

The Effect of Dietary Habbit of Phosphorus Intake in Chronic Kidney Disease Patients on Hemodialysis

Vajed Mogal^{1*}, Samrin Khan¹, S. Kulkarni¹, K. Gadekar¹, R. Bhattu¹ and A. Data¹

¹Department of Nephrology, M.G.M. Medical College, Aurangabad, Maharashtra, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author VM designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author SK managed the analyses of the study & managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Phosphorus is an essential nutrient required for multiple physiological functions, recent researches found that high phosphorus intake could have detrimental effects on health. Hyperphosphatemia is one of the most important risk factors for morbidity and mortality for chronic kidney disease (CKD) patients. High phosphorus intake can cause vascular and renal calcification, renal tubular injury, and premature death in multiple animal models. Limited data exist linking high phosphorus intake directly to adverse clinical outcomes. Small studies in human suggest that high phosphorus intake may result in positive phosphorus balance and correlate with renal calcification and albuminuria. Further prospective studies are needed to determine whether phosphorus intake is a modifiable risk factor for kidney disease.

Aims & Objectives: To study the effect of dietary habits on dietary phosphorus intake in chronic kidney disease patients on hemodialysis.

To study the prevalence of hyperphosphatemia in patients of CKD on maintenance hemodialysis.

To see the impact of dietary control of phosphorus in CKD patients.

*Corresponding author: E-mail: drvajedmogal@gmail.com;

Methods:

- This was a cross sectional comparative study. It was carrying in tertiary care centre in western region Maharashtra state.
- A total of 80 patient's diagnosed case of CKD on maintenance of hemodialysis were selected for the study, patients on maintenance hemodialysis program twice in a week with 4 hour duration.
- Patients were divided into two groups as 1st group is on given diet to control phosphorus level in body and 2nd group is on phosphate binder to control phosphorus level.
- Baseline serum phosphorus was measured 1 month before hemodialysis and after 1 month prior hemodialysis in both group patients.

Results: It was observed that there was a significance difference between the pre and post phosphorus of group A(experimental group). The main difference was seen between age group 20-40 and 40-60, no difference was seen in age group 60-80. There was significant difference in pre and post phosphorus was also seen in group B, in group B age group 60-80 has shown good response.

Conclusion: Renal diet education can reduce phosphorus level and guided diet education provides an additional benefit on controlling hyperphosphatemia in haemodialysis patient. The purpose of the study is to see the effect of dietary habits on dietary phosphorus intake in CKD Patients on haemodialysis. Dietary counseling encourage the consumption of foods with least amount of inorganic or absorbable serum phosphorus, low phosphorus- to -protein ratio an adequate protein content .Our phosphorus additives list helps to reduce indirectly intake of phosphorus. Younger group of patient have followed renal diet for hyperphosphatemia effectively.

Keywords: Phosphorus; chronic kidney disease; hemodialysis.

1. INTRODUCTION

Phosphate is an electrolyte, which is an electrically charged substance that contains the mineral the mineral phosphorus [1]. A high phosphate level is often sign of kidney damage. It is more common in a people with chronic kidney disease (CKD). Hyperphosphatemia is a major concern in chronic kidney disease patients (CKD). Phosphorous intake is restricted in order to prevent hyperphosphatemia in these patients [2].

Hyperphosphatemia also seems to be associated with a faster progression rate of CKD [3]. Patients with chronic kidney disease (CKD) have reduced kidney function, which worsens with disease progression. As the function of the kidney declines, the ability of the kidney to excrete phosphorus is reduced, resulting in the accumulation of phosphorus. Serum phosphorus levels increase, and to accommodate this, patients with hyperphosphatemia must reduce their consumption of phosphorus containing foods.

Kestanbaum and colleagues were the first to publish data from a large observational study studying the relationship between phosphate serum level and outcomes in a CKD cohort [4]. Hyperphosphatemia is a major problem in dialysis patients in developing countries,

regarding to dietary habits, ethnic factor, dialysis quality, as well as economic factors hampering the use of the more expensive phosphate binders.

The risk of disease progression and complications such as metastatic calcification, cardiovascular complications [5] and the increased risk of morbidity and mortality which result from hyperphosphatemia precipitate the need for improved phosphorus control in patients with chronic kidney disease [6].

The cause of excessive mortality in people with chronic kidney disease (CKD) who undergoes maintenance dialysis treatment is not clearly defined [7]. Whereas the traditional cardiovascular risk factor do not account for the increase mortality in CKD patients, measures of mineral and bone disorders (MBD), including hyperphosphatemia are associated with increase death risk [8,9].In a recent randomized controlled trial, Sullivan et al. [10] have shown that the inorganic phosphorus in processed foods contributed significantly to the phosphorus load of dialysis patients and educating patients with ESRD to avoid phosphorus containing food additives lead to improvements in hyperphosphatemia.

Lumertgul et al. [11] shown that increasing poverty was independently associated with

higher serum phosphorus levels and greater likelihood of hyperphosphatemia in a cohort of over 14,000 adults with largely preserved kidney function.

Hyperphosphatemia occurs as a result of impaired renal phosphate excretion, where there is a difference between the rate at which phosphate enters and is excreted by the kidneys. Hyperphosphatemic patients with CKD often have to limit dietary intake of phosphorus, as declining renal function increases serum phosphorus levels [12].

Block et al. [13] were able to demonstrate that elevated serum phosphorus was associated with an increased risk of mortality and morbidity in hemodialysis patients. The association between elevated serum phosphorus and mortality has been shown in dialysis patients; however this evidence is not as widespread with pre-dialysis CKD.

A study conducted by Kestenbaum et al. [14] aimed to associate elevated serum phosphorus with increased risk of death in patients with pre-dialysis CKD.

The consequences of hyperphosphatemia that are of greatest concern and mentioned most frequently in the literature, which will be outlined below, include secondary hyperparathyroidism, renal osteodystrophy, soft tissue calcification, and the cardiovascular complications resultant from calcification. With a greater risk of mortality in patients on dialysis, it is necessary to prevent and manage these elevated levels to possibly reduce the risk in patients with CKD [15].

1.1 Aims and Objectives

- 1) To study the effect of dietary habits on dietary phosphorous intake in chronic kidney disease patients on hemodialysis.
- 2) To study the prevalence of hyperphosphatemia in patients of CKD on maintenance hemodialysis.
- 3) To see the impact of dietary control of phosphorus in CKD patients.

2. MATERIAL AND METHODS

The main aim of research is to find out the truth which is hidden and which has not been discovering as yet. In the present study also, the researcher has made a systematic study of the problem chosen and tried to establish a cause

and effect relationship to find feasible solutions to the problem.

2.1 Location, Sample Size of the Study

All subjects were randomly selected in tertiary care centre in western region Maharashtra state "To study the effect of dietary habits on dietary phosphorous intake in chronic kidney disease patients on hemodialysis." The Duration of the study was 1 year from Nov 2019 to Oct 2020.

2.2 Selection of the Subject

Selection criteria of subject greater than 18 year of both genders. 80 subject will be select from tertiary care centre in western region Maharashtra state.

2.2.1 Inclusion criteria

We were include patients of chronic kidney disease (CKD) undergoing hemodialysis.

1. Age more than 18 years
2. Hemodialysis vintage > 30 days
3. Ability to consent

2.2.2 Exclusion criteria

1. Patients of Acute Kidney Injury.
2. Patients not willing to give consent.
3. Patients of CKD on peritoneal dialysis.

Survey method is used for Data Collection in which a self prepared Questionnaire was used to see the prevalence of various types of CKD patients in tertiary care centre in western region Maharashtra state. Comparative characteristics collected at baseline included: age, gender, cause of renal Disease. Body mass index was calculated.

3. METHODOLOGY

This is a prospective and observational study was carrying in tertiary care centre in western region Maharashtra state. A total of 80 patients diagnosed case of CKD on maintenance of hemodialysis were selected for the study, patients on hemodialysis program twice in a week with 4 hour duration. Patients were divided into two groups as 1st group is on given diet to control phosphorus level in body and 2nd group is on phosphate binder to control phosphorus level. We did quantitative determination of phosphorus concentration in human serum, plasma on COBAS INTEGRA systems by

Molybdate method. Baseline serum phosphorus was measured 1 month before hemodialysis and after 1 month prior hemodialysis in both group patients.

- A structural proforma to collect General Demographic profile
- To evaluate the dietary intake of the participants, and to estimate the amount of phosphorus being consumed, repeated 24-hour recalls were performed . 24-hour recalls are considered to be the method of choice for assessing dietary intakes of groups (86) descriptions and amounts of each of the foods reported and the final probe which asks for any other items that may have been consumed during the 24-hour time period (84)
- Dietary satisfaction measurement questionnaire Preliminary studies conducted with the tool measured dietary satisfaction using a modified questionnaire adapted from the validated questionnaire

developed for the Modification of Diet ; this tool was also used in the current study to assess dietary satisfaction (Appendix, Form 7). The concepts covered within this questionnaire included thoughts on food choices such as satisfaction with intake, perceived challenges and barriers, and food consumption during social events.

3.1 Statistical Analysis

- The collected data was compiled in EXCEL sheet and Master sheet was prepared. Data was presented by visual impression like Bar-Diagram; pie-diagram etc. qualitative was represented in form values & percentages.
- For comparison of Quantitative variables of t test for equal variance was applied. It was also represented in form of mean & SD. P- Value was checked at 5 and 1% level of significance.

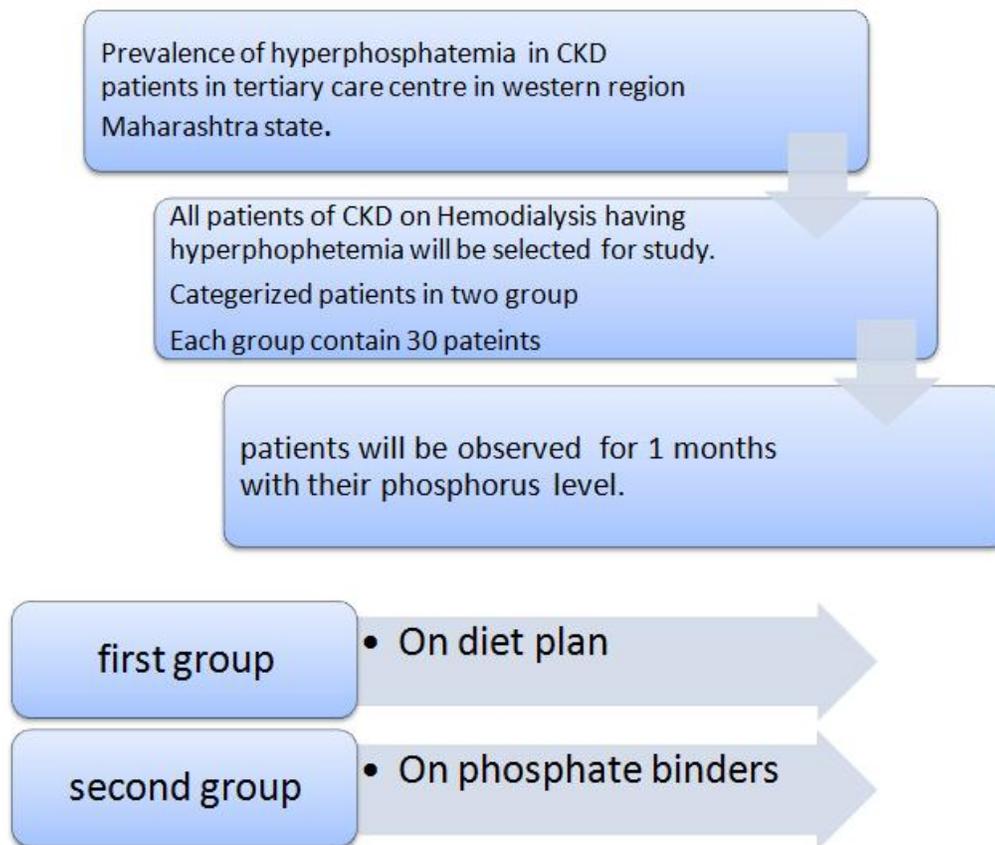


Fig. 1. Structural protocol of study

4. OBSERVATION AND RESULTS

Present study "To study the effect of dietary habits on dietary phosphorous intake in chronic kidney disease patients on hemodialysis" Was done in tertiary care centre in western region Maharashtra state. Total number of cases studied was 80. Out of 80 patients, 60 (60%) patients were found to have Hyperphosphatemia (high serum phosphorus level > 5.5 mg/dl).

The maximum patients of the present study was from age group 40-60 years 42(42%), where as minimum age group 60-80 years 10 (10%) and age group 20-40 is 28 (28%).

Out of 80 patients, 52 male (52%) and 28 female (28%) respectively. The maximum patients are on daily wages 37(37%), where as minimum are self employed 10(10%), 10 (10%) females are housewife's.

The main cause of CKD seen in patient is CGN (chronic glomerular nephritis) in 30 (30%) patients, major cause is unknown 20 (20%) diabetic nephropathy seen in 20 (20%) patients,

Where as chronic tubule-intestinal nephritis (CTIN) is seen in 10 (10%) patients.

Out of 80 patients, 38 patients (38%) were vegetarian and 42(42%) were Non-vegetarian. 50 Patients (50%) having hypertension, where as 30 (30%) patients are non hypertensive. maximum patients were having hypertension.

While CVD present significant health burden on the general population as the fourth leading cause of mortality, CVD present disproportionately greater burden on HD patients because Maximum patients were present in group of more than 12 month of HD is 30 (30%) , where as 6-12 month patients are 30 (30%) and less than 6 month are 20 (20%). DM is seen in 20 (20%) patients where as Non-Diabetic patients were high 60 (60%).

HB level were seen <7mg/dl in 14 (14%) patients, where as HB level >7mg/dl seen in 66 (66%) patients. Creatinine level <8mg/dl patients were 30 (30%) and >8mg/dl were 50 (50%) observed. In all patients 55 (55%) patients were Non-smoker & 25 (25%) patients were Smoker.

Table 1. Demographic information of the hyperphosphatemia in CKD patients [n=80]

| Parameters | Sub-Parameters | No Of Patients N=80 | Percentage[%] |
|------------------|----------------------|------------------------|---------------|
| Age In Years | 20-40 | 28 | 28 |
| | 40-60 | 42 | 42 |
| | 60-80 | 10 | 10 |
| Gender | Male | 52 | 52 |
| | Female | 28 | 28 |
| Occupation | Self Employed | 10 | 10 |
| | Services | 23 | 23 |
| | Daily Wages | 37 | 37 |
| | Housewives | 10 | 10 |
| Cause | Daibetic Nephropathy | 20 | 20 |
| | Cgn | 30 | 30 |
| | Ctin | 10 | 10 |
| | Unknown | 20 | 20 |
| Duration Of Hd | <6month | 20 | 20 |
| | 6-12 Month | 30 | 30 |
| | >12month | 30 | 30 |
| Diabetes | Diabetic | 20 | 20 |
| | Non-Diabetic | 60 | 60 |
| Hypertension | Htn | 50 | 50 |
| | Non-Htn | 30 | 30 |
| Dietary Habbit | Vegetarian | 38 | 38 |
| | Non Vegetarian | 42 | 42 |
| Hemoglobin Level | <7 mg/dl | 14 | 14 |
| | >7 mg/dl | 66 | 66 |
| Serum Creatinine | <8 mg/dl | 30 | 30 |
| | >8mg/dl | 50 | 50 |
| Smoking | Smoker | 25 | 25 |
| | Non Smoker | 55 | 55 |

Table 2. (Group A) Pre & post phosphorus of group A (group on diet)

| Age Group | Number | Pre P Mean \pm Sd | Post P Mean \pm Sd | P Value |
|-----------|--------|---------------------|----------------------|---------|
| 20-40 | 19 | 7.56 \pm 1.05 | 7.13 \pm 0.91 | 0.00036 |
| 40-60 | 18 | 6.52 \pm 0.745 | 6.23 \pm 0.8519 | 0.056 |
| 60-80 | 3 | 6.53 \pm 0.339 | 6.83 \pm 0.329 | 0.095 |

Table 3. (Group B) pre & post phosphorus of group b (on binder)

| Age Group | Number | Pre P Mean \pm Sd | Post P Mean \pm Sd | P Value |
|-----------|--------|---------------------|----------------------|---------|
| 20-40 | 14 | 6.928 \pm 1.104 | 6.843 \pm 0.920 | 0.482 |
| 40-60 | 22 | 6.73 \pm 0.815 | 6.73 \pm 0.815 | 0.024 |
| 60-80 | 4 | 6.82 \pm 1.075 | 6.35 \pm 1.042 | 0.352 |

We have found that young group patients (20-40) have a good response of dietary control in reduction of phosphorus level, observed level reduction is (7.13 \pm 0.91) There were 19 patients on experiment of this age group in that 15 patients result are positive in reduction of phosphorus level.

Age group (40-60) out of 18 patients 12 patients phosphorus level are reduce so this age group is also effective in dietary control of phosphorus. Observed level of post phosphorus is (6.23 \pm 0.8519) .

Old age group (60-80) are not seen positive to dietary reduction of phosphorus level , because of low socioeconomic group they don't follow diet they eat what other family members are eating, another reason is there body's low ability of absorption of food and vitamin , mineral deficiency . Observed post phosphorus level is (6.83 \pm 0.329)

- There were no significant differences within the age groups (20-40) out of 14 patients in this group only 6 responses to binder to reduce phosphorus level. Age group (40-60) out of 22 patients 14 patient reduces phosphorus level by binder
- Thus, we can conclude that age group (60-80) has shown more response to the phosphate binders on serum phosphorus levels during the study period. If these binder consumption had increased, this could have been thought to be the cause of the of decreasing serum phosphorus.

5. DISCUSSION

The usual dietary education provided by renal dietitians to patients with hyperphosphatemia includes a standard one page handout. The handout typically lists food items that are high in

phosphorus to avoid and substitution food items low in phosphorus to choose more often. This tool along, with the limited time that patients are given with the dietician, may not provide the patients with enough knowledge and understanding of the diet to successfully achieve adequate phosphorus control.

Thus, the rationale for the current study is that, in the pre-dialysis population: 1) dietary phosphorus restriction is prescribed to hyperphosphatemic dialysis patients in order to reduce serum phosphorus levels and possibly reduce health-related complications, 2) studies have shown that more intensive follow-up and approaches in dialysis patients can lead to improvement in dietary adherence and satisfaction 3) studies involving intensive, innovative patient education interventions have not been previously conducted in the pre-dialysis patient population to our knowledge.

Primary hypothesis is that in patients educated by dietary modification: Serum phosphorus levels will be lower than those of patients receiving the standard education.

The primary objective of this study was to determine the effectiveness of the dietary control of Phosphorus in reducing serum phosphorus levels in hyperphosphatemic participants with CKD. In patients with CKD, serum phosphorus is affected by renal function, consumption of phosphate binders and dietary intake of phosphorus.

Morey et al. [16] found that advanced monthly counselling aimed at reducing dietary phosphate intake and improving binder compliance reduced serum phosphorus significantly from baseline to 3-months in the intervention hemodialysis group (2.05 \pm 0.48 to 1.80 \pm 0.48) We have found that young group patients (20-40) have a good response of dietary control in reduction of

phosphorus level, observed level reduction is (7.13 ± 0.91) .

Cupisti et al. [17] (20) which showed that phosphorus knowledge of HD patients is low in comparison to their knowledge in other nutrients such as protein and potassium. In most of studies, healthy dietary patterns were consistently associated with lower mortality. However no statistically significant association was observed between healthy dietary pattern and the risk of ESRD and CKD therefore it seems that implementation of healthy dietary pattern could be an efficient tool to reduce mortality in people with kidney disease [18].

There were no significant differences within the age groups (20-40) out of 14 patients in this group only 6 responses to binder to reduce phosphorus level. Age group (40-60) out of 22 patients 14 patient reduces phosphorus level by binder. Thus, we can conclude that age group (60-80) has shown more response to the phosphate binders on serum phosphorus levels during the study period. If these binder consumption had increased, this could have been thought to be the cause of the of decreasing serum phosphorus.

We found that based upon 24-hour dietary recalls .The decrease in dietary phosphorus intake at week 3 appears to be linked to a decreased consumption of phosphorus-rich protein foods, as there is also a significant decrease in dietary protein intake at week 3.

A study by Sullivan et al. [6] found that providing dietary education specifically focused on food additives resulted in a significant improvement in the change in serum phosphorus levels between the groups, in participants on hemodialysis.

6. CONCLUSION

Hyperphosphatemia in CKD patient is an important complication of reduced kidney function. Dietary phosphorus restrictions are usually combined for effective management of hyperphosphatemia. Renal diet education can reduce phosphorus level and guided diet education provides an additional benefit on controlling hyperphosphatemia in hemodialysis patient.

Dietary counselling encourages the consumption of foods with least amount of inorganic or absorbable serum phosphorus. Our phosphorus

additives list helps to reduce indirectly intake of phosphorus. Younger group of patient have followed renal diet for hyperphosphatemia effectively. If they follow diet properly, requirement of binder will be reduced.

7. RECOMMENDATIONS AND IMPLICATION FOR ADVANCED CLINICAL PRACTICE

1. Providing patient education is an important part of ensuring that patients have adequate knowledge about their treatment regime.
2. Including friends and family members in educational interventions for individual for HD may be especially beneficial
3. Provide information on high phosphorus foods and drinks to avoid an example of low phosphorus foods and drinks that may be consumed, importance of properly taking phosphorus binders, and the provision of colourful handout to patients.

CONSENT AND ETHICAL APPROVAL

Ethical approval for the study was obtained from the Institutional Ethical Committee at tertiary care centre in western region of Maharashtra state. Informed Written consent was obtained from all the study participants.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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