A Comparative Study of 24-Hour Urine Calcium and Serum Calcium Levels in Preeclampsia Pregnant Patients with Pregnant Patients without Hypertension

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ABSTRACT

Preeclampsia is a pregnancy-specific syndrome where due to vascular spasm and activation of the vascular endothelium, perfusion of the organs reduces and proteinuria is of its important symptoms. In this study, 24-hour urine calcium levels and serum calcium levels in pregnant patients with Preeclampsia was compared with pregnant patients without hypertension. This was a clinical trial conducted on the pregnant women with gestational age of 20 weeks referring to the obstetrics and gynecology wards Ahvaz Imam and Razi Hospitals during 2009. The difference between the average serum calcium (mg per deciliter) in the control group with preeclampsia group was not statistically significant (p= 0.07). The difference between 24-hour urine calcium (mg in 24 hrs) in the control group compared with preeclampsia group was statistically significant at 5% level (p= 0.003). The mean 24-hour urine calcium in a group of patients with preeclampsia with liver enzymes at normal level and the group with liver enzymes higher than normal was statistically significant (p= 0.002). The relationship of 24-hour urine calcium (mg in 24 hrs) in preeclampsia group with 24-hour urine protein was greater than 2 grams and 24-hour urine protein was less than or equal to 2 grams and significant. It is recommended that in patients with preeclampsia, in collecting urine, calcium levels be checked and people with hypocalciuria be controlled in terms of progression towards severe preeclampsia and further studies be conducted about giving calcium supplements to people at risk for preeclampsia.

Keywords: Preeclampsia, Pregnant patients, Hypertension
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INTRODUCTION

Preeclampsia is a pregnancy-specific syndrome where due to vascular spasm and activation of the vascular endothelium, perfusion of the organs reduces and proteinuria is of its important symptoms and in the absence of these symptoms, diagnosis results go under question. Proteinuria in random urine samples is defined as 300 mg or more of protein in 24-hours urine with enduring presence of 30 mg proteinuria (result + a urine dipstick test). Even in severe cases, proteinuria may fluctuate during 24 hours. Therefore, a single random sample may fail to show significant proteinuria (1, 2). Preeclampsia is the leading cause of maternal mortality (3).

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One way to reduce maternal mortality due to blood pressure is rapid and accurate diagnosis of preeclampsia (1, 2). Calcium and phosphorus metabolism in normal pregnant women is along minor changes in serum calcium and phosphorus levels and levels of calcium and serum phosphorus slightly increase (4, 5). A number of studies state that urinary calcium excretion in patients with preeclampsia reduces (6). However, a number of studies have found no connection between these two (7). Hypocalciuria can be a risk factor for preeclampsia (5).

In patients with preeclampsia who have hypercalciuria, the risk of obstetric complications such as impaired fetal growth is more (8, 9). In this study, 24-hour urine calcium levels and serum calcium levels in pregnant patients with Preeclampsia was compared with pregnant patients without hypertension.

MATERIALS AND METHODS

The study population consisted of pregnant women with gestational age of 20 weeks referring to the obstetrics and gynecology wards Ahvaz Imam and Razi Hospitals during 2009. Sequential sampling is the start of sampling and based on inclusion and exclusion criteria of the study continue and finishes by reaching the intended number of samples. In the study, which is an analytic epidemiological study, 100 pregnant women were studied as the population, 50 of whom were pregnant women who had been hospitalized as patients with preeclampsia in Ahvaz Imam and Razi Hospitals during 2009 due to high blood pressure. Confirmation of preeclampsia was reached with blood pressure greater than or equal to 140.90 mm Hg after 20 weeks of pregnancy along proteinuria (two times of urinary albumin $\geq$ +1 in random urine sample or 24-hour urine protein $\geq$ 300 mg).

In order to avoid interference of confounding factors, women who had proteinuria due to other known diseases like renal failure, diabetes, pyelonephritis, and connective tissue disease and so on were excluded. In addition, patients who entered delivery phase on the day of collection and patients who used oral calcium during pregnancy were excluded.

After verification of preeclampsia, blood samples of the patients were sent to laboratory to assess the level of calcium, creatinine, platelets, hemoglobin, and liver enzymes. At the same time, blood samples of 50 healthy pregnant women with normal pregnancy, as the control group, were sent to laboratory. Before urine collection, all the women under study received information on the method of urine collection and its importance. Each of the containers had profile labels. At the end of 24 hours, each sample was sent to the laboratory.

Data were analyzed by SPSS16. Independent t-test and chi-square were used for comparison of mean and descriptive statistics were used to describe the results.

Patients' records were strictly confidential and mentioning the names and disclosure of patients' profiles were avoided in this project. Examinations were done with full knowledge of the patients, and in any cases where the patients wished not to cooperate, they were excluded.

RESULTS

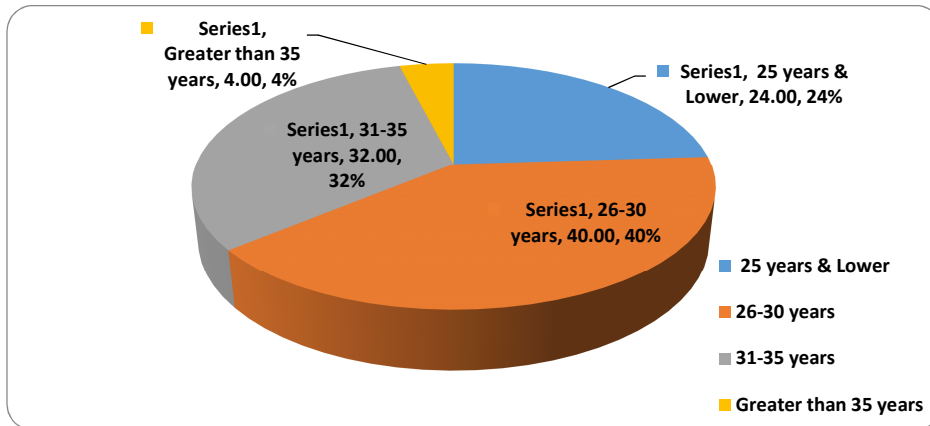Age percentages of experiment and control groups are in accordance with Figure 1.

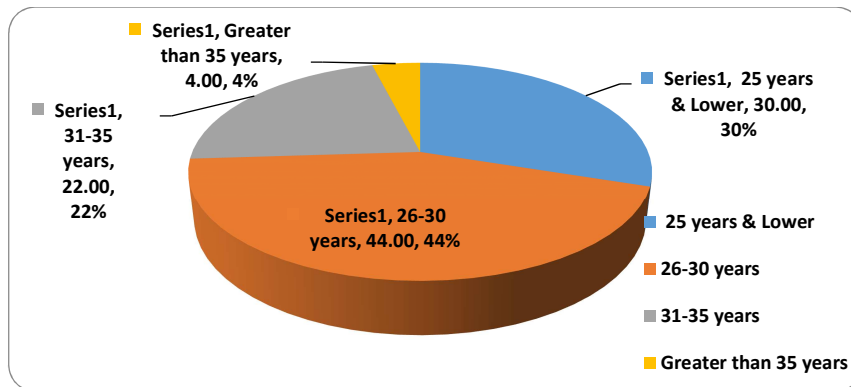**Figure 1. Percentage of frequency of age in the experiment group (preeclampsia)**

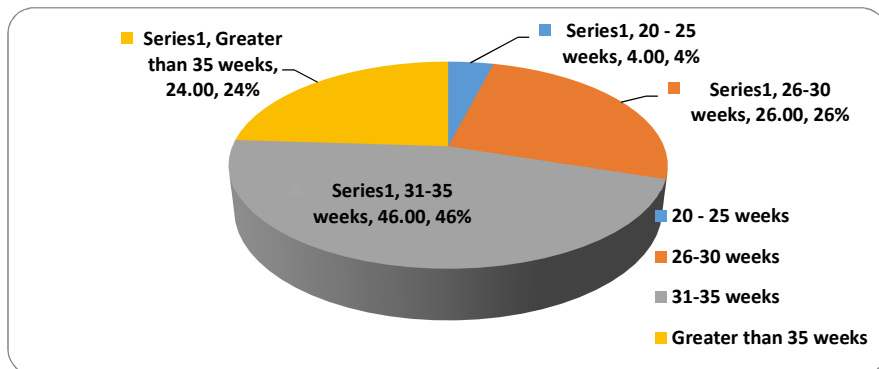**Figure 2. Percentage of frequency of age in the control group**

Figure 3. Percentage of frequency of gestational age in experimental group (preeclampsia)
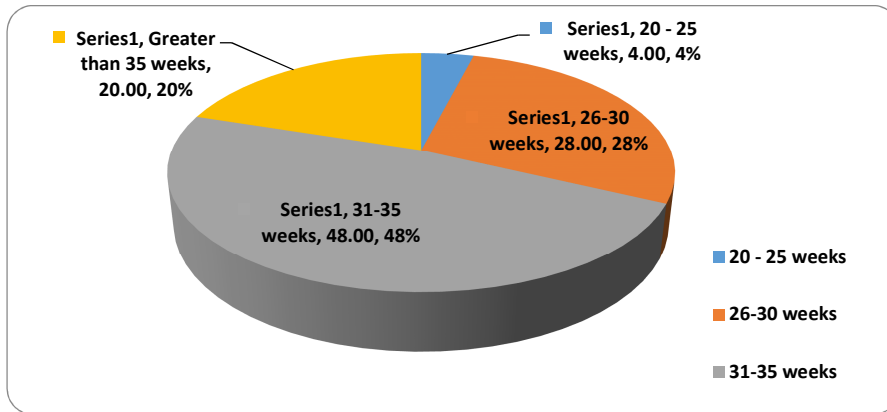
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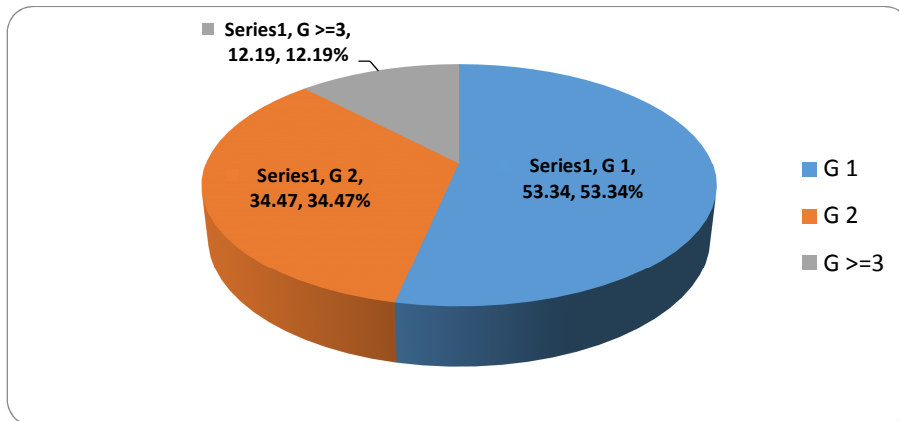**Figure 4. Percentage of frequency of gestational age in the control group**

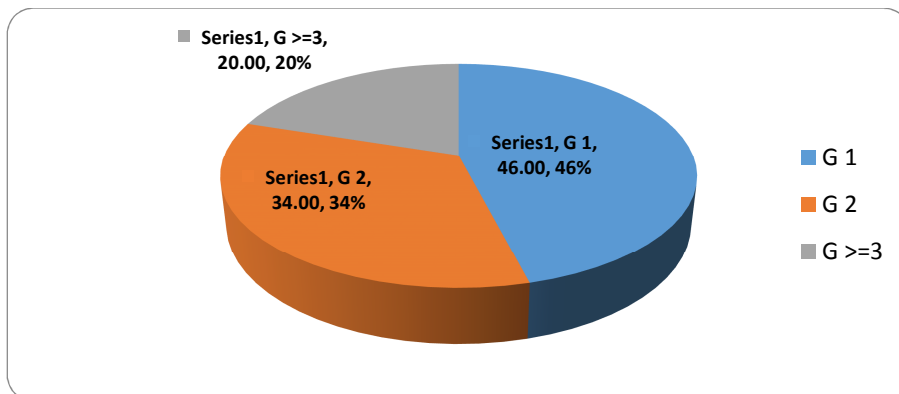**Figure 5. Percentage of frequency of number of pregnancies patients in the control group**

Figure 6. Percentage of frequency of number of pregnancies patients in the experimental group (preeclampsia)

The comparison of serum calcium in control and experimental groups
In statistical analysis of Independent-Samples T-Test, the difference between the average serum calcium (in mg per dL) in the control group and preeclampsia group was not statistically significant (p= 0.07) (Figure 7).
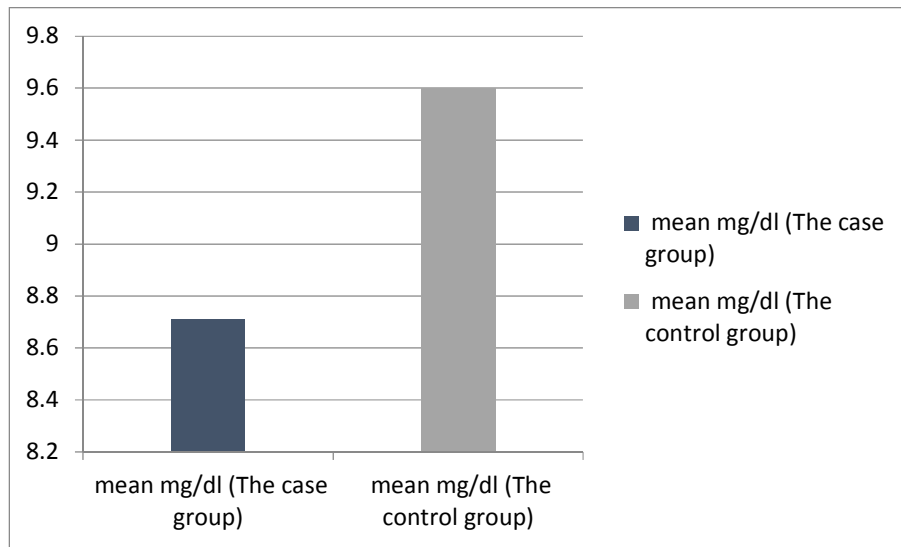
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Figure 7. Average serum calcium in patients in terms of mg/dL

Comparison of 24-hour urine calcium in experiment and control groups

In statistical analysis of Independent-Samples T-Test, the differences between 24-hour urine calcium (in mg/ 24 hrs) in the control group and the group with preeclampsia was significant at 5% level (p= 0.003) (Figure 8).
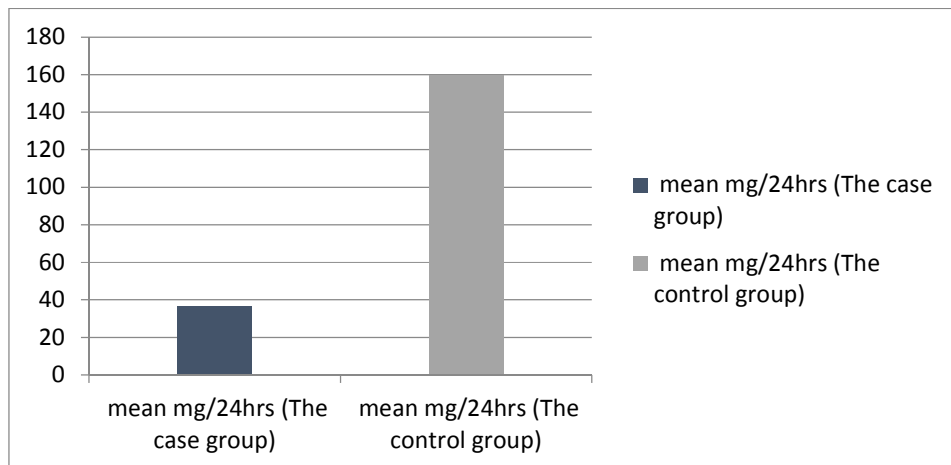

Figure 8. The mean of 24-hour urine calcium in patients in mg/ 24 hrs

Comparison of serum calcium levels with liver enzymes

Mean of serum calcium in patients with preeclampsia who had normal liver enzymes with patients who have liver enzymes higher than normal (Figure 9) was not statistically significant (p= 0.06).
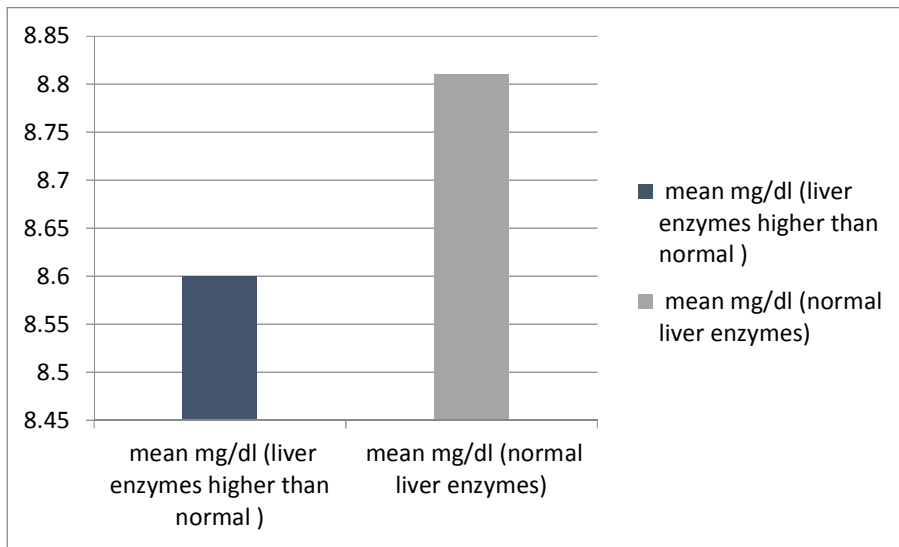
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Figure 9. Comparison of mean serum calcium (Mg dl) with liver enzyme levels

Comparison of 24-hour urinary calcium levels with liver enzymes

The mean difference of 24-hour urine calcium in preeclamptic patients with normal liver enzymes with group with higher than normal liver enzymes (Figure 10) is statistically significant (p= 0.002).
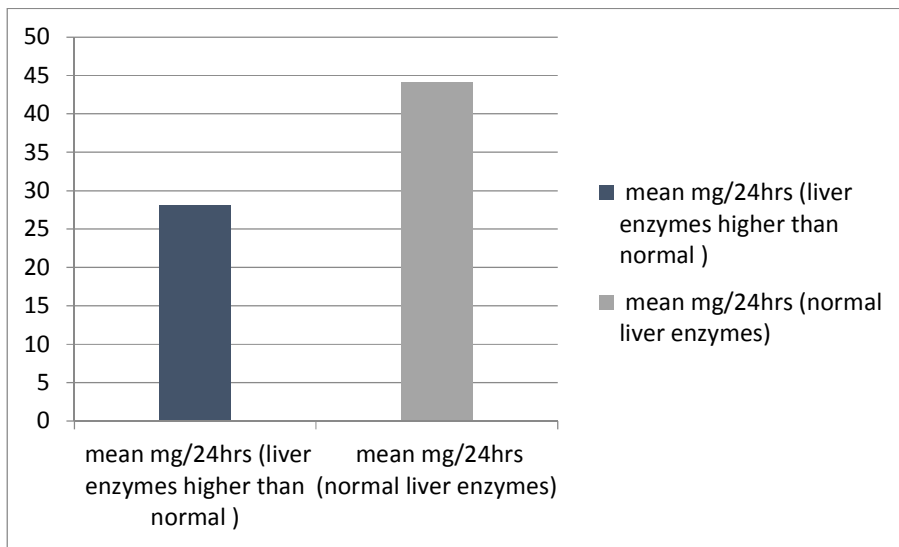

Figure 10. Comparison of mean 24-hour urinary calcium levels with liver enzymes

Comparison of serum calcium levels with platelets levels

In the Independent-Samples T-test statistical analysis, the observed difference between the average serum calcium (mg per deciliter) in patients with platelet under hundred thousand and those with more than one hundred thousand (Figure 11) is not statistically significant (p> 0.05).
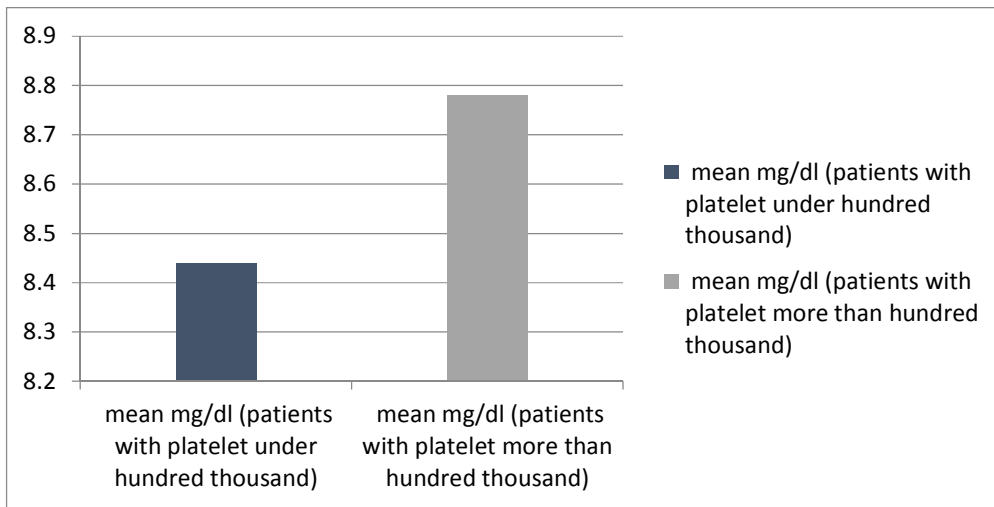
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Figure 11. Comparison of mean serum calcium level with platelets

Comparison of 24-hour urine calcium levels with platelet levels
In Independent-Samples T-test statistical analysis, the difference observed between the mean 24-hour urine calcium (24 mg) in patients with platelets under one hundred thousand with those having more than one hundred thousand (Figure 12) is statistically significant (p< 0.05).
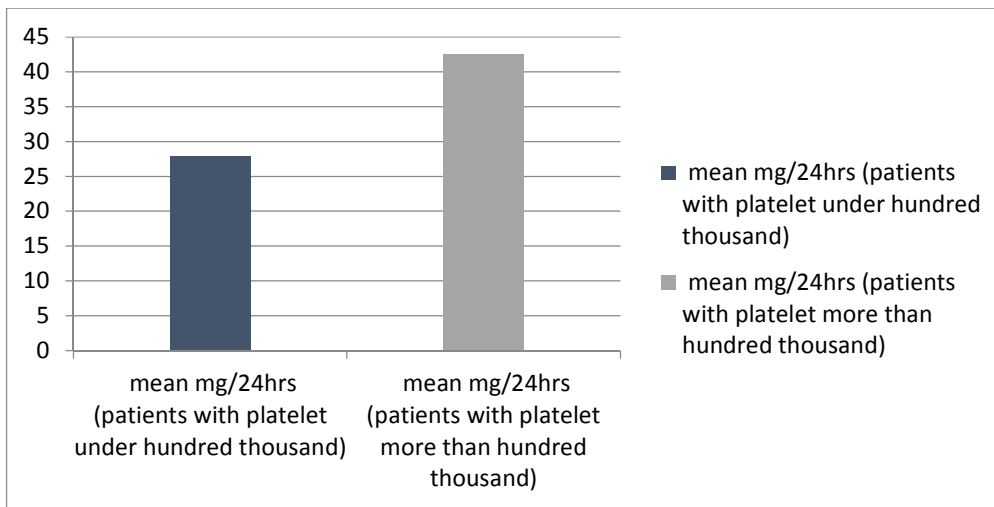

Figure 12. Comparison of the relationship of 24-hour urine calcium with platelet levels

Comparison of the relationship between serum calcium and creatinine in the group with preeclampsia
The relationship between serum calcium (in milligrams per deciliter) in preeclampsia group with creatinine greater than 1.2 mg/dl and the one with less than or equal to 1.2 mg/dl (Figure 13) is not statistically significant (P= 0.093).
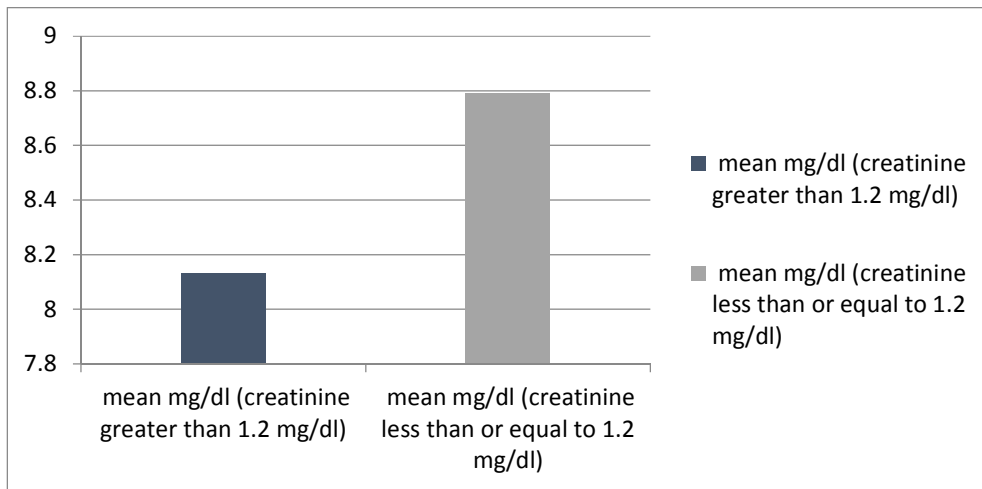
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Figure 13. Comparison of the relationship between the mean serum calcium with creatinine level

Comparison of 24-hour urinary calcium and creatinine in preeclampsia group
The relationship between 24-hour urine calcium (mg in 24 hours) in preeclampsia group with creatinine greater than 1.2 mg/dl with the one less than or equal to 1.2 mg/dl (Figure 14) is statistically significant (P= 0.005).

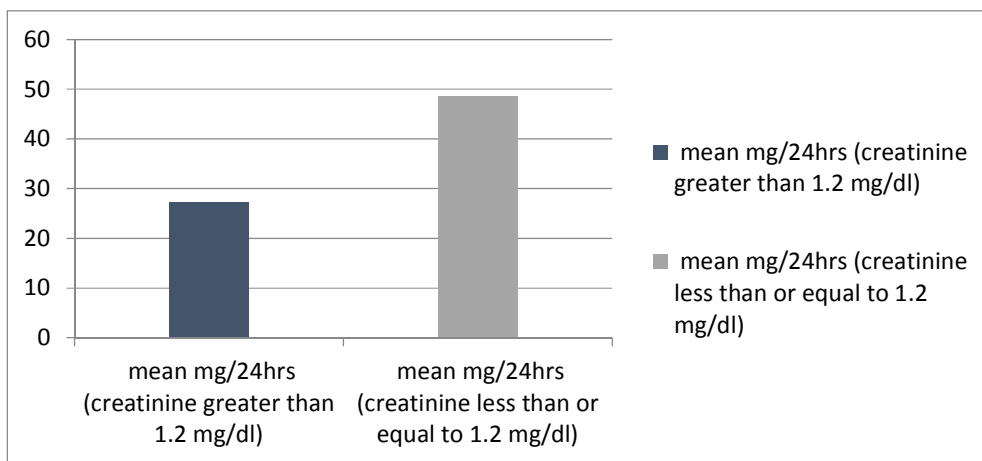**Figure 14. Comparison of the relationship between the mean 24-hour urinary calcium and creatinine levels**

Comparison of the relationship between serum calcium with albuminuria in preeclampsia group
The relationship between serum calcium (in milligrams per deciliter) and albuminuria (greater than or equal to 2 Plus/ less than 2 Plus) in preeclampsia (Figure 15) is not statistically significant (P= 0.082).
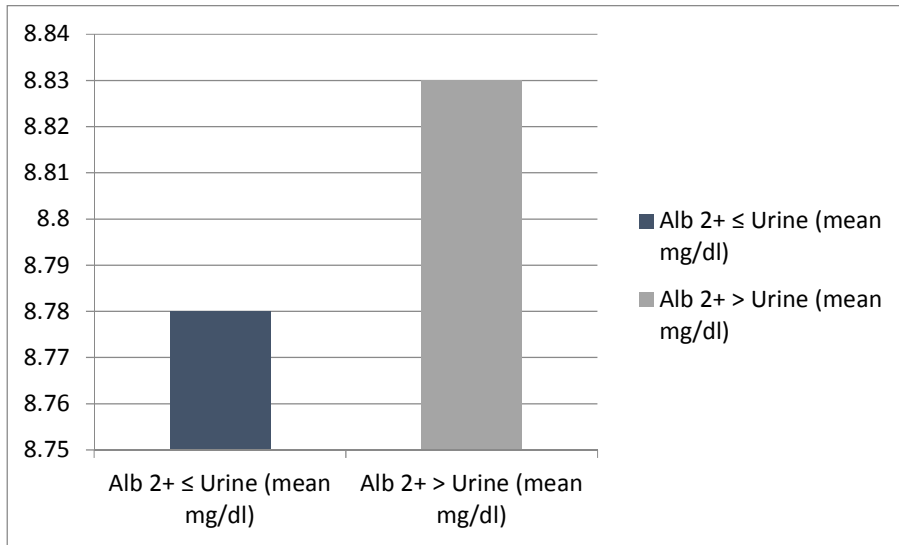
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Figure 15. Comparison of the relationship between serum calcium with albuminuria

Comparison of 24-hour urine calcium with albuminuria in preeclampsia group

The relationship between 24-hour urine calcium (mg in 24 hrs) and albuminuria (greater than or equal to 2 Plus/ less than 2 Plus) in preeclampsia (Figure 16) is the statistically significant (P= 0.003).
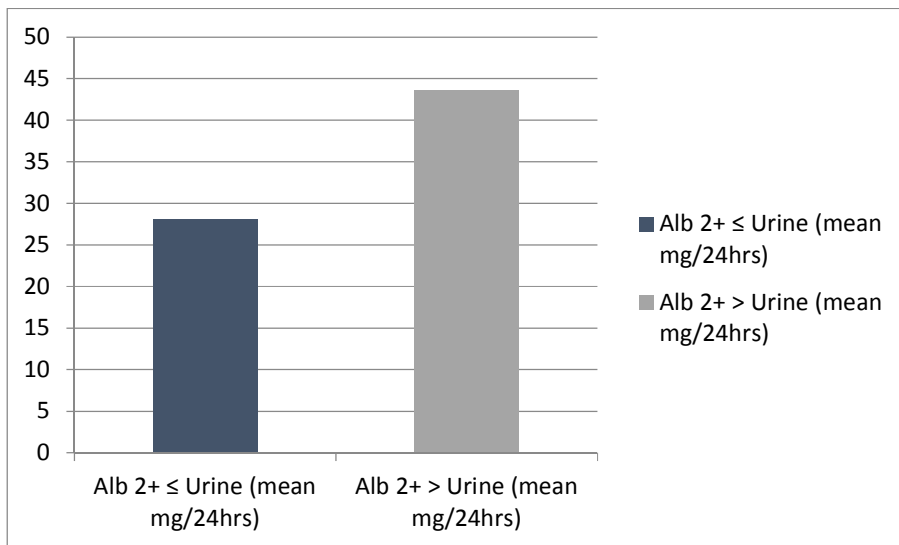
Figure 16. Comparison of the relationship between 24-hour urine calcium with albuminuria

Comparison of the relationship between serum calcium and 24-hour urinary protein excretion in the group with preeclampsia

The relationship between serum calcium (milligrams per deciliter) in preeclampsia group with 24-hour urine protein greater than 2 grams and the one with less than or equal to 2 (Figure 17) is not significant (P= 0.91).
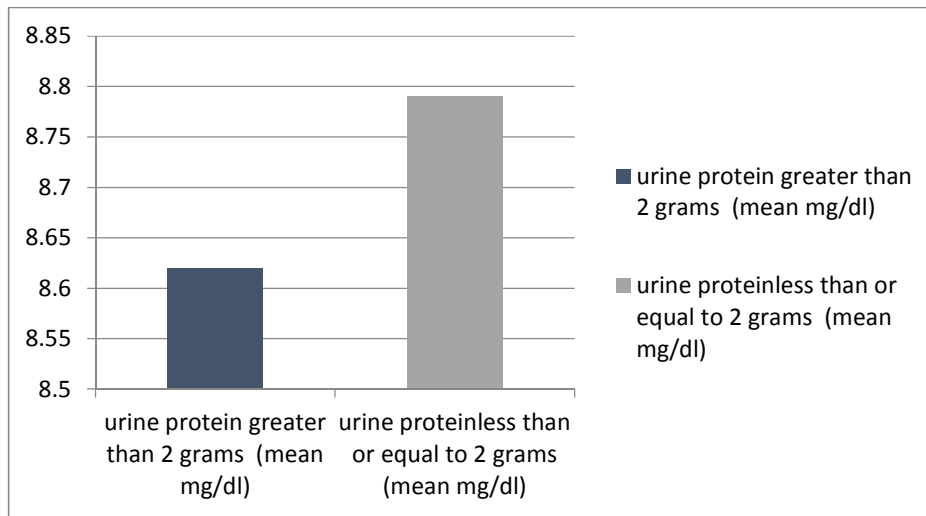
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Figure 17. Comparison of serum calcium with 24-hour urine protein

Comparison of the relationship between 24-hour urine calcium with the 24-hour urine protein in preeclampsia group

The relationship between 24-hour urine calcium (24 mg per 24- hour) in preeclampsia group with 24-hour urine protein greater than 2 grams and 24-hour urinary protein less than or equal to 2 grams (Figure 18) was significant (P= 0.001).
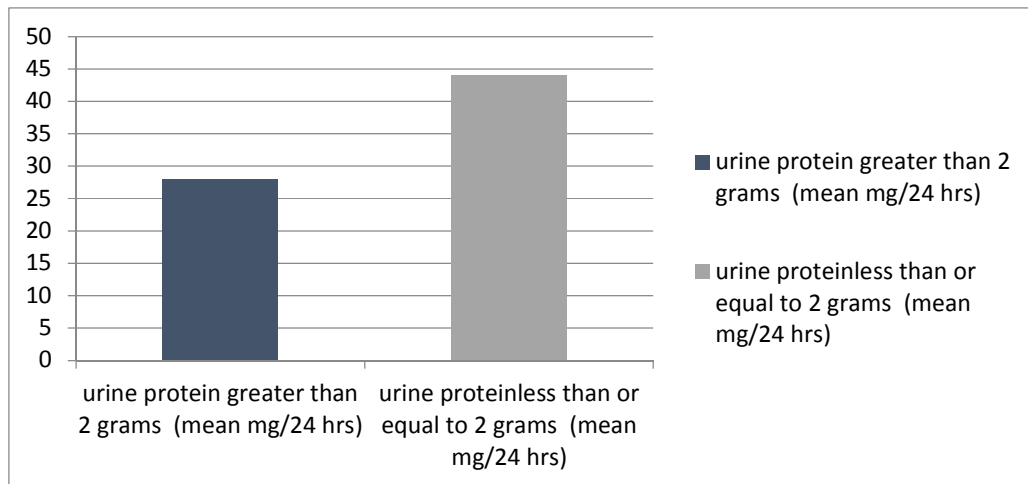

Figure 18. Comparison of the relationship between 24-hour urine calcium with 24-hour urine protein

DISCUSSION

These data suggest that serum calcium level in patients with preeclampsia compared with normal pregnant women is not significantly different (P= 0.07), and serum calcium in patients with preeclampsia has no relationship with laboratory parameters like platelets, liver enzymes, proteinuria more than 2 g, and high creatinine. These findings correspond with the findings of several previous studies (5-7).

Twenty-hour urine calcium levels in patients with preeclampsia is clearly less (P= 0.0003). The 24-hour urine calcium level in preeclampsia patients with impaired liver enzymes, thrombocytopenia, elevated creatinine, and proteinuria greater than 2 g is significantly less than in mild preeclampsia patients. These results are consistent with the results obtained by several researchers (8-10). Changes in urine calcium are mainly dependent on calcium

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homeostasis at the molecular level. Normally, in pregnant women, intracellular calcium levels increases and this effect is intensified in patients with preeclampsia, but intracellular magnesium levels in patients with preeclampsia reduce (11).

Similar studies have been conducted in the world on the relationship between serum calcium and 24-hour urine calcium with preeclampsia. In a case-control study (12), 47 pregnant women with preeclampsia and 50 healthy pregnant women with normal blood pressure were included, where the 24-hour urinary calcium and serum calcium were checked. Women with preeclampsia had significantly lower 24-hour urine calcium (P= 0.0001). Serum calcium between the two groups showed no significant difference.

In a study that was conducted in Japan in 2000 (13), 24-hour urine calcium levels in three groups of normal pregnant women, women with mild preeclampsia and women with severe preeclampsia were examined. 24-hour urinary calcium in three group was 161 mg/ 24h, 44.3 mg/ 24h, 11.6 mg/ 24h respectively, where calcium levels were clearly lower in patients with severe preeclampsia.

In a study conducted in the West India (14), 83 pregnant women were enrolled, 29 cases had preeclampsia, 27 cases chronic hypertension, and seven cases had normal blood pressure. The 24-hour urinary calcium and serum calcium were examined and compared, the level of serum calcium and 24-hour urinary calcium were clearly lower in preeclampsia compared to other 2 groups.

Studies show that hypocalcemia in patients with preeclampsia is not dependent on renal function but dependent on calcium homeostasis at the cellular level (10). Our study shows that in patients with severe preeclampsia, serum calcium levels are the same with patients with mild preeclampsia, but the level of 24-hour urine calcium in patients with severe preeclampsia is clearly less. We suggest that in patients with preeclampsia, in collecting urine, calcium levels be checked and people with hypocalciuria be controlled in terms of progression towards severe preeclampsia and further studies be conducted about giving calcium supplements to people at risk for preeclampsia.

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