

Original Research Article

Study of evaluation and correlation of calcium and phosphorus in chronic kidney disease with reference to parathyroid hormone

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ABSTRACT

Background: Recent guidelines for bone metabolism and disease in CKD recommend that, the target levels for calcium (Ca), phosphorus (P), calcium x phosphorus product (Ca x P) and parathyroid hormone (PTH) levels should be maintained at 8.8-10.2 mg/dl, 2.1-5.6 mg/dl, < 57.1mg²/dl² and 8.7-79.6 pg/ml, respectively in patients of CKD.

Methods: This was an observational study done in 70 patients, presenting in outpatient and inpatient department of tertiary care multi-specialty teaching hospital. Study was carried out at Dhiraj Hospital, Vadodara, Gujarat, in interval of one and half year. The study was investigation based, in the age group of 18 years and above who presented with chronic kidney disease. Serum Ca and serum P levels were measured by Fully Automated Colorimetry and Parathyroid hormone was measured by FLIA-fluorescence linked immunoassay.

Results: Among the 70 patients of chronic kidney disease, 55.7% showed abnormal calcium levels, 41.4% showed abnormal phosphorus levels, 72.9% showed abnormal PTH levels, 11.4% showed abnormal Ca x P levels.

Conclusions: The correlation between the phosphorus and PTH was linear and statistically significant. But the correlation between calcium and PTH was statistically insignificant and between Ca x P and PTH was very weak and statistically insignificant in CKD patients.

Keywords: Calcium-Phosphorus product, Chronic kidney disease, Calcium, phosphorus, Parathyroid hormone

INTRODUCTION

Chronic kidney disease (CKD) comprises a spectrum of pathophysiologic processes associated with deranged kidney function and a progressive decline in glomerular filtration rate (GFR). The term end-stage renal disease represents a stage of CKD where accumulation of non-volatile metabolites normally excreted by the kidneys leads to death unless the toxins are removed by renal replacement therapy, using dialysis or kidney transplantation.¹

Alteration in macro-mineral system, especially calcium and phosphorus levels, in addition to abnormal status of

parathyroid hormone (PTH) level is common in patients with chronic kidney disease (CKD). Eventually, hypocalcemia, hyperphosphatemia, and strain on parathyroid glands result in excess of PTH concentration.²⁻⁵

All individuals with a glomerular filtration rate (GFR) <60 ml/min/1.73 m² for 3 months are classified as having chronic kidney disease. The rationale for including these individuals is that reduction in kidney function to this level or lower represents loss of half or more of normal kidney function, which may be associated with the development of cardiovascular disease.⁶

Study aimed to evaluate and correlate the Calcium and Phosphorus levels with the Parathyroid hormone in chronic kidney disease.

Objectives of the study was to gather and analyze data from chronic kidney disease patients to find out integrity of parathyroid hormone status and to find out the correlation between level of serum calcium, serum phosphorus, calcium x phosphorus product and serum parathyroid hormone in chronic kidney disease patients.

METHODS

Study was carried on patients of CKD admitted in Dhiraj General Hospital affiliated to S.B.K.S Medical Institute and Research Centre, Sumandeep Vidyapeeth.

Serum calcium and serum phosphorus levels are measured by Fully Automated Colorimetry and Parathyroid hormone is measured by FLIA-fluorescence linked immunoassay.

Normal values of Parathyroid hormone, Calcium, Phosphorus, Ca x P are 8.7-79.6 pg/ml, 8.8-10.2mg/dl, 2.1-5.6 mg/dl, 18.5-57.1 mg²/dl² respectively.

Inclusion criteria

- Patients include both sexes who fulfill the criteria for CKD and who are on conservative management.
- Criteria for Chronic Kidney Disease.
- Patients with symptoms of uremia for 3 months or more with elevated blood urea and serum creatinine and with ultrasound evidence of chronic kidney disease such as bilateral contracted kidneys with size less than 8 cm in male and female with poor

corticomedullary differentiation and type 2 or 3 renal parenchymal changes.

Exclusion criteria

Patients with thyroidectomy or parathyroidectomy, with low serum protein especially albumin and other conditions like recent surgery, trauma or burns and liver disease.

Statistical analysis

- Mean, median and mode of all parameters were determined.
- Standard deviation of all parameters were determined.
- Correlating studies were done to find out any possible significance.
- p value of <0.05 was considered significant.

RESULTS

Total 70 patients having CKD has been enrolled in the present study. Analysis of various parameters of participants having CKD is as follows.

Table 1 shows that there were 55.7% of participants having calcium level less than 8.8 and 44.3% of participants having calcium level between 8.8 - 10.2. There were 58.6% of participants having phosphorus level between 2.1 to 5.6 while 41.4% participants had more than 5.6. There were 27.1% of participants having PTH level from 8.7 - 79.6 and 72.9% having more than 79.6. The level of Ca x P product was 18.5 to 57.1 in 88.6% of participants and 11.4% had more than 57.1 level of Ca x P product.

Table 1: The frequency distribution of Ca, P, PTH and Ca x P levels.

Calcium level (mg/dl)	Frequency	Percent	Mean	Standard deviation
Less than 8.8	39	55.7	7.95	0.38
8.8 - 10.2	31	44.3	9.05	0.22
Total	70	100	8.45	0.6
Phosphorus Level(mg/dl)	Frequency	Percent	Mean	Standard deviation
2.1 - 5.6	41	58.6	4.46	0.6
> 5.6	29	41.4	6.1	0.5
Total	70	100	5.18	1
PTH Level(pg/ml)	Frequency	Percent	Mean	Standard deviation
8.7- 79.6	19	27.1	68.72	6.6
> 79.6	51	72.9	156.68	51
Total	70	100	131.2	59
Ca x P product Level(mg/dl) ²	Frequency	Percent	Mean	Standard deviation
18.5 - 57.1	62	88.6	42.2	8.4
> 57.1	8	11.4	61.01	4.67
Total	70	100	43.94	9.8

Table 2: Correlation between calcium, phosphorus, Ca x P and PTH.

	Calcium with phosphorus	Calcium with PTH	Phosphorus with PTH	Ca x P with PTH
Pearson correlation	0.220	-0.061	0.253	0.107
p value	0.008	0.054	0.035	0.380
N	70	70	70	70

Table 2 shows that the correlation between calcium and PTH is statistically insignificant in CKD patients. The correlation between the phosphorus and PTH is significant statistically and between Ca x P is very weak and statistically insignificant as the p value is more than 0.05.

DISCUSSION

Calcium, Phosphorus, Parathyroid hormone (PTH) and Calcium-Phosphorus product are the important investigations in the patients of CKD.

In this study, 44.3% patients of CKD had normal and 55.7% reduced calcium levels. Mean value of serum calcium in all the patients was 8.45 ± 2.1 mg/dl and in patients with hypocalcemia, mean value of serum calcium was 7.95 ± 0.38 mg/dl. In a similar study of 80 patients conducted by Shamala HM et al, the mean value of serum calcium in patients of CKD was 8.5 ± 0.90 mg/dl. In another study of 526 patients by Tayebah Soleymanian et al, mean value of serum calcium in all the patients was 8.87 ± 0.73 mg/dl.⁷ This shows the prevalence of hypocalcemia in CKD patients.

In present study, 58.6% patients of CKD had normal phosphorus levels and 41.4% had increased phosphorus levels. Mean value of serum phosphorus in CKD patients was 5.18 ± 1 mg/dl and in patients with hyperphosphatemia mean value of serum phosphorus was 6.1 ± 0.5 mg/dl. In a similar study conducted by Tayebah Soleymanian et al, mean value of serum phosphorus in all CKD patients was 5.5 ± 1.3 mg/dl.⁷ In another study of 80 patients by Shamala HM et al, mean value of serum phosphorus in CKD patients was 6.60 ± 1.4 mg/dl. This indicates the prevalence of hypophosphatemia in CKD patients.

Parathyroid hormone status

In this study 27.1% patients had normal parathyroid hormone levels and 72.9% patients had increased parathyroid hormone levels. In a similar study of 60 patients conducted by Rajeshwari S. Vhora et al, 96% of the patients showed increased parathyroid hormone levels.⁸ Mean value of parathyroid hormone in all patients of CKD was 131.2 ± 59 pg/ml and mean value in patients with hyperparathyroidism was 156.68 ± 51 pg/ml. In a similar study conducted by Luca De Nicola et al,

mean value of serum parathyroid hormone in CKD patients was 102 pg/ml.⁹ In another study conducted by Rajeshwari S. Vhora et al, mean value of serum parathyroid hormone in patients of secondary hyperparathyroidism was 162 ± 37 pg/ml.⁸ This indicates secondary hyperparathyroidism is very common in CKD patients.

Ca x P levels

In this study, 88.6% patients of CKD had normal Ca x P product levels and only 11% of the patients showed increased Ca x P levels. In a similar study conducted in by Eric W. Young et al, 56.6% showed normal Ca x P product levels in group 1 and 61.4% patients showed normal Ca x P levels in group 2.¹⁰ This indicates Ca x P product levels are not much affected in CKD patients.

Correlation of mean between Ca x P product and PTH in CKD patients is statistically insignificant as p-value is greater than 0.05. The correlation of mean between calcium and PTH in CKD patients is statistically insignificant as p-value is not less than 0.05.

The correlation of mean between phosphorus and PTH in CKD patients is statistically significant and positive as the p-value is less than 0.05 which indicates that phosphorus increases with increase in parathyroid hormone levels in CKD patients.

The correlation of mean between Calcium and phosphorus is statistically significant and negative as p-value is less than 0.05 which indicates that with increase in phosphorus levels, there is decrease in calcium levels.

In a similar study by Shamala HM et al, the correlation between the PTH with serum calcium among CKD patients was statistically insignificant. There was positive correlation between serum PTH and serum phosphorus which denotes that the increase in serum phosphorus leads to the increase of PTH levels among patients of CKD.

Data published before suggests that the correlation between the PTH with serum calcium among patients statistically insignificant. There was significant correlation present between serum PTH and serum phosphorus in CKD patients.

CONCLUSION

The correlation between the phosphorus and PTH in CKD patients was statistically significant indicating that with increase in the level of phosphorus the level of PTH also increases. However, the correlation between Ca x P with PTH in CKD patients was very weak and statistically not significant and there was no correlation between calcium and PTH in CKD patients.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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