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Serum Electrolyte Status and Liver Functions in Different Phases of Menstrual Cycle

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ABSTRACT

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 and liver functions have not been clearly established. To compare the serum electrolyte level and liver functions in different phases of menstrual cycle.The present study was carried out on 92 healthy female medical students in the age group of 18 to 23years with normal menstrual cycle of 27-33 days. Serum electrolytes like, calcium, sodium, potassium, magnesium and liver function parameters like total protein, albumin and globulin levels were estimated during menstrual, Proliferative and Secretory phases of menstrual cycle using standard procedures. There was a nonsignificant changes in the level of serum calcium, sodium, potassium, magnesium in different phases of menstrual cycle and total protein, albumin and globulin levels were significantly increased ($p<0.05$) in proliferative phase of menstrual cycle. ($P<0.05$). Nonsignificant variation in Serum electrolytes during various phases of menstrual cycle may be due to the effect of estrogen and changes in liver function may be due to the influence of progesterone during menstrual cycle.

Keywords: Menstrual cycle, Serum Electrolytes, Total protein, Albumin, Globulin.

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INTRODUCTION

The menstrual cycle is characterized by cyclical fluctuations in the levels of FSH, LH, estrogen and progesterone. These hormones are known to have an effect on oxygen carrying capacity, immune response, bleeding and also changes in serum electrolytes which may be responsible for variable physical, psychological symptoms and autonomic changes.

Up to 18 % of women have severe postmenopausal syndrome (PMS) and 3–8 % qualify for a diagnosis of premenstrual dysphoric disorder (PMDD) [1,2]. Two to ten percent of women have significant premenstrual symptoms that are different from the normal discomfort associated with menstruation in healthy women [3,4]. Low levels of certain vitamins and minerals, particularly magnesium, manganese, Vitamin E , Vitamin D [5] 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 [6]. Estrogen like aldosterone and some other adrenocortical hormones causes sodium and water retention by kidney tubules [7]. Whereas progesterone is a competitive inhibitor of aldosterone at the kidney, it has natriuretic action [8] .Certain autonomic changes have also been reported during these phases, though more so during the premenstrual phase. It is likely that an exaggerated response to hormonal changes may be responsible for variable physical and psychological symptoms [9].

Serum proteins bind sex steroids and regulate activity of menstrual cycle. The sex steroids have an anabolic effect. Estrogen causes positive nitrogen balance due to growth promoting effect which causes slight increase in the total body proteins [10]. Progesterone exerts anabolic effect & this partly accounts for some of the weight gain [11]. Oestrogen has an effect on calcium homeostasis. Estrogen inhibit secretion of cytokines such as interleukin 1, IL-6, tumour necrosis factor (TNF-α), cytokines foster the development of osteoclasts. It also stimulates production of transforming growth factor (TGF-β) which increases apoptosis of osteoclasts. Estrogen increases calcification of bone [12]. But the changes occur in serum electrolyte level and liver functions have not been clearly established. Hence, the present study was undertaken to investigate and thus provide a screening tool to avoid morbidity and mortality related to menstrual cycle.

MATERIALS AND METHODS

The study protocol was approved by the institutional ethical committee. Ninety two subjects were recruited after the informed and written consent. In the present study, apparently healthy thirty female medical students aged between 18-23 years and Normal regular menstrual cycles of 27-33 days with ovulatory cycles were included. Subjects below 18yrs and above 23yrs of age, Subjects with endocrinal & gynecological disorders, chronic diseases, allergic conditions, presence of infection at the time of sampling, subjects with diabetes, pregnancy, subjects with irregular menstrual cycle, and subjects performing regular exercise were excluded.

Venous blood sample was collected from the antecubital vein (2 ml) in a disposable syringe between 1- 2 pm to avoid diurnal variation and analysis was done within half an hour to avoid variations due to storage. The investigations were performed using automated analyzer Erba chem-7, Easy Lyte Plus in the department of Bio-chemistry. The blood sample was centrifuged using R-8C centrifuge machine and serum was separated and used for the estimations.

Serum Calcium estimation was done by dye binding method [13]

The method used here is based on the metallo-chromogen Arsenazo-III which combines with calcium ions at pH 6.75 to form highly colored chromophore, the absorbance of which is measured at 650 nm. Arsenazo III has a high affinity for calcium ions and shows no interference from other cations normally present in serum, plasma or urine.

Serum Magnesium estimation was done by dye binding method [14]

At alkaline pH magnesium reacts with xylidyl blue and produces chelating red color compound. The red increasing color is proportional to magnesium concentration. Mix incubates for 5min. at RT. Measure absorbance of sample (AT) and standard (AS) against reagent blank at 505nm.

Serum Sodium and Serum potassium estimation was done using Easy Lyte Plus

The Easy Lyte measures sodium, potassium in biological fluids, using Ion selective Electrode technology. The flow through sodium and pH electrodes contains glass tubing, specially formulated to be sensitive to sodium ions. The flow through potassium electrode employs a plastic tube, incorporating neutral carrier ionophores. The potential of each electrode is measured relative to a fixed, stable voltage established by the silver/silver chloride reference electrode. An ion selective electrode develops a voltage that varies with the concentration of the ion to which it responds. This relationship between the voltage developed and the concentration of the sensed ion is logarithmic as expressed by the Nernst equation.

Serum Total protien estimation was done by Biuret method [13]

The peptide bonds of protein react with the copper II ions in alkaline solution to form blue –violet complex (Biuret reaction).Each copper ion complexing with 5 or 6 peptide bonds. Tartarate is added as a stabilizer whilst Iodide is used to prevent auto reduction of the alkaline copper complex. The color formed is proportional to the protein concentration and is measured at 546 nm (520-560nm).

Serum Total albumin estimation was done by BCG Dye method [15]

Albumin binds with bromocresol green (BCG) at Ph 4.2 causing a shift in absorbance of the yellow BCG dye. The blue green color formed is proportional to the concentration of

albumin present, when measured photometrically between 580-630nm with maximum absorbance at 625nm.

Serum Globulin estimation was done by calculation

Serum Globulin (g/dl) =Serum Total protein (g/dl)-Serum Albumin (g/dl)

Statistical Analysis

Data was expressed as Mean ± S.D. and was analyzed for statistical analysis using SPSS 17.0 Software. To compare means of two independent groups, student's t- test was used. $P<0.05$ was considered the level of significance.

RESULTS

Serum Calcium level (Fig-1) in menstrual phase (MP), proliferative phase (PP) and Secretory phase (SP) were 8.47±1.81, 8.29±1.38 and 7.79±1.28 respectively. It was increased in MP compared to other phases but not statistically significant when compared during different phases of menstrual cycle. Serum Sodium levels (Fig-2) in MP, PP and SP were 141.77±1.55, 141.55±2.08) and 141.59±1.82 respectively. It was also increased in MP compared to other phases but not statistically significant when compared during different phases of menstrual cycle.

Serum Potassium level (Fig-3) in MP, PP and SP were 4.05 ± 0.39, 4.19 ± 0.33, 4.04 ± 0.38 respectively. It was increased in PP compared to other phases but not statistically significant when compared during different phases of menstrual cycle. Serum Magnesium level (Fig-4) in MP, PP and SP were 1.74±0.38, 1.77±0.36 and 1.71±0.38 respectively. It was increased in PP compared to other phases but not statistically significant when compared during different phases of menstrual cycle.

The liver functions were analyzed by estimating the total protein, albumin and globulin level in the serum. Serum total protein level (Fig-5) in MP, PP and SP were 7.61±1.42, 8.01±0.74 and 8.35±1.12 respectively. It was significantly increased in SP compared to MP ($P<0.05$).The Serum Albumin level (Fig-6) in MP, PP and SP were 3.80±0.64, 4.09±0.58 and 3.81±0.44 respectively. It was significantly increased ($P<0.05$) in PP compared to SP. Serum globulin level (Fig-7) in MP, PP and SP were 3.81±1.59, 3.92±0.95 and 4.47±1.39 respectively. It was significantly increased in SP compared to PP ($P<0.05$).

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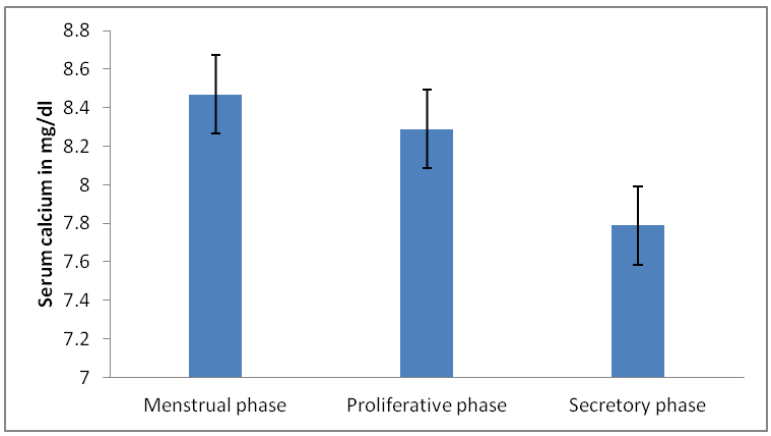

Fig-1: Serum calcium level in different phases of menstrual cycle. N=92. Variation in calcium level is insignificant when compared between different phases of menstrual cycle.

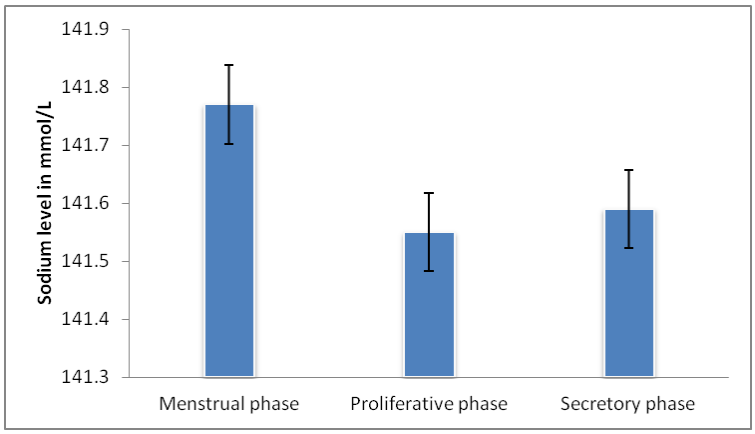

Fig-2: Serum sodium level in different phases of menstrual cycle. N=92. Variation in sodium level is insignificant when compared between different phases of menstrual cycle.

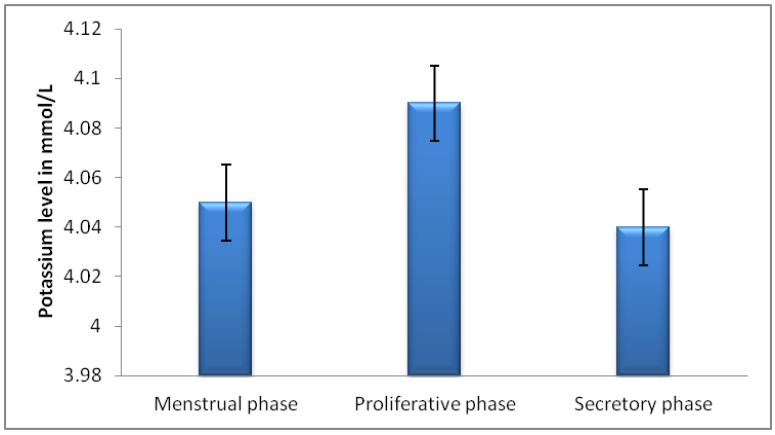

Fig-3: Serum potassium level in different phases of menstrual cycle. N=92. Variation in potassium level is insignificant when compared between different phases of menstrual cycle.

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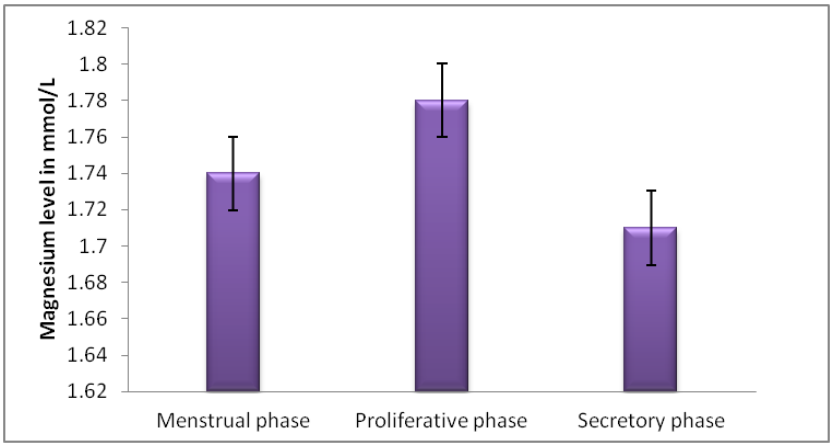

Fig-4: Serum magnesium level in different phases of menstrual cycle. N=92. Variation in magnesium level is insignificant when compared between different phases of menstrual cycle.

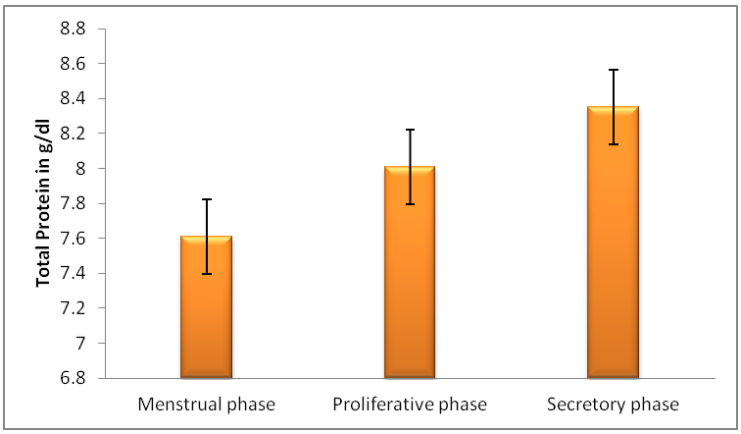

Fig-5: Serum total protein level in different phases of menstrual cycle. N=92. Variation in total protein level is significantly increased ($p<0.05$) during SP as compared to other phases of menstrual cycle.

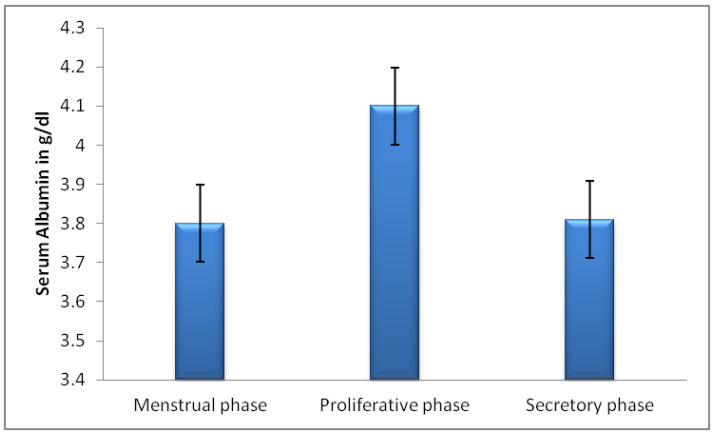

Fig-6: Serum Albumin level in different phases of menstrual cycle. N=92. Variation in Albumin level is increased significantly ($p<0.05$) in PP whereas, insignificant between other phases of menstrual cycle.

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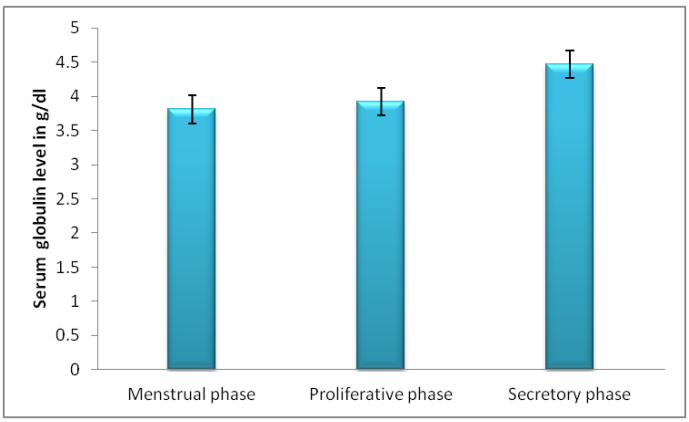

Fig-7: Serum globulin level in different phases of menstrual cycle. N=92. Variation in globulin level is significantly increased ($p<0.05$) during SP but, insignificant between different phases of menstrual cycle.

DISCUSSION

Menstruation is a phenomenon unique to females and nearly universal experience in women's lives and is poorly understood. In the present study, Serum Calcium was nonsignificantly increased in MP compared to other phases which is in line with other studies [16]**.** 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 [17, 18]**.**

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 [17, 18]. 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 phases [17, 19]**.** Increase in the serum Magnesium level in PP compared to other phases is due to the raised estrogen levels possibly by acting through parathyroid hormone could be responsible for decreasing the reabsorption of magnesium ions by the renal tubules thus resulting in decline in PP and also magnesium ions and oxidative enzymes are needed for carbohydrate utilization which increases significantly during the luteal phase [17]**.** In each woman, there was a comparatively high ionized Magnesium (Mg) level in the early follicular phase, and a significant decrease in ionized and total Mg when the serum progesterone concentration peaked [20]**.** The significantly increased serum total protein in SP may be due to the influence of progesterone as a protein anabolic effect on synthetic mechanism in liver but interestingly significant increase in serum albumin at PP & total protein in SP in our study remained unanswerable. In other study total protein was significantly increased in the luteal compared to the follicular phase [21]**.** The significantly increased serum albumin in PP corresponds to increase in the serum albumin in luteal phase [21, 22]. The Serum albumin concentrations are sometimes used to indicate the degree of hemodilution [23]**.**

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CONCLUSION

Nonsignificant variation in Serum calcium, serum magnesium, 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. Changes in serum total protein & albumin may be due to the influence of progesterone as a protein anabolic effect on synthetic mechanism in liver.

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