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ORIGINAL RESEARCH

A STUDY OF EFFECTS ON QRS DURATION, QT AND QTC INTERVAL IN DIFFERENT PHASES OF MENSTRUAL CYCLE

[1]Dr. Anju Jha, [2]Dr. Priyanka Tiwari, [3]Dr.Satyendra Uike

[1]Associate Professor, Department of Physiology, Bundelkhand Medical College, Sagar, Madhya Pradesh, India

[2]Assistant Professor, Department of Obstetrics and Gynecology, Bundelkhand Medical College, Sagar, Madhya Pradesh, India

[3]Associate Professor, Department of Anesthesiology, Bundelkhand Medical College, Sagar, Madhya Pradesh, India

Correspondence:

Dr Satyendra Uike

Associate Professor, Department of Anesthesiology, Bundelkhand Medical College, Sagar, Madhya Pradesh, India

Email:last21dream@yahoo.com

Abstract

Aim: To investigate the change in duration of QRS, QT and QTc interval in ECG during different phases of menstrual cycle using Electrocardiograph in females having normal menstrual cycle.

Material and Methods: The present observational analytical study was carried on 30 healthy females, aged between 18-25 years with normal regular menstrual cycles of 27-33 days.Recording of ECG which was done on:

i. Menstrual phase (MP) - (2nd day)

ii. Proliferative phase (PP) - (11th day)

iii. Secretory phase (SP) - (22nd day),

Participant's ECGs was examined for duration of QRS, QT interval in Lead II and QTc interval is calculated using Bazett's formula ($QTc = QT/\sqrt{RR}$).

Statistical analysis: data was analyzed on SPSS version 1.0.0.1406 for paired t-test and Microsoft excel to calculate mean value. The p-value of 0.05 considered statistically significant.

Results: It was observed that the QRS duration and QT interval was statistically insignificant during menstrual compared to proliferative phase but QTc interval was statistically significant (p-value- 0.0299). While QT and QTc interval between the proliferative and secretory phase were statistically highly significant.

Conclusion: Our study showed that QTc interval changes are there with phases of menstrual cycle and as it represents the electrophysiological events in the ventricles and it may be affected more by some drugs which alter the electrophysiological activities in the heart.

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Hence suggesting QTc screening as primary prevention of high risk for repolarization abnormality in future.

Keywords: QRS duration, QT and QTc interval, menstrual cycle

Introduction

Associated with the monthly cyclical production of estrogens and progesterone by the ovaries is an endometrial cycle in the lining of the uterus that operates through the stages of proliferation of the uterine endometrium, development of secretory changes in the endometrium and desquamation of the endometrium, which is known as menstruation[1]. Systematic alteration in the release of female steroid hormones like progesterone and estrogen affects periodic ovarian variation. This periodic variation is termed as menstrual cycle, and it is restricted to primates[2]. It is stated that more than 200 psychological, physiological, and behavioral alterations occur in the body due to the menstrual cycle Typically, this cycle repeats every 21–35 days (approximately 28 days)[3].

Noninvasive method to detect the electric abnormalities of heart is 12 Leads electrocardiogram which is an inexpensive, essential, reproducible and patient friendly[4].Repolarization abnormality of heart can be diagnosed by a simple, objective, validated tool QTc interval by using Bazett's formula applied on QT interval measured from simple electrocardiogram (ECG)[5]. Duration of QRS complex indicates the ventricular depolarization with normal duration of 0.06–0.10 s. The widened QRS can occur in different conditions like ventricular premature beats, bundle branch blocks, toxic levels of certain drugs (e.g., flecainide, propafenone, quinidine) and severe hypokalemia. QT interval signifies about ventricular depolarization as well as repolarization status. QT should be <50% of RR interval and corrected QT (QTc) should be ≤0.44 s. Prolongation of this interval can be in cases of: congenital, hypokalemia, hypocalcemia, drugs (e.g., class IA and class III antiarrhythmics, tricyclics)[6]. It is stated earlier the cyclical production of sex steroid in females of reproductive age group show physiological alteration in the body.

Aim

To investigate the change in duration of QRS, QT and QTc interval in ECG during different phases of menstrual cycle using Electrocardiograph in females having normal menstrual cycle.

Study design

Observational analytical study

Materials and Method

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

Place of study

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

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Sample size

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

Duration of study

6-10 months

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.

Exclusion Criteria

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

Method

After taking approval from institutional ethical committee the participants were enrolled for the study with fulfilling the criteria for exclusion and inclusion. Study methodology was explained to the participants and informed consents were taken from all the participants. They were instructed to withhold smoking or alcohol, caffeine or to engage in strenuous physical activity 12 hours prior to testing. Participants were taken a thorough history and general examination prior to recording of ECG which was done according to the day of menstrual cycle.

Recording of ECG which was done on:

i. Menstrual phase (MP) - (2nd day)

ii. Proliferative phase (PP) - (11th day)

iii. Secretory phase (SP) - (22nd day)

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 duration of QRS, QT interval in Lead II and QTc interval is calculated using Bazett's formula ($QTc = QT/\sqrt{RR}$).

Statistical analysis was done SPSS version 1.0.0.1406for paired t-test and Microsoft excel to calculate mean value. The p-value of 0.05 considered statistically significant.

Observation

Table – 1: Baseline Demographic characteristics

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

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

Phase of menstrual cycle	Duration of QRS (m.sec)	QT interval (m.sec)	QTc interval (m.sec)
Menstrual phase	78.83	392.83	440.90
Proliferative phase	77.73	410.90	500.93
Secretory phase	78.93	370.07	436.47

Table – 3: Menstrual phase Vs Proliferative phase

S. No	Parameters	p-value	Statistical significance
1	QRS duration	0.1176	Not significant
2	QT interval	0.425	Not significant
3	QTc interval	**0.0299**	**Significant**

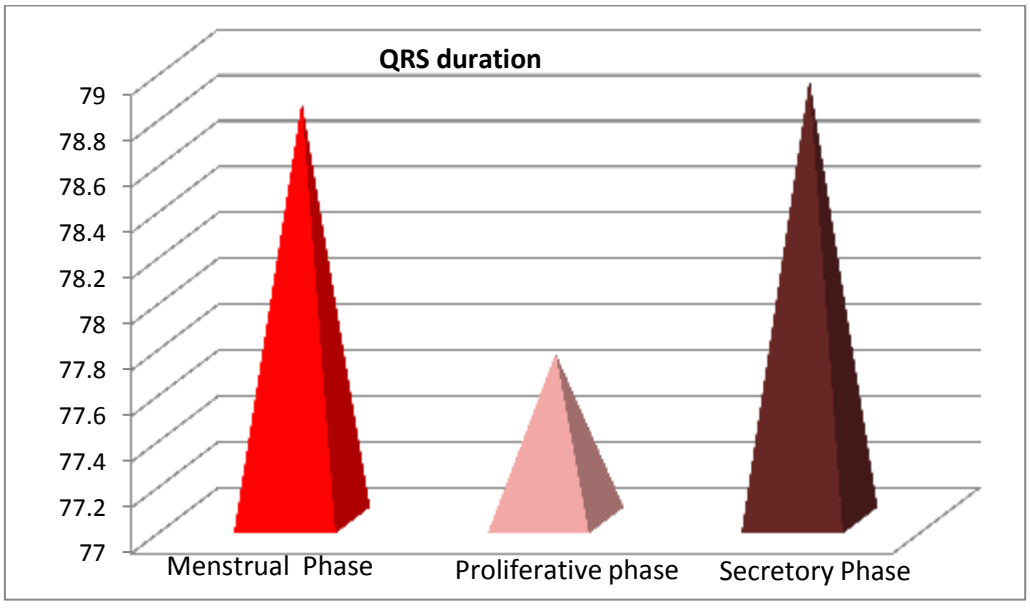
Table – 4: Menstrual phase Vs Secretory phase

Sr. No	Parameters	p-value	Statistical significance
1	QRS duration	0.95	Not significant
2	QT interval	0.3155	Not significant
3	QTc interval	0.9357	Not significant

Table – 5: Proliferative phase Vs Secretory phase

Sr. No	Parameters	p-value	Statistical significance
1	QRS duration	0.3836	Not significant
2	QT interval	**0.0184**	**Significant**
3	QTc interval	**0.0069**	**Highly significant**

Graph 1– QRS complex during different phases of menstrual cyclein milliseconds.



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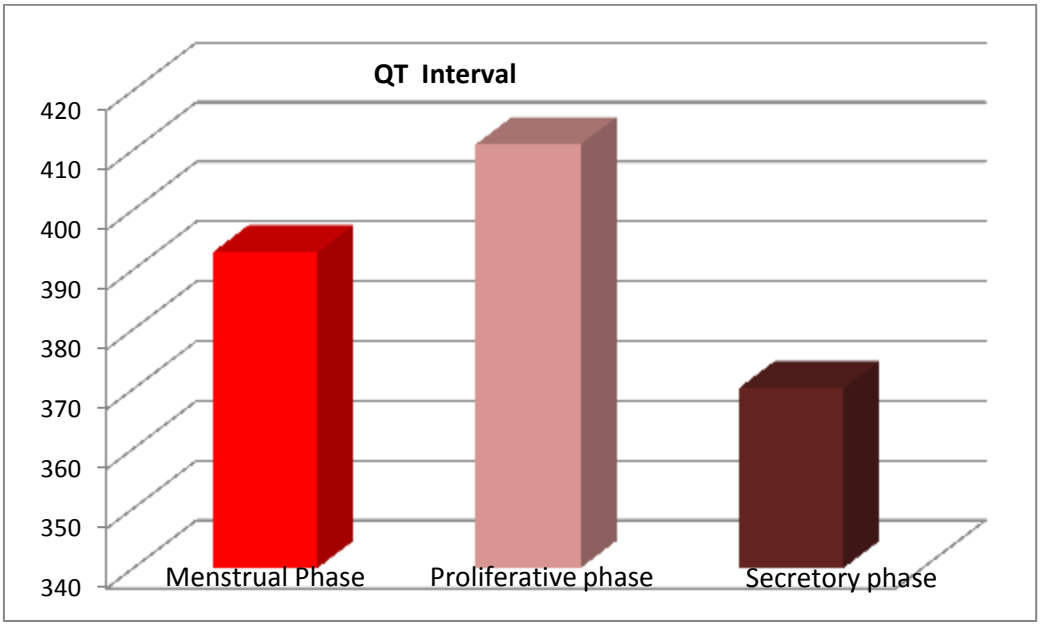
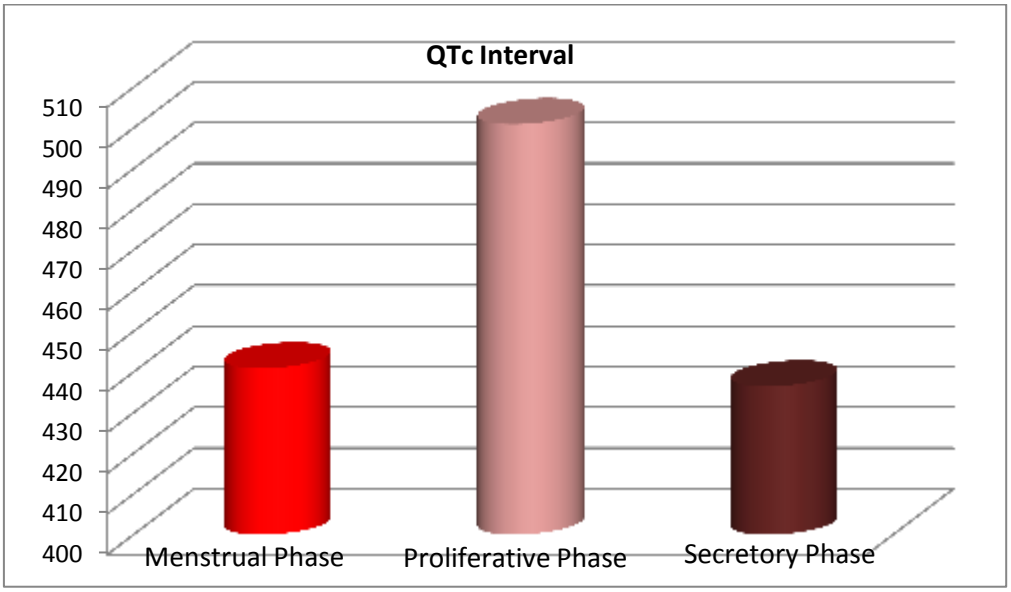
Graph 2 – QT interval during different phases of menstrual cycle in milliseconds.



Graph 3 – QTc Interval during different phases of menstrual cycle in milliseconds.



Discussion

The menstrual cycle is a part of periodic histo-chemical alterations in all reproductively active females. Typically, this cycle repeats every 21–35 days (approximately 28 days) and associated with various psychological, physiological, and behavioural alterations occur in the body [3].

Alterations in the level of sex hormones during different phases of the menstrual cycle also affect the cardiovascular activity of reproductively active females. The ovarian hormones influence the CVS either directly by affecting repolarization or indirectly through the autonomic nervous system[7,8]. The direct effects are mediated by alterations in potassium

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channel expression, potassium ion conductance, repolarization in the cardiac smooth muscle cells and response of QT interval to drugs [9,10]. These hormones influence the CVS indirectly by modulating the autonomic tone[11] and ultimately result in morphological variations in the ECG pattern.

According to our study QT and QTc intervals are prolonged in the proliferative phase as compared with menstrual and secretory phases. It has been found that oestrogen and progesterone have a significant impact on cardiac ventricular repolarization as well as exhibit a regional heterogeneity in their effects on cardiac muscles. The QRS duration was statistically insignificant in the present study in all phases of menstrual cycle. QT interval is also statistically insignificant when analysed between menstrual and secretory phase while change in QTc interval was statistically significant. Study done by the authors shows that although there is no statistical difference in QRS duration but on analysing the duration of QT and QTc intervals there are statistically significant difference during proliferative and secretory phase of menstrual cycle. It is consistent with the findings of another study[12] that the QT interval values fluctuate in correlation with the surges in gonadal hormones during the menstrual cycle.

There is evidence that the short QT interval observed during the luteal phase is caused by the high levels of progesterone, which is known to reduce calcium channel current and increase potassium channel current during this phase.

In accordance with our results, it was progesterone and oestrogen which affected the ventricular repolarization in women during a single cycle, with progesterone shortening the action potential and oestrogen counterbalancing it by prolonging it[13].

A possible molecular mechanism that oestrogen uses to prolong the action potential is by inhibiting potassium channels that are responsible for ventricular repolarization, and by decreasing mRNA levels that encode potassium rectifier channels.

Normal physiological changes in the circulating levels of estrogen and progesterone could influence baseline cardiac repolarization and momentarily predispose to greater QT and QTc intervals, especially when the patient is on certain drugs like antipsychotics[14]. In general, women are at higher risk than men for developing dangerous and potentially fatal drug-induced arrhythmias. This risk is more during menstruation and ovulation[15].

Conclusion

Our study showed that QTc interval changes are there with phases of menstrual cycle and as it represents the electrophysiological events in the ventricles and it may be affected more by some drugs which alter the electrophysiological activities in the heart. high prevalence of prolonged QTc, both qualitatively and quantitatively, in hypertensives on monotherapy with poor pressure control, associated with female gender and age but not duration or blood pressure. This underscores high risk of repolarization abnormality induced future event, suggesting QTc screening as primary prevention.

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Conflict of interest

Nil

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