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SERUM CALCIUM, MAGNESIUM AND INORGANIC PHOSPHOROUS LEVELS DURING VARIOUS PHASES OF MENSTRUAL CYCLE

ASHA K. PANDYA*, S. CHANDWANI, TARUN K. DAS AND KAUSHIK D. PANDYA

Department of Physiology, Medical College, Baroda - 390 001

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Abstract: Serum Calcium (Ca), Magnesium (Mg) and Inorganic phosphorous (Pi) were investigated serially during menstrual, follicular, ovulatory and luteal phases of menstrual cycle in 25 healthy medical student volunteers. The result shows significant cyclic variations within physiological limits in all parameters. Ca level was highest during ovulation ($P<0.001$) and lowest during luteal phase ($P<0.001$) compared to other phases. Exactly opposite result was observed for Ca level. It is lowest during ovulation ($P<0.001$) and highest during the luteal phase ($P<0.001$). However, the highest level of Pi was seen during menstrual phase ($P<0.001$) and lowest during the luteal phase ($P<0.001$). These changes are probably brought about under the influence of cyclic variations of the ovarian hormones.

Key words: menstrual cycle, calcium, magnesium, inorganic phosphorous

INTRODUCTION

Menstrual cycle is a result of complex interacting processes within the hypothalamus, hypophysis, ovaries and uterus. The cyclic physiologic changes are mainly brought about by the ovarian hormones; estrogen and progesterons, the levels of which show variation during menstrual cycle.

Effect of ovarian hormones on water and electrolyte balance is well documented and has been published earlier by the author (1). Estrogen leads to a marked acceleration of Calcium uptake and decrease of its elimination through pigeon's gut (2). In non-pregnant women estrogen administration produces increased parathyroid activity (3). It is known that the Calcium homeostasis is maintained by parathyroid glands, However, effect of menstrual cycle on serum Calcium remains controversial (4). It is also reviewed that published literature does not assign specific role to Magnesium in regulation of menstrual function, although Magnesium is involved in basal metabolism that changed over the course of menstrual cycle (5). These evidences suggest possibly ovarian hormones influence Ca, Mg and Pi metabolism during the different phases of menstrual cycle.

The purpose of this study is to evaluate changes in serum Ca, Mg and Pi levels during menstrual cycle in healthy normally menstruating women.

METHODS

Twenty five healthy medical student volunteers, 18-25 years of age, participated as subjects in this serial study. The subjects were selected on the basis of normal and regualr menstrual cycle (28±2 days cycle). The blood sample was taken from each subjects during their Menstrual, Follicular, Ovulatory and Luteal phases.

The determination of different phases and the procedures of collection of blood during those phases has been explained earlier (1). In brief, 10 ml venous blood was drawn between 8.00 a.m. and 9.00 a.m. in each phase. Period of ovulation

*Corresponding Author

was judged by daily basal oral temperature recordings. Estimation of serum Ca, Mg and Pi was carried out on the same day of collection by standard methods :

Ca and Mg by Ethylene diamine tetra acetic acid titration (6).

Pi by Photometric method of Fisk and Subbarow (6).

Statistical analysis was done by paired 't' test. Level of significance was set at a P value of <0.05.

RESULTS

Serum Ca, Mg and Pi levels during various phases of menstrual cycle are summarised in Table I and represented graphically in Fig. 1.

Gradual increase in serum Ca level was seen from menstrual to follicular (P<0.001) and then to ovulatory phase (P<0.001) followed by luteal decrease (P<0.01) as compared to menstrual phase.

Serum Mg level gradually decreases from menstrual to ovulatory (P<0.001) phase only. Thereafter it rises to its maximum in luteal phase (P<0.001).

There is a cyclic variation in Pi level during the menstrual cycle. The highest level was seen during menstrual phase (P<0.001) compared to all the three phases. During ovulation Pi level increased significantly (P<0.001) compared to follicular phase. The Pi level is lowest (P<0.001) in luteal phase compared to all other phases of the menstrual cycle.

TABLE I : Shows mean (± S.D.) serum Ca, Mg and Pi levels during menstrual cycle.

Phases of menstrual cycle	*Ca mg/100 ml*	*Mg mg/100 ml*	*Pi mg/100 ml*
Menstrual (M)	9.14±0.42	1.56±0.10	5.10±0.48
Follicular (F)	9.66±0.49	1.46±0.09	4.28±0.31
Ovulatory (O)	10.34±0.48	1.32±0.14	4.63±0.37
Luteal (L)	8.80±0.34	1.63±1.17	3.84±0.34

On comparison the values are significant with each other at the level of P<0.001 except for M vs L in case of Ca concentration (P<0.01).

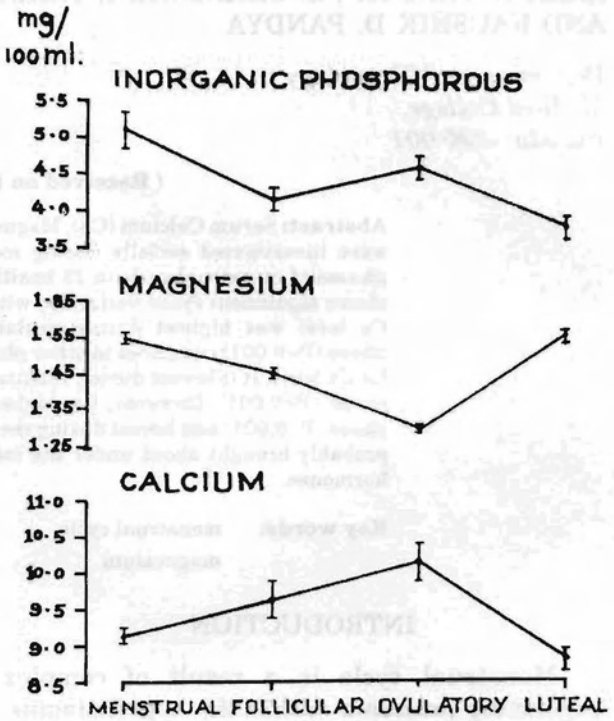

Fig. 1 : Represents Ca, Mg and Pi level in serum during various phases of menstrual cycle.

DISCUSSION

During past several years there has been increased interest in the study of relationship between the essential minerals and ovarian hormone activity. Although the coordinated sequence of hormonal changes during the normal menstrual cycle is well characterised, whether similar or parallel changes occur in the distribution of selected minerals has not been clearly established. Several studies have provided evidence for phase related changes in blood constituents during menstrual cycle (1, 7, 8).

Present study revealed distinct changes occured in serum Ca, Mg and Pi level during menstrual cycle. Gradual but significant increase in serum Ca level was seen during menstrual,

follicular and ovulatory phases compared to luteal phase. The results are analogous to the studies that report serum Ca is in highest concentration during ovulatory phase and in lowest concentration during premenstrual phase (4) while some have stated slight variation during mensus and intermensus though not significant (9).

It is reported that estrogen causes increase in parathyroid activity (7) which leads to marked acceleration of Ca uptake (10, 11) and decrease of its elimination from pigeon's gut (2). Increments in blood Ca can result in increased bone density in healthy women (12). From results it is evident that estrogen alone possibly causes increase in blood Ca level during follicular and ovulatory phase through parathyroid hormone regulation. Withdrawal of estrogen causes significant loss of bone Ca (13, 14).

Although estrogen increases during luteal phase, Ca level was found to be low. This cannot be explained on the basis of estrogen levels and parathyroid activity alone, probably progesterone might have more influence on it. Higher level of progesterone than estrogen during luteal phase may interfere the activity of estrogen. Alternatively, because of priming effect of estrogen is utilized to enhance the progesterone activity and may not involve in Ca uptake during luteal phase.

There is controversy regarding serum Mg concentration during menstrual cycle (7, 8). Our study shows serum Mg level is maximum during luteal phase, gradually decreases during menstrual and follicular phases and is lowest during ovulatory phase. The cyclic variation was found to be statistically significant.

Ovulatory decrease of serum Mg may be related to preovulatory estrogen peak (15). It could be related to concurrent leutinising hormone and follicle stimulating hormone peaks but gonadotrophin effect on mineral retention probably requires an active gonad (16).

Changes in plasma Mg level could also be related to changes in basal metabolic rate-BMR (5). Increase in BMR and Oxygen consumption during luteal phase is associated with increased carbohydrate utilization. This carbohydrate utilization requires Mg ion and oxidative enzymes which was found to be increased significantly during luteal phase (17, 18). Serum Mg concentration has been possibly correlated with basal body temparature (BBT) during ovulation and the luteal phase half cycle (19) but whether Mg increase is a cause or effect of increased heat content is difficult to decide. Although the hormone levels were not measured during this study, it seems likely that progesterone is responsible for rise in both BBT and serum Mg, which increased in parallel in a single day (18, 19). Midcycle decline in Mg may be due to increased parathyroid hormone or aldosterone, both of which increase before ovulation (7, 20). Progesterone is also known to act on central nervous system to produce the luteal increase in basal temperature (21). It is emphasized that the luteal phase is associated with increased sympathetic activity (22). Thus increase in Mg may cause decrease in Ca level by inhibiting or competing for common Ca reabsorptive sites in loop of Henle. Specific inhibition of Ca reabsorption by Mg increases urinary Ca excretion (23). Thus decline in serum Ca is a direct response to elevated serum Mg and its action on nephron.

Cyclic changes in Pi level were observed in this study. The decrease in Pi level during ovulation could be on account of estrogen as indicated by earlier studies (24). Carvelho has stated high production of estrogen leads to decrease in serum Pi level (25). Thus inverse relation of Pi and estrogen level is seen. At present it is difficult to explain the cause.

In conclusion, although the cyclic changes are noted in serum Ca, Mg and Pi level during the menstrual cycle, they were all found to be within physiological limits. These changes are probably brought about under the influence of cyclic variations of the ovarian hormones.

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