

Original article

# Cyclical Fluctuations in Blood Pressure during Different Phases of Menstrual Cycle in Eumenorrhic Women

Shilpi Vashishta<sup>1,\*</sup>, Sushila Gahlot<sup>2</sup>

<sup>1</sup> Assistant professor, Department of physiology, Chirayu medical college & Hospital, Bhopal, Madhya pradesh, India;

<sup>2</sup> Ex- Professor & Head, Department of Physiology, Gian sagar medical college & hospital, Patiala, Punjab, India.

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## Corresponding author \*

**Dr. Shilpi Vashishta,**

Assistant Professor, Department of Physiology, Chirayu Medical College, Bhopal, Madhya Pradesh  
E Mail: shilpivash@gmail.com

## ABSTRACT:

**Aim:** To study the cyclical fluctuations in blood pressure during different phases of menstrual cycle in eumenorrhic women.

**Material and method:** Study was conducted in 111 healthy eumenorrhic women of reproductive age 15-45 years. Blood pressure by auscultatory method was recorded during different days of follicular and luteal phase of menstrual cycle. Average blood pressure of the follicular and luteal phase was calculated and results were statistically analyzed using paired t-test. **Results:** Non-significant lower systolic and diastolic blood pressure was observed in the luteal phase compared to the follicular phase of menstrual cycle in eumenorrhic women. **Conclusion:** These findings support the hypothesis that ovarian hormones have antihypertensive effect by its sympatho-vagal effect on cardio-vascular system.

**Keywords:** Menstrual cycle, blood pressure, follicular phase, luteal phase, eumenorrhic women

## 1. INTRODUCTION

The menstrual cycle is a complex process involving multiple hormones which are regulated by intricate feedback mechanisms [1]. Hormones, such as LH, FSH, estrogen and progesterone follow a cyclical pattern which is co-ordinated by the hypothalamic-pituitary-ovarian axis [2].

Cyclical fluctuations in female reproductive hormones besides causing changes in reproductive organs also causes related changes in other organs system. Cyclical fluctuations in blood pressure during different phases of menstrual cycle may be possibly due to the variations in female reproductive hormones on cardiovascular function [3].

Estrogen is the principal sex hormone among the female species. Apart from being important for normal activity of the reproductive system, estrogen lower the risk of development of hypertension in pre-menopausal women through its peripheral actions such as up-regulation of endothelium derived nitric oxide (NO) and up-regulate the expression of nitric oxide (NO) synthase, leading to vasodilation. Estrogen by inhibiting the activity of sympathetic nervous system might protects against elevated arterial pressure. While there are conflicting results for progesterone. Progesterone may have neutral or lowering effects on blood pressure [4].

As already established by various studies that female reproductive hormones have cardio-protective effect against the development of cardio-vascular disease in women [5], several studies researched on the effect of menstrual cycle phase on blood pressure but most of the studies found no significant effect of menstrual cycle phases on blood pressure.

The present study examined the blood pressure during follicular and luteal phase of menstrual cycle in eumenorrhic women.

## 2. MATERIAL AND METHODS

The study was conducted in Gian Sagar Medical College & Hospital, Rajpura. 111 apparently healthy and eumenorrhic women of reproductive age 15-45 years were recruited for the study after obtaining permission from institutional ethical committee and informed consent from all the participants.

Reproductive age women of 15-45 years with average menstrual cycle length (24-38 days), average flow (4-8 days) and variation (2-20 days) were considered as eumenorrhic women and were included for one menstrual cycle for study as per International consensus conference proposed terms for menstrual bleeding patterns [6].

**Exclusion criteria:**

1. Women using oral contraceptives during last three months
2. Pregnancy or breast-feeding in the last 6 months.
3. Diagnosis of polycystic ovarian syndrome.
4. Recent history of infections or diagnosis of chronic medical conditions.
5. Having auto-immune disease or thyroid disorder.
6. Having a history of coronary vascular disease.
7. Current use of supplements or prescription medications.
8. Having body mass index at screening of <18.5 or >24.9 kg/m<sup>2</sup>.

**Blood pressure measurement:**

Detailed menstrual histories regarding average length, average flow and variation in number of days from cycle to cycle were recorded along with anthropometric measurement like height, weight and BMI.

Blood pressure measurement of each participant was carried out one during the follicular phase and one during the luteal phase of a menstrual cycle. Follicular Phase studies were carried out in early, mid and late follicular phase of menstrual cycle, approximately corresponding to days 2,7,12 days after the onset of menstruation while luteal phase studies were carried out in early, mid and late luteal phase approximately corresponding to days 18, 22, and 27 days after the onset of menstruation.

The participant were called on the scheduled day of menstrual cycle and after half an hour of rest on the examination couch Blood pressure was measured in supine position using calibrated mercury sphygmomanometer and litman stethoscope by auscultatory method.

The average of blood pressure recorded on scheduled days of follicular phase was termed as average follicular phase blood pressure. Similarly average blood pressure recorded on scheduled days of luteal phase was termed as average luteal phase blood pressure.

**Statistical analysis:**

Data collected was statistically analysed using Microsoft excel data analysis tool. The data obtained during both phases of menstrual cycle was represented as mean ± standard deviation and was compared using paired Student’s “t”-test. P value of 0.05 was considered as statistically significant.

**3. OBSERVATIONS AND RESULTS**

Table I shows the menstrual cycle characteristics of the study participants with mean length of menstrual cycle of 29.55± 2.71 days , flow of 4.88± 1.14 days and variation of length of menstrual cycle of 4.27±3.22 days.

**Table I: Menstrual bleeding patterns in eumenorrhic women:**

	Mean	SD
Average length of menstrual cycle(days)	29.55	2.71
Average flow(days)	4.88	1.14
Variation from cycle to cycle(days)	4.27	3.22

**Table II: Comparison of average Systolic and diastolic blood pressure during follicular and luteal phase of menstrual cycle in eumenorrhic women:**

Parameter	Follicular phase	Luteal phase	p-value
<b>SBP(mmHg)</b>			
Mean	114.46	112.05	0.14
SD	12.40	11.04	
<b>DBP(mmHg)</b>			
Mean	72.39	71.76	0.62
SD	9.24	8.99	

Blood pressure measured during luteal phase was non-significantly lower than measured during follicular phase of the menstrual cycle in eumenorrhic women.

**Discussion:**

Due to cyclical fluctuation in hormonal levels during various phases of the menstrual cycle, female sex hormones have profound influence on autonomic and metabolic activities<sup>3</sup>. Variations in blood pressure during the normal menstrual cycle are not well documented, and previous studies found conflicting results. Hence this study was conducted to analyze the Blood Pressure changes during the follicular and luteal phase of the menstrual cycle in eumenorrhic women.

In the present study, though there was a decrease in systolic Blood Pressure (S.B.P) & diastolic Blood Pressure (D.B.P) in the luteal phase compared to follicular phase of menstrual cycle but they were not statistically significant.

The present study findings were similar to previous study findings who noted no change in SBP and DBP across the menstrual cycle [7-11]. According to these studies raised serum nor-epinephrine levels during luteal phase is counter-balanced by a decrease sensitivity of receptors towards nor-epinephrine. Hence there is no change in blood pressure levels during menstrual cycle.

The results of this study did not support findings of some of the previous studies [12-17] which showed an increased sympathetic activity in luteal and increased parasympathetic activity in follicular phase and noted a non-significant increase in systolic blood pressure in the luteal phase compared to follicular phase. Differences in findings of these studies with present may be due differences in the age of the eumenorrhic women from previous studies and measurement of blood pressure at different day of the menstrual cycle leading to complex interactions among

vasoactive mediators (e.g., nitric oxide, prostaglandins, prostacyclins, and the rennin-angiotensin system), hemodynamic changes (i.e., cardiac output and systemic vascular resistance), and sex hormones (i.e., estrogens and progesterone).

Due to conflicting results from previous studies the responses of BP across the phases of the menstrual cycle warrants further research.

A decrease in arterial pressure at the luteal phase compared to the follicular phase in the present study may be associated with a decrease in peripheral vascular resistance. Fluctuations of female reproductive hormones estrogens and progesterone may be possibly responsible for variations in blood pressure during menstrual cycle [18]. Estrogens promote vasodilatation by stimulating the release of prostacyclin and stimulating the opening of calcium activated potassium channels by nitric oxide and cyclic guanosine monophosphate pathway that causes vasodilatation [4] and inhibit the production of vasoconstrictors like Angiotensin II and endothelins [19, 20] Other postulated mechanism of estrogens anti-hypertensive role is by increasing cardio-vagal function by increasing acetylcholine concentration. A significant positive correlation was observed between serum levels of estrogens and the cardiovascular baroreflex sensitivity [21].

As blood pressure (BP) did not show significant change when compared in follicular and luteal phase of menstrual cycle in eumenorrhic women. It may be due to the increase in plasma renin activity, aldosterone, plasma nor-epinephrine and plasma volume in the high hormonal environment during the luteal phase is counter-balanced by a decrease in  $\alpha_1$  adrenoreceptor sensitivity and an increase in cardiovagal baroreflex activity. These opposite influences of the ovarian hormones result in BP to remain unchanged throughout the menstrual cycle [7].

#### 4. CONCLUSION

There was no significant difference in both systolic and diastolic blood pressure among phases of the menstrual cycle. This study concluded that cyclical fluctuations in ovarian hormones may have sympatho-vagal balance in eumenorrhic women. Any hormonal imbalance may lead to the disruption of this balance, resulting in cardiac autonomic dysfunction. Further researches are required with a larger sample size to ascertain the results and to improve the clinical interpretation which may further improve the quality of life of women of reproductive age.

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