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SYMPATHETIC FUNCTION TESTS DURING VARIOUS PHASES OF MENSTRUAL CYCLE

Physiology

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ABSTRACT

Background : Menstruation is governed by tightly orchestrated changes in the levels of ovarian estrogen and progesterone, which produce varying responses in diverse tissues and organs. Studies suggest that all types of hormonal changes and a regular fluctuation in numerous functions affecting all body systems in women is the result of disturbed autonomic nervous system (ANS). Thus this study was designed to study sympathetic function tests during various phases of menstrual cycle.

Materials & Methods: The present study was a cross sectional type of study involving 50 female subjects. Two sympathetic function tests i.e. Cold Pressor Test (CPT) and Sustained Handgrip Test (SHG) were included in the study. Sympathetic function tests were carried out during each of the three phases of the menstrual cycle. Statistical analysis was done with one way ANOVA and paired 't' test.

Result: Cold pressor test and sustained hand grip tests showed that systolic and diastolic blood pressures were greater during secretory phase as compared to other phases of menstrual cycle and the difference was statistically significant by ANOVA test and paired T test.

Conclusion: Our findings indicate a higher sympathetic activity in secretory phase as compared to other phases.

KEYWORDS

Menstrual cycle, Cold Pressor test, Sustained Handgrip test, Progesterone

INTRODUCTION

Menstrual cycle is broadly divided into three phases, based on endometrial changes, as menstruation, proliferative phase and secretory phase characterised by cyclical changes in endogenous sex hormone secretion.[1] Certain autonomic changes have also been reported during these phases, though more so during the pre-menstrual phase. It is likely that an exaggerated response to hormonal changes may be responsible for variable physical and psychological symptoms.[2]

Cardiovascular Autonomic reactivity refers to cardiovascular responses to potential stimuli, which are essentially reflexive in nature indicating cardiovascular tolerance and adaptation.[3]

The cold pressor test (CPT) devised by Hines and Brow involves exposure of the individual to cold as a stressful stimulus.[4]The reaction of the individual to this is measured by the change in his systolic and diastolic blood pressures after the exposure to cold stress.

The cardiovascular response to acute sympathetic stress was assessed by Sustained Hand Grip test (SHG), which evaluates the cardiovascular adrenergic function and is recommended as an investigational autonomic function test by the American Academy of Neurology.[5]The isometric hand grip exercise activates the mechanoreceptors immediately due to the increased muscle tension. The recruitment of new motor units to maintain the muscle tension, increases the excitatory state of the central nervous system and results in a possible increase in the sympathetic outflow and a decrease in parasympathetic outflow, which explain the increase in the blood pressure response.[6]

The aim of present study was to assess sympathetic nervous system activity throughout the menstrual cycle.

MATERIALS AND METHODS

The present study was a cross sectional type of study. The study was conducted at Grant Government Medical College, Mumbai in the Department of Physiology over a period of 6 months. 50 healthy female volunteers in the age group of 18 to 25 yrs and having regular menstrual cycle of 28 to 35 days for the past six months were selected as subjects. Subjects with history of menstrual disorders, premenstrual syndrome, smoking, alcoholism, diabetes or any other endocrinological disorder were excluded from the study. Written informed consent was taken from all the enrolled subjects. Subjects were asked to avoid caffeinated beverages for at least 12 hours prior to the experiments and to avoid strenuous physical activity from the previous evening. The subject was allowed to relax on a bed in supine position for 10 minutes and then sympathetic function tests were performed after initial 1-2 sessions of practice.

Tests were carried out during following three phases:

1.Menstrual phase – 1st or 2nd day of menstrual cycle (Group I : n=50)
2.Follicular phase – 9th to 12th day of menstrual cycle (Group II : n=50)
3.Luteal phase – 19th to 21st day of menstrual cycle (Group III : n=50)

Sympathetic Function Test :

Blood Pressure Response To Cold Pressor Test :

After recording of baseline BP subject was asked to immerse his hand in cold water maintained at 10^0 C for 1 – 2 minutes; blood pressure was recorded from the other arm at the end of 2 minute. Maximum increase in systolic and diastolic blood pressure was determined and compared with normal subjects.

Blood Pressure Response To Sustained Hand Grip : The subject was asked to exert maximal hand grip strength on hand grip dynamometer, with dominant hand. First the maximum voluntary contraction (MVC) is determined and then the subject was asked to exert 30 % of MVC for 3 minutes with dominant hand. The Blood pressure was measured in the non-exercising hand at rest and just before the release of hand grip pressure.

Data recorded was segregated into three groups according to the three phases of menstrual cycle and was analysed with one way ANOVA. Each of the groups was compared with the other two and analysed by paired 't' test.

RESULTS

The mean age of the subjects was 18.433 ± 0.626 years. The mean height and weight of the subjects were 153.066 ± 10.044 cm and 48.766 ± 7.214 kg respectively. The mean calculated BMI of the subjects was 21.189 ± 3.621 kg/m^2.

Table No. 1 : Parameters Of Sympathetic Function Tests During Various Phases Of Menstrual Cycle

	Menstrual Phase(MP)	Follicular Phase(FP)	Secretory Phase(SP)
	MEAN±S.D	MEAN±S.D	MEAN±S.D
CPT SBP(mmHg)	110.16 ± 8.56	113.92 ± 7.86	118.52 ± 7.24
CPT DBP(mmHg)	71.32 ± 9.89	71.52 ± 7.67	76.24 ± 5.91
SHG SBP(mmHg)	120.44 ± 6.48	124.08 ± 8.08	130.2 ± 8.88
SHG DBP(mmHg)	78.48 ± 7.0	79.16 ± 6.46	84.32 ± 7.92

(SBP – Systolic blood pressure, DBP – Diastolic blood pressure, CPT - Cold pressor test, SHG - Sustained Hand Grip)

Table No. 2 : Analysis Of Sympathetic Function Tests In All Three Groups Using One Way ANOVA Test

	F Value	P value	Statistical Significance
CPT SBP(mmHg)	13.99848	< 0.00001	Statistically significant
CPT DBP(mmHg)	6.06405	0.002947	Statistically significant
SHG SBP(mmHg)	19.59699	< 0.00001	Statistically significant
SHG DBP(mmHg)	9.95767	0.000088	Statistically significant

Table 3 : Analysis Of Sympathetic Function Tests Within Groups In Pairs Using Paired 't'test

Parameters	MP AND PP		PP AND SP		MP AND SP	
	P value	Statistical Significance	P value	Statistical Significance	P value	Statistical Significance
CPT SBP(mmHg)	0.0002	Statistically significant	0.0001	Statistically significant	0.0001	Statistically significant
CPT DBP(mmHg)	0.8230	Not significant	0.0001	Statistically significant	0.0001	Statistically significant
SHG SBP(mmHg)	0.002	Statistically significant	0.0001	Statistically significant	0.0001	Statistically significant
SHG DBP(mmHg)	0.434	Not significant	0.0001	Statistically significant	0.0001	Statistically significant

As shown in table 1 & 2, cold pressor test and sustained hand grip tests showed that SBP and DBP were greater during secretory phase as compared to other phases of menstrual cycle and the difference was statistically significant by ANOVA test. As shown in table 3 analysis by paired T test showed that the difference in the SBP and DBP between each of the two phases of menstrual cycle were statistically significant with the exception of difference in the DBP after sustained hand grip test between menstrual & proliferative phase, which was statistically not significant.

DISCUSSION

The present study was undertaken to show the effect of various phases of menstrual cycle on sympathetic function tests. In our study cold pressor test and sustained hand grip tests showed that in general systolic and diastolic blood pressures were greater during secretory phase as compared to other phases of menstrual cycle and the difference was statistically significant by ANOVA test and paired T test. Thus our study indicates a higher sympathetic activity in secretory phase as compared to other phases. A difference of a balance of ovarian hormones may be responsible for these changes of sympathetic functions during the menstrual cycle.

Present study is in accordance with the study done by Christina et al who found out that there was higher sympathetic activity and a higher basal heart rate in secretory phase as compared to other phases of menstrual cycle.[7] Similarly Kisan Ravikiran et al observed that there was variation in autonomic function tests in different phases of menstrual cycle with predominant sympathetic activity in luteal phase than the follicular phase.[8]

Alteration in autonomic functions in different phases of menstrual cycle could be under the influence of fluctuating levels of female sex hormones that lead to salt and water retention.[8] The higher sympathetic activity may be due to higher levels of progesterone in the secretory phase as was shown in the study done by Leicht et al.[9] Stimulation of sympathetic activity by progesterone may be due to central release of noradrenaline or by increased sensitivity to adrenaline.[10,11] This is in accordance with study done by Christopher T. Minson et al showing high plasma norepinephrine in midluteal phase than in early follicular phase.[12]

In contrast to our study some studies showed opposite results. Strauss B et al in their study tested 40 female subjects premenstrually and postmenstrually for their autonomic reactivity during stress (cold pressor test, mental arithmetic) and for their acquisition of conditioned electrodermal responses, using a standardized auditory conditioning procedure. None of the differences between the cycle phases were significant in their study.[13] Also Hastrup JL et al did not observe any differential changes during the cold pressor test across the different phases of menstrual cycle.[14]

CONCLUSION

Our study shows that sympathetic nervous system activity changes across the different phases of the menstrual cycle. The higher sympathetic activity may be correlated with higher progesterone levels during the secretory phases of menstrual cycle.

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