

Control of Phosphate Levels in Haemodialysis Patients: Why is it so Difficult?

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The **aim** of this study was to evaluate the patient's compliance in treatment of hyperphosphatemia and to assess the fraction of patients reaching the targets of K/DOQI guidelines.

Patients and methods

The most recent values of total calcium, phosphate, alkaline phosphatase and parathyroid hormone (PTH) levels were recorded in 285 patients, i.e. more than 10% of all dialysis patients in Croatia. The patients were from 3 dialysis units, two from universities hospitals and one from a small general hospital. Their mean age was 61.7 ± 12.6 years and they were on haemodialysis 4.7 ± 4.3 years. All patients were dialysed 3 times 4 hours per week. Bicarbonate dialysate with calcium concentration 1.5 mmol/l was used in all patients. Low flux dialysers were used in majority of patients, i.e. high flux dialysers were used sporadically and in short term. Serum calcium and phosphorus levels were determined using standard methods and intact PTH by radioimmunometric assay.

All patients were interviewed by one of the authors, regarding when and how many of phosphate binders are used and how many other drugs, i.e. number of pills are used.

Results

The mean Ca level was 2.2 ± 0.25 mmol/l; 45 of 285 (5,7%) had Ca level higher than 2.4 mmol/l, mean P level was 1.74 ± 0.52 mmol/l and 118 of 285 (41,2%) patients had P level higher than 1.8 mmol/l, Ca x P product was 3.84 ± 1.19 mmol²/l², but 83 patients (23%) had Ca x P product higher than 4.4 mmol²/l². The mean PTH level was 33.8 ± 29.4 pmol/l, in 84 of 218 patients (38,5%) the level of PTH was higher of 31.4 pmol/l.

The mean number of all pills taken by our patients was 7 per day (range 1 to 19). 33 (11,5%) of our patients did not take any phosphate binder. All others used calcium carbonate as phosphate binder. Sevelamer hydrochloride was used only sporadically. The average dose of calcium carbonate was 3.4 g (range 1 to 12 g). 78 of patients (31%) take phosphate binders only with main meals (dinner or lunch), 28 patients (11%) take them between meals and 11 (4,3%) after meals. All the others take phosphate binders just before or during all meals. During a week, 46 patients (18,2%) missed once or twice to take a phosphate binder, and 22 (8,7%) more than twice missed taking phosphate binders.

A large group of patients (up to 41%) did not reach the targets of K/DOQI guidelines, i.e. they had Ca or P levels higher than 1.8 and 2.4 mmol/l or increased CaxP product (>4.4 mmol²/l²) and PTH level higher than 31.6 pmol/l.

Discussion

Compliance with therapeutic regimens is often very difficult, particularly in chronic conditions and in patients requiring very large pill burdens. There is no doubt that chronic haemodialysis patients belong to that group.

In our group of patients, 252 of them were using phosphate binder, but 117 of them (46,4%) did not take phosphate binder properly, i.e. during each meal. Even more, some of them skipped taking the phosphate binder during a week several times.

A large group of our patients did not reach the targets of K/DOQI guidelines. Hyperphosphatemia was the most common deviation from K/DOQI guidelines (up to 41% of our patients). On the other side, calcium concentrations above target value were encountered in only 5,4% patients, despite the relative high dialysate concentration, i.e. 1.5 mmol/l. The explanation could be that the mean dose of calcium carbonate in our patients is less than 3.5 g per day.

There are three different modalities in prevention and therapy of hyperphosphatemia: restriction of dietary phosphorus intake, phosphate binder therapy and phosphorus removal by dialysis. (1, 5)

First one is essential but practically impossible. The recommendation for haemodialysis patients is a minimum of 1.2 g/kg bw/day of proteins and this will result in ingestion of 1000 to 2000 mg/d of phosphorus. The gastrointestinal absorption rate is about 70%, i.e. up to 4900 mg per week is phosphorus burden in majority of well-nourished patients. If we restrict protein intake, there is a great risk for development of malnutrition. Despite that, education of patients regarding phosphorus reach food is very important.

Our patients, as most other haemodialysis patients, are dialysed 3 times per week. About 800 mg of phosphorus is removed per treatment with low-flux dialyzers, i.e. 2400 mg per week. Therefore by "standard" dialysis it is not possible to prevent hyperphosphatemia. Daily dialysis is very effective in reduction of phosphorus level but it is not available in our and many other countries.

Phosphate binders are indispensable in many patients. (1, 6) Calcium carbonate is the phosphate binder of choice in our country. It is well known that there is increased risk of hypercalcemia, increased Ca x P product and a risk of

cardiovascular calcification with calcium-based binders. If we want to prevent hyperphosphatemia, the time when our patients are taking binders is very important i.e. they have to take them during the meal.(7) In our group of patients only 53.6% take the binder just before or during the meal and during each meal.

Prevention and treatment of hyperphosphatemia are and will be very difficult processes for dialysis patients and for the whole dialysis medical staff. One of the biggest problems is poor compliance of our patients. Some data in literature suggest that the compliance of the patients could be improved by better knowledge of dietary principles and the consequence of increased phosphorus levels. (5) Therefore, we need to educate our patients to understand the importance of phosphorus control and compliance with the prescribed diet, phosphate binding therapy and dialysis dose. (6, 7) Even new phosphate binders will not help in prevention of hyperphosphatemia without better compliance of patients. Therefore, greater effort of the whole dialysis medical staff in dialysis patients' education could be of great value. In the dialysis centres without renal dietitians, nephrologists and renal nurses have a paramount role.

References

1. Levin NW, Gotch FA, Kuhlmann MK. Factors for increased morbidity and mortality in uremia: hyperphosphatemia. *Semin Nephrol* 2004;24:396-400
2. Eknoyan G, Levin A, Levin NW. Bone metabolism and disease in chronic kidney disease. *Am J Kidney Dis* 2003;42:1-201
3. Rodriguez-Benot A, Martin-Malo A, Alvarez-Lara A, Rodriguez M, Aljama P. Mild hyperphosphatemia and mortality in hemodialysis patients. *Amer J Kidney Dis* 2005;46:68-77
4. Uribarri J. K/DOQI guidelines for bone metabolism and disease in chronic kidney disease patients: some therapeutic implications. *Semin Dial* 2004;17:349-350
5. Ford CJ, Pope JF, Hunt AE, Gerald B. The effect of diet education on the laboratory values and knowledge of hemodialysis patients with hyperphosphatemia. *J Renal Nutr* 2004;14:36-44
6. Tomasell S, Dhupar Sh, Sherman RA. Phosphate binders, K/DOQI guidelines, and compliance: the unfortunate reality. *Dial Transplant* 2004;33:236-291
7. Cupisti A, Alessandro C, Baldi R, Barsotti G. Dietary habits and counseling focused on phosphate intake in hemodialysis patients with hyperphosphatemia. *J Renal Nutr* 2004;14:220-225