



ORIGINAL ARTICLE

Influence of the use of phosphate binders on serum levels of calcium phosphate in patients with chronic kidney disease undergoing hemodialysis: A retrospective and prospective study



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Abstract Hypercalcemia–hyperphosphatemia is an unavoidable consequence of end-stage chronic kidney disease and common in hemodialytic patients. Calcium carbonate (CaCO_3) is one type of phosphate binder used widely and prescribed in patients undergoing hemodialysis, aiming to control the levels of calcium and phosphate. These drugs are most effective if taken with meals. This study aimed to evaluate the use of phosphate binders in hemodialysis patients and the factors that influence the success of phosphate binder therapy by experimental studies with retrospective data collection through the medical records and prospectively through the questionnaire and interviews with patients. The research was conducted in the Unit Hemodialysis building floor 8 of Cipto Mangunkusumo Hospital, Jakarta. The data were collected in a retrospective way for two months (January–February 2013) and a prospective study in March–April 2013. Patients included were stage 5 chronic kidney disease patients who underwent hemodialysis in hemodialysis ward of Cipto Mangunkusumo Hospital. Patients who had data of serum levels at the beginning of the use of calcium phosphate and the final data in 2013 got the phosphate binder therapy.

Results: Ninety six patients with stage 5 chronic kidney disease who underwent hemodialysis had been using phosphate binder for 3 years in average. Patient evaluation showed that hypocalcemia was obtained in 23%; normokalemia in 42.7% and hypercalcemia in 34.3%. While the percentage

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of patients with hipofosfatemia 14, 6%, normofosfatemia 32.3% and 53.1% hyperphosphatemia. Results obtained by the prospective analysis of factors that affect the success of the use of phosphate binder therapy are related to how the routine use of phosphate binders is made by the patient. Chi square test showed a significance of 0.000 ($p < 0.05$), the effect of 54%.

Conclusion: We can conclude there are many events happening such as hyperphosphatemia in hemodialysis patients that use phosphate binders. Monitoring of serum levels of calcium phosphate in patients with chronic kidney disease undergoing hemodialysis should be performed every month. Education and the role of clinical staff required to assist compliance and therapeutic efficacy of phosphate binder are necessary.

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1. Introduction

Risk of death in patients with chronic kidney disease (CKD) is much higher than the normal population. Data from the United States Renal Data Systems (USRDS) in 2010, state that the risk of death in patients with chronic kidney disease was 59% greater than that in normal population (United States Renal Data Systems, 2012). The United States Population data issued by the National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC) at the end of 2009 showed that the prevalence of patients with end-stage renal disease was 1738 per 1 million citizens and 370,274 of them lived on hemodialysis (United States Renal Data System, 2001). Many factors contributed to the high risk of death, including: cardiovascular disorders, diabetes, hypertension, inflammation, dyslipidemia, and bone mineral disorders, one of which is phosphate and calcium metabolic disorder (Foley et al., 2009).

Mineral and bone disorder is found in the majority of patients with chronic kidney disease stages 3–5, and is universally experienced by patients with stage 5 on dialysis. Therefore it is recommended to start the diagnostic check of stage 3. Therapeutic strategies aimed at correcting the disorders, including low-phosphate diets, and at reducing intestinal phosphate absorption by using phosphate binders in the drugs. In addition, stage 5 chronic kidney disease patients were recommended to undergo hemodialysis to improve the dialysis (PERNEFRI, 2009).

Hyperphosphatemia is common in patients with chronic kidney disease stage 5. Several studies have shown that increases in serum phosphate are associated with increased morbidity and mortality from cardiovascular disease in the hemodialysis patient population (Block et al., 2004). Increased serum phosphate is also involved in the pathogenesis of secondary hyperparathyroidism (Jorna et al., 2004).

Phosphate binders that contain aluminum and calcium have been used extensively since 1970, and non-calcium or aluminum-based agents such as sevelamer hydrochloride and lanthanum carbonate have recently been available. Its use increased in current practice, although more expensive, the potential reduction in the risk of vascular calcification and toxicity of therapeutic support for a wider application. To control hyperphosphatemia, the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative (NKF-KDO-QI) recommends the use of calcium-based phosphate binders in patients with chronic kidney disease stages 3 and 4, and both calcium-based and calcium-aluminum binders in patients with stage 5 CKD and dialysis, but the relative usefulness of phosphate binding agents available is still controversial.

To suppress morbidity and mortality, KDOQI target serum phosphate levels in CKD patients are 3.5–5.5 mg/dL, and the multiplication of phosphate and calcium levels is less than 55 mg/dL (National Kidney Foundation, 2003). But this target was not fully achieved, as evidenced by the high prevalence of hyperphosphatemia in CKD patients.

Patients in the hemodialysis ward of RSCM get most of phosphate binder therapy with calcium carbonate (CaCO_3). The use of this therapy has been started since patients were diagnosed for CKD stages 3 and 4. The most effective use of phosphate binders is when they are taken with meals (National Kidney Foundation, 2003). Binding phosphate in the diet thus leaves little for the absorption of calcium. For comparison, administration of phosphate binders between meals showed a greater result, as evident in the decreased intestinal calcium absorption. However, this therapy is preferred in patients with hypocalcemia despite normal serum phosphate concentrations or lower.

Based on the description above, the researcher tried to perform and observe the effect of the use of phosphate binders on serum levels of calcium phosphate in CKD patients undergoing hemodialysis in the Cipto Mangunkusumo Hospital. This study is expected to evaluate the therapeutic efficacy of the use of phosphate binders and the factors that influence the success of the therapy.

2. Method

The research used experimental research design. Data were collected retrospectively using medical records of patients with serum levels of calcium phosphate examined at the beginning of the use of phosphate binders and calcium phosphate serum levels in 2013. The populations in this study were patients with chronic kidney disease undergoing routine hemodialysis every week in the hospital ward of cipto Mangunkusumo Jakarta.

The sample size (n) can be determined by using the formula:

$$n = \frac{Z\alpha^2 \times PQ}{d^2} \quad (1)$$

n = sample size; $Z\alpha = 1.96$ ($\alpha = 5\%$); P = proportion: 0.714 (Ozkan and Ulusoy, 2011); $Q = 1 - P \rightarrow 0.286$; $d = 0.1$.

Sample data were selected through inclusion and exclusion criteria which are as follows:

2.1. Inclusion criteria

1. Patients consuming calcium carbonate phosphate binder (CaCO_3).

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