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Intensive Nutritional Counseling and Education for Management of Hyperphosphatemia in Hemodialysis Patients at Al-Khor Hospital- Hamad Medical Corporation - State of Qatar

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Abstract

Objectives: To assess the dietary phosphate intake of hemodialysis patients with hyperphosphatemia and the effects of a dietetic intervention focused on limiting dietary phosphate load.

Design: Cross-sectional dietary phosphate intake assessment and prospective intervention study.

Setting: Hospital hemodialysis units of AL-Khor hospital – Hamad Medical Corporation, Qatar. Subjects: sixteen stable adult hemodialysis patients, who had phosphorus serum levels ≥1.6 mmol/L. Intervention: Analysis of dietary composition and of the effects of individual dietetic counseling to reduce phosphorus intake while preserving the same or improving protein intake.

Main outcome measures: Differences in nutrient intake between pre and post-dietary intervention among hyperphosphatemia patients, and changes in phosphorus–protein ratio, and serum phosphate, after the dietetic intervention.

Results: Significant differences in nutrient intake including energy, protein, and phosphorus were detected after the intervention. After dietetic intervention in the hyperphosphatemia patients, a decrease in the dietary phosphate–protein ratio (28.9 -13.4 mg/g, $P < 0.05$) also occurred. Serum phosphate showed a trend of a significant decrease after the dietary intervention (2.2mmol/L-1.68mmol/L), $P < 0.05$).

Conclusion: Individual intensive nutritional education and counseling may be useful in reducing phosphate load and improving serum phosphorus with a positive effect on nutrient intake. A phosphate-controlled diet has a role in an integrated therapeutic approach to hyperphosphatemia and positive calcium-phosphorus balance in hemodialysis patients.

Keywords: Dietary phosphorus; Education; Hemodialysis; Counseling

1. Introduction

Mineral bone disorder in chronic kidney disease and cardiovascular mortality risk among hemodialysis patients is mainly caused by hyperphosphatemia [2-5]. Phosphorus-restricted diets (800–1,000 mg/day) are considered the cornerstone of treating a mineral bone disorder in hemodialysis patients [6,7]. Hemodialysis patients have reported that adhering to the recommended phosphorus levels is the most complicated dietary restriction-related task [8,9].

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Numerous articles over the past decade and many evidence-based guidelines have been published about effective strategies to achieve optimal dietary adherence to a phosphorus-restricted diet in hemodialysis patients. Patients must be provided with consistent and frequent dietary consultations with experts as well as regular follow-ups in the context of a nutrition education program as per recommendations of the Kidney Disease Outcomes Quality Initiative (K/DOQI) [6], and the Kidney Disease Improving Global Outcomes (KDIGO) foundation [10]. Dietitian-to-renal-patient consultation time to achieve adherence to a phosphorus-restricted diet was estimated at least 2 hours per patient per month for 12 months to be effective [11]. Hyperphosphatemia is a prevalent complication in approximately 50% of patients with advanced CKD treated with maintenance hemodialysis [12,13].

Phosphate homeostasis normally is maintained by the interaction of several factors including intestinal absorption, bone deposition, soft tissue transport, and kidney excretion, along with regulation by hormones, including parathyroid hormone (PTH), 1,25-dihydroxy vitamin D (1,25[OH]2D), and fibroblast growth factor 23 (FGF23). However, due to mineral metabolism disorders, improper kidney excretion, hyperphosphatemia may develop and cause vascular calcification and stiffness, altered cardiac structure and function, kidney osteodystrophy, and heightened mortality. Hyperphosphatemia mainly results from dietary phosphate, phosphorus has two forms (organic versus inorganic sources), or animal- versus plant-based phosphate with varying degrees of bioavailability (40%–60% versus 20%–40%, respectively) [14]. Plant-based phosphate occurs in the form of phytates and has lower bioavailability because of a lack of the degrading enzyme phytase in humans [14]. Narasaki Y et al., 2020 [15], reported that low phosphatic index foods (plant-based food) led to decreased PTH, and increased 1,25(OH)2D levels, compared with high phosphatic index foods (animal-based food) with equivalent amounts of phosphate in healthy adults [15]. In addition, additives in processed foods are another source of inorganic phosphate with around 90% bioavailability. Pharmacotherapies (phosphate binders, calcimimetics) and thrice-weekly hemodialysis provide limited phosphate removal relative to the dietary phosphate intake of patients on dialysis (6300–10,500mg/week, on average) [16]. Furthermore, poor adherence of hemodialysis patients to high pill burden (phosphate binders), leads to impaired health-related quality of life, and higher serum phosphate levels [17]. So, the cornerstones of hyperphosphatemia management include dietary interventions, Hence, dietary therapy plays a critical role in achieving target phosphate levels. Patients with stages 3A–5D CKD were recommended by the 2020 National Kidney Foundation, Kidney Disease Outcomes Quality Initiative, Clinical Practice Guidelines for Nutrition in CKD to adjust their dietary phosphate intake to maintain serum phosphate in the normal range and to consider the bioavailability of phosphate sources [12]. Individualizing treatments based on patient needs and clinical judgment required an expert kidney dietitian to evaluate patients' daily intake and provide recommendations [18]. Hyperphosphatemia management may be achieved through dietary interventions including dietary assessment, dietary phosphate restriction, education on reading food labels, and meal preparation. Although dietitians contribute substantial time and effort in providing tailored nutrition therapy to patients on hemodialysis, the efficacy and safety of phosphate-specific dietary interventions delivered by dietitians on hyperphosphatemia management have a crucial role. In this issue of CJASN, St-Jules et al. [13]. Studies deemed eligible for synthesis included 12 clinical trials (11 randomized and one nonrandomized) conducted from 2000–to 2019 across an international catchment (United States, South America, Europe, Asia, and the Middle East), which were categorized according to [12] intervention focus (multicomponent versus targeted interventions), and [13] intervention "dose" (frequency of sessions) in the multicomponent studies. Across nine studies examining multicomponent interventions, two trials of low cure (single session) diet remedy demonstrated nonsignificant diminishments in serum phosphate (mean difference 20.45mg/dl), whereas two out of three – moderate cures (one session every 1 to1.5 month) and three out of four high-cure (further than one session per month) trails showed significant diminishments in serum phosphate although these reductions were doubtful to be sustained if discontinued. Among three studies examining targeted interventions, two trials that concentrated on avoidance of phosphate complements demonstrated significant diminishments in serum phosphate (mean differences 21.18 mg/ dl), whereas one trial that concentrated on mess medications didn't observe significant differences. Pooled analysis of 11 trials with adequate data showed that diet therapy significantly decreased serum phosphate versus controls. Notably, no ill effects of diet therapy on patients' nutritional and protein indices, body composition, physical function, or health-related quality of life were observed. Medical nutrition therapy (MNT) services at AL- Khor hospital – Hamad medical corporation – in the state of Qatar encompasses individualized nutrition assessment, dietary care planning, and dietary education /counseling provided by a clinical dietitian. The objective of this study is to examine nutritional education interventions aimed at improving serum phosphorus levels in hemodialysis patients by enhancing their knowledge and adherence to dietary instructions related to phosphorus restriction. This study adds important knowledge to the field by (1) demonstrating the efficacity of phosphate-specific diet remedies administered by dietitians in lowering serum phosphate, and 2) attesting to the safety of these interventions on nutritive and patient-centered endpoints. (in addition to affirming the critical significance of dietitians in multidisciplinary hyperphosphatemia operation, this study also underscores the need for frequent, ongoing administration of personalized diet remedies to achieve and maintain advancement in patient phosphate control, although the authors conceded the diversity of the interventions across trials, this study emphasizes the value of exercising combinations of salutary strategies (low-phosphate diet, avoidance of

phosphate complements, training in mess medication) with nondietary strategies (binder and dialysis adherence, druggist discussion) in achieving phosphate control.

2. Material and methods

This cross-sectional study is conducted in the hemodialysis unit at AL-Khor hospital – Hamad Medical Corporation- in the state of Qatar in 2020. The participants in the study included hemodialysis HD patients who have criteria for enrolment. Inclusion criteria were: CKD on HD for at least 6 months, age between 20 and 80 years, [19], stable conditions, no malignancy, the ability to collaborate on one-person and group training sessions, no waiting list for kidney transplantation in the next 6 months, high phosphorus for two consecutive lab readings, and non-pregnancy and lactation. Exclusion criteria included unwillingness to continue cooperation, moving from the center of HD to other centers for any reason, the occurrence of acute and malignant disease, and planning for transplantation within 6 months.

There are one hundred twenty patients undergoing HD in 3 shifts 38, 42, and 40 patients in the morning, afternoon, and night shifts respectively, in the dialysis unit at AKH. Only the morning shift patients were invited to participate in this study. The study objectives were explained to patients and reminded them that if they did not want to cooperate, they can leave the study at any time. So, twenty-five patients with end-stage renal disease on maintenance HD were enrolled. Then demographic data were collected. Sixteen out of 25 participants (65%) completed this study. Nine patients were excluded from the study because of their unwillingness to continue. The questionnaire was designed for data collection and consists of 3 parts: demographic information, Nutritional knowledge, and dietary assessment. Dietary intake for 2 days was assessed using 24-h recall method. Total calorie, protein, and phosphorus intake for the two days were calculated based on the available and updated tables of the nutrient composition of food. During the follow-up period, all patients have prescribed the Kidney Disease Outcomes Quality Initiative (KDOQI)-which recommended a daily protein intake of 1.2 g/kg of body weight [20]. When the daily caloric intake was below 30 kcal/kg of body weight, a nutritional intervention was provided according to the DOQI guidelines [20], consisting of an individualized diet elaborated by a clinical dietitian, based on a patient's specific needs and, possibly, on food preferences. These recalls were completed two times by a clinical dietitian for each patient, the first time before the intervention, and the second time immediately after the end of the intervention. 2-3 sessions of intensive nutrition education and counseling per month were conducted for each patient including high phosphors food sources, how to read food labels, determining the phosphorus content of processed food, and how to reduce phosphorus during food preparation. 4-h sessions, three times a week, were prescribed for patients on regular HD. Most patients were receiving a weekly injection of erythropoietin and most of them were on antihypertensive therapy (i.e., angiotensin-converting enzyme inhibitors, angiotensin II receptor antagonists, calcium channel blockers). Phosphate and potassium binders and vitamin supplements were prescribed to most patients. In all patients, dry weight, weight change in the previous 6 months, height, and body mass index, were recorded at baseline. This study is conducted to summarize the existing evidence on the nutritional management of hyperphosphatemia and to recognize the importance of dietitians' role in caring for hyperphosphatemia patients, Data are presented as mean ± standard deviation. The Student's t-test for unpaired data and the Mann–Whitney test for parametric and non-parametric statistical analyses, respectively, were used as appropriate. The presence of significant correlations was assessed according to the Spearman test. $P < 0.05$ was considered statistically significant.

3. Results

Analysis of demographic variables showed that 13 (81.25 %) of the patients were males and only 3(18.75%) were females. The overall mean age was (59±1.54) years, with (78.0 ±1.65) and (47.3 ±2.03) years for males and females respectively. Only three patients (18.75%) were Qatari and thirteen patients (81.25%) were non-Qatari. Diabetes, hypertension, or both, were the main cause of end-stage renal disease in 73.30%. The mean duration of HD was 4.6±4.62 years. The number of HD per week was | (2.87± 0.34) [Table 1].

Dietary intake was assessed using 24-hour recall for two days at the beginning of the study (pre-intervention) and at the end of the study (post-intervention). The same procedure was used for all patients. Phosphorus, protein, and energy intakes were assessed based on the available and updated tables of the nutrient composition of food. The overall analysis of the dietary composition of the 16 studied patients showed that as a mean, an energy intake has been significantly increased from 1489 ±366.7 Kcal/day (19.3±11.3 kcal/kg/day) to 1770±386.0 Kcal /day (23.9 ±13.2 kcal/kg/day) figure 1a. Protein intake showed a significant increase from 56.8±18.54 g/day (0.79 ± 0.40 g/kg/day) to 78.0±29.13 g/day (1.05 ± 0.31g/kg/day) figure 1b. A significant decrease in phosphorus intake from (1650± 439.9 mg/day) to (1051 ± 379.5 mg/day), has been found in this study Fig 1c, with a further decrease in phosphate to protein

ratio (28.9± 1.8 mg/g/day to (13.4±2.1 mg/g/day) *P* <0.05) figure 1 d. Serum phosphorus concentration significantly decreased (2.32±0.23 mmol/L to 1.68 ±0.38mmol/L) post-dietary intervention figure 2.

Table 1 Basic Characteristics of Study Participants (n=16)

Nationality n (%)	
Qatari	3 (18.75)
Non-Qatari	13(81.25)
age (years) Mean (SD)	
Male Female	78.0 (1.65) 47.3 (2.03)
Gender	
Male n (%)	13 (81.25)
Female n (%)	3 (18.75)
Cause of illness n (%)	
Diabetes	7 (43.75)
Hypertension	4 (25.00)
Diabetes and hypertension	3 (18.75)
Others	2 (12.50)
Duration of HD (year) Mean (SD)	4.60 (4.62)
Number of HD sessions per week Mean (SD)	2.87 (0.34)

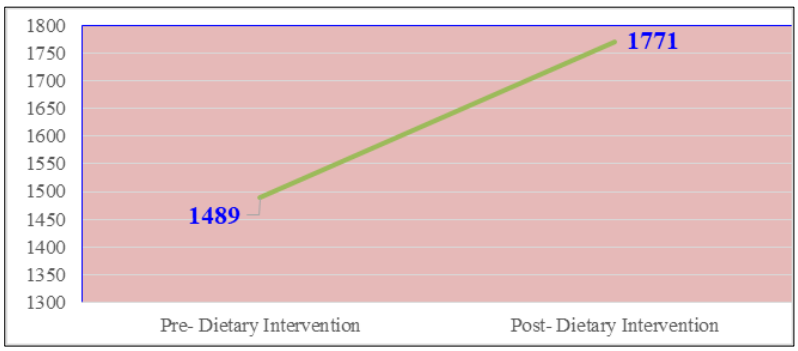

Figure 1a Energy Intake (Kcal/d) / Pre-Post Dietary Intervention

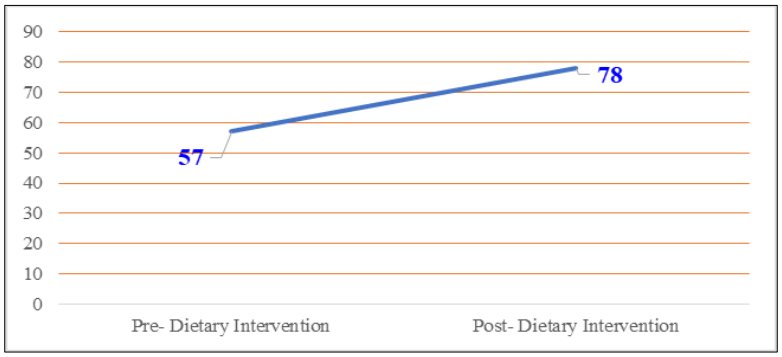

Figure 1b Protein Intake (g/d) / Pre-Post Dietary Intervention

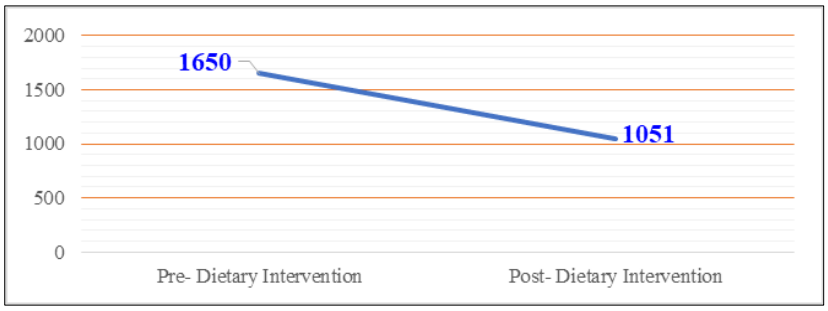

Figure 1c Phosphorus Intake (mg/d)/Pre-Post Dietary Intervention

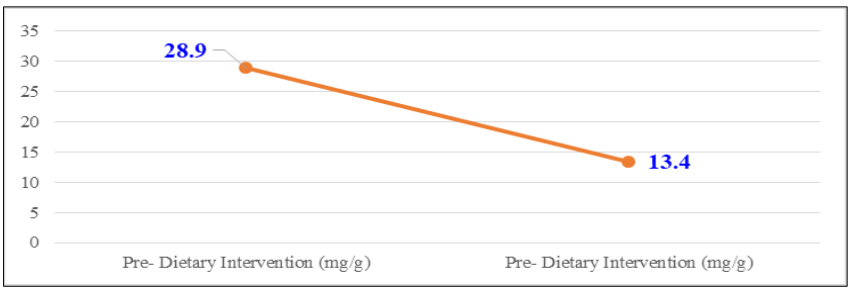

Figure 1d Phosphate to Protein Ratio (mg/g/d) / Pre-Post Dietary Intervention

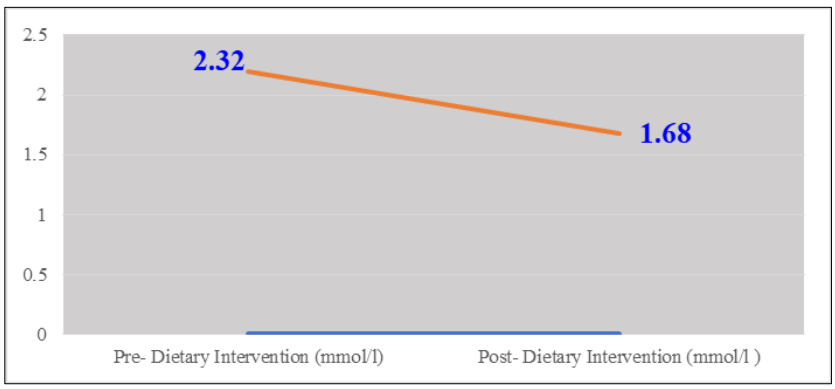

Figure 2 Serum phosphate (mmol/l) pre-post dietary intervention

4. Discussion

In dialysis patients, a well-known factor favoring hyperphosphatemia includes severe hyperparathyroidism, calcitriol treatment, inadequate dialysis, and medical and dietary noncompliance [21,22], patients with hyperphosphatemia showed a post-intervention lower dietary phosphorus-to-protein ratio of 13.4 mg/g/d compared with pre-intervention 28.9 mg/g/d despite the protein intake being more in post-intervention than in pre-intervention, namely a lower phosphorus intake per gram of protein intake. A possible explanation is that patients with hyperphosphatemia may be more aware of the type of protein source foods i.e differentiate between organic and inorganic phosphorus foods and therefore, the dietary general recommendations for limitation of phosphate intake become better adherence. [23]. In these patients, one-to-one dietary counseling produced a further reduction in the phosphorus-to-protein ratio. Two-day food records were used to assess dietary habits because, up to now, this has been the preferred method of dietary assessment, [24]. A color photograph method was used by a dietitian as an educational tool for patients to estimate their phosphorus intake of the most commonly eaten foods. A possible underestimation of energy and nutrient intake may have occurred. Substantial restriction in simple sugars consumption was observed leading to a slight reduction in energy intake. Our data are in keeping with the chance to reduce dietary phosphorus content without dramatic changes in protein and energy intake, thus limiting the phosphorus load. Phosphate binder's efficacy can be increased through day-by-day reduction of dietary phosphate dose.

This may ameliorate compliance and tolerability and reduce the dosage needed. All the data we reported on dietary composition analysis refers to the raw edible part of the food, and thus they reflect changes in food choice. These features can be potentially ameliorated by paying appropriate attention to food processing [25]. Meanwhile, boiling foods can be useful to eliminate some minerals, including phosphorus [26]. More studies may be useful in defining cooking procedures that can discharge phosphorus while preserving protein, thus attenuating the conflict between dietary phosphorus and protein. The success of the dietary approach is largely dependent on the patient's compliance and effective interaction between the nephrologist, dietitian, and patient. This approach would include the patient in the decision-making process regarding the changes in dietary habits [27]. Although dietary intervention alone is not enough to control serum phosphorus levels, nutritional education and dietary counseling have a role in the management of dialysis patients [28]. Phosphorus and protein content in common foods and their phosphorus to protein ratio. To deal with the conflict between phosphorus and protein dietary intake affecting dialysis patients. The phosphorus-protein ratio is an important parameter [29] because it can help patients to avoid excess phosphate intake and limit the phosphate burden related to an adequate protein intake. We believe that nutritional education and dietary counseling underlie the importance of a phosphate-controlled diet as an integrated therapeutic approach to hyperphosphatemia and positive calcium-phosphorus balance incompliant and motivated patients.

The results of this study confirmed that an effective nutritional education program plays a vital role in the improvement of nutritional knowledge, perceived benefits, perceived barriers, and self-efficacy. The present study results on 16 HD patients showed that intensive nutritional education and counseling significantly improve the nutritional knowledge in hyperphosphatemia patients and improve serum phosphorus, these results are inconsistent with the findings of Ford *et al*. in 2004. A study about the effects of adding 30-min monthly training, focusing on phosphorus on knowledge in HD patients investigated. There was a significant positive effect on knowledge in the intervention group [30]. Ebrahimi et al. [2016] reported that 40-60 min educational sessions lasting 3 months significantly improved the dietary knowledge in hyperphosphatemia patients with HD [31]. In another study done by Duzalan et al. [2018] on HD patients, it was shown that the dietary knowledge post-test scores significantly increased compared with the pretest scores [32]. This finding is consistent with the other two investigations, which demonstrated an improvement in the score of knowledge through education in the intervention group in HD patients [33,34].

In our study, the mean protein intake was increased significantly in the hyperphosphatemia patients, which means that patients after taking intensive nutritional counseling and education training sessions found themselves exposed to know the importance of consuming enough amount of Protein in their diet as well as the type of protein. The findings of this study emphasize that patients' education improves their diet adherence and its benefits. There was a significant difference between the pre-intervention and post-intervention in phosphorus intake. In other words, the impact of intensive nutrition education and counseling is to improve adherence to the low phosphorus diet, which means that after education patients' belief in the ability to adhere to the diet was higher compared with before dietary intervention. These findings agreed with the findings of Cupisti *et al*.,2004, and phosphorus intake in HD patients with hyperphosphatemia was significantly reduced following nutritional education [35]. The intake of protein in the present study increased significantly post-intervention which is consistent with the result of Cupisti et al. [35]. It has been suggested that interventions aimed at upgrading the patient's adaptive behavior should focus on lowering the environmental barriers that prevent the patient from responding to recommendations. For example, to increase the utility of the low phosphorus diet, several recommendations have been proposed that could be useful.

To eliminate food insomnia patients can use flavors such as onion powder, garlic powder, and curry powder. In addition, they can discuss a variety of foods that can be appropriate for them in a restaurant and the consistent patients can share their experiences on modifying nutritional behaviors [36]. It is very important to provide an appropriate educational method in dietary management to encourage the patients to adhere to their diet and improve their quality of life. The present study is the first study to examine the effect of intensive nutrition education in hyperphosphatemia patients on hemodialysis in AL-Khor hospital.

5. Conclusion

The present study indicated that intensive nutritional education and counseling significantly improve serum phosphorus with a positive effect on nutrient intake. Long-term change in patients' dietary habits needs continuous monitoring and comprehensive programs through long-lasting interventions and the participation of people who are involved in the lifestyle of patients. It is suggested that further studies in this field be carried out to achieve more results that are definitive.

Compliance with ethical standards

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Disclosure of conflict of interest

The author has no conflicts of interests to declare.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study

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