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RESEARCH ARTICLE

Sympathetic function tests during pre- and post-menstrual phases in young women

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ABSTRACT

Background: Women undergo many types of behavioral and hormonal changes, especially during reproductive life. Besides reproductive changes, there occur cyclical fluctuations in various functions of body systems. Autonomic nervous system provides physiological adaptive background for these changes. In these cyclical changes, pre-menstrual phase stress can be assessed by sympathetic function tests to avoid further cardiovascular complications. **Aims and Objectives:** The aim of the study is to carry out sympathetic function tests during pre-menstrual phase and post-menstrual phase of healthy young women. **Materials and Methods:** The study was carried out in 50 healthy females of age between 18 and 25 years. They undergo the sympathetic function tests such as pulse rate, blood pressure (BP), orthostatic variation on BP, and cold pressor test. Statistical analysis was done by student paired *t*-test. **Result**: Response to various sympathetic tests were altered in pre-menstrual phase as compared to that of post-menstrual phase reflecting highly significant increase in the sympathetic activity. **Conclusion:** Neurohormonal changes and pre-menstrual stress during the pre-menstrual phase are interrelated to each other and increases the sympathetic activity.

KEY WORDS: Autonomic Nervous System; Pre-menstrual Phase; Post-menstrual Phase; Sympathetic Activity

INTRODUCTION

Female reproductive cycle shows regular cyclical changes that teleologically may be regarded as periodic preparation for fertilization and pregnancy.[1] This cycle in addition to reproductive system also affects the homeostasis of body systems. Effects can be demonstrable in the form of physical psychological or behavioral changes.[2]

Various autonomic functional changes have been reported during menstrual phases. These variations get reflected by behavioral changes such as mood swinging and sudden aggressiveness. Cause behind these changes might be one or more variables such as hormone 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 natural rhythms and hormonal balancing mechanisms that affect the overall as well as sexual and reproductive health. Particularly hormonal imbalance affects not only physical health but also psychological health, manifesting as problems ranging from depression to panic disorders.[3,4]

The key organs involved in these behavioral and psychological changes in response to hormonal imbalance during pre-menstrual phase, pregnancy, and menopause are limbic system and hypothalamus.[2] Hypothalamus acts integrating center for nervous and hormonal regulation. Most of the behavioral and emotional patterns are exhibited

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through autonomic nervous system. In this sympathetic system acts as accelerating system. Walter Canon called the emergency-induced discharge of the sympathetic nervous system the "preparation for flight or fight".[1] Therefore, the present research work was conducted to see the sympathetic functions in various phases of menstrual cycle and whether these changes are in physiological limit or pathological. This would help predict any existing sympathetic dysfunction during various phases of menstrual cycle that might help prevent stress complications and giving them better quality of life.

MATERIALS AND METHODS

The study of sympathetic function tests was carried out in 50 healthy female volunteers from general population of town area in two different phases of menstrual cycle, i.e., pre-menstrual and post-menstrual phase. All were from the middle socioeconomic class. The approval for the study was obtained from Institutional Ethics committee.

Selection Criteria

- Age group between 18 and 25 years.
- They had regular menstrual cycle with an average length of 28-30 days.

Exclusion Criteria

- Volunteers with irregular menses.
- Volunteers with menorrhagia and oligomenorrhea.
- Volunteers having history of diabetes mellitus and cardiovascular diseases.
- Those having history of addiction of tobacco, alcohol, and smoking.

All the volunteers were assessed for sympathetic function tests during pre-menstrual phase, i.e., around 25^{th}-26^{th} day of menstrual cycle and during post-menstrual phase, i.e., on 6^{th}-7^{th} day of menstruation. All tests were carried out in the morning hours. They were asked to abstain from tea or coffee for 12 h before the procedure. Before starting the procedure, physical examination of all the females was done with the help of predesigned pro forma and written informed consent form was signed by all of them. The procedure was explained to all participants to alleviate fear. Blood pressure (BP) was recorded with sphygmomanometer by auscultatory method. After giving rest for 5 min, the following parameters were recorded.

Sympathetic Function Tests[2]

1. Pulse rate (per minute) by palpatory method.
2. Arterial BP (mm Hg).
   Procedure: The individual was asked to sit comfortably in a chair for 5 min. The BP was measured from the left arm with the help of sphygmomanometer by auscultatory method. BP recoding was taken three times and average value is taken as baseline BP.
3. Orthostatic variation in arterial BP.
   Procedure: BP recoding was taken three times in supine position and average value is taken as baseline BP. After recording the baseline BP in supine position by auscultatory method, the individual was asked to stand up and after 50 s the BP was recorded. Any change in BP is determined as the difference between the recording while supine and standing position. A decrease in systolic BP (SBP) >20 mm Hg and decrease in diastolic BP (DBP) >10 mm Hg during 1 min standing suggest autonomic dysfunction.
4. Cold pressor test.
   Procedure: The baseline BP was recorded from the left arm by ausclatatory method in sitting position. Then, the individual was asked to immerse the hand in ice cold (4°C) water for 1 min and the BP was recorded every 30 s for 1 min by auscultatory method. The maximum BP recording obtained with a hand in 4°C water was taken as an index of response. Normally, both SBP and DBP should increase at least by 10 mm Hg at the end of 1 min of immersion. This is used to evaluate the peripheral sympathetic vasoconstrictor mechanism.

Statistical Analysis

It was done by student paired *t*-test. $P < 0.05$ was considered as statistically significant.The software used for it is Graph pad Prism 5.

RESULTS

In Table 1, sympathetic activity was compared during pre- and post-menstrual phases. It was observed that pulse rate, BP, orthostatic variation in arterial BP, and cold pressor test were statistically highly significant ($P < 0.01$) in pre-menstrual phase as compared to post-menstrual phase of menstrual cycle.

DISCUSSION

In the present study, responses to pulse rate, BP orthostatic variation in arterial BP, and cold pressor test were significantly ($P < 0.001$) altered inpre-menstrual phase as compared to that of post-menstrual phase, reflecting a significant increase in sympathetic activityBhat.[5] Benment *et al*.,[6] Janowsky *et al*.[7] also showed the increased sympathetic activity in pre-menstrual phase. Seward,[8] Schroder,[9] Strauss *et al*.[10] found no differences in autonomic reactivity in different phases of menstrual cycle.

Physical and psychological changes occurs throughout the menstrual cycle are in the three form, namely, behavioral,

Table 1: Comparison of sympathetic functions in two different phases

Sympathetic functions	Mean±SD		*t* value	*P* value result	Result
	Pre-menstrual (LL) phase (*n*=50)	Post- and pre-menstrual (EF) phase (*n*=50)			
Pulse rate (per min)	82.8±2.94	75.4±2.73	14.58	*P*<0.001	Highly significant
Supine (mm Hg)					
SBP	117.08±3.34	110.48±3.42	9.7	*P*<0.001	Highly significant
DBP	73.76±3.42	67.64±2.52	11		
Standing (mm Hg)					
SBP	110.92±2.95	106.72±2.48	9.3	*P*<0.001	Highly significant
DBP	78.32±2.54	72.30±4.35	8.9		
Orthostatic variation in BP (mm Hg)					
SBP	3.72±1.32	8.12±1.09	6.9	*P*<0.001	Highly significant
DBP	1.96±1.71	6.8±1.87	3.6		
Cold pressor test (mm Hg)					
SBP	124.28±2.59	115.20±2.52	18	*P*<0.001	Highly significant
DBP	88.28±1.38	78.96±2.12	25		

BP: Blood pressure, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SD: Standard deviation, LL: Late luteal phase, EF: Early follicular phase

autonomic, and cortical. Lader and Wing revealed that tension and anxiety were reliably associated with an autonomic arousal.[11] This can be explained on the basis of hypothalamic-pituitary-adrenal axis (HPA axis), which in association with autonomic nervous system, form the stress system that regulates homeostatic mechanisms of the body. Female reproductive hormones are the modulators of this HPA axis. HPA axis that is corticotropin-releasing hormone (CRH) induced proopiomelanocortin peptide inhibits GnRH secretion from hypothalamus that affects the ovarian estrogen and progesterone levels.[12] The gonadal hormones fluctuation during the menstrual cycle is associated with significant changes in multiple neurohumoral homeostatic mechanisms of the body.[13]

Estrogen increases sympathetic baroreflex sensitivity and also has a prolonged stimulatory action on CRH gene promoter and central non-adrenergic system which indicate changes in sympathetic activity responses significantly more during premenstrual late luteal phase (LL) phase than post-menstrual early follicular phase.[14,15]

Kale and Kathole[4] observed that increased activity of sympathetic system during pre-menstrual phase is due to pre-menstrual stress. The cause of this stress is increase in peripheral resistance causing pre-capillary resistance. This 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. Rise in BP due to stress leads to increased epinephrine secretion and this rise in BP is important sympathoadrenal response to physiological stressful experience caused by pre-menstrual stress.[16] Most evidence suggest that there is decrease in serotonin and beta-endorphins level during pre-menstrual phase and this might be associated with changes in mood and behavioral symptoms.[1,17,18] Thus during different phases of menstrual cycle neurohormonal changes, stress, and sympathetic activity are interrelated to each other.

Implications

Although young women of the present study did not complain of any physical or psychological symptoms during pre-menstrual phase, yet significantly increased sympathetic activity responses indicate an increased stress. Today, young women are under many kinds of stress which may be precipitated during LL phase of menstrual cycle.

Limitations

Further study is required to correlate autonomic nervous system (ANS) functions with hormonal imbalance showing significant fluctuation in reproductive hormones.

CONCLUSION

The cumulative effect of neurohormonal and behavioral changes get reflected in the form of increased stress in the pre-menstrual phase. We have to try to relive that stress due to increased sympathetic activity by meditation, yoga, and exercise.

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