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A HOSPITAL BASED COMPARATIVE STUDY OF METABOLIC BONE MARKERS IN DIABETIC AND NON DIABETIC CHRONIC KIDNEY DISEASES IN A TERTIARY CARE HOSPITAL

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Abstract

Introduction: Chronic kidney disease (CKD) is an important public health issue with its incidence varying between 5-10% of population. Bone and mineral disorders constitute an important factor in morbidity and mortality of elderly CKD patients Bone and mineral metabolism differ in younger and older individuals due to their differences in dietary habits leading to lower protein, phosphorus and calcium intake in older patients. Elderly patients also have lower physical activity and bone turnover.

Materials and Methods: The study was a hospital based cross-sectional study done among patients attending the Department of biochemistry, AIIMS, Patna, from March 2020 to March 2022. A total of 300 patients were included in the study to increase the sensitivity of the study. On admission, data regarding the baseline characteristics of each patient Age, Sex, history of DM, duration of haemodialysis was collected. The patients were grouped according to diabetic status (diabetic or non-diabetic). Venous blood samples were drawn from the patient before the start of haemodialysis for the estimation of the various biochemical parameters in metabolic bone disease. Estimation of serum FBS, creatinine, calcium, phosphorus and ALP was done.

Results: The mean age of the study population was found to be 50.21 ± 12.80 years. The mean age of the male study subjects was 52.45 ± 11.73 years, and that of the female study subjects was 45.65 ± 13.97 years. The number of male and females were found to be 204 (68 %) and 96 (32 %) respectively. The characteristics of the study population are described in Table 1. Among the 300 CHD study subjects, there were 134 diabetics and 166 non-diabetic patients. The prevalence of DM among CHD patients was found to be 44.70 %.

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Conclusion: The serum levels of PTH and phosphorus were found to be significantly lower in diabetic CHD patients than in their non-diabetic counterparts. Serum ALP levels were significantly higher in the diabetics. This demonstrates that a relative hypoparathyroidism is prevalent among the diabetic CHD patients and hence, prevention of deterioration of the already existing low turnover bone disease in such patients should be the treatment motto. Avoidance of oral calcium supplements, vitamin D supplements and increased calcium in the dialysate would be ideal, since these can lead to hypercalcemia and further suppress the PTH secretion.

Key Words: Chronic kidney disease, serum FBS, creatinine, calcium, phosphorus and ALP.

INTRODUCTION

Chronic kidney disease (CKD) is an important public health issue with its incidence varying between 5-10% of population.[1] Bone and mineral disorders constitute an important factor in morbidity and mortality of elderly CKD patients Bone and mineral metabolism differ in younger and older individuals due to their differences in dietary habits leading to lower protein, phosphorus and calcium intake in older patients. Elderly patients also have lower physical activity and bone turnover.[2]

Evaluation of bone health is required for correctly predicting risk of fracture, for appropriate management of abnormal mineral metabolism, and for making decision regarding treatment of osteoporosis including type of therapy required. Many of the processes involved in the initiation and continuation of the derangements of bone and mineral metabolism have been identified and are being successfully utilized in clinical management of these patients.[3]

As elderly patients with CKD have age related bone loss similar to general population and in addition to that they have mineral and bone disorders secondary to reduced renal function resulting in bone disease where traditional approach for management of bone health alone are not sufficient. With the increasing average age of population and ever increasing prevalence of CKD in the elderly, a detailed understanding of these processes is essential for making better treatment choices available for these patients.[4]

Diabetes mellitus (DM), one of the most common chronic metabolic diseases, has been on the increase worldwide and in India. This can be attributed to the increasing obesity and sedentary lifestyle which have now become the most important risk factors associated with DM. It has been noted in studies that DM is one of the two leading causes of CKD in India.[5] In CKD, hyperphosphatemia is encountered with due to the decreased excretion of phosphorus by the kidneys. Also, inadequate production of the active form of vitamin D by the kidney results in decreased levels of serum calcium. Both these factors together cause hyper secretion of PTH in an attempt to normalize the levels of serum calcium and serum phosphorus. Alkaline phosphatase (ALP) levels are also found to be increased in CKD due to the high bone turnover state induced by PTH over activity. However, it has been demonstrated in various studies that

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diabetic CKD patients on regular haemodialysis have an impaired secretion of PTH when compared to the non-diabetics on haemodialysis.[6] There have been very few studies conducted concerning this subject in India. Hence, this study is being done to prove a relation between DM with serum PTH, calcium, phosphorus and ALP in CHD patients attending the Dialysis Unit of Department of biochemistry, ESIC Medical College, Bihta, Patna.

MATERIALS AND METHODS

The study was a hospital based cross-sectional study done among patients attending the Department of biochemistry, AIIMS, Patna, from March 2020 to March 2022.

A total of 300 patients were included in the study to increase the sensitivity of the study.

Inclusion Criteria: CKD patients irrespective of cause, aged between 18-80 yrs, undergoing haemodialysis > 3 months.

Exclusion Criteria: Subjects diagnosed with primary hyperparathyroidism and those with liver disease.

On admission, data regarding the baseline characteristics of each patient - Age, Sex, history of DM, duration of haemodialysis was collected. The patients were grouped according to diabetic status (diabetic or non-diabetic). Venous blood samples were drawn from the patient before the start of haemodialysis for the estimation of the various biochemical parameters in metabolic bone disease. Estimation of serum FBS, creatinine, calcium, phosphorus and ALP was done using clinical chemistry autoanalysers by Beckman coulter and estimation of PTH in the serum sample was done by siemens.

All the data collected was coded and analysed using SPSS 18.0 statistical software. The frequency distribution and descriptive statistics of the study population was done. The quantitative variables were presented as mean ±standard deviation (SD). The qualitative variables were expressed in percentage. Comparison of the means of serum PTH, calcium, phosphorus, ALP and magnesium among diabetic and non-diabetic CHD patients was done using Student's t-test. Comparison of the means of serum PTH, calcium, phosphorus, and ALP among the different age categories was done using one-way analysis of variance (ANOVA). All the tests were 2-tailed and taken to be statistically significant if p value < 0.05.

Statistical Analysis: All the data collected was coded and analyzed using SPSS 18.0 statistical software. Comparison of the means of serum PTH, calcium, phosphorus and ALP among diabetic and nondiabetic CHD patients was done using Student's t-test.

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RESULTS

The mean age of the study population was found to be 50.21 ± 12.80 years. The mean age of the male study subjects was 52.45 ± 11.73 years, and that of the female study subjects was 45.65 ± 13.97 years. The number of male and females were found to be 204 (68 %) and 96 (32 %) respectively. The characteristics of the study population are described in Table 1.

Parameter	Mean ± SD	Minimum	Maximum
Age (Years)	50.21±12.80	23	77
Duration of haemodialysis (years)	3.56±1.76	1	8
Creatinine (mg / dL)	8.70 ± 2.72	3	16.5
Fasting blood sugar (mg / dL)	98.67 ± 28.56	62	170
Parathyroid hormone (pg / mL)	356.25 ± 222.41	46	830
Calcium (mg / dL)	7.90 ± 0.81	5	11
Phosphorus (mg / dL)	5.02 ± 1.45	1.7	8.2
Alkaline phosphatase (U / L)	280.32 ± 202.45	45	1045

Table 1: Patient characteristics

Among the 300 CHD study subjects, there were 134 diabetics and 166 non-diabetic patients. The prevalence of DM among CHD patients was found to be 44.70 %.

Aetiology of CKD	Percentage
Diabetes Mellitus	44.6
Non-Diabetes Mellitus	55.4

Table 2: Prevalence of Diabetes and Non-Diabetes in Chronic Kidney Disease

	Male	Female
Diabetes Mellitus	71.64	65.06
Non-Diabetes Mellitus	28.36	34.94

Table 3: Gender Distribution among Diabetics and Non-Diabetics

Parameter	Diabetics (n=134) Mean ± SD	Non-Diabetics (n=166) Mean ± SD	P Value
Parathyroid hormone (pg / mL)	146.57 ± 50.12	527.12 ± 148.17	0.001
Calcium (mg / dL)	7.80 ± 0.80	7.99 ± 0.76	0.256
Phosphorus (mg / dL)	4.53 ± 1.57	5.45 ± 1.28	0.001
Alkaline phosphatase (U / L)	344.51 ± 224.12	230 ± 167.12	0.001

Table 4: Serum Metabolic Bone Disease Markers in Diabetic and Non-Diabetic CHD Patients

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The mean levels of serum phosphorus and PTH are significantly lower in the diabetic CHD population than in the non-diabetics, but mean serum ALP is significantly higher in the diabetic CHD patients. Statistical significance is seen in the serum metabolic bone disease markers except calcium among diabetic and non-diabetic chronic kidney disease.

DISCUSSION

It has been estimated that there are around 55,000 patients who are on dialysis in India. This population is growing at an alarming trend of 10-20 % annually. DM, HTN, autoimmune disease, old age, previous episode of acute kidney injury and family history of renal disease are some of the risk factors predisposing to CKD. Data collected from around the world, between 1990 and 2002, showed that DM and HTN alone accounted for the majority of kidney failure cases (44.6 % due to DM and 26.9 % due to HTN).[7]

It has been seen in studies that the aetiological spectrum of primary disease among CKD patients in India comprise of DM (41 %), HTN (22 %), chronic glomerulonephritis (16 %), chronic interstitial disease (5.4 %), ischaemic nephropathy (5.4 %), obstructive uropathy (2.7%), miscellaneous (2.7 %) and other unknown causes (5.4 %). Variations have been observed from region-to-region in this distribution pattern. Nevertheless, it has now been reported that DM and HTN account for about 40-60% of CKD cases in India, with diabetic nephropathy emerging as the major cause.[8]

The mean serum total ALP level among the study subjects was found to be above the cut-off of the target range (> 128 U / L). Both the diabetic and non-diabetics had mean ALP values above the target range.[9] It was noted that there was a statistical significance in the serum ALP levels among diabetic and non-diabetic CHD patients. This could be explained by the increased bone turnover seen in CKDMBD. This is similar to the findings seen in a study done by Nasri H et al.[10]

From the above observations, it can be inferred that statistical significance was noted in the serum levels of PTH, Phosphorus and ALP among diabetic and non-diabetic CHD patients. Thus it can be said that a relative hypoparathyroidism is more prevalent among diabetic CHD patients that could manifest as a dynamic bone disease. Care should be taken while treating diabetic CHD patients with bone disease. Oral calcium supplements, vitamin D supplements and increased calcium in the dialysate should be avoided since they can lead to hypercalcemia. This can further suppress the PTH secretion and result in aggravation of the already existing low turnover bone disease in such patients.[11]

CONCLUSION

The serum levels of PTH and phosphorus were found to be significantly lower in diabetic CHD patients than in their non-diabetic counterparts. Serum ALP levels were significantly higher in

the diabetics. This demonstrates that a relative hypoparathyroidism is prevalent among the diabetic CHD patients and so care should be taken while treating such patients. Prevention of deterioration of the already existing low turnover bone disease in such patients should be the treatment motto. Avoidance of oral calcium supplements, vitamin D supplements and increased calcium in the dialysate would be ideal, since these can lead to hypercalcemia and further suppress the PTH secretion.

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