Serum Electrolytes During Different Phases Of Menstrual Cycle

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ABSTRACT

Background: 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.

Materials and methods: This corollary follow up study on 50 healthy normal menstruating females presents variation in serum calcium, magnesium, sodium and potassium during menstrual, follicular and luteal phases of menstrual cycle.

Results: The study demonstrated that serum calcium levels were significantly ($p < 0.001$) higher in follicular phase than menstrual and luteal phases. Serum magnesium levels were significantly ($p < 0.001$) lower in follicular phase than menstrual and luteal phases. Serum sodium levels were significantly lower in luteal phase than the menstrual and follicular phases. Serum potassium levels were higher (non-significant) in luteal phase than menstrual and follicular phases.

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.

Key words : Calcium, Magnesium, Sodium, Menstrual cycle.

INTRODUCTION

The cyclic hormonal changes can affect a variety of physiological and biochemical processes [1-4], however, changes in other biochemical variables have not been studied.

It has been reported that estrogen induces hypercalcemia through the action of the parathyroid gland [5]. Withdrawal of estrogen is reported to cause a significant loss of bone calcium [6]. It was observed that an increase in the basal metabolic rate and oxygen consumption during the luteal phase was associated with increased carbohydrate utilization. This elevated metabolism requires magnesium ions and oxidative enzymes which were found to be increased significantly during the luteal phase [7].

During the part of the cycle between ovulation and the onset of menstruation (postovulatory phase), the concentration of progesterone is high. Progesterone reportedly has a natriuretic effect [8] and the increase in progesterone after ovulation is thought to be followed by a compensatory rise in aldosterone concentration [9].

These evidences suggest possibly ovarian hormones influence calcium, magnesium, sodium and potassium metabolism during different phases of menstrual cycle. 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 these electrolytes has not been clearly established. Hence, this corollary follow up study carried presents variation in serum calcium, magnesium, sodium and potassium during menstrual, follicular and luteal phases of menstrual cycle.

MATERIALS AND METHODS

The study was conducted on 50 healthy females in the age group of 18-35 menstruating regularly (cycle length between 25 and 35 days).

Subjects using hormonal methods of contraception, having a history of any significant past illness or recent acute illness affecting the menstrual cycle and subjects taking any medication (including dietary supplements such as vitamins) for at least a month before the study were excluded.

The clinical history of the subjects was noted and different phases of the menstrual cycle (menstrual, follicular and luteal phases) were determined by a detailed menstrual history.

5 ml Blood was drawn within the first 2 days of the cycle during the menstrual phase, within the 8^{th} to 14^{th} days during the follicular phase and after the 22^{nd} day during the luteal phase until the next cycle began. Each sample was analyzed for levels of serum calcium and magnesium on Selectra-E random access clinical chemistry analyzer and sodium and potassium on Medica's EasyLyte analyzers.

Statistical analysis of the three sets of data (menstrual, follicular and luteal phases) for each analysis was carried out by ANOVA Test.

RESULTS AND DISCUSSION

Hormonal changes during the menstrual cycle are well documented but there are very few reports on the changes in serum calcium, magnesium, sodium and potassium levels in various phases of the menstrual cycle.

Table 1 shows our results that serum calcium levels were significantly higher in follicular phase than menstrual and luteal phases. 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 [10]. Serum calcium in the present study was found to be lowest during luteal phase in spite of 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 [11].

The levels of serum magnesium in present study were significantly highest during the luteal phase and lowest during the follicular phase. The raised estrogen levels possibly by acting through parathyroid hormone could be responsible for depicting the body stores of magnesium by decreasing the reabsorption of magnesium ions by the renal tubules thus resulting in midcycle decline [12]. It has also been reported that magnesium ions and oxidative enzymes are needed for carbohydrate utilization which increases significantly during the luteal phase [13].

Increased serum calcium levels during the ovulatory phase may also contribute to the decreased magnesium levels by exerting an effect on the cell permeability [14]. Therefore, it is suggested that calcium/magnesium ratio may be related to the premenstrual syndrome complaints that some women have during this period [15]. 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 [16,17].

Our findings of serum sodium and potassium levels during menstrual cycle correlated well with the findings of M. Mira et al [18]. Although, it is documented that during the luteal phase of the menstrual cycle sodium-retaining hormone secretion increase [19], 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 [20] and the antagonism effect of progesterone to the typical sodium-retentive influence of aldosterone [21]. 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 [22].

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

In 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.

ACKNOWLEDGEMENT

We acknowledge the President of Shri Shivaji Education Society & Dean of Dr. Panjabrao Deshmukh Memorial Medical College, Amravati for providing the financial support to carry out this research work in the Department of Biochemistry.

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TABLE 1
Serum calcium, magnesium, sodium and potassium levels in different phases of menstrual cycle

Phases of Menstrual cycle	**Menstrual phase**	**Follicular phase**	**Luteal phase**
Calcium (mg/dl)	9.50 ± 0.43	9.74 ± 0.43*	9.28 ± 0.41
Magensium (mg/dl)	2.156 ± 0.25	1.984 ± 0.30**	2.41 ± 0.30
Sodium (mmol/L)	142.51 ± 2.03	141.108 ± 1.74	140.02 ± 2.12***
Potassium (mmol/L)****	4.13 ± 0.31	4.20 ± 0.42	4.28 ± 0.43

n = 50

*Significantly higher as compared to the other two ($p < 0.01$)
**Significantly lower as compared to the other two ($p < 0.01$)
***Significantly lower as compared to the other two ($p < 0.01$)
**** Potassium values are not significant.