A Comparative Study Of Heart Rate Variability Between Pre And Post Menopausal Women From Health Care Profession

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Abstract: **Background & Objectives:** Ageing is associated with decline in short term indices of heart rate variability (HRV). However there is little evidence regarding the extent to which HRV also depends upon simultaneous changes in the level of estrogen and body fat composition. The aim of the present study was to compare HRV between pre and post menopausal women and to study the effect of estrogen level and body fat composition on HRV. **Method**: HRV was assessed in 30 premenopausal and 30 post menopausal women of medical profession, using frequency domain spectral analysis. Estrogen level was estimated by Chemiluminescence immunoassay method and body fat composition in terms of percent body fat by measurement of skin fold thickness .**Result**s: Post menopausal women have significantly lower high frequency power (HF) (p value <0.001) and higher low frequency power (LF) (p value <0.001) and LF/HF Ratio (index of sympathovagal balance) significantly higher (p value <0.001) among post menopausal women. Analysis after adjusting for age revealed that difference in estrogen level and body fat percentage accounted for the difference of HRV in the study groups. **Interpretation & Conclusion:** Declined estrogen level and increased body fat percentage are associated with autonomic alteration observed among postmenopausal women.

Keywords : Body fat composition, Chemiluminescence immunoassay (CLIA), Heart rate variability (HRV).

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Introduction: Autonomic functions can be assessed by heart rate variability. HRV is beat to beat variation in heart rate (i.e. R-R interval) under resting conditions. These beat to beat variations occur due to continuous changes in sympathetic and parasympathetic outflow to the heart [1,2]. HRV has been shown to be a good tool to measure the degree of autonomic modulation rather than the level of autonomic tone. The analysis of HRV was done by time, frequency and non-linear domains[3].

For short term HRV measurement of 5 minutes, the frequency and non-linear method of HRV are taken into consideration in order to evaluate and comment on the dynamic state of autonomic nervous system.

In the present study we evaluated HRV in frequency domain spectral components.

Low frequency (LF) (0.04-0.15Hz)
High frequency (HF) (0.15-0.4Hz)

High frequency power is largely a function of parasympathetic outflow to the heart while low frequency component normalized for total power is used as a representative index of sympathetic activity to the heart [2,3].

Menopause is defined as the time of cessation of ovarian function resulting in permanent amenorrhea. It takes 12 months of amenorrhea to confirm that menopause has set in; therefore it is a retrospective diagnosis .[5.]

Menopause is multidimensional and influenced by many endogenous and exogenous factors mainly perceived as reproductive hormones deficiency. Their deficiency affect many metabolic and physiological function in the women's body including cardio vascular system[4,6] .

Cardio protective role of estrogen is supported by the observation that the excess risk of cardio vascular disease in women who underwent oophorectomy in young adulthood is prevented by estrogen. In addition data shows a significant reduction in the risk of heart disease in women who take estrogen after a non-surgical menopause[7,8,9].

Analysis of HRV among pre and post menopausal women can be used to evaluate the adaptation of autonomic nervous system due to ageing, decreased estrogen and altered body fat composition.

Material and Method: The study was conducted on 30 premenopausal (age 40-50 yrs) and 30 post menopausal women (age 45-55 yrs) of medical profession from medical colleges of Jaipur .All the post menopausal women in the study reported that they had menopause naturally at

least one year before. Premenopausal women had a regular menstrual cycle. Experimental procedures were performed during the follicular phase.

After detailed inquiry of medical history the subjects with diabetes, hypertension, or other cardiovascular disease were excluded. Subjects on oral contraceptive pills, hormone replacement therapy, drugs that alter the cardiovascular functions were also excluded from the study. Informed written consent was obtained from all participants and the experimental protocol was approved by ethics committee of the college. Subjects were screened after measuring height, weight, basal blood pressure and basal heart rate. The basal recording of blood pressure was done using sphygmomanometer by standard Riva-Roci method. The experiment was carried out in the morning in the fasting state. Subjects were refrained from caffeinated beverages for at least 12 hrs prior to the experiment .All the subjects underwent the test for the study in the following order.

1. Blood sample collection- 5 ml of venous blood sample was collected and serum was separated .Samples were stored at 20^0 C until further analysis and serum estradiol assay was performed using CLIA.
2. Body fat percentage – included the measurement of skin fold thickness at triceps, sub scapular and suprailiac sites. The sum of three skin folds was used in age and gender specific equation to obtain an estimate of body fat percentage.
3. Heart rate variability was recorded by medical analyzer module (based on principle of impedance plethysmography) of NIVOMON, L&T and analysis of signal were done in frequency domain measures. In the frequency domain analysis the power spectrum for the HRV was calculated by the traditional fast Fourier transform (FFT) based method .Data was edited manually for artefacts and ectopic beats .Frequency domain measurement including total variance, high frequency power HF(0.15-0.40 Hz),low frequency power (0.04-0.15Hz) and LF/HF ratio was calculated to assess sympathetic/parasympathetic modulation .

Analysis of data –Numerical data are expressed as means± SD (analysis was performed using Microsoft excel software, Microsoft corporation USA, 2003. Data between the study groups were compared using unpaired student t–test .Statistical significance was assigned at $p<0.05$.

Results: Table I shows subjects characteristics of study groups. It shows that basal systolic and diastolic blood pressure were significantly higher ($p<0.001$) in postmenopausal women. Body fat percentage was also significantly higher ($p<0.001$) among postmenopausal women. Estrogen level in postmenopausal women was significantly lower than premenopausal women ($p<0.001$).

Table 1: Subject characteristics, anthropometric measures & estrogen level.

Parameters	Premeno pausal (n=30)	Postmeno pausal (n=30)	P Value
	MEAN ± S.D	MEAN ± S.D	
Age (yrs)	42.83± 2.59	50.37± 3.22	< 0.001**
Weight (kg)	55.3± 4.68	61.9± 7.14	<0.001**
Systolic blood pressure (mm of Hg)	121.6± 4.91	130.80± 8.41	<0.001**
Diastolic blood pressure (mm of Hg)	78± 4.30	80.9± 2.81	<0.05*
Basal heart rate(BPM)	72.1± 3.8	77.8± 5.6	<0.001**
Body fat percentage	227.9± 19.93	253.93± 29.49	<0.001**
Estrogen (pg/ml)	37.34± 6.12	16.03± 3.82	<0.001**

*Data expressed as mean and SD **p<0.01,*p<.05*

HRV parameters were analyzed after adjusting for age, estrogen and body fat percentage. Table II provides analysis of HRV expressed as total power, high frequency power, low frequency power in normalized units, & LF/HF ratio.

It was found that the total power was significantly lower ($p<0.001$) in postmenopausal women. Post menopausal women had significantly lower HF ($p<0.001$) and higher LF ($p<0.001$) when normalized (nu) for total power. The ratio of LF/HF, the index of sympathovagal balance was significantly higher ($p<0.001$) among post menopausal women.

Table 2: comparison of HRV spectral power between the study groups.

Parameters	Premeno pausal (n=30)	Postmeno pausal (n=30)	P Value
	MEAN ± S.D	MEAN ± S.D	
Total power (ms^2)	3002.9± 2102.4	791.7± 770.3	<0.001**
HIgh frequency power (nu)	65.18± 6.69	32.63± 6.10	<0.001**
Low frequency power (nu)	34.50± 6.69	67.37± 6.10	<0.001**
LF/HFRatio	.54±.16	2.17±.59	<0.001**

*Data expressed as mean and SD **p<0.01,*p<.05*

Discussion: Autonomic modulation is main mechanism responsible for heart rate control in normal subjects. Various techniques and manoeuvres have been developed to detect the integrity of sympathetic and parasympathetic nervous system. Most of the tests such as cold pressure test, Valsalva manoeuvre and tilting table test have evoked response of autonomic nervous system.

Besides being a non invasive study procedure, an important advantage of frequency domain analysis of HRV is that it utilizes spontaneous fluctuations in heart rate to estimate the autonomic nervous system functions. In the present study we recorded HRV while subjects were supine, relaxing and resting in a quiet environment. Since the daily physical activity level is considered as one of the potential confounders in the measurement of autonomic nervous activity .Previous study on comparison of HRV of time domain indices was not constrained for the phases of menstrual cycle during subject recruitment despite the possibility of ovarian hormonal influences on ANS. In the present study all premenopausal subjects were recruited for the study during their follicular phase of menstrual cycle to find out the contribution of estrogen for the difference in HRV between the study groups.

The study indicated that there was significant difference in HRV between postmenopausal and pre menopausal women. It was found that postmenopausal women had a significantly reduced overall fluctuation in autonomic input to the heart and vagal index of HRV, which is reflected by lower total power and HF(nu) .The higher LF(nu) and ratio of LF to HF in postmenopausal women suggest that postmenopausal status is associated with shifting of cardiac autonomic tone towards sympathetic dominance .Such physiological changes can be confounded by age ,declined estrogen level and increased body fat content which take place from pre menopausal to postmenopausal status[10,11]

Conclusion: This study indicates that estrogen and body fat percentage are important confounders responsible for lower HRV in postmenopausal women compared to that of premenopausal women associated with increased sympathovagal balance in postmenopausal women.

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Disclosure: No conflicts of interest, financial or otherwise are declared by the authors.