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RESEARCH ARTICLE

A study of sympathetic autonomic function in different phases of menstrual cycle among young adult females

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ABSTRACT

Background: Menstrual cycle involves three phases: Menstrual, follicular, and luteal which are regulated by the sex hormones, estrogen and progesterone from the ovary, and also by the gonadotropins – leutinizing and follicle-stimulating hormone from the anterior pituitary. Fluctuations in hormone levels could be associated with autonomic function modulations. There are very few studies related to autonomic function modulation during different phases of menstrual cycle. **Aims and Objective:** The present study was, therefore, taken up to look into the difference in mean sympathetic autonomic parameters during proliferative and secretory phases of menstrual cycle. **Materials and Methods:** A total of 120 healthy young adult female volunteers were recruited among the students of KIMS, KINS, and KIDS. 20 students who were in the bleeding phase of their cycle were excluded from the study. The mean age, heights, and weight of the subjects were 18.9 ± 0.70 years, 156.6 ± 5.25 cm, and 53.7 ± 8.63 kg, respectively. The electrocardiogram was recorded and sympathetic parameters were measured. A statistical analysis was performed by STATA software 15.1. **Results:** There was a significant increase in the parameters such as resting heart rate in beats per minute (≤0.05), fall in systolic blood pressure (SBP) (↓SBP in mm of Hg) on standing, and rise in diastolic (DBP) (↑DBP in mm of Hg) on sustained hand grip ($P \leq 0.001$). **Conclusion:** The results of the present study revealed an increase in the sympathetic modulation during the secretory phase of menstrual cycle.

KEY WORDS: Sympathetic Autonomic Function; Menstrual Cycle; Young Adult Females

INTRODUCTION

Menstrual cycle involves three phases: Menstrual, follicular, and luteal which are regulated by the sex hormones, estrogen and progesterone from the ovary, and also by the gonadotropins, leutinizing and follicle-stimulating hormone from the anterior pituitary.[1] Variations in the functional parameters of many systems may be related to fluctuations in the hormonal levels during different phases of menstrual cycle.[2] Therefore, certain physiological parameters and performance could change along with the menstrual phases.[3] Premenstrual symptoms are a major cause of reduced work efficiency during luteal phase among young adult females. Studies done on animals in the past have shown that estrogens act centrally to modulate the autonomic nervous system, increasing vagal and decreasing sympathetic activity,[4] having a cardiovascular protective function. Progesterone, on the other hand, appears to have an opposing effect, elevating central noradrenaline release.[5] Given these effects, changes in progesterone and estradiol across the menstrual cycle may be associated with changes in autonomic nervous system function. There have been research works relating

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the premenstrual syndrome to hormonal changes. Related research work in human subjects has been scantily reported. The fluctuations in hormone levels could be associated with autonomic function modulations. There are very few studies related to autonomic function modulation during different phases of menstrual cycle. The present study was, therefore, taken up to look into the difference in mean sympathetic autonomic parameters during proliferative and secretory phases of menstrual cycle.

MATERIALS AND METHODS

A total of 120 healthy young adult female volunteers were recruited among the students of KIMS, KINS, and KIDS. 20 students who were in the bleeding phase of their cycle were excluded from the study. The mean age, heights, and weight of the subjects were 18.9 ± 0.70 years, 156.6 ± 5.25 cm, and 53.7 ± 8.63 kg, respectively. The study period was between October 2016 and October 2018. The purpose and procedure of the study were explained to each subject. Written informed consent was taken from all the participants. The study protocol was approved by the Institutional Ethics Committee. The electrocardiogram was recorded and parameters were taken by CANWIN machine of genesis medical systems. CANWIN is the state-of-the-art PC Windows based on cardiac autonomic neuropathy analysis system with interpretation. The subjects were advised not to consume any medicines specifically anticholinergics, cough, and cold mixtures 24 h before the study. The subject was asked to lie supine for 10 min before testing. The testing was done between 10 am and 11 am daily to avoid diurnal variation. The testing for proliferative phase was done on the 7th day and for the secretory phase on the 21st day of the menstrual cycle.[6]

The following parameters were included in the study:

- Resting heart rate (HR) in beats per minute (bpm) during proliferative and secretory phases of menstrual cycle.
- Blood pressure (BP) response to standing (fall in systolic BP [SBP] in mm of Hg) in both the phases.

BP was measured with the subject in supine position and then twice in standing position with an interval of 1 min. BP was measured for the 1st time when the subject was in supine position; then, the subject was asked to stand immediately and BP was measured. Again after 1 min, another measurement was taken for the subject in standing posture. The test ended automatically and the result was displayed immediately. The BP cuff should be connected to the dominant arm of the subject who is undergoing the test.

Normal value is ≤10 mm of Hg.

- BP response to sustained handgrip (increase in diastolic BP [DBP] in mm of Hg) in both the phases.

Maximum voluntary contraction (MVC) for the subject was recorded along with the anthropometric measurement using a handgrip dynamometer. For which, she was asked to grip the dynamometer with maximal force with the dominant hand and the value was recorded.

Basal BP and HR were recorded for the subject. Then, the subject was instructed to maintain 30% of the MVC for 1 min. BP and HR were recorded just before the release of the handgrip pressure, and another recording was taken after 2 min rest.

Normal value is ≥16 mm of Hg

Calculation of BMI

BMI was calculated from the formula: Weight in Kg/height in m^2, and the data were recorded in the data collection form.

$P < 0.05$ was considered to be statistically significant. The data of the above-mentioned parameters were compiled, tabulated, and entered into Microsoft Excel 2013 (15.0.4551.1011) and statistically analyzed using STATA software (version 15.1). All the data were expressed as mean ± SD and analyzed by paired Student's *t*-test.

Exclusion Criteria

Subjects with a history of menstrual irregularities, smoking, alcohol consumption as well as known cases of cardiorespiratory and endocrine ailments were excluded from the study. Subjects who did not give their consent were also excluded from the study.

RESULTS

Figure 1 shows the comparison of mean heart rate between proliferate and secretory phases of menstrual cycle with significantly higher value during the secretory phase.

Figure 2 shows the comparison of mean values of fall in systolic blood pressure between both the phases with the significantly higher value during the secretory phase.

Figure 3 shows the comparison of mean values of rise in diastolic blood pressure between both the phases with the significantly higher value during the secretory phase.

DISCUSSION

The mean resting HR was significantly higher in secretory (81.26 ± 7.57 bpm) phase as compared to proliferative phase (83.34 ± 6.64 bpm) suggesting sympathetic dominance. However, the mean HRs in both the groups are within the normal range. The mean fall in systolic BP on standing is more pronounced during the secretory phase (6.20 ± 3.45 mm of Hg) as compared to the proliferative phase (4.86 ± 2.55 mm of Hg). The difference is statistically significant. The rise in DBP on

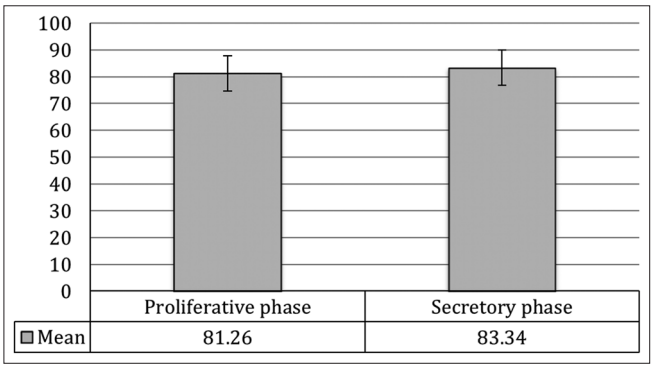

Figure 1: Mean resting heart rates (beats/min) among female subjects in proliferative and secretory phases of menstrual cycle. $P \leq 0.05$ (significant)

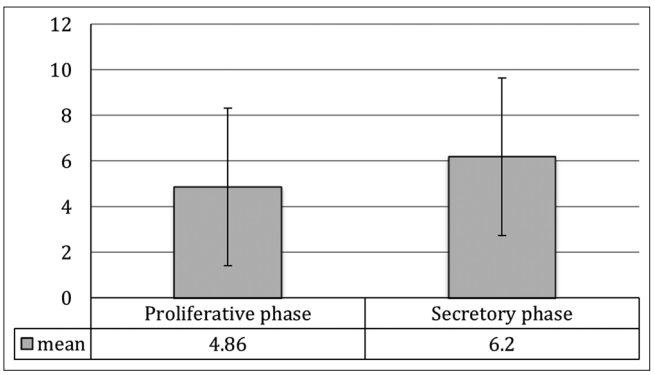

Figure 2: Mean fall in systolic blood pressure (mm of Hg) among female subjects in proliferative and secretory phases of menstrual cycle. $P \leq 0.001$ (highly significant)

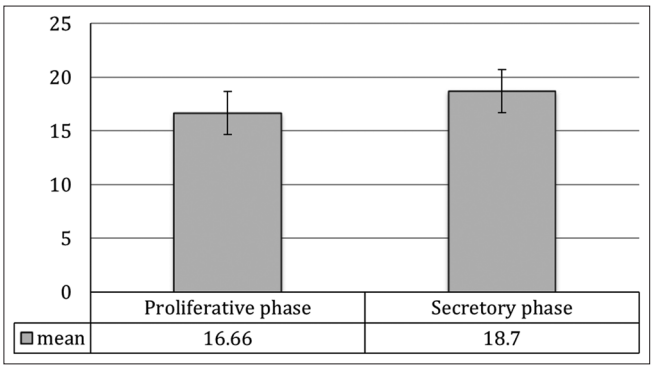

Figure 3: Mean rise in diastolic blood pressure (mm of Hg) among female subjects in proliferative and secretory phases of menstrual cycle. $P \leq 0.001$ (highly significant)

sustained handgrip maneuver is more pronounced during the secretory phase (18.70 ± 2.84 mm of Hg) as compared to the proliferative phase (16.66 ± 2 mm of Hg) with a statistically significant difference.

The resting HR scores in the present study hint at a significant increase in the sympathetic activity during the secretory phase of menstrual cycle. This finding well correlates with some studies done in the recent past.[7,8] The mean value of fall in systolic blood pressure shows significantly higher value in the secretory phase as compared to the proliferative phase. This is an indication of sympathetic activity increase during the secretory phase. The mean values in both the phases are, however, within normal limits. However, from the above findings, we can see that there is increased sympathetic modulation during the secretory phase of menstrual cycle among the subjects. The findings of some researchers well correlate with our study with respect to sympathetic scores.[8] The mean values of rise in DBP on sustained handgrip show normal values among both the groups with a significantly higher value in the secretory phase which is statistically significant. These findings correlate with the previous workers as far as scores are concerned. The results hint at a higher sympathetic modulation during secretory phase. Sympathetic activities are on a higher side during the secretory phase in the present study. The increase in some parameters such as resting HR, fall in SBP, and rise in DBP indicates a sympathetic predominance during secretory phase. This could be attributed to the fact that progesterone counters the influence of estrogen on cardiac autonomic control with some limitations as demonstrated by the similar findings during the ovulation and luteal phases in the current and previous studies.[9,10] The sympathetic predominance in secretory phase could be due to increase in sympathetic nervous activity or to elevation of circulating catecholamines while other active hormones such as renin-angiotensin-aldosterone system also might contribute as reflected by a rise in DBP (sympathoadrenal response to physiological stressful experience caused by premenstrual stress).[11] Hastrup *et al*. found a similar finding of a significant rise of pulse rate and changes in systolic and diastolic BP in the secretory phase of menstrual cycle.[12] Hormonal fluctuation such as increase level of estradiol and progesterone during premenstrual phase is also responsible for premenstrual changes.[13,14] Interaction of central nervous system neurotransmitters and sex hormones may contribute to such findings. However, some researchers in the recent past did not find any association of hormonal changes with autonomic function among females.[15] In the present study, fluctuation of estrogen and progesterone levels may be responsible for the changes in sympathetic activity in follicular and secretory phases of menstrual cycle with an increase during the secretory phase. However, further longitudinal study may help to strengthen the findings of the present study.

CONCLUSION

The sympathetic activity shows an increase during the secretory phase. These changes such as increase in sympathetic modulation during the secretory phase could be associated with the symptoms of premenstrual tension.

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