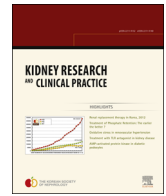




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Original Article

Serum calcium and phosphorus levels in patients undergoing maintenance hemodialysis: A multicentre study in Korea



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ABSTRACT

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Background: In many countries, nephrologists follow clinical practice guidelines for mineral bone disorders to control secondary hyperparathyroidism (SHPT) associated with abnormal serum calcium (Ca) and phosphorus (P) levels in patients undergoing maintenance hemodialysis (MHD). The Kidney Disease Outcomes Quality Initiative (KDOQI) Guidelines have long been used in Korea, and this study was undertaken to investigate the current status of serum Ca and P control in MHD patients.

Methods: Data were collected from a total of 1,018 patients undergoing MHD without intercurrent illness, in 17 hemodialysis centers throughout the country. Serum levels of Ca, P, and intact parathyroid hormone (iPTH) were measured over 1 year, and the average values were retrospectively analyzed.

Results: Serum levels of Ca, P, and the Ca × P product were 9.1 ± 0.7 mg/dL, 5.3 ± 1.4 mg/dL, and 48.0 ± 13.6 mg²/dL², respectively. However, the percentages of patients with Ca, P, and Ca × P product levels within the KDOQI guideline ranges were 58.7%, 51.0%, and 70.7%, respectively. Of the 1,018 patients, 270 (26.5%) had iPTH > 300 pg/mL (uncontrolled SHPT), whereas 435 patients (42.7%) showed iPTH

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< 150 pg/mL. Patients with uncontrolled SHPT had significantly higher values of serum Ca, P, and Ca × P product than those with iPTH ≤ 300 pg/mL.

Conclusion: Despite the current clinical practice guidelines, SHPT seems to be inadequately controlled in many MHD patients. Uncontrolled SHPT was associated with higher levels of serum Ca, P, and Ca × P product, suggestive of the importance of SHPT management.

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Introduction

Secondary hyperparathyroidism (SHPT) is a common complication of chronic kidney disease (CKD). In addition, hyperphosphatemia has emerged as an important clinical issue in dialysis patients over the past decade because higher levels of serum phosphorus (P) and calcium-phosphorus (Ca × P) product have now been associated with increased vascular calcification and cardiovascular mortality [1–6]. Similar to other countries, the number of patients with end-stage renal disease (ESRD) has been increasing in Korea. According to 2010 registry data from the Korean Society of Nephrology, hemodialysis was the most frequently used renal replacement therapy (in 39,509 patients) among the total 58,860 patients with ESRD. Diabetes mellitus was the leading cause of ESRD (45.2%), and cardiovascular disease was the major cause of death (45%) in patients undergoing dialysis [7].

To improve the quality of care in patients undergoing maintenance hemodialysis, clinical practice guidelines have been developed and used in many countries. Globally, including Korea, the Kidney Disease Outcome Quality Initiative (KDOQI) and Kidney Disease: Improving Global Outcomes (KDIGO) guidelines are popular [8,9]. In the Asia-Pacific area, Australia and Japan have their own guidelines for CKD-mineral bone disorder (MBD) management (Caring for Australasians with Renal Impairment [CARI] and Japanese Society for Dialysis Therapy [JSDT] guidelines, respectively) [10,11]. In these guidelines, target ranges for serum minerals have been recommended for the optimal management of patients undergoing MHD.

In Europe, America, and Japan, epidemiologic studies have been conducted in patients with MHD and demonstrated associations between abnormal mineral metabolism, based on patient serum mineral levels and patient outcomes [12–14]. We aimed to evaluate serum mineral levels in Korean patients undergoing MHD to determine their relationship with parathyroid hormone control. These results may provide insight into the status of current practice in the era of such guidelines.

Methods

Between January 1, 2009 and June 30, 2009, clinical data were collected from patients undergoing MHD in 17 centers (10 university hospitals and 7 secondary-care general hospitals) in Korea. Enrollment criteria included (1) patient age ≥ 18 years, (2) chronic hemodialysis for ≥ 6 months, and (3) multiple measurements of serum Ca, P, and intact parathyroid hormone (iPTH) during the preceding 12 months. Patients with intercurrent illnesses requiring hospitalization were excluded. As a result, 1,018 patients were found to be eligible among the 1,060 enrolled MHD patients. Patient

consent was obtained, as required by the institutional review boards of the participating medical facilities.

Patient demographic and laboratory data were obtained by reviewing medical records from 2008 to 2009. The laboratory values were averaged because most centers measured serum Ca and P monthly, and measured iPTH quarterly. Albumin-corrected calcium (mg/dL) was calculated as $[4 - \text{albumin (g/dL)}] \times 0.8 + \text{total serum calcium (mg/dL)}$ when the serum albumin level was less than 4.0 g/dL. The iPTH concentration was measured by second-generation PTH assays using four different assay kits: Elecsys PTH (Roche Diagnostics; Meylan, France), Immulite 2000 intact PTH (DPC; Los Angeles, USA), ELISA-PTH (Schering-Cis Bio; Gif-sur-Yvette, France), and Architect intact PTH (Abbott; Wiesbaden, Germany). Among different second-generation PTH assays, our methods had a relatively small interassay variability [15]. After data collection, the distributions of serum mineral levels were examined, based on the KDOQI guidelines.

Continuous data are presented as means ± standard deviation, and categorical variables are expressed as frequency counts and percentages. Box plots are used for a visual presentation of continuous variables; median, 75th, and 25th percentiles, and ranges between the 10th to 90th percentile are shown. The Kruskal-Wallis test was used to compare continuous variables among three or more groups, and the Mann-Whitney *U* test was used for comparisons between two groups. The chi-square test and Pearson correlation efficiency test were used to evaluate associations between categorical and continuous variables, respectively. Statistical significance was defined as $P < 0.05$.

Results

General patient characteristics

Table 1 shows the general characteristics of the 1,018 patients. The mean age was 54 years, with an equal distribution by sex. In most patients, hemodialysis was performed three times a week, in 4-hour sessions. Interestingly, 87.2% of patients reported adherence to dietary phosphorus restrictions. Phosphorus binders were used by 72.3% of the study participants and vitamin D receptor agonists were used by 45.9% of the participants. The former covered both calcium-based and calcium-free phosphate binders (Table 2), and the latter included calcitriol, paricalcitol, and alfacalcidol, in order of the frequency of their use. Nevertheless, 270 patients (26.5%) had iPTH > 300 pg/mL. Most of the patients used a dialysate calcium concentration of 3.0 mEq/L. Fig. 1 illustrates the distribution of dialysate calcium concentrations.

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