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Original Research Article

Variations serum electrolyte level during different phases of menstrual cycle in healthy female medical students

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Abstract

Introduction: The menstrual cycle is characterized by cyclical fluctuations in the levels of FSH, LH, estrogen and progesterone. But the changes occur in serum electrolyte level have not been clearly established.

Objective: To compare the serum electrolyte level in different phases of menstrual cycle.

Material and method- The present study was carried out on 54 healthy female medical students in the age group of 18 to 24 years with normal menstrual cycle of 27-33 days. Serum electrolytes like, calcium, sodium and potassium, were estimated during menstrual, Proliferative and Secretory phases of menstrual cycle using standard procedures.

Results: There was a significant change in the level of serum calcium during proliferative phase, sodium is increased maximally during menstrual phase and potassium in secretory phase of menstrual cycle.

Conclusion: Alternation of serum calcium, serum sodium and Potassium levels were noted during uterine changes of menstrual cycle, however, none of all the mention levels were outside the physiological limits.

Keywords: menstrual cycle, calcium, sodium, potassium, progesterone, estrogen, menstrual phase, proliferative phase, secretory phase.

1. Introduction

The menstrual cycle is the scientific term for the physiological changes that can occur in fertile female humans and apes [1]. It is defined as the cyclic event that takes place in a rhythmic fashion during the reproductive period of a woman's life.

The cyclic hormonal changes can affect a variety of physiological and biochemical processes however, changes in other biochemical variables have not been studied. Although the coordinated sequence of hormonal changes during the normal menstrual cycle are well characterized, whether similar or parallel changes occur in the distribution of various electrolytes has not been clearly established .It has been reported that estrogen induces hypercalcemia through the action of the parathyroid gland[2]. Withdrawal of estrogen is reported to cause a significant loss of bone calcium [3].

Up to 18 % of women have severe postmenopausal syndrome (PMS) and 3–8 % qualify for a diagnosis of premenstrual dysphoric disorder (PMDD)[4,5]. Two to ten percent of women have significant premenstrual symptoms that are different from the normal discomfort associated with menstruation in healthy women [6,7]. Low levels of certain vitamins and minerals, particularly magnesium, manganese, Vitamin E, Vitamin D [8] and pyridoxine are associated with PMS. Although exact etiology of PMS is not known but low progesterone levels, high estrogen levels, increased aldosterone activity, increased rennin-angiotensin activity have been implicated[9].

Many women reports retention of fluid during the premenstrual days, especially noting breast swelling and abdominal bloating [10]. Possible causes for this claim of many women could be due to change in sodium concentration includes the increased concentrations of antidiuretic hormone in the luteal Phase[11] and the antagonism effect of progesterone to the typical sodium retentive influence of aldosterone[12]. The concentration of uric acid in plasma increases after menopause. This is believed to be the result from decrease in sex-steroid

concentration, similar to that which occurs at the time of onset of menstruation [13]. It is possible that changes in hormone concentrations during the uterine change of menstrual cycle may influence the concentrations in serum of commonly measured analytes. Hence, the purpose of this study was to estimate serum levels of inorganic sodium, potassium and calcium, levels during uterine changes of menstrual cycle.

2. Materials and Methods

2.1 Study Area

The study will be conducted in the Clinical Physiology lab of the department of Physiology, Motilal Nehru medical college, Allahabad over a period of one year (Aug, 2014 to July, 2015) after approval from institutional ethical committee.

2.2 Study Group

This group will include the apparently healthy female medical students of Motilal Nehru medical college, Allahabad between the ages of 18 to 24 year

2.3 Methodology

The present study will be carried in between (2014- 2015) in healthy female undergraduate medical students as volunteers aged between 18 - 24 years will be selected with the normal menstrual cycle of 30±3 days.

The study protocol will be explained to the subjects and oral and written informed consent will be obtained.

Prior to that all: age, height, weight will be noticed.

A demonstration will be given to the subject before performing the test

The first sample will be taken on 2 nd day of onset of menstruation (Menstrual phase.) Second sample during 12 th day of Proliferative phase, and the third sample were collected 22nd day during (Secretory Phase).

All samples will be taken at 10 am to avoid diurnal variations. The parameters analyzed will be sodium, potassium and calcium levels by selectra E analyser.

2.4 Inclusion criteria

This study includes, healthy north Indian undergraduate medical student's population of age group 18-24 years having regular menstrual cycles will be chosen.

2.5 Exclusion criteria:

Contraceptive pills users, lactating women, H/O diabetes mellitus, Cases suffering from cardiovascular abnormalities, Psychiatric illness, Irregular periods, heavy Dysmenorrhoea, Oligomenorrhoea, Polymenorrhoea have been excluded from my study.

2.6 Statistical analysis

Sample size will be taken by Nonrandomized Judgemental Study and has been taken maximum possible number. Data collected from these tests will be subjected to SSPS software analysis and the results will be given after the completion of the study.

Statistical analysis was done by Student's t-test. Comparison of data was done by using ANOVA. The p value of <0.05 indicates statistically significant. The results are expressed as Mean ± SEM (Standard error of mean).

3. Results

The serum electrolyte parameter levels at three different periods (menstrual phase, proliferative phase and secretory phase) are summarized in the given table and shown graphically in Fig. 1,2 and 3, the mean levels of serum electrolyte parameters varied between the periods. The mean level of sodium was highest menstrual phase followed by proliferative phase and secretory phase. The mean potassium was highest in secretory phase followed by proliferative phase and menstrual phase. The mean calcium was highest in proliferative phase followed by secretory phase and menstrual phase.

Comparing the mean levels of each serum electrolyte parameter between the three groups, ANOVA revealed significantly ($p<0.001$) different levels of all the parameters among the groups.

Further, Tukey test revealed that the mean sodium decreased significantly ($p<0.001$) in both proliferative phase and secretory phase as compared to menstrual phase (Table 6). Furthermore, the mean sodium also decreased significantly ($p<0.05$) in secretory phase as compared to proliferative phase. In contrast, the mean potassium was significantly ($p<0.001$) higher in sectretory phase as compared to both menstrual phase and proliferative phase. Conversely, the mean calcium was significantly ($p<0.001$) higher in both proliferative phase and secretory pahse as compared to menstrual phase. The mean calcium was also significantly ($p<0.001$) higher in proliferative phase as compared to secretory phase.

Table1: Serum electrolyte parameter levels (Mean ± SD, n=55) at three different phases of menstrual cycle in undergraduate female medical students

Parameters	Menstrual phase	Proliferative phase	Secretory phase	F value (2,162 DF)	p value
Sodium (mmol/L)	139.53 ± 3.93	136.71 ± 3.90	134.91 ± 3.07	22.29	<0.001
Potassium (mmol/L)	4.37 ± 0.45	4.49 ± 0.37	4.81 ± 0.35	18.27	<0.001
Calcium (mmol/L)	1.17 ± 0.05	1.26 ± 0.04	1.21 ± 0.06	47.89	<0.001

Table2: For each parameter, comparison (p value) of mean difference between the groups by Tukey test

Comparisons	Sodium	Potassium	Calcium
Menstrual phase vs. Proliferative phase	<0.001	0.234	<0.001
Menstrual phase vs. Secretory phase	<0.001	<0.001	<0.001
Proliferative phase vs. Secretory phase	0.027	<0.001	<0.001

***p<0.001- as compared to Menstrual phase

Figure 1: Mean calcium at three different periods

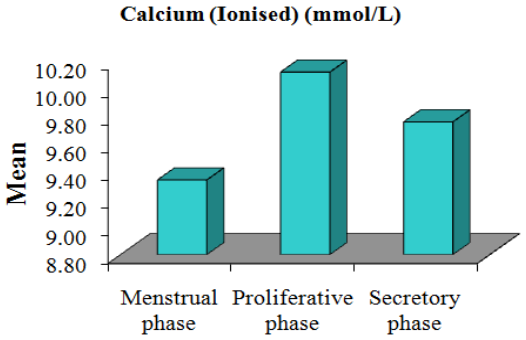
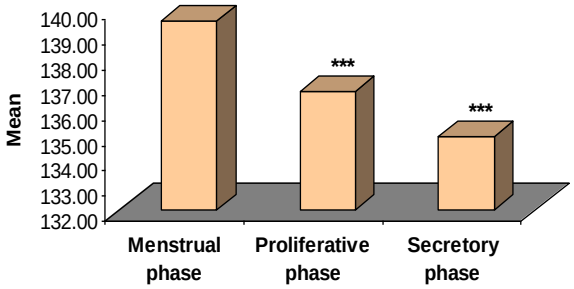
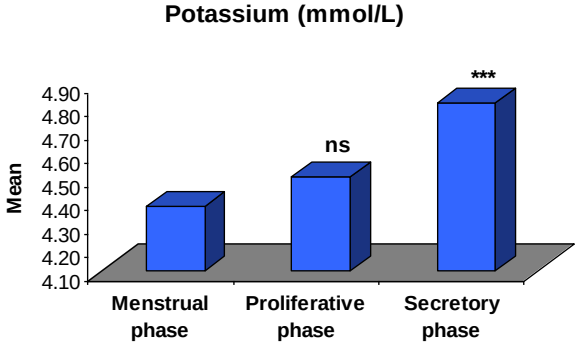


Figure 2: Mean sodium at three different periods



***p<0.001- as compared to Menstrual phase

Figure 3: Mean potassium at three different periods



nsp>0.05 or ***p<0.001- as compared to Menstrual phase

4. Discussion

Menstruation is a phenomenon unique to females and nearly universal experience in women's lives and is poorly understood. There are scanty reports on the changes in the levels of serum inorganic sodium, potassium and calcium levels in various Phases of the menstrual cycle. The cyclic hormonal changes can affect a variety of physiological and biochemical processes. Changes in these analytes are, however, reported to be mainly due to changes in the hormonal levels during the different Phases of the menstrual cycle [14,15].

On analyzing the results of our study, we observed that levels of serum calcium (10.02 ± 0.78) were significantly higher in proliferative Phase or follicular Phase as compared to the other two Phases. These results agree with previous findings of some other workers [16]. Some workers reported that higher serum calcium levels during proliferative Phase could be due to the effect of estrogen on the parathyroid glands.

But during the secretory Phase or luteal Phase serum calcium levels were low, could be due to higher levels of progesterone compared to estrogen, as reported by Christiansen *et al* in his study [17].

Earlier research showed that the increase in serum calcium levels during the follicular and ovulatory phases could be due to the effect of estrogen on the parathyroid glands. The estrogen causes increase in parathyroid activity which leads to marked acceleration of calcium uptake. Serum calcium in the present study was found to be lowest during menstrual phase; it might be due an increase in estrogen level.

This relationship cannot be explained on the basis of estrogen levels and parathyroid activity alone. The higher levels of progesterone than estrogen during luteal phase could be responsible for low serum calcium levels.

Alternatively, because estrogen is utilized to enhance the progesterone activity (priming effect) it may not be involved in calcium uptake during luteal phase [18].

Increased serum calcium levels during the ovulatory phase may also contribute to the decreased magnesium levels by exerting an effect on the cell permeability. Therefore, it is suggested that calcium/magnesium ratio may be related to the premenstrual syndrome complaints that some women have during this period [19]. Also, we were able to reduce varied premenstrual syndrome symptoms with the use of magnesium infusion or its salts along with Vitamin D during the second week of the luteal phase [20,21].

Malipatil BS [22] study, Serum Calcium was nonsignificantly increased in MP compared to other phases which is in line with other studies[23]. This is because of the fact that estrogen causes increase in parathyroid activity which leads to marked acceleration of calcium uptake and the higher levels of progesterone than estrogen during luteal phase could be responsible for low serum calcium levels in luteal phase [24]. The result in our present study does not match with the results of Malipatil BS [2013].

The serum Sodium was nonsignificantly increased in MP compared to other phases corresponding to significantly lower serum sodium levels in luteal phase than the menstrual and follicular phases due to the increased concentrations of antidiuretic hormone in the luteal phase and the antagonism effect of progesterone to the typical sodium retentive influence of aldosterone[24]. The serum Potassium was nonsignificantly increased in PP compared to other phases corresponding to a non-significant higher level in luteal phase than menstrual and follicular phase.

Our findings of serum sodium and potassium levels during menstrual cycle correlated well with the findings of Das B [16]. Although, it is documented that during the luteal phase of the menstrual cycle sodium-retaining hormone secretion increase, present study found a significant decrease in sodium in luteal phase. Possible causes for this change in sodium concentration include the increased concentrations of antidiuretic hormone in the luteal phase and the antagonism effect of progesterone to the typical sodium retentive influence of aldosterone. Further, this change in serum sodium during menstrual cycle affects expression of somatic symptoms and suggests a possible role for sodium to alleviate these symptoms [25].

Although the cyclic changes were noted in these electrolytes during the menstrual cycle, they were all found to be within normal physiological limits.

5. Conclusion

The concurrence of these cyclical changes in these electrolytes supports the claim of many women that they suffer changes in fluid and electrolyte balance in the premenstrual days. Moreover, these changes may have significance in terms of the normal reference interval; hence necessitate small but significant alterations to the normal reference interval for calcium, magnesium and sodium in menstruating women.

Significant variation in Serum calcium, serum sodium, serum potassium during various phases of menstrual cycle may be due to the effect of estrogen which increases the electrical excitability in cardiac tissue.

6. Limitations

As the hormone levels were not measured in the present study. It needs further evaluation and a correlation study between sex hormone level and serum electrolytes during different phases of menstrual cycle.

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