

Serum Electrolytes and Ovarian Hormones Levels in Young Unmarried Women with Premenstrual Syndrome

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Abstract

Background: Alteration of serum electrolyte levels may occur during late luteal phase of the menstrual cycle due to the rhythmical fluctuations of serum estrogen and progesterone levels. The rhythmical fluctuation in ovarian hormonal levels with serum electrolyte during the menstrual cycle affects their daily activities and personal life.

Methods: A cross-sectional study was conducted to observe the serum electrolytes and ovarian hormones levels in 30 young unmarried women with PMS from July 2016 to June 2017 in the Department of Physiology, Sir Salimullah Medical College, Bangladesh.

Results: The mean age of the non-PMS and PMS group was 20.30 ± 1.15 and 20.53 ± 1.17 years. The mean of serum sodium level was significantly higher in the group B in comparison to group A ($p < 0.05$). The mean of serum calcium and magnesium levels were significantly lower in group B in comparison to those of group A ($p < 0.05$). The mean estrogen level was significantly higher in group B in comparison to group A; and serum progesterone level was significantly lower in group B in comparison to group A ($p < 0.05$).

Conclusion: In young unmarried women with premenstrual syndrome, changes in serum electrolytes and ovarian hormones were occurred. These changes may be due to hormonal imbalance in the PMS group.

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Keywords: PMS, sodium, potassium, calcium, magnesium, ovarian hormones, PMS symptoms scores.

Introduction

Menstrual cycle is a monthly rhythmical change in the rate of secretion of the female hormones and corresponding physical changes in the ovaries and other sexual organs. It consists ovarian and endometrial cycle. The ovarian cycle have follicular phase and luteal phase.¹ During follicular phase, a new endometrium regrows under the influence of estrogen from the developing follicle. After ovulation,

endometrium becomes highly vascular and slightly edematous under the influence of progesterone and estrogen from corpus luteum which coincides with the luteal phase of ovarian cycle.² Progesterone, acting on an endometrium primed by estrogen, produces the secretory nature of endometrium which is progestational in character and ends at about 28 days with the onset of menstruation.³

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PMS is a recurrent moderate psychological and physical symptom that may occur during the late luteal phase of menstrual cycle and resolve with menstruation.⁴ According to American College of Obstetricians and Gynecologists criteria, PMS can be diagnosed if the patients report at least 1 affective symptom (depression, angry outbursts, irritability, anxiety, confusion, or social withdrawal) and somatic symptom (breast tenderness, abdominal bloating, headache, or swelling of the extremities) during the 5 days before menstruation in each of the 3 prior menstrual cycles. These symptoms are relieved within 4 days of onset of menstruation. More severe symptoms include irritability, dysphoria and mood liability.⁵ The etiology of PMS is unknown, although several theories have been proposed, including estrogen-progesterone imbalance, prolactin excess, hypoglycemia, thyroid dysfunction, increase activity of aldosterone, vitamin B₆ deficiency, psychogenic factors and also alteration of neurotransmitters.^{5,6}

The level of serum sodium was significantly decreased but no significant difference of potassium was found in luteal phase as compared to those of follicular and menstrual phases.⁷⁻⁹ Again, the level of serum sodium was significantly decreased, whereas serum potassium was significantly increased in secretory phase.^{10,11} However, some other researchers have found a higher level of calcium in proliferative phase,^{12,13} significantly decreased in follicular phase^{13,14} and highest level of serum magnesium was observed during luteal phase and lowest during ovulation.¹⁵ But no published data has yet been available on the rhythmical fluctuation of ovarian hormones level along with the alteration in serum electrolytes level in late luteal phase and their association with PMS in young unmarried women in our country. Therefore, the present study has been undertaken.

Methods

Study design and settings

This is a cross-sectional study was commenced to observe the serum electrolytes and ovarian hormones levels in young unmarried women with premenstrual syndrome from July 2016 to June 2017 in the Department of Physiology, Sir Salimullah Medical College, Dhaka 1000, Bangladesh.

Sample selection criteria

Participants were purposively selected 60 with apparently healthy young unmarried women age range 18-25 years having regular menstrual cycle of 28 ± 3 days for at least 6 months and BMI within normal reference range (18.5-24.9kg/m²). Participants were divided two groups equally, 30 women in each group. Group A (Non-PMS group) young unmarried woman without premenstrual syndrome, and Group B (PMS group) young unmarried woman with premenstrual syndrome for at least 3 consecutive symptomatic cycles before starting treatment. Woman had history of having any chronic or systemic illness, known thyroid dysfunction, adrenocortical dysfunction, any other gynecological disorder, psychiatric disorder and prescribed medicine user (Diuretics, Calcium, Magnesium, and OCP) was excluded from this study.

Data collection procedures

All the subjects of non-PMS and PMS groups were inquired to attend again in their late luteal phase (any of the day from 24-26th day of the menstrual cycle) to assess their study parameters. To measure the serum electrolyte levels, serum sodium, potassium were estimated by integrated multisensor technology (IMT), serum calcium and magnesium were estimated by o-cresolphthaleincomplexone (OCPC) method and methyl thymol blue (MTB) complexometric method in the Department of Biochemistry, BSMMU, Dhaka. For the assessment of glycemic status and renal function, random blood glucose level and serum

creatinine level were estimated by using glucose oxidase (GOD-POD) method and fixed time kinetic method respectively in a semi-autoanalyzer in the Department of Physiology, SSMC. Again, for the assessment of ovarian hormonal status, serum estrogen and progesterone levels were assessed by chemiluminescent microparticle immunoassay (CMIA) method in ARCHITECT plus ci8200 system in the Department of Biochemistry, BSMMU, Dhaka.

Statistical analysis

The data analyses were done by IBM SPSS v22. Descriptive statistics such as mean,

standard deviation and percent were computed for continuous variables of the participants. Unpaired 't' test was done to assess the significance of associations. A p-value of <0.05 at a 95% confidence interval was taken as significant. The results were presented in tables.

Ethical approval

Informed written consent was obtained from each participant. Ethical approval was obtained from the Institutional Ethics Committee (IEC) of Sir Salimullah Medical College, Dhaka 1000, Bangladesh. (Reference: SSMC/2017/40)

Results

Table I depicts the age, body weight and BMI of the both groups of women. The mean age of the participant was 20.30 ± 1.15 and 20.53 ± 1.17 years; and mean weight was 49.60 ± 3.69 and 50.07 ± 4.23 kg in the group A and B, respectively. The mean BMI was 20.48 ± 1.14 and 20.65 ± 1.27 kg/m² in the group A and B respectively. The values were almost similar within the groups and no statistically significant difference found within the age, body weight and BMI.

Table I: Age, body weight and BMI of the women (n=60)

Parameters	Group A (n=30)	Group B (n=30)	p value
	Mean± SD	Mean± SD	
Age (years)	20.30 ± 1.15 (18.00-23.00)	20.53 ± 1.17 (19.00-23.00)	0.438
Weight (kg)	49.60 ± 3.69 (45.00-58.00)	50.07 ± 4.23 (45.00-62.00)	0.651
BMI (kg/m ²)	20.48 ± 1.14 (18.66-22.50)	20.65 ± 1.27 (18.75-22.86)	0.594

Unpaired 't' test was done

Table II represents the systolic and diastolic blood pressure, random blood sugar (RBS) and serum creatinine level of the women. The mean of SBP was 113.67 ± 6.15 and 115.33 ± 5.07 mm of Hg, and DBP was 76.33 ± 3.70 and 75.83 ± 4.17 mm of Hg in group A and B, respectively. The mean of RBS was 6.08 ± 0.92 and 6.15 ± 0.75 mmol/L, and serum creatinine was 0.69 ± 0.22 and 0.71 ± 0.15 mg/dl in the group A and B, respectively. The values were almost similar within the groups and no statistically significant difference found within the blood pressure, RBS and serum creatinine level of the women.

Table II: Blood pressure, RBS and serum creatinine level of the women (n=60)

Parameters	Group A (n=30)	Group B (n=30)	p value
	Mean± SD	Mean± SD	
Systolic blood pressure (mm of Hg)	113.67±6.15 (100.00-120.00)	115.33±5.07 (110.00-120.00)	0.257
Diastolic blood pressure (mm of Hg)	76.33±3.70 (70.00-80.00)	75.83±4.17 (70.00-80.00)	0.625
RBS (mmol/L)	6.08±0.92 (4.50-7.67)	6.15±0.75 (4.60-7.34)	0.718
Serum creatinine (mg/dl)	0.69±0.22 (0.40-1.30)	0.71±0.15 (0.40-1.10)	0.587

Unpaired 't' test was done

Table III denotes the serum electrolytes and ovarian hormones level of the women. The mean of serum sodium level was 139.97±1.30 and 140.93±1.68 mmol/L, and serum potassium level was 4.20±0.32 and 4.17±0.31 mmol/L in group A and B, respectively. The mean serum calcium level was 9.34±0.53 and 8.85±0.55 mg/dl and serum magnesium level was 2.36±0.37 and 2.08±0.38 mg/dl in the group A and B, respectively. The mean of serum sodium level was significantly higher in the group B in comparison to group A ($p<0.05$). The mean of serum calcium and magnesium levels were significantly lower in group B in comparison to those of group A ($p<0.05$). The mean of serum estrogen level was 177.10±6.90 and 283.53±5.73 pg/ml and serum progesterone was 19.35±2.55 and 14.67±2.20 ng/ml in group A and B, respectively. The mean estrogen level was significantly higher in group B in comparison to group A; whereas, serum progesterone level was significantly lower in group B in comparison to group A ($p<0.05$).

Table III: Serum electrolytes and ovarian hormones level of the women (n=60)

Parameters	Group A (n=30)	Group B (n=30)	p value
	Mean± SD	Mean± SD	
Serum electrolytes			
Serum sodium (mmol/L)	139.97±1.30 (137.00-142.00)	140.93±1.68 (138.00-143.00)	0.016*
Serum potassium (mmol/L)	4.20±0.32 (3.70-4.90)	4.17±0.31 (3.80-5.00)	0.714
Serum calcium (mg/dl)	9.34±0.53 (8.50 - 10.20)	8.85±0.55 (7.90-9.80)	0.003*
Serum magnesium (mg/dl)	2.36±0.37 (1.70-2.80)	2.08±0.38 (1.50-2.50)	0.007*
Serum ovarian hormones			
Serum estrogen (pg/ml)	177.10±6.90 (158.00-202.00)	283.53±5.73 (277.00-304.00)	0.001*
Serum progesterone (ng/ml)	19.35±2.55 (14.80-23.70)	14.67±2.20 (10.50-19.20)	0.001*

Unpaired 't' test was done, *Statistically significant value

Discussion

In the current study, the mean age of the young unmarried women with premenstrual syndrome was 20.30 ± 1.15 and 20.53 ± 1.17 years; and the mean BMI was 20.48 ± 1.14 and 20.65 ± 1.27 kg/m² in the group A and B. The values were almost similar within the groups and no statistically significant difference found within the age, body weight and BMI.

The present study revealed that the mean of SBP was 113.67 ± 6.15 and 115.33 ± 5.07 mm of Hg, and DBP was 76.33 ± 3.70 and 75.83 ± 4.17 mm of Hg in group A and B. The mean of RBS was 6.08 ± 0.92 and 6.15 ± 0.75 mmol/L, and serum creatinine was 0.69 ± 0.22 and 0.71 ± 0.15 mg/dl in the group A and B. All the parameters were within normal reference value. There was no statistically significant difference found within the blood pressure, RBS and serum creatinine level of the women.

The mean of serum sodium level was 139.97 ± 1.30 and 140.93 ± 1.68 mmol/L, and serum potassium level was 4.20 ± 0.32 and 4.17 ± 0.31 mmol/L in group A and B. The mean of serum sodium level was significantly higher in the group B in comparison to group A ($p < 0.05$). This observation was almost in consistent with those studies.^{16,17} The mean serum calcium level was 9.34 ± 0.53 and 8.85 ± 0.55 mg/dl and serum magnesium level was 2.36 ± 0.37 and 2.08 ± 0.38 mg/dl in the group A and B. The mean of serum calcium and magnesium levels were significantly lower in group B in comparison to those of group A ($p < 0.05$). Similar observation was found in the studies.^{18,19}

In this study, the mean of serum estrogen level was 177.10 ± 6.90 and 283.53 ± 5.73 pg/ml and serum progesterone was 19.35 ± 2.55 and 14.67 ± 2.20 ng/ml in group A and B. The mean estrogen level was significantly higher in group B in comparison to group A; whereas, serum progesterone level was significantly lower in

group B in comparison to group A ($p < 0.05$). Similar observation was found in the studies.²⁰

Conclusion

The study revealed that alteration in serum electrolytes and ovarian hormones were occurred in young unmarried women with PMS and this alteration due to hormonal imbalance in PMS group. It is expected that the findings provide a guideline for the gynecologists for early detection and management of PMS and also help women to live a healthy productive life.

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References

1. Hall JE, Guyton AC. Female physiology before pregnancy and female hormones. Guyton and Hall Textbook of Medical Physiology. 2011; 13:593-602.
2. Ganong WF. Reproductive development and function of the female reproductive system. Review of medical physiology. 24th edition. Singapore: Lange Medical Publications. 2012:401-4.
3. Keele CA, Neil E, Joels N. Female reproductive system. Samson Wright's Applied Physiology. 13th edition. Oxford University Press, New York, 1984; 566.
4. Biggs WS, Demuth RH. Premenstrual syndrome and premenstrual dysphoric disorder. American Family Physician. 2011; 84(8):918-24.
5. Shushan A. Complications of menstruation and abnormal uterine bleeding. Current Diagnosis and Treatment: Obstetrics and Gynecology, 11th edition. McGraw-Hill Education. 2013:611-3
6. O'Brien PMS. 'Premenstrual Syndrome' In: Edmonds, K., Dewhurst's Textbook of Obstetrics and Gynaecology. 8th edition. Black well Publishing limited, London. 2012; 544-52.

7. Mira M, Stewart PM, Gebiski V, Llewellyn-Jones D, Abraham SF. Changes in sodium and uric acid concentrations in plasma during the menstrual cycle. *Clinical Chemistry*. 1984; 30(3):380-1.
8. Lanje MA, Bhutey AK, Kulkarni SR, Dhawie UP, Sande AS. Serum electrolytes during different phases of menstrual cycle. *International Journal of Pharma Sciences and Research*. 2010; 1:435-7.
9. Malipatil BS, Patil S. Hematological modulation in different phases of menstrual cycle. *International Journal of BioMed Research*. 2013; 4(2):89-93.
10. Das B, Prasanna Chandra M, Samanta S, Mallick AK, Sowmya MK. Serum inorganic phosphorus, uric acid, calcium, magnesium and sodium status during uterine changes of menstrual cycle. *International Journal of BioMed Research*. 2012; 3(4):209-13.
11. Mishra A. Variation's serum electrolyte level during different phases of menstrual cycle in healthy female medical students. *International Journal of Biomedical Research*. 2015; 6(7):504-08.
12. Lanke V, Vadugu S. Phasic Variation of Serum Calcium and Magnesium in Menstrual Cycle. *International Journal of Biomedical Research*. 2015; 6(1):4785-9.
13. Nepalia R. Measurement of serum calcium, magnesium and phosphorus level during different phases of menstrual cycle. *International Archives of Integrated Medicine*. 2016; 3(4):53-6.
14. Dullo P, Vedi N. Changes in serum calcium, magnesium and inorganic phosphorus levels during different phases of the menstrual cycle. *Journal of Human Reproductive Sciences*. 2008; 1(2):77.
15. Pandya AK, Chandwani S, Das TK, Pandya KD. Serum Calcium Magnesium and Inorganic Phosphorous Levels during various Phases of Menstrual Cycle. *Indian Journal of Physiology and Pharmacology*. 1995; 39:411-4.
16. Schmalenberger KM, Tauseef HA, Barone JC, Owens SA, Lieberman L, Jarczok MN, Girdler SS, Kiesner J, Ditzen B, Eisenlohr-Moul TA. How to study the menstrual cycle: Practical tools and recommendations. *Psychoneuroendocrinology*. 2021; 123:104895.
17. Dos Santos Andrade M, Mascarini NC, Foster R, de Jarmy di Bella ZI, Vancini RL, Barbosa de Lira CA. Is muscular strength balance influenced by menstrual cycle in female soccer players?. *The Journal of Sports Medicine and Physical Fitness*. 2016; 57(6):859-64.
18. Pambudi MF. Calcium level is lower in women with premenstrual syndrome. *Indonesian Journal of Obstetrics and Gynecology*. 2013:99-102.
19. Kia AS, Amani R, Cheraghian B. The association between the risk of premenstrual syndrome and vitamin D, calcium, and magnesium status among university students: a case control study. *Health Promotion Perspectives*. 2015; 5(3):225.
20. Wang MI, Seippel LE, Purdy RH, Backstrom T. Relationship between symptom severity and steroid variation in women with premenstrual syndrome: study on serum pregnenolone, pregnenolone sulfate, 5 alpha-pregnane-3, 20-dione and 3 alpha-hydroxy-5 alpha-pregnan-20-one. *The Journal of Clinical Endocrinology & Metabolism*. 1996; 81(3):1076-82.