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RESEARCH ARTICLE

A Comparative Study Of Cardiovascular Parasympathetic Functions During Different Phases Of Menstrual Cycle In Young Healthy Females.

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ABSTRACT

Various studies conducted so far for the evaluation of effect of menstrual cycle on cardiovascular parasympathetic functions have come up with inconsistent results. The high incidence of ischemic heart disease during menopause suggests a close association between ovarian hormone levels and the cardiovascular system. Recent studies suggest that estrogen affects several vital organ systems, including the cardiovascular system and autonomic nervous system, and contributes to the maintenance of an adequate sympathovagal balance. So assessment of autonomic functions during different phases of menstrual cycle is an essential element of clinical examination. Hence, the present study was planned to compare the changes in cardiovascular parasympathetic functions with pre and post menstrual phases of menstrual cycle in 1st year MBBS students. This was a prospective observational study with the primary data that includes 40 healthy volunteer 1st year MBBS students of Government Medical College, Shivpuri. For all the subjects' anthropometric data was collected and cardiovascular parasympathetic functions were assessed by recording electrocardiogram in lead II. Descriptive statistics was done by using IBM SPSS (Software Package used for Statistical Analysis) software version 20.0 and statistical analysis was carried out separately in premenstrual and postmenstrual phases by applying "unpaired t test". The study concludes that no any significant impact is exerted on cardiovascular autonomic functions during the menstrual cycle.

Keywords: Cardiovascular, Parasympathetic Function, Menstrual cycle.

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AIM AND OBJECTIVE

- To study the Effect of Menstrual Cycle on Cardiovascular Parasympathetic functions
- To compare the changes in cardiovascular parasympathetic functions with pre and post menstrual phases of menstrual cycle in 1st year MBBS students

INTRODUCTION

All types of behavioral and hormonal changes occur in women especially during reproductive life. In addition to many changes in the reproductive system, there occurs a regular fluctuation in numerous functions affecting all body systems. These can be physical, psychological or behavioral. Autonomic nervous system (ANS) which provides the physiological background for the perceived changes. Certain autonomic changes have also been reported during menstrual phases. These changes might be due to one or more variables like hormonal levels, physical as well as mental stress, personality characteristics, genetic determinants and social factors which may contribute directly or indirectly. Most often the cumulative physiological effect of stress causes disruption of the natural rhythms and balancing mechanism of female hormones, thereby compromising overall health as well as sexual and reproductive health. Various studies conducted so far for the evaluation of effect of menstrual cycle on cardiovascular parasympathetic functions have come up with inconsistent results [1]. Regular menstrual cycle is an index of women's normal reproductive health. It includes follicular phase and luteal phase [2]. The biological rhythmicity of the cycle is created by the interplay among hypothalamic, hypophyseal and ovarian hormones [3]. The high incidence of ischemic heart disease during menopause suggests a close association between ovarian hormone levels and the cardiovascular system [4,5]. In addition, there are several lines of evidence connecting symptoms and illnesses such as edema idiopathic orthostatic intolerance, syncope, mood, and psychiatric illness to the hormonal alterations along the menstrual cycle [6-8]. The autonomic nerves have a pivotal role in the regulation of the cardiovascular system. Certain autonomic changes have been reported during premenstrual phase. It is likely that the varying levels of ovarian hormones in the normal menstrual cycle may be responsible for such changes in autonomic functions [9]. Recent studies suggest that estrogen affects several vital organ systems, including the cardiovascular system and autonomic nervous system, and contributes to the maintenance of an adequate sympathovagal balance [10]. Because estrogen levels vary throughout the menstrual cycle, cardiac autonomic nervous system activity might also vary within the menstrual cycle. Nonetheless, studies examining the impact of menstrual cycle phases on cardiac autonomic regulation have produced inconsistent results. So assessment of autonomic functions during different phases of menstrual cycle is an essential element of clinical examination so that autonomic dysfunction if any can be ruled out during different phases of menstrual cycle and appropriate measures can be applied to prevent cardiovascular disturbances especially during the reproductive age. It was therefore the present study was planned out to assess cardiovascular parasympathetic functions during different menstrual phases.

MATERIAL AND METHODS

This prospective observational study was conducted over a period of 06 months from September 2019 to February 2020 in department of Physiology, at Govt. Medical College Shivpuri (MP).

Inclusion criteria: 40 healthy, volunteer, 1st year MBBS students in Government Medical College, Shivpuri (MP), with no any major complaints during the menstrual cycle & with no other major illness were selected for the study.

Exclusion criteria: Students suffering from any major illness, with irregular menses, menorrhagia and oligo-menorrhoea were excluded from study.

Special emphasis was given in history for finding out any symptoms suggestive of autonomic neuropathy. All the volunteers were assessed for parasympathetic functions during premenstrual phase i.e. around 25th -26th day of menstrual cycle and during postmenstrual phase i.e. on 6th -7th day of menstruation. Physical parameters like age in years & weight in Kgs were noted in each volunteer.

Electrocardiogram (CARDIOFAX – MS-ECG-1357-Medicaid Systems, Mohali, India) recordings were carried out in Lead II. All the following tests for assessment of cardiovascular parasympathetic functions were carried out in the morning and afternoon hours with the consent of volunteers.



RECORD OF PHYSIOLOGICAL PARAMETERS:

Procedure

The subject was asked to rest in supine position for 15 mins. After fixing the leads, the subject was asked to lie down quietly for 3 mins and at the end of 3 mins HR was recorded. ECG was recorded in lead II, which was run for 1 full minute for each test. The R-R peaks indicated the HR and the calculation was done noting the speed of the ECG paper in unit time. Since 25 mm/sec was the speed normally used, the HR was counted with the following calculation:-

$$\text{HR} = \frac{1500}{\text{Distance between two successive R-R waves (mm)}} \quad [11]$$

RECORDING OF CARDIOVASCULAR PARASYMPATHETIC FUNCTIONS [11]

a) Resting Heart rate (RHR) - Procedure:

- The subject was asked to lie down in the supine position.
- The ECG limb leads were connected for recording lead II
- The subject was asked to relax completely for a minimum of 10 min.
- The basal Heart Rate was recorded.

Interpretation – Normal RHR = 60 – 90 bpm

b) Heart Rate response to standing / 30:15 Ratio: Procedure:

- The subject was asked to lie down in the supine position.
- The ECG limb leads were connected for recording lead II
- The subject was asked to relax completely for a minimum of 10 min.
- The basal Heart Rate was recorded.
- The subject was asked to stand up and immediately the change in HR was noted.
- HR was recorded serially for 1-3 min after standing.
- On standing, the HR increases until it reaches a maximum at approx 15th beat, after which it slows down to stable state at approx 30th beat.
- The 30:15 Ratio was calculated from the observed ECG recording

$$30:15 \text{ Ratio} = \frac{\text{longest RR interval occurring about 30 beat after standing}}{\text{Shortest RR interval occurring about 15 beat after standing}}$$

Interpretation

	Normal	Borderline	Abnormal
30:15 Ratio	>1.04	1.01-1.03	<1.00

c) Heart Rate Variation to Deep Breathing: Procedure:

- The procedure of the test was explained and demonstrated to the subject.
- Then the subject was asked to lie down comfortably in supine position with head elevated at 30 degree.
- The ECG limb leads were connected for recording lead II.
- The basal HR was recorded.
- The subject was asked to breathe deeply at a rate of 6 breaths/min (5 seconds each for inspiration & expiration).
- The maximum & minimum HR was recorded with each respiratory cycle.
- The E:I Ratio was calculated as:



$$\text{E:I Ratio} = \frac{\text{Mean of maximum RR intervals during deep expiration}}{\text{Mean of minimum RR intervals during deep inspiration}}$$

Interpretation:

	Normal	Abnormal
E:I Ratio	>1.21	<1.20

d) Heart Rate Response to Valsalva maneuver: Procedure:

- The procedure regarding how to exhale forcefully into the manometer and maintaining the pressure at 40 mmHg was explained to the subject.
- Then the subject was asked to sit comfortably on a stool.
- Both the nostrils were closed with the help of nose clip.
- The mouth piece was put into the mouth of the subject which is connected to the mercury manometer.
- The ECG machine was switched on for continuously recording the ECG changes and also for 15 seconds before starting of the straining.
- The subject was asked to breathe forcefully into the mercury manometer and maintain the expiratory pressure at 40 mmHg for 10-15 seconds.
- The ECG changes were recorded throughout the procedure and 15seconds after the straining.
- The procedure was repeated for three times with a gap of 5minutes between the manoeuvres.
- The Valsalva Ratio was calculated as:

$$\text{Valsalva Ratio} = \frac{\text{Maximum RR interval after strain}}{\text{Shortest RR interval during strain}}$$

Interpretation:

	Normal	Borderline	Abnormal
Valsalva Ratio	>1.45	1.2-1.45	<1.20

Statistics

The data was calculated, compiled and then tabulated. All statistical analysis was done by using IBM SPSS (Software Package used for Statistical Analysis) software version 20.0. The statistical analysis for parasympathetic tests was carried out separately in premenstrual and postmenstrual phases by applying “unpaired t test”. After analyzing cardiovascular parasympathetic functions were compared between premenstrual and postmenstrual groups by applying the statistical significance test (‘p’ value). On the basis of P value, significance level was calculated as, P Value < 0.05 is taken as significant & P Value > 0.05 is taken as not significant.

RESULTS

Table 1: Comparison of mean values of parasympathetic functions

Parasympathetic function test	Premenstrual (LL) phase (N=40) Mean± SD	Postmenstrual (EF) phase (N=40) Mean± SD	‘P’ value	Results
RHR	74.06 ± 8.078	72.1±6.41	P > 0.05	Not Significant
30:15 Ratio	1.92±3.40	1.11 ± 0.27	P > 0.05	Not Significant
E:I Ratio	1.13±0.23	1.16±0.124	P > 0.05	Not Significant
Valsalva Ratio	4.09±4.98	1.675±0.36	P > 0.05	Not Significant

After analyzing cardiovascular parasympathetic functions were compared between premenstrual and postmenstrual groups by applying the statistical significance test (‘p’ value). It was observed that RHR, 30:15 ratio, E:I Ratio and Valsalva Ratio tests were statistically not significant (p>0.05), on comparison



between premenstrual phase and post menstrual phase of menstrual cycle. Thus, it was observed that there was no variation in parasympathetic activity during this period.

DISCUSSION

In present study, there was no any statistically significant difference observed in various cardiovascular parasympathetic function tests between premenstrual phase (late luteal phase) and post menstrual phase (early follicular Phase) of the menstrual cycle of the subjects evaluated. Result of the present study were different from that of other studies like , a higher resting heart rate was observed in the luteal phase than in the follicular phase [12]. The heart rate variability was significantly higher in the luteal phase compared to the follicular phase, suggesting increased sympathetic activity in the luteal phase; the alteration in the balance of ovarian hormones might be responsible for these changes in the cardiac autonomic innervations [13]. For instance, several studies have reported increases in sympathetic activity [14, 15] increases in measurements [16] during the luteal phase, as compared to the follicular phase of the menstrual cycle and this difference in result may be because of a single autonomic variable like only heart rate or skin potential or skin conductance was tested in other studies, while in the present study, multiple variables were tested. Findings of the present study are found to be consistent in some other studies which found no differences in autonomic reactivity in different phases of menstrual cycle [17, 18]. It was found that there were no changes in parasympathetic reactivity in the premenstrual phase [19, 20]. We have extensively reviewed the literature regarding the physiological role of the autonomic nervous system in premenstrual symptomatology. Kondo et al. [21] measured the coefficient of variation of R-R interval during the menstrual cycle and demonstrated that the parasympathetic nerve activity was lower in the late luteal phase than in the follicular phase.

Though the present study reflects no changes associated with the premenstrual phase (late luteal phase) and post menstrual phase (early follicular Phase) of the menstrual cycle in the cardiovascular autonomic functions, in future studies of similar kind it is required to emphasize specifically on multidirectional and interdisciplinary approaches in order to confirm an etiological association of premenstrual & postmenstrual symptomatology with the complex factors like biological, psychological & social around the menstrual cyclicity of sympathovagal function.

CONCLUSION

Present study evaluates effects of premenstrual phase and post menstrual phase of menstrual cycle on cardiovascular parasympathetic functions in 40 completely healthy volunteers and concludes that no any significant impact is exerted on cardiovascular autonomic functions during the menstrual cycle.

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