



Original Research Article

Do different phases of menstrual cycle affect the HR, PR interval and duration of ST segment?: A study

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ARTICLE INFO

Article history:

Received 07-10-2021

Accepted 14-12-2021

Available online 07-04-2023

Keywords:

Menstrual phases proliferative phase

Secretory phase

ECG

PRinterval

ST Segment

ABSTRACT

Introduction: Alteration in the release of female steroid hormones like progesterone and estrogen in a systematic manner is due to periodic ovarian variation. The alteration in female steroid hormones causes physiological alteration of cardiovascular activities and ultimately affects Electrocardiogram (ECG) parameters.

Aim: To analyze the heart rate and the changes in PR interval and duration of ST segment in ECG during menstrual phases.

Objective: To investigate any change in heart rate, PR interval and duration of ST segment in ECG during different phases of menstrual cycle.

Materials and Methods: 30 apparently healthy female aged between 18-25 years were selected for the study and ECG was recorded using Electrocardiograph during the different phase of menstrual cycle:- a): Menstrual phase(MP) (2nd day), b): Proliferative phase(PP) (11th day) c): Secretory phase(SP) (22nd day).

Results: Statistical analysis paired t-test was done by using online statistical calculator. There was statistical significant change in Heart rate, PR interval and ST segment duration. HR is increased more as compared to menstrual phase, it showing p-value of 0.000133 in paired t-test between Menstrual phase with secretory phase. There was no statistical significant change in PR interval during proliferative change on comparison with menstrual Phase.

Conclusion : Cyclical fluctuation of hormones during menstrual cycle changes electrophysiological parameters, affecting cardiovascular system.

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1. Introduction

In female reproductive system the cyclical changes occurs and menstruation is periodic bleeding due to shedding of uterine mucosa and there is effect on the ECG changes and blood pressure changes in different phases of menstrual period. So many physical, psychological and behavioral changes are related to menstrual cycle due to changes in ovarian hormones and menstruation is only one manifestation of the ovarian hormones. Alteration in

the release of female steroid hormones like progesterone and estrogen in a systematic manner is due to periodic ovarian variation.¹ Menstrual cycle normally repeats in every 21–35 days (approximately 28 days). Menstrual cycle can be divided into four different phases, which is based on ovulation time i.e. (a) menstrual phase, (b) follicular phase, (c) ovulatory phase, and (d) luteal phase.

The normal physiological, psychological, and behavioral outcome of the a female body is influenced by changes during menstrual cycle. There is affect on the electrophysiology of the cardiovascular system in humans due to variations in hormone during different

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phases of menstrual cycle. The hormonal fluctuation during menstrual cycle could stimulate the ion channels result in to affecting the electrophysiological characteristics of the heart. Reproductively active women have different levels of steroid hormone than postmenopausal women and this difference is related to an increase in the incidence of many cardiovascular diseases like sudden cardiac death in postmenopausal women.² The cardiovascular system is influenced by gonadal hormones directly as well as indirectly. In women suggesting possible sex differences in atrial and AV nodal physiology and this is been suggested due to PR intervals are shorter in females.³ During the luteal phase of the menstrual cycle, pregnancy, and the perimenopausal period palpitations occur frequently in women at all ages. The increased sympathetic activity may be related to palpitation during the perimenopausal period.⁴ Due to the variation in the hormonal flux occurrence of several cardiac diseases varies throughout the menstrual cycle. The occurrence of ventricular tachycardia, Torsade de Pointes (TdP) increase in the reproductively active women.⁵ Throughout the menstrual cycle in reproductive women there is cyclic variation of sex hormones occurs and this variation results in to physiological alteration of cardiovascular activities which ultimately affects Electrocardiogram (ECG) parameters.⁶ Progesterone shortens the duration of action potential and QT interval duration in the woman due to effect on ventricular repolarization. In a single menstrual cycle it is the progesterone level which affects electrophysiology of than estrogen.⁷ The time from the beginning of atrial depolarization to the onset of ventricular depolarization denotes the PR interval which is measured from the surface electrocardiogram (ECG). Prolonged PR interval is significantly associated with the risk of cardiovascular mortality and sudden cardiac death (SCD).⁸

The delay in conduction at AV node influences the PR interval and change in conduction velocity in bundle of His and Purkinje fibers is denoted by change in width of QRS complex. The QT interval represents the time during which the ventricles are depolarized and thus reflects the duration of the ventricular action potential. Any change in the processes occur during ventricular repolarization is represented by change in QT Interval.⁹

2. Aim

The aim of this study is to analyze the heart rate, the changes in PR interval and duration of ST segment in ECG in reproductive women during menstrual phases.

3. Objectives

To investigate any change in heart rate, PR interval and duration of ST segment in ECG during different phases of menstrual cycle using Electrocardiograph in females having

normal menstrual cycle.

4. Materials and Methods

4.1. Study design

Observational analytical study.

4.2. Place of study

Central research laboratory situated in the department of Physiology at Bundelkhand medical college, Sagar, M.P.

4.3. Sample size

Apparently healthy female aged between 18-25 years has been selected for the study.

4.4. Duration of study

6-10 months.

4.5. Inclusion criteria

1. Normal regular menstrual cycles of 27-33 days.
2. Candidates who give consent for recording of ECG in different phases of menstrual cycle.

4.6. Exclusion criteria

1. Subjects below 18yrs and above 25yrs of age.
2. Subjects with endocrinal & gynecological disorders, chronic diseases and any allergic conditions.
3. Subjects with Diabetes.
4. Pregnant or lactating females.
5. Subjects with irregular menstrual cycle.
6. History of drugs intake affecting menstrual cycle.

4.7. Method

Approval from institutional ethical committee has been taken and the participants were enrolled for the study after fulfilling exclusion and inclusion criteria. After explaining the study methodology informed consents were taken from the participants. They were instructed not to smoke or consume alcohol, caffeine or to engage in strenuous physical activity 12 hours prior to testing. They were called according to the day of menstrual cycle. Participants were taken a thorough history and general examination prior to recording of ECG. The resting ECG was recorded to a segment length of 10 seconds, at a paper speed of 25 mm per second by using Bene Heart R3 Electrocardiograph by mindray. Participant's ECGs was examined for PR interval and duration of ST segment. Heart rate was calculated using R-R interval in lead II.

According to the phases of menstrual cycle candidates have undergone the recording of ECG which was done on:

1. Menstrual phase (MP - (2nd day)
2. Proliferative phase (PP - (11th day)
3. Secretory phase (SP - (22nd day)

Statistical analysis was done by using statistical online calculator statskingdom.com for paired t-test and Microsoft excel to calculate mean value. The p-value of 0.05 considered statistically significant.

4.8. Ethical clearance

The study protocol was approved by the institutional Ethics Committee with letter no. IECBMC/2021/15 date 05/03/2021.

5. Observation and Result

Table 1:

Average age of participants (years)	Average weight of participants (Kilogram)	Average height of participants (CM)	Average duration of Menstrual cycle (Days)
21.6	47.7	149.0667	3-4/26-30

Table 2: Different parameters – (Average value of each parameter)

S.No.	Phases of menstrual cycle	Heart rate beats/min	PR Interval millisecond	ST segment
1	Menstrual phase	75.3	148.6667	135.1667
2	Proliferative phase	83	137.0667	120.9333
3	Secretory phase	85.53333	126.5667	97.6

5.1. Statistical analysis

Table 3: Menstrual phase Vs Proliferative phase

S.No	Parameters	p-value	Statistical significance
1	Heart rate	0.002877	Highly significant
2	PR interval	0.1223	Not significant
3	ST segment	0.02572	Significant

6. Discussion

In all reproductively active females cyclical changes in female reproductive system occur due to changes in level of female sex steroids and due to these hormonal changes there are periodic histochemical alterations. In present study the change in heart rate starts in proliferative phase which

Table 4: Menstrual phase Vs Secretory phase

S.No	Parameters	p-value	Statistical significance
1	Heart rate	0.0001332	Highly significant
2	PR interval	0.002373	significant
3	ST segment	0.000006277	Highly significant

Table 5: Proliferative phase Vs Secretory phase

S.No.	Parameters	p-value	Statistical significance
1	Heart rate	0.001436	Highly significant
2	PR interval	0.00172	Highly significant
3	ST segment	0.03587	Significant

is the phase of high estrogen as compared to progesterone level. During secretory phase the sex steroids estrogen and progesterone are in action and heart rate increases more which is statistically significant in this study. Study done by Ezequias RP et al supports that there is an increased sympathetic and decreased parasympathetic balance in the luteal phase when compared to the follicular phase.¹⁰

Increase in heart rate during luteal phase is more as compared to follicular phase supporting the increase sympathetic action of the body which is due to probably more progesterone level during luteal phase.

PR interval is the time from atrial depolarization to starting of ventricular depolarization. Average time of PR interval is reduced in proliferative phase but it is not statistically significant in present study. Statistically significant reduction in duration of PR interval is seen during secretory phase. The result is same as study done by Shahina Khan et al shows that there is statistical difference in PR interval between menstrual and secretory phase.¹ During luteal phase which corresponds to secretory phase of uterine cycle sympathetic balance is increased¹⁰ and this supports the finding of the study.

In an electrocardiogram (ECG) between ventricular depolarization (QRS complex) and repolarization (T wave) the ST segment normally represents an electrically neutral area of the complex and this ST segment encompasses the region between the end of ventricular depolarization and beginning of ventricular repolarization. Indication of benign or clinically significant injury or insult to the myocardium may show various waveform morphologies of ST segment.¹¹ Present study there is decrease in duration of ST segment starts in secretory phase and further decreased in proliferative phase showing statistically highly significant during secretory phase. In prior studies it has been shown that there is decrease in QTc interval during secretory phase of menstrual cycle.^{1,5,7,9}

7. Conclusion

Due to cyclical fluctuation of hormones during different phases of menstrual cycle alterations in several electrophysiological parameters occurs and it affects the cardiovascular system which is evident in the present study. Sex steroids during different phases certainly show effect on the cardiovascular function indicators. Further study to be done with females using Oral Contraceptive pills as contraceptive method as well as for treatment of PCOS.

8. Conflict of Interest

None.

9. Source of Funding

None.

10. Acknowledgement

We are thankful to all the subjects who participated in the study and also like to thank to staff of department of physiology, BMC, Sagar.

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Cite this article: Jha A, Tiwari J, Uike A. Do different phases of menstrual cycle affect the HR, PR interval and duration of ST segment?: A study. *Panacea J Med Sci* 2023;13(1):213-216.