

# Comparative study of RR, PR and JT intervals during the different phases of menstrual cycle

Rajeshwari L<sup>\*</sup>, Uma R<sup>\*\*</sup>, A R Gorkal<sup>\*\*\*</sup>

<sup>\*</sup> Associate Professor, <sup>\*\*</sup> Lecturer, <sup>\*\*\*</sup> Professor, Department of Physiology, JSS Medical college and Hospital, JSS University, SS Nagar, Mysuru, Karnataka, INDIA.

Email: [rai0522004@gmail.com](mailto:rai0522004@gmail.com)

## Abstract

**Aim:** Cardiac functions are influenced by gender and gonadal steroids. Ventricular arrhythmias are more common in women and seem to exhibit during the menstrual cycle. JT interval is major component of QT interval. It measures ventricular repolarization. According to literature, estrogen lengthens the JT interval. Hormonal changes during menstrual cycle may cause changes in ECG intervals. **Objective:** The objective of the present study is to evaluate the effect of different phases of menstrual cycle on the RR, PR and JT intervals of ECG. **Methods:** This is a prospective study among a cohort of 30 healthy female students, who were aged 18-22 years and had regular menstrual cycles over past six months. Subjects were monitored on three separate occasions during two consecutive menstrual cycles. ECG was recorded for 5 minutes in Lead –II using Power lab multichannel polygraph instrument, once during every phase. The computerized recordings of RR, PR and JT intervals thus obtained were analyzed statistically using pooled t test, probability  $\leq 0.05$  to assess if any significant difference existed in these parameters during the different phases of menstrual cycle. **Results:** This study did not show any statistically significant variation in RR, PR and JT intervals between the menstrual, follicular and luteal phases of the menstrual cycle. **Conclusion:** It may be concluded that there was no statistically significant variation in RR, PR and JT intervals during different phases of the menstrual cycle which may be due to the small sample size.

**Keywords:** Autonomic functions, PR interval, JT interval.

## \*Address for Correspondence:

Dr. Uma R, Lecturer, Department of Physiology, JSS Medical college and Hospital, JSS University, SS Nagar, Mysuru, Karnataka, INDIA.

Email: [raj0522004@gmail.com](mailto:raj0522004@gmail.com)

Received Date: 08/05/2015 Revised Date: 22/06/2015 Accepted Date: 27/07/2015

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	Volume 5 Issue 3

## INTRODUCTION

The menstrual cycle is much more than a cycle of periods. Gonadal hormones influence the cardiovascular system both directly and indirectly. PR intervals are shorter in women suggesting possible sex differences in atrial and AV nodal physiology. Study reported that premenopausal women have shorter atrial refractory periods compared with postmenopausal women or age matched men suggesting that the effect of the menopause and is mediated by ovarian steroids<sup>1</sup>. The JT interval is the

measured distance from the J point to the T-wave. A prolonged JT interval has the same significance as the prolonged QT interval. The JT interval is measured only when QT interval is prolonged or QRS duration is prolonged as seen with ventricular disturbances<sup>2</sup>. The JT interval has been proposed as a more appropriate measure of ventricular repolarization than the QT. This seems justified, because in normal conduction, the QT interval is largely determined by the duration of repolarization, and that corresponds to the JT interval<sup>3</sup>. Additionally, several investigators have reported that JT is independent of QRSd and suggest that the JT interval better represents the specific repolarization time than does the QT interval<sup>4</sup>. Other researchers have found that the JT interval is not independent of the QRS duration, with the relationship varying according to the conduction abnormality<sup>5</sup>. Other study noted that JT is an index of repolarization largely independent of ventricular depolarization<sup>2</sup>. In men, the JT provides prognostic information about future CHD events in wide QRS complex. However, the QTc is more useful than the JT in normal conduction. However, the literature regarding the

phase of menstrual cycle during which women are most vulnerable to arrhythmias is scanty and controversial.

### MATERIAL AND METHODS

The present study was conducted in the Department of Physiology, JSS Medical College, Mysuru. Female undergraduate medical students in the age group of 18 – 22 years, who volunteered to participate in the study, were screened through a detailed clinical history and general physical examination. Among them, 30 healthy students with history of regular menstrual cycles (between 28-30 days) over a minimum time period of past 6 months were selected at random for this study. After the purpose of the study and the procedure to be followed were clearly explained and understood by the participants, written informed consent was taken from them. The study was approved by the Institutional Ethics Committee of JSS Medical College and Hospital, Mysuru. Fertility thermometer and AD Instruments computer based Power Lab data acquisition systems with bioamplifier and Lab Chart software for Windows were used to collect the required data. AD Instruments Power Lab was used to record the ECG from the limb leads. The digitalised ECG signals were stored on removable hard disks for off-line verification and analysis. The RR intervals, PR intervals and JT intervals were noted after analysis of the data. The study was done over a time period of three months. Throughout these 90 days, the subjects were asked to record and note down their basal body temperature (BBT) every morning, (immediately on waking up) in order to find out the time of ovulation during each menstrual cycle. Then, they were asked to report on specified days, in the evenings between 4 p.m. and 6 p.m. Recording of the RR, PR interval and JT interval was done via ECG for 5 minutes in Lead II using AD Instruments Power Lab instrument. This was carried out in a well ventilated quiet room with the subject in supine position after she rested for 20 minutes. The ECG of all the 30 subjects were recorded on three separate occasions during each menstrual cycle -once during the menstrual phase (from 1<sup>st</sup>- 5<sup>th</sup> day after the onset of menstruation), once during the follicular phase (from 8<sup>th</sup> - 12<sup>th</sup> day of menstrual cycle) and once during the luteal phase (20<sup>th</sup> and 21<sup>st</sup> day of the menstrual cycle). The procedure was repeated for all the subjects during their successive menstrual cycle also. This means that ECG was recorded on six different occasions for each subject. The mean of the two readings (recorded during the same phase of consecutive menstrual cycles) was noted for each of the parameters. The data collected were entered in MS Excel 2010 and analyzed using SPSS version 18. Descriptive statistical measures of mean and standard deviation were applied. Repeated measures

ANOVA was applied to test the difference between mean RR interval, PR interval and JT intervals across menstrual, follicular and luteal phases.

### RESULTS

This study did show variation in RR, PR and JT intervals between the follicular, luteal and menstrual phases of menstrual cycle but these were not statistically significant.

**Table 1:** Phases of menstrual cycle

Phases of menstrual cycle	Mean ± Standard Deviation (SD)		
	RR interval (seconds)	PR interval (seconds)	JT interval (seconds)
Menstrual phase (MP)	0.6838±0.087	0.1366 ± 0.548	0.2346±0.450
Follicular phase (FP)	0.6779 ±0.082	0.1408± 0.538	0.2364± 0.442
Luteal phase (LP)	0.6650 ±0.076	0.1390 ± 0.545	0.2343± 0.445

**Table 2:** Comparison of RR Intervals (seconds) between the different phases of menstrual cycle

	SD	Pooled t test	p value	p value
MP vs. FP	0.0857	0.3740	0.7090	NS
FP vs. LP	0.0802	0.2163	0.3788	NS
MP vs. LP	0.0828	1.2429	0.2163	NS

**Table 3:** Comparison of PR interval (in seconds) between the different phases of menstrual cycle

	SD	Pooled t test	p value	p value
MP vs. FP	0.5476	0.0425	0.9609	NS
FP vs. LP	0.5463	0.0187	0.9850	NS
MP vs. LP	0.5483	0.0257	0.9795	NS

**Table 4:** Comparison of JT interval (in seconds) between the different phases of menstrual cycle

	SD	Pooled t test	p value	p value
MP vs. FP	0.450	0.02163	0.9828	NS
FP vs. LP	0.455	0.1460	0.8845	NS
MP vs. LP	0.456	0.1244	0.9011	NS

Pooled t-test at 5% level for large sample. Difference is not significant when p > 0.05 (NS)

### DISCUSSION

The high incidence of ischemic heart disease after menopause suggests a close association between ovarian hormone levels and the vulnerabilities in cardiovascular system<sup>6</sup>. It is now evident that both estrogen and progesterone have marked effects on cardiovascular system<sup>7</sup>. In our study RR interval does not show any statistically significant changes during different phases of menstrual cycle. In our study RR interval recorded during resting conditions did not show any statistically significant changes during different phases of menstrual cycle. It indicates there are no changes in parasympathetic

activity. In a study by Tada H *et al* showed shortened PR interval in women suggesting possible sex differences in atrial and AV nodal physiology. Actually the shortening of the effective refractory periods in response to brief episode of Atrial fibrillation was attenuated in younger women suggesting involvement of ovarian steroids<sup>8</sup>. AV nodal re-entrant tachyarrhythmia has 2:1 female predominance. The female dominance has explained due to shorter PR intervals. Changes in plasma ovarian hormones may be of importance in determining episodes of supraventricular tachyarrhythmia. Plasma progesterone has a positive correlation with episodes number and duration of supraventricular arrhythmia, plasma estrogen has a negative correlation with them<sup>9</sup>. In our study there is no statistically significant PR interval change during different phases of menstrual cycle. In our study, we had also attempted to assess the JT interval, it is considered better index of assessing repolarization of cardiac muscle. Phase 2 and 3 ventricular action potential corresponds with JT interval. Liu *et al* noted that  $I_{ks}$  and  $I_{kr}$  in the ventricular muscle of Rabbit. Estrogen up regulates the  $I_{caL}$  density through genomic pathway in the ventricular muscle of the rats. This increased  $I_{caL}$  transmural dispersion prolongates ventricular repolarization, Progesterone rapidly shorten the action potential duration through slow delayed K rectifier current under basal conditions and inhibition of L type of calcium currents under cAMP stimulated conditions<sup>10</sup>. Primary repolarization abnormalities can be detected from JT interval<sup>11</sup>. In general, women are at higher risk than men for developing dangerous and potentially fatal drug induced arrhythmias. In our earlier study<sup>12</sup>, QT and QTc intervals prolonged in follicular phase, in present study JT intervals are not showing any changes. In our study fluctuation in ovarian hormones in different phases of menstrual cycle not affecting PR and JT intervals. JT interval may be better predictor of ventricular arrhythmias related to prolonged QTc interval<sup>12</sup>.

### LIMITATION

The small sample size may be the reason for the statistically not significant findings of our study. Also in

this serum hormonal level not assessed during different phases of menstrual cycle.

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Source of Support: None Declared  
Conflict of Interest: None Declared