

# Mineral-Nutritional Interaction in Hemodialysis Patients: A Clinical Pharmacy Perspective

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## Abstract

A common feature of chronic kidney disease especially in maintain hemodialysis patients is the mineral metabolism. Among other biochemical parameters known for vascular calcification and cardiovascular morbidity are the calcium phosphate concentrations (Ca×P). To test whether renal function biomarkers associated on hemodialysis patients are related to the mineral metabolism we undertook an observational, cross-sectional study on 110 maintenance hemodialysis patients in the clinic with their data and medical history. Our patients' demography and laboratory parameters (hemoglobin, ferritin, glucose, urea, creatinine, calcium, phosphate and albumin) were obtainable from the patients' medical records. The Ca×P product was determined using the concentration of serum calcium and phosphate. Statistical analysis was conducted using descriptive statistics and correlation analysis. Mean Ca×P product was  $42.31 \pm 12.44 \text{ mg}^2/\text{dL}^2$  and significant positive relation between Ca×P product and serum phosphate was found ( $r = 0.52 \text{ p} < 0.001$ ) while the same correlation happened for serum creatinine ( $r = 0.45 \text{ p} < 0.001$ ). No correlation was noted with Ca×P product and albumin. The phosphate retention and renal dysfunction are the factors of mineral metabolism deterioration seen in hemodialysis patients. Therefore, monitoring Ca×P product would be an important therapeutic and clinical marker for determining if there is a mineral derangement of dialysis patients to guide treatment.

## Keywords

Clinical Pharmacy, Chronic Kidney Disease, Hemodialysis, Mineral–Nutritional Interaction.

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## INTRODUCTION

Chronic kidney disease (CKD) is an international health challenge with millions of people being suffering [1]. In the later stages of CKD patients receive dialysis to replace the renal kidney with a liquid (to keep them alive) or be at least kidney-therapeutic (for kidney loss in later stages). In of the many metabolic symptoms of CKD, changes of the mineral metabolism may be the most challenging, and we refer to them as chronic kidney disease (mineral and bone disorder) and chronic kidney disease–bone disorder because CKD-MBD is formed by the deterioration of calcium, phosphate, parathyroid hormone and vitamin D metabolism. These disturbances cause vascular calcification, bone damage and death in dialysis patients. One of the most striking biochemical signs of mineral imbalance can be seen in the Ca×P of calcium and phosphate, in which the patients in this disease should have calcification problems from calcification and adverse cardiovascular disease. Hyperphosphatemia and vascular complications

linked have a very well-defined association, but the association of Ca×P product between renal function and other bioassay parameters such as health and nutrition may not be well-studied in combination [3], 4[5]. If we know more about this relationship, we can also set some parameters to optimal treatment treatments along with phosphate binder therapy treatment with dialysis and nutritional treatment [4,5] and follow along as possible. Hence, the purpose of this study is to address the relationship between calcium–phosphate product and biochemical markers for renal function of patients receiving maintenance hemodialysis and are taking care of diabetes or cancer.

## MATERIALS AND METHODS

### Study Design

This study is cross-sectional observational research

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**Setting of Study**

The study was conducted using patients in maintenance hemodialysis in a hospital dialysis unit in the area of hospital.

**Study Population**

Population of study was 110 and included 110 patients who do their regular hemodialysis.

**Inclusion Criteria**

- Adult patients aged  $\geq 18$  years.
- patients with ongoing hemodialysis.
- Evidence of biochemical research, and the access.

**Exclusion Criteria**

- Acute kidney injury.
- Incomplete laboratory data.
- Active infection or malignancy.

**Data Collection**

Data were obtained from patient medical records and laboratory reports. The variables included are as follows:

**Demographic Variables**

- Age.
- Sex.
- Weight.

**Laboratory Parameters**

- Hemoglobin

- Ferritin
- Glucose
- Urea
- Creatinine
- Calcium
- Phosphate
- Total Protein
- Albumin

**Calculation of Ca-Phosphate Equation**

Calculation of the calcium-phosphate product was performed by the equation:

$$\text{Ca} \times \text{P} = \text{Calcium (mg/dL)} \times \text{Phosphate (mg/dL)}.$$

**Statistical Analysis**

Statistical analyses have been done using SPSS. Continuous variables were averaged with mean  $\pm$  standard deviation (SD). We have considered Pearson correlation between the  $\text{Ca} \times \text{P}$  product and the biochemical parameters. This correlation is statistically significant if the  $p < 0.05$ .

**RESULTS****Patient Characteristics**

In Table 1, we display the patient characteristics and demographic information. The average age was  $53.07 \pm 13.15$  years and was an average weight of  $78.36 \pm 14.88$  kg. The average hemoglobin level was  $11.17 \pm 1.52$  g/dL (which would correspond to anemia in most patients on dialysis).

**Table 1:** Demographic Characteristics of the hemodialysis patients.

Demographic Characteristics	Variable (Mean $\pm$ SD)
Age (years)	$53.07 \pm 13.15$
Weight (kg)	$78.36 \pm 14.88$
Hemoglobin (g/dL)	$11.17 \pm 1.52$

**Biochemical Characteristics**

Table 2 shows laboratories parameters of the study population. The average concentration of serum creatinine and urea was  $11.36 \pm 2.86$

mg/dL and  $128.97 \pm 27.72$  mg/dL, respectively. Level of calcium and phosphate respectively was  $7.91 \pm 1.61$  mg/dL and  $5.48 \pm 1.57$  mg/dL.

**Table 2:** Biochemical Parameters of the hemodialysis patients.

Biochemical Parameters	Parameter (Mean ± SD)
Urea (mg/dL)	128.97 ± 27.72
Creatinine (mg/dL)	11.36 ± 2.86
Calcium (mg/dL)	7.91 ± 1.61
Phosphate (mg/dL)	5.48 ± 1.57
Total Protein (g/dL)	6.79 ± 0.68
Albumin (g/dL)	3.86 ± 0.61

**Calcium-Phosphate Product**

Participants had mean Ca×P product of: 42.31 ± 12.44 mg<sup>2</sup>/dL<sup>2</sup>.

**Correlation Analysis**

Correlation analysis found a significant correlation between Ca×P product and various biochemical markers (Table 3).

**Table 3:** Correlation Between Ca×P Product and Biochemical Markers on hemodialysis patients.

Correlation Between Ca×P Product and Biochemical Markers	Variable (r)	Correlation P value
Albumin	0.09	
Creatinine	0.45	
Phosphate	0.52	

**DISCUSSION**

In this study the mineral metabolism had a considerable effect in maintenance hemodialysis patients which was undergo investigation [6]. The average amount of Ca×P product in the study population was 42.31 mg<sup>2</sup>/dL<sup>2</sup>, which is so comparable to previous reports from various international dialysis patients in many other report [7]. The strongest correlation between Ca×P product and the serum phosphate level was the most significant information found in this study [8]. Hyperphosphatemia is considered to pose a serious risk for CKD-MBD as well as to be associated with vascular calcification and cardiovascular complications [10]. Also, the relation between creatinine and Ca×P product was moderate [11]. Creatinine is associated with renal impairment and metabolic burden in patients on dialysis (12,13), so it is likely that deteriorating renal function is related to deficiencies in mineral metabolism. Furthermore, albumin and Ca×P were not positively correlated with each other while dialysis patients do not show a correlation (13). The findings make me think mineral metabolism errors in dialysis patients could lie primarily in retention of phosphate but not only in being malbalanced nutritionally [14]. Data for

monitoring patient compliance or phosphate binder therapy, phosphate tolerability during treatment, and physician-physician interactions through nephrologists help us assess patient care and treatment for disease effects to ensure the best possible treatment for dialysis patients, from clinical pharmacist point of view.

**CONCLUSION**

The problems in mineral metabolism of hemodialysis patients are reflected in calcium-phosphate product as biochemical marker. This study finds that Ca×P product plays a very strong role in phosphate levels, kidney function indicators and more. Regular monitoring of Ca×P product to monitor at some level that a patient may be at risk from metabolic issues would be an effective marker to guide treatment, since it is usually a critical marker for dialysis patients as we now know it is in terms of their body temperature (as compared with a placebo point before this study).

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