Adherence and knowledge about hyperphosphatemia treatment in hemodialysis patients with hyperphosphatemia

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Abstract

Introduction: Adequate dietary phosphorus intake and the use of phosphorus binders are the main tools for treating hyperphosphatemia. Thus, its success depends essentially on the patient's ability to understand and adhere to the dietary plan and the use of phosphate binders. **Objective:** To evaluate hyperphosphatemic patients adherence and knowledge about phosphate control treatment. **Methods:** This is a cross-sectional study. One hundred and twelve patients on hemodialysis (60 males; age = 49.3 ± 13.3 years), from five dialysis centers with mean serum phosphorus > 5.5 mg/dL between July and December of 2008 (mean = 6.57 ± 0.73 mg/dL) were included. A questionnaire with questions about the consequences of hyperphosphataemia, foods high in phosphorus, appropriate use of phosphate binders and patient's opinion about reasons for treatment failure was administered. Laboratory parameters assessed were serum urea, calcium, phosphorus and parathormony (PTH), and dialysis adequacy by means of urea Kt/V. **Results:** The average score of questionnaire was 78.5%. Regarding the reasons for the failure of the treatment of hyperphosphataemia, 87% indicated the response "because I eat more phosphorus than I should" and / or "because I do not take the phosphate binder as I should". Among those who said they did not use phosphate binder correctly, most (62%) justified to forget as the reason. The serum phosphorus correlated directly with serum urea ($R = 0.33$, $p < 0.01$) and inversely with Kt/V ($R = -0.20$, $p < 0.05$). There was no correlation between the phosphorus, the education level and the scores on questionnaire. **Conclusion:** Patients showed a good level of knowledge about the hyperphosphatemia treatment, but the vast majority were noncompliant to that. Strategies to improve compliance are necessary to decrease the incidence of hyperphosphatemia in hemodialysis patients.

Keywords: dialysis, hyperphosphatemia, diet, phosphorus.

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Introduction

Cardiovascular events constitute the major cause of death among dialysis patients.[1] The association with hyperphosphatemia has been shown in several studies.[2,3] In addition, the inadequate control of phosphorus is related to the appearance of hyperparathyroidism and mineral and bone disorders.[2,3] Thus, controlling hyperphosphatemia, highly prevalent in dialysis patients, is of paramount relevance and is one of the major objectives of health care professionals involved with dialysis patients.[4]

The following three strategies help controlling serum phosphorus: adequate dialysis; dietary phosphorus restriction; and use of phosphorus binders.[5]

The nutritional guidance about phosphorus intake is very delicate, because severe restrictions are contraindicated and, in addition, a great part of the food that is a source of phosphorus is also a source of protein.[6] Therefore, ingestion of protein food with a low phosphorus/protein ratio is recommended according to the patient's need.[7,8]

Conventional dialysis is insufficient to maintain a negative balance of

phosphorus in most dialysis patients,[9] because the phosphorus clearance of a 4-hour hemodialysis session is lower than the daily ingested amount to guarantee an adequate protein intake.[10] Thus, the prescription of phosphorus binders at meals is an alternative to decrease the intestinal absorption of that mineral.[11]

Nutritional counseling is routinely used to educate patients about the amount of phosphorus in food, to adequate the use of binders according to phosphorus ingestion at meals,[12] to emphasize adherence, and to raise awareness about the consequences of hyperphosphatemia.[13] Although many dialysis centers have nutritionists to provide that counseling, patients often have difficulties to understand, assimilate, and apply the nutritional recommendations.[13]

A simple instrument used to measure knowledge about the treatment of hyperphosphatemia – both in our country[14] and abroad[13] – is the questionnaire. Because there is no consensus about the model to be used, the questions have been formulated according to the objectives of the interviewers.

According to Poduval *et al.*, the patient's educational level influences the ability to understand the recommendations.[15] In addition, the low socioeconomic level and multiple comorbidities affecting most patients on dialysis are problems that hinder dietary adherence. Of the factors limiting adherence to diet and to the use of medications, the authors mention the following: lack of understanding about the importance of phosphorus control; difficulty in differentiating food that is a source of potassium and phosphorus; functional inability to prepare meals; and financial restrictions.[15]

In fact, some studies have shown that less than 25% of the patients undergoing dialysis adhere to diet and to the prescribed medications.[16] According to Karamanidou *et al.*, adherence to phosphorus binders can be an even greater challenge because of the complexity of treatment, which sometimes has no perceptible symptomatic effect.[5]

Thus, this study aimed at assessing adherence to and knowledge about hyperphosphatemia treatment in patients undergoing hemodialysis.

Methodology

This was a cross-sectional study.

Patients

This study included the patients on a chronic hemodialysis program (three times a week, with 4-hour sessions) at two units of the Fundação Pró-Rim, in the cities of Joinville and Balneário Camboriú, and at three units of the Centro de Tratamento de Doenças Renais, in the cities of Joinville, Jaraguá do Sul, and Mafra, all of them in the Brazilian State of Santa Catarina. Of 380 patients, 112 were selected according to the following criteria: being older than 18 years; being on dialysis for at least three months; and having a mean serum phosphorus concentration higher than 5.5 mg/dL from July to December 2008. All patients had already received individualized nutritional guidance and were followed up by a professional nutritionist monthly. Cognitively impaired patients were not considered for this study.

Assessment questionnaire

From January to March 2009, the patients answered a questionnaire with closed questions about the consequences of hyperphosphatemia, phosphorus-rich food, and adequate use of binders. The questionnaire also had a question about the possible reasons for failing the hyperphosphatemia treatment and another about the lack of adherence to the use of binders. To standardize the technique of the questionnaire application, the questions were read out loud by the interviewers (nutritionists of the units) to all patients during the dialysis session, regardless of the patient's educational level, which was also investigated.

Biochemical parameters

The laboratory tests performed were as follows: urea (enzymatic method; reference values: 15 to 40 mg/dL for women aged up to 50 years, 21 to 43 mg/dL for women older than 50 years, 19 to 44 mg/dL for men aged up to 50 years, and 18 to 55 mg/dL for men older than 50 years); total calcium (colorimetric method; reference values: 8.6 to 10.3 mg/dL); serum phosphorus (colorimetric method; reference values: 2.5 to 4.8 mg/dL) and parathormone (PTH) (chemiluminescence method; reference values: 16 to 87 pg/mL), obtained before the second dialysis session of the week. The calcium x phosphorus product was obtained by multiplying serum calcium by serum phosphorus. The urea Kt/V was calculated according to the formula recommended by the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative (NFK-KDOQI).

The PTH concentration of September 2008 was used for the study. For analyzing calcium,

phosphorus, and Kt/V, the six-month mean was calculated (from July to December 2008).

Medications

All patients were asked about their use of phosphorus binders and vitamin D from July to December 2008. In addition, their medical records were sought for that information.

Statistical analysis

The statistical analysis was performed by using the SPSS software, version 13.0 for Windows (SPSS, Inc. Chicago, IL). The results were expressed as mean and standard deviation. For the correlation analysis, Pearson or Spearman tests were used according to the distribution of the variables. For comparing variables inside and between groups, Student t test was used. The significance level of $p < 0.05$ was adopted.

Results

The main characteristics of the patients studied are listed in Table 1. Their age ranged from 21 to 74 years, 51% had not completed elementary school, and the male sex predominated. Only seven patients (6%) were not on phosphorus binders. The mean PTH concentration was high (802 ± 698 pg/mL), and the mean Kt/V value indicated adequate dialysis (1.33 ± 0.23).

The mean percentage of right answers of the 20 alternatives was 78.5 ± 12.5%. Table 2 shows the percentage of right answers for each question.

Most patients knew the consequences of hyperphosphatemia, but 23% of them did not know that high phosphorus could increase the risk of death. Regarding the question about phosphorus-rich food, most answers were correct, but almost half of the patients answered that potassium-rich food was a source of phosphorus. Almost the entire sample answered that binders should be taken at meals. On average, 42% of the patients answered that binders should be taken at meals without any phosphorus-rich food, and 86% answered that they would take binders at the meals containing food that is a source of phosphorus.

The fifth question was: "Why do you think your phosphorus is high? You may choose more than one alternative". The answers are shown in Table 3.

Regarding that question, 87% of the patients studied answered that they ingested more phosphorus than they should and/or they did not take phosphorus binders as they should. Thus, lack of adherence to treatment was identified as the justification for hyperphosphatemia by most interviewees.

Regarding question 5, the patients who answered not taking the phosphorus binder as they should were asked about their reason for doing so. The most common answer attributed it to forgetfulness (62%). Twelve percent of the interviewees answered "because they are bad for you"; 3%, "because I cannot buy the necessary amount"; and 16% chose "other reasons".

According to statistical analysis, serum phosphorus correlated directly with serum urea ($R = 0.33$; $p < 0.001$) and inversely with Kt/V ($R = -0.20$; $p < 0.05$). The score obtained in the questionnaire (total or by question) correlated with neither phosphatemia nor educational level.

When patients were divided according to dialysis adequacy, the serum phosphorus of those with an inadequate Kt/V (< 1.20) was higher than that of the other patients (6.85 ± 0.87 *versus* 6.45 ± 0.63 mg/dL; $p < 0.01$).

In the sample divided according to PTH concentrations (cutoff point of 800 pg/mL), no difference of phosphatemia was observed between the groups (6.5 ± 0.8 *versus* 6.6 ± 0.6 mg/dL).

Table 1 Main characteristics of the patients studied (n = 112)

Age (years)	49.3 ± 13.3
Male sex (%)	54
Years of schooling	7.0 ± 3.8
Dialysis time (months)	61.9 ± 55.3
Diabetes mellitus (%)	21
Use of phosphorus binders (%)	94
Use of calcitriol (%)	28
Serum PTH (pg/mL)	802 ± 698
Serum urea (mg/dL)	150.4 ± 32.2
Serum phosphorus (mg/dL)	6.57 ± 0.73
Serum calcium (mg/dL)	9.72 ± 0.79
Ca x P Product (mg^2/dL^2)	63.8 ± 9.2
Kt/V	1.33 ± 0.23

Table 2 Percentage of right answers of the questionnaire applied

Question	Right answer (%)
1) What problems can the high phosphorus level cause?	
Itching all over the body	94
Heart stiffness	68
Bone pain and weakness	82
Increased risk of death	77
Mean percentage of right answers	**80**
2) Check the foods that are rich in phosphorus.	
Milk, yogurt, and cheese	98
Banana, orange and papaya	47
Sausages, baloney	87
Bovine meat, chicken and fish	76
Coke and beer	82
Fruit juices	56
Mean percentage of right answers	**74**
3) When should binders be taken?	
During meals	96
In between meals	96
4) Binders should be taken at meals containing phosphorus-rich foods. Check the meals at which you would take them.	
Black coffee and bread with butter	54
Tea and cheese sandwich	92
Salad, rice and fried eggs	73
Soda and fried chicken snack	91
Coffee with milk and bread with butter	87
Tea with water biscuit crackers	69
Salad and pasta with meat	88
Juice and bread with fruit marmalade	51
Mean percentage of right answers	**76**

Table 3 Patients' opinions about failing hyperphosphatemia treatment

Answer	% Patients
Because I ingest more phosphorus than I should	61
Because I do not take phosphorus binders as I should	54
Because I did not understand what I should do	9
I do not know	10
Other reasons	1

Discussion

In the present study, hyperphosphatemic patients on hemodialysis, undergoing nutritional guidance and follow-up, showed adequate knowledge about the consequences and treatment of hyperphosphatemia. It is also worth noting that most patients attributed treatment failure to some degree of lack of adherence to dietary guidance and/or adequate use of phosphorus binders.

In a study conducted in our country also assessing, by use of a questionnaire, the knowledge of 147 hemodialysis patients (45% were hyperphosphatemic) about the consequences and treatment of hyperphosphatemia, the mean score obtained of 79.1% was very similar to that of the present study (78.5%).[14]

No relation between the patient's knowledge (assessed through total score and each question) and the phosphorus concentrations of the population studied was found. In fact, the relation between information or knowledge and adherence to dietary and medicamentous treatments in hemodialysis patients is still controversial.[14] Thomas *et al.* have reported that adherence increases if patients know about an adequate diet.[17] Patients who understood the consequences of hyperphosphatemia were also shown to maintain lower phosphatemia than the others.[18] On the other hand, Durose *et al.*, studying 71 hemodialysis patients, showed that patients with a better knowledge of dietary phosphorus restriction and of the consequences of hyperphosphatemia were less prone to adherence.[19]

Another study assessing the dialysis patients' knowledge about hyperphosphatemia by use of a questionnaire reported that those who did not attend university courses had poorer results and were more likely to have a Ca x P product > 55 mg2/dL^2 than the others.[15] In this study, the educational level did not influence the score obtained in the questionnaire, because patients having only the elementary educational level scored similarly to those who completed middle school. This may have been due to the fact that we used easily understandable nutritional guidance strategies that were reinforced monthly. This finding emphasizes the importance of quality and regularity in the health care provided to patients.

The positive correlation found between serum urea and phosphorus is due to the fact that urea generation relates to protein ingestion, and, consequently, to phosphorus intake.[20] That relation has also been evidenced in other studies.[14,21]

Eighty-seven percent of the sample answered that nonadherence to dietary phosphorus restriction and/or to the adequate use of binders accounted for the failure in the hyperphosphatemia treatment.

According to Ashurst *et al.*, good adherence depends on the patient's ability and will to cooperate, and the therapeutic regimen is very complex, comprising several medications, severe dietary restrictions, and dialysis.[22] Thus, low adherence to treatment, defined as the process in which those involved are influenced by several factors that determine its continuity or discontinuity, can be understood and is very common in that population.[23,24]

A recently published review has concluded that the factors influencing adherence to treatment of hemodialysis patients are as follows: confidence in the professional team; support network; educational level; acceptance of the disease; side effects of the treatment; lack of access to medications; long treatment; complex therapeutic regimen; and lack of symptoms.[25]

Nonadherence to prescribed phosphorus binders was reported by 54% of the interviewed patients, and forgetfulness was indicated as the major reason. In fact, many dialysis patients do not comply with the use of binders,[26] but the magnitude of the problem and the reasons are not well known.[5] In a recently published systematic review about the prevalence and the determinants of nonadherence to the use of phosphorus binders, 22 to 74% (mean of 51%) of the patients were considered to be nonadherent. Regarding the determinants, the possible predictors were divided into the following three categories: demographic, clinical, and psychosocial. The first two do not correlate consistently with adherence, except for age (the older were more adherent). The authors have concluded that psychosocial factors seem to be the greatest determinants of nonadherence, including the patient's beliefs about his/her treatment and his/her perception of social support.[5]

Because phosphorus clearance occurs in dialysis, patients on inadequate dialysis were expected to have even higher phosphorus concentrations than the others. The inadequate removal of phosphorus during hemodialysis results from its own kinetics, which has two phases. In the first two hours of dialysis, phosphorus is removed from the extracellular compartment. After that, phosphorus flows from the intra- to the extracellular medium, which maintains its level constant over the rest of treatment. It is precisely the velocity of mobilization between the intra- and extracellular compartments that limits phosphorus clearance.[9]

Although no difference has been found in phosphatemia when the sample was divided according to PTH, one should consider that severe hyperparathyroidism can have influenced phosphorus concentration in some patients, because that situation prevents the reduction in serum phosphorus, even with dietary restriction and massive use of binders.

In conclusion, the results of this study have shown that hyperphosphatemic patients on hemodialysis showed good knowledge about the consequences and treatment of hyperphosphatemia, but a low adherence to dietary recommendations and use of phosphorus binders. To increase adherence to treatment, the promotion of integrated actions with constant supervision and guidance is necessary, counting on a multidisciplinary team, in addition to the physician and the nutritionist. We believe that those actions should involve family members and caregivers so that they can learn about the importance of the treatment of hyperphosphatemia and take part on it effectively.

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