at their baseline and after 3 months and also paired sample t-test was done to compare mean values of data between before and after intervention with SR. p value of < 0.05 was taken as statistically significant.

## Results

In this study, all diabetic patients were similar to non diabetic subjects by mean age but not by BMI, though not all patients were overweight (Table I). In diabetic patients, the baseline mean values of resting pulse rate, SBP, DBP, urinary VMA, LF nu and LF/HF were found significantly higher ( $p < 0.01$ ) whereas HF nu, were found significantly lower ( $p < 0.01$ ) than those of non diabetic control subjects (Table I & II). Again, after 3 months of SR, patterns of all these parameters remained similar in diabetic patients compared to non diabetic control subjects (Table I and II).

The post intervention values of pulse rate, SBP, DBP, urinary VMA, LF nu, LF/HF decreased and HF nu, increased shown by the percentage of changes of these parameters but it failed to show any statistical significance. (Table I and II).

**Table I:** General Characteristics in different groups (n=90)

Parameters	Control (n=30)		T2DM (n=60)		Change %
	Baseline	after 3 months	Baseline	after 3 months	
Age (years)	51.03±0.31		51.62±0.46		
BMI (hg/m <sup>2</sup> )	22.88±0.38		25.97±0.60*		
Pulse (beats)	81.23 ± 1.05	74.61 ± 0.26	85.73 ± 1.22*	83.08±1.09###	-1.09%
SBP (mm of hg)	124.84 ± 1.19	121.61 ± 1.30	133.65±1.16**	130.96±1.33###	-2.01%
DBP (mm of hg)	76.35 ± 0.85	72.97 ± 0.79	85.95 ± 0.98**	84.61±0.10###	-1.56%

Data were expressed as mean ± SE. Statistical analysis was done by independent sample t-test and paired sample t-test. SBP= systolic blood pressure; DBP=diastolic blood pressure; (\*= control baseline vs T2DM baseline; # = control after 3 months vs T2DM after 3 months; \*p<0.01; \*\* p <0.001;###p <0.001; n = number of subjects.

**Table II:** Power Spectral measures of HRV in different groups (n = 90)

Parameters	Control (n=30)		T2DM (n=60)		Change %
	Baseline	after 3 months	Baseline	after 3 months	
LF (n.u.)	55.27±1.60	53.30±1.24	65.05±2.92*	62.12±1.52##	-4.5%
HF (n.u.)	39.67±1.52	40.48±1.58	30.50±2.4*	32.61±1.33##	+6.92%
LF/HF	1.39±0.09	1.40±0.06	2.74±0.47*	1.94±0.13#	-29.20%
VMA	09.06±0.19	09.06±0.19	12.20±0.50**	11.00±0.58###	-9.84%

Data were expressed as mean ± SE. Statistical analysis was done by independent sample t-test and paired sample t-test. LF = Low frequency ; HF = High frequency.(\*= control baseline vs T2DM baseline; # = control after 3 months vs T2DM after 3 months) \* = p <0.01; \*\* = p <0.001;## = p <0.01;### = p <0.001; n = number of subjects, VMA = Vanillyl mandelic acid

## Discussion

The present study observed the changes in HF norm, LF norm, LF/HF and urinary excretion of VMA in T2DM induced by practicing supine rest for 3 months. This study found significantly higher values of LF norm, LF/HF and lower values of HF norm, in diabetic patients compared to non diabetic subjects both at baseline and after 3 months of SR practice. These results suggest deterioration of parasympathetic function and shifting of autonomic balance towards higher sympathetic activity in diabetic patients. Similar results were reported by other studies.<sup>17,24-28</sup> These results of this study did not observe any expected significant changes about autonomic status when compared between

patients and control even after performing SR by the patients.

After 3 months of practicing SR, the diabetic patients did not show any statistically significant change in the components of HRV but there is a trend of increase in the HF norm (6.92%), and decrease in the LF norm (4.5%), LF/HF (29.20%). These data predict the possibility of favorable changes in autonomic nerve function status in diabetic patients though it failed to achieve statistical significance. In addition, this change of autonomic function remain away from that of healthy person demonstrated by significant difference of the post intervention data from that of nondiabetic subjects at follow-up.

Literature review showed that urinary VMA is one of the end product of metabolic degradation of catecholamines in circulation<sup>32</sup>. Its urinary excretion is a measure of sympathetic activity which cause release of catecholamines in circulation<sup>32-33</sup>. Urinary level of VMA in all diabetic patients showed significantly higher level than nondiabetic control group before intervention but this result after intervention did not reflect any significant variation than their corresponding pre-intervention value. The VMA results in diabetics provided further evidence for increased sympathetic activity in diabetics. Though the exact mechanism of these small changes under SR was not well understood but despite absence of statistical significance, changes towards favorable autonomic function induced by SR is quite apparent. The body of literature review proposed, activation of neural network<sup>10,14,38-43</sup>. Furthermore, the failure of SR to bring any significant improvement might be linked to short duration of the intervention. Besides, in several studies, SR for different duration did not show any significant changes in frequency domain measures in healthy individuals<sup>21,34-35</sup>.

Research evidences showed different types of relaxation practice improved several cardiovascular risk in adult with T2DM including glucose tolerance and insulin sensitivity, lipid profiles, anthropometric characteristics and blood pressure and also enhanced cardiac vagal activity and reduces sympathetic activity in healthy volunteers<sup>2,34,35,44</sup>. Therefore, if supine rest could be practiced for sufficient length of time, then it might have brought improvement of autonomic nerve function in T2DM as well.

### Conclusion

In conclusion, though autonomic dysfunction occurred in T2DM, but supine rest did not bring any significant improvement of autonomic nerve function in T2DM after 3 months of intervention. Therefore, present findings suggested supine rest

may not have any effect on autonomic dysfunction in patients with T2DM due to shorter duration of practice but practicing for longer duration may improve cardiac autonomic dysfunction in T2DM patients which warrants further investigation.

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### Conflict of interest

None

### Author affiliations

1. \*Farhana Rahman, Lecturer, Department of Physiology, Sir Salimullah Medical college, Dhaka. Email: rum121285@gmail.com.
2. Sultana Ferdousi, Associate professor, Department of physiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Bangladesh. Email: sferdousiratna@gmail.com. sferdousiratna@bsmmu.edu.bd

\*For correspondence

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