

Alterations of Serum Calcium, Phosphorus and Alkaline Phosphatase in Postmenopausal Women

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Received 17/2/2010 Accepted 29/3/2010

Abstract

In the present study 3 biochemical parameters (Calcium, Phosphorus and Alkaline phosphatase) has been measured in blood of 111 apparently healthy volunteers women, including 41 apparently healthy premenopausal women aged between (21- 42) years as a control group and 70 apparently healthy postmenopausal women (the menopause occur normally) aged between (50- 69) years which divided into two age groups. From the results it is found that there were a significant difference of serum calcium, phosphorus and alkaline phosphatase between postmenopausal women group and control group also the current study showed that the serum calcium and phosphorus declines with age within postmenopausal women group, while the mean value of alkaline phosphatase activity showed a significant increase with increasing age in postmenopausal women group.

تغيرات الكالسيوم, الفسفور وإنزيم الفوسفاتيز القاعدي في مصل دم النساء بعد سن اليأس

إسراء حكمت الحمداني

المستخلص

تضمنت هذه الدراسة قياس 3 متغيرات كيميوية وهي مستوى الكالسيوم, الفسفور وإنزيم الفوسفاتيز القاعدي في مصل دم 111 متطوعة منهم 41 متطوعة من النساء اللاتي لم يبلغن سن اليأس وتتراوح أعمارهن ما بين (21- 42) سنة و 70 متطوعة من النساء اللاتي بلغن سن اليأس وتتراوح أعمارهن ما بين (50- 69) سنة. كما تم تصنيف النساء بعد سن اليأس إلى مجموعتين عمرية مختلفة. إن الهدف من البحث هو دراسة تأثير مرحلة سن اليأس على مستوى الكالسيوم, الفسفور وإنزيم الفوسفاتيز القاعدي مقارنة مع مجموعة السيطرة ودراسة تأثير العمر في مجموعة النساء بعد سن اليأس على هذه المتغيرات الكيميائية. ومن النتائج المستحصلة من البحث وجد أن هناك اختلافا معنويا في مستوى كل من الكالسيوم, والفسفور وإنزيم الفوسفاتيز القاعدي بين مجموعة النساء بعد سن اليأس ومجموعة السيطرة كما لوحظ أن مستوى الكالسيوم والفسفور في مصل الدم ينخفض انخفاضاً معنويًا مع تقدم العمر في مجموعة النساء بعد سن اليأس بينما وجد أن هناك ارتفاعاً معنويًا في مستوى فعالية إنزيم الفوسفاتيز القاعدي مع زيادة العمر في مجموعة النساء بعد سن اليأس.

Introduction

The term menopause means literally "pause in menses" and refers to the cessation of ovarian activity and menstruation that occurs at about the age of 50 years⁽¹⁾. During the postmenopausal years which account for about a third of a woman's life span, the ovaries are depleted of follicles and stop secreting estradiol and inhibin^{(1),(2)}. The decrease in estrogen levels gives rise to vasomotor instability and "hot flashes"⁽³⁾. In addition, the incidence of cardiovascular disease increases after menopause (estrogen exerts beneficial action on plasma cholesterol and also exerts multiple direct protective action on vessel walls)^{(1),(4)}, because estrogen is a potent bone-protective hormone, significant decrease in bone mass may occur (osteoporosis), this results in an increased risk of bone fractures in postmenopausal women (PMW)⁽⁴⁾. The bone profile consists of some biochemical parameters such as serum calcium, inorganic phosphorus and alkaline phosphatase⁽⁵⁾. Calcium is the fifth most common element and the most abundant mineral in the body about 99% stored in bones as the mineral hydroxyapatite where it is combined with phosphate^{(6),(7)}. An average human body contains approximately 1 Kg of body weight (24.95 mol of body weight) of calcium⁽³⁾. Calcium exists in three physiochemical states in plasma, of which approximately 50% is free or ionized, 40% is bound to plasma proteins chiefly albumin, and 10% is complexed with small anions. Free or ionized calcium fraction is the biologically active form^{(3),(8)}. In adults, the reference interval for serum calcium is about 8.6-10 mg/dl (2.15-2.5 mmol/l)⁽³⁾. Phosphorus in the form of inorganic or organic phosphate is an important and widely distributed element in the human body. An adult human has approximately 600g of

body weight (19.4 mol of body weight) of phosphate expressed as phosphorus of which about 85% is in the skeleton and the rest principally in soft tissues. Plasma contains both inorganic and organic phosphate but only inorganic phosphate is measured. Inorganic phosphate exists as both the monovalent (H_2PO_4^-) and divalent (HPO_4^{2-}) phosphate anions. In soft tissues, most phosphate is cellular. Although both inorganic and organic phosphate are present in cells, most is organic and incorporated into nucleic acids, phospholipids, phosphoproteins, and high energy compounds involved in cellular integrity and metabolism. Plasma contains approximately 2.5 to 4.5 mg/dl (0.81-1.45 mmol/l) of inorganic phosphate⁽³⁾. Extracellular phosphate maintains the critical intracellular concentration and provides substrate for bone mineralization^{(3),(9)}. The calcium and phosphate concentrations of plasma are affected by bone formation and resorption, intestinal absorption of Ca^{+2} and PO^{-3} and urinary excretion of these ions. These processes are regulated by parathyroid hormone, 1,25 dihydroxy vitamin D_3 and calcitonin⁽¹⁾. Alkaline phosphatase (ALP) are a group of enzymes which catalyze the hydrolysis of phosphate in alkaline medium⁽¹⁰⁾. It is found in many tissues including bone (osteoblasts) and is necessary for mineralization, liver, intestine, kidney, and placenta^{(11),(12),(13)}. In order to investigate the effect of menopause on serum calcium, phosphorus and alkaline phosphatase and identify the effect of age on these biochemical parameters within postmenopausal women

group.

Materials And Method

The study was performed on 111 apparently healthy women. Their ages

ranged between (21- 69) years. The control group included 41 apparently healthy non pregnant women, their ages ranged between (21- 42) years, with a mean (31) years. The second group involved in this study included 70 apparently healthy postmenopausal women (PMW) (the menopause was occur normally), their ages ranged between (50- 69) years, with a mean (58) years. A complete information was taken from each woman of both groups including name, age, occupation, and family history. The postmenopausal women group was subdivided into two subgroups according to their age. The first subgroup (PMW₁) included 39 apparently healthy postmenopausal women aged between (50- 59) years, with a mean of (54) years. The second subgroup (PMW₂) included 31 apparently healthy postmenopausal women aged between (60- 69) years, with a mean of (63) years. Approximately 5 ml of fasting blood samples was collected from all women included in the study by anticubital venepuncture without tourniquet. The samples were transferred immediately into plain plastic tubes and left on the bench at room temperature for 20 minutes to allow the blood to clot before separation, then the samples centrifuged at 3000 rpm for 15 minutes, the serum samples were then collected and used for the following tests: Serum calcium, phosphorus and alkaline phosphatase, which determined by colorimetric method^{(14),(15),(16)}, using a kit supplied by biomerieux (France).

Statistical Analysis

Data were analyzed using unpaired t-test. The results were expressed as mean± standard deviation (SD). P≤ 0.05 was considered as statistically significant⁽¹⁷⁾.

Results

The comparison of the mean values of serum calcium, phosphorus and alkaline phosphatase between the control group and postmenopausal women group as shown in table (1), there were a significant decrease in the mean values of serum calcium and phosphorus concentration in postmenopausal women (2.073± 0.056), (1.01± 0.071) respectively in comparison with control group (2.27±0.132), (1.19±0.124) respectively; as in figure (1). However there was a significant increase in the mean value of serum alkaline phosphatase activity in postmenopausal women group (67.2±10.7) compared with control group (53.61±7.41); as in figure (2). A comparison of the serum calcium, phosphorus and alkaline phosphatase between the postmenopausal women aged between (50- 59) years (PMW₁) and postmenopausal women aged (60- 69) years (PMW₂) as shown in table (2), there were a significant decrease in the mean values of serum calcium and phosphorus in PMW₂ group (2.04±0.037), (0.96 ±0.048) respectively as compared with PMW₁ group (2.1±0.055), (1.049±0.062) as in figure (3). While the results of serum alkaline phosphatase activity showed that there was significantly higher in (PMW₂) group (70.42±9.31) compared with (PMW₁) group (64.6±11.2); as in figure (4).

Table (1): Comparison of serum calcium, phosphorus and alkaline phosphatase between postmenopausal women group and control group.

Parameters	Mean± SD		T-value	P-value
	Control group No.= 41	PMW group No.= 70		
Serum calcium (mmol/l)	2.27±0.132	2.073±0.056	10.92	S
Serum phosphorus (mmol/l)	1.19±0.124	1.01±0.071	9.72	S
Serum alkaline phosphatase (U/l)	53.61±7.41	67.2±10.7	-7.15	S

S: Significant at $P \leq 0.05$.

Table (2):- Comparison of serum calcium, phosphorus and alkaline phosphatase for postmenopausal women according to age groups.

Parameters	Mean± SD		T-value	P-value
	PMW ₁ group No.= 39 Aged(50-59) yr.	PMW ₂ group No.= 31 Aged(60-69)yr.		
Serum calcium (mmol/l)	2.10±0.055	2.04±0.037	5.17	S
Serum phosphorus (mmol/l)	1.049±0.0623	0.96±0.048	6.60	S
Serum alkaline phosphatase (U/l)	64.6±11.2	70.42±9.31	-2.32	S

S: Significant at $P \leq 0.05$.

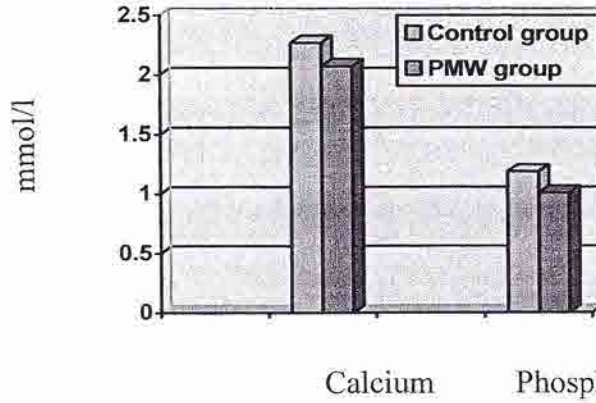


Figure (1): Serum calcium & phosphorus in postmenopausal women (PMW) group and control group.

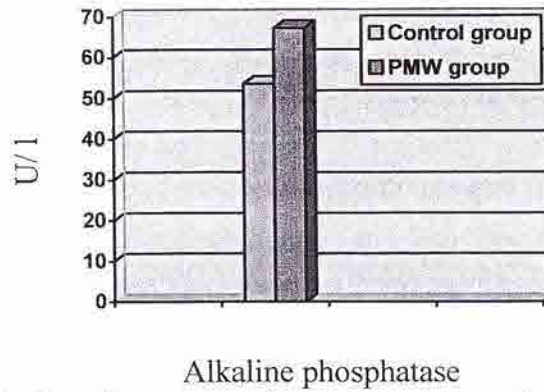


Figure (2):- Serum alkaline phosphatase in postmenopausal women (PMW) group and control group.

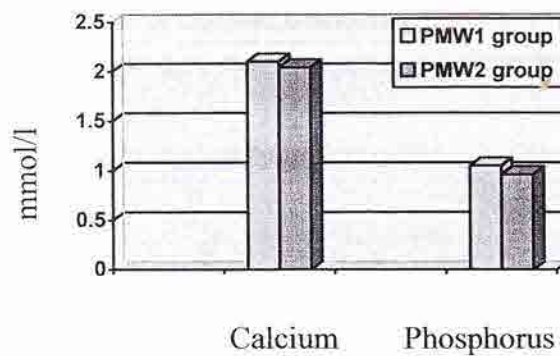
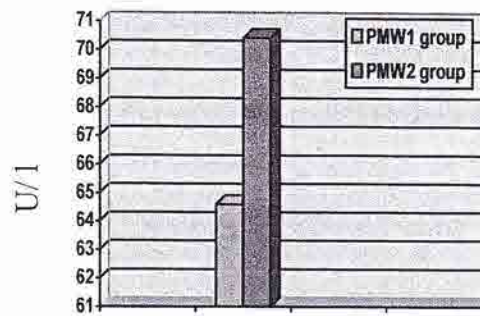


Figure (3):- Serum calcium & phosphorus for postmenopausal women (PMW) according to age groups.



Alkaline phosphatase

Figure (4): Serum alkaline phosphatase for postmenopausal women (PMW) according to age groups.

Discussion

This study showed that there was a significant difference in the mean values of serum calcium and phosphorus between PMW group and control group with a lower level in PMW group. However, the mean value of serum alkaline phosphatase activity showed a significant increase in PMW group compared with control group as shown in table (1); figure (1)& (2). This may be attributed to the deficiency of estrogen hormone after menopause. This estrogen deficiency leads to increased osteoclastic activity in the bones, decreased bone matrix and decreased deposition of bone calcium and phosphate ^{(1),(18)}. The present study, also showed that the serum calcium and phosphorus declines with age within PMW group while the mean value of serum alkaline phosphatase activity showed a significant increase in PMW₂ group aged between (60-69) years compared with PMW₁ group aged between (50-59) years as shown in table (2); figure (3)& (4). These results were in agreement with Lori& Bess (1988)⁽¹⁹⁾; Hu et al.(1999)⁽²⁰⁾ and Suresh & Naidu (2006)⁽²¹⁾. It can be concluded that the serum calcium, phosphorus and alkaline phosphatase

are affected during the postmenopausal years, which leads to increase the progression of osteoporosis.

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