Internal Medicine

Prevalence and Severity of Mineral Bone Disorders in Chronic Kidney Disease Patients

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ABSTRACT

Background: Bone abnormalities are frequently developed in hemodialysis patients and people with chronic kidney disease (CKD). It results from aberrant bone turnover and a decline in bone mineral density (BMD).

Aim of the work: With the help of dual energy X-ray absorptiometry in this study, poor bone mineral density in CKD patients at Al-Hussein University Hospital will be analysed for prevalence and severity.

Patients and Methods: This Cross-Sectional research included 120 Patients (2 groups) 60 CKD Patients and 60 Hemodialysis Patients. The study has been conducted in Nephrology Unit Al-Hussien University Hospital.

Result: In ESRD group there was Significant statistically (p-value = 0.008) T score femur and eGFR had a positive connection (r = 0.34). Significant statistically (p-value = 0.008) There is an r-value of 0.34 between the T score of the spine and the eGFR. While in CKD group significantly significant (p-value = 0.001) differences. T score femur and Creat have a negative connection (r = -0.41) with each other. Significant statistically (p-value = 0.001) T score femur and eGFR had a positive connection (r = 0.43). Significant statistically (p-value = 0.02) The T score forearm and the eGFR have a positive connection (r = 0.3).

Conclusion: MBD are common features among CKD patients especially in late stages leading to Osteoporosis and fractures. Dual Energy X- Ray (DXA) could be utilized as efficient method for detection of the level of bone affliction in CKD patients and is essential for bone loss monitoring.

Keywords: *Prevalence; mineral bone disorders; chronic kidney diseases.*

INTRODUCTION

A common health issue is chronic kidney disease, or CKD. If a person has renal illness or an eGFR of 60 ml/min/1.73 m2 for three months, they are said to have CKD. [1]

According to eGFR and albuminuria, the Kidney Disease Outcomes Quality Initiative (KDOQI) of the National Kidney Foundation advises classifying CKD into several stages. [2]

Patients with CKD, especially those in stages 3 to 5 frequently experience bone fractures.[3]

An imbalance in the metabolism of calcium, phosphorus, intact parathyroid hormone (iPTH), and vitamin D is one instance of a systemic condition known as CKD-MBD. Anomalies in bone turnover, mineralization, or strength are some other situations.[4]

They also include calcification of the vascular or soft tissues. In CKD stages 3a–5D, low bone mineral density (BMD) and a 1.5–2 times greater risk of fractures are seen. [5]

Dual-energy X-ray absorptiometry (DXA), the most accurate method for calculating BMD, is also a highly effective fracture likelihood predictor. 2009 saw the publication of the Kidney Disease Improving Global Outcomes (KDIGO) recommendations for routine BMD testing.[6]

In the meanwhile, these guidelines were modified in 2017 to allow for their application in determining the risk of fracture in CKD patients. [7]

The most recent recommendations show that CKD patients can benefit from BMD measuring and T-score screening for osteoporosis and osteopenia.[8]

Additionally, people receiving dialysis for chronic kidney illness frequently have bone disorders. [9]

It can cause severe issues with bone health, including fragility fractures. This results from aberrant bone turnover and a drop in BMD. The gold standard for identifying anomalies in bone turnover is a bone

biopsy. Only individuals with a history of fractures and those who have a high risk of fractures should have their BMD measured using dual-energy x-ray absorptiometry (DXA).[10]

PATIENTS AND METHODS

This cross-sectional research conducted in Al-Hussien University Hospital includes 120 patients with chronic kidney disease. Patients were classified into 2 groups Group (1) 60 patients stage 3 to stage 5, Group (2) 60 patient stage 5 on regular hemodialysis more than 6 months.

Methods: All patients in this study underwent the following; Full history taking including age, sex, fracture history menopausal status and medications induced osteoporosis, Full clinical examination, Labs include: Complete blood count and serum urea, creatinine, and calcium testing for the kidneys , albumin, phosphorus, HbA1c, Intact Para-thyroid hormone (iPTH), Imaging includes abdominal ultrasound and DEXA scan for assessment of radial, femoral, and lumbar spine BMD with severity of CKD and prevalence of osteopenia or osteoporosis among these groups. Estimated glomerular filtration rate (eGFR) is calculated using the MDRD GFR equation.

Inclusion Criteria: Patients who meeting criteria for diagnosis of CKD, age between 18 and 60 years. In dialysis Patients duration of HD more than 6 months.

Exclusion Criteria: Patients without CKD, Patients less than 18 years or more 60 years, Patients using drugs induced osteoporosis.

Ethics and patient consent: For every procedure that carried out, the patients' written informed permission has been acquired. All procedures were flow Al-Azhar University Ethical Commitee Regulation.

Statistical analysis Version 24 of the Statistical Program for Social Science (SPSS) was utilized to analyze the data. Both qualitative and quantitative data were reported utilizing frequency and % for quantitative data. The mean (average) is the middle value in a collection of discrete numbers; it is the sum of values divided by the total number of values. The measure of a collection of values' dispersion is the standard deviation (SD). As opposed to a higher SD, which suggests that the results are dispersed across a greater range, a lower SD implies that the values tend to be near to the established mean. Data correlation was done using the Pearson's correlation coefficient (r) test.

RESULTS

		ESRD (N = 60)	CKD (N = 60)	MW	P-value
WBCs (x10³/ul)	Mean	7.1	8.6	1254	0.004 S
	±SD	3.0	3.8		
Hb (g/dl)	Mean	9.9	9.7	1696	0.585 NS
	±SD	2.0	2.2		
PLT (x10³/ul)	Mean	224.7	257.9	1586	0.261 NS
	±SD	63.7	112.5		
Creat (mg/dl)	Mean	9.6	3.1	85	< 0.001 HS
	±SD	3.2	1.6		
Urea (mg/dl)	Mean	110.4	129.6	1768	0.867 NS
	±SD	58.9	85.3		
ALB (g/dl)	Mean	4.2	3.4	624	< 0.001 HS
	±SD	0.4	0.7		
Ca (mg/dl)	Mean	9.2	9.2	1605	0.305 NS
	±SD	2.5	1.0		
PO4 (mg/dl)	Mean	4.9	5.7	1408	0.04 S
	±SD	1.8	2.0		
Ca x PO4	Mean	44.6	52.7	1324	0.012 S
	±SD	18.8	19.5		
PTH (pg/ml)	Mean	417.6	277.1	1794	0.975 NS
	±SD	514.7	196.0		
HbA1C (%)	Mean	6.4	7.1	1360	0.021 S
	±SD	1.6	2.3		
eGFR	Mean	6.7	25.8	132	< 0.001 HS
	±SD	3.0	17.6		

Table 2: comparison between studied groups as regard studied laboratory data.

This table shows:

Statistically significant (p-value = 0.004) decreased WBCs in ESRD group (7.1 ± 3) when compared with CKD group (8.6 ± 3.8).

Highly statistical significant (p-value < 0.001) increased Creat in ESRD group (9.6 ± 3.2) when compared with CKD group (3.1 ± 1.6).

Highly statistical significant (p-value < 0.001) decreased ALB in CKD group (3.4 ± 0.7) when compared with ESRD group (4.2 ± 0.4).

Statistically significant (p-value = 0.04) decreased PO4 in ESRD group (4.9 ± 1.8) when compared with CKD group (5.7 ± 2.0).

Statistically significant (p-value = 0.012) decreased Ca X PO4 in ESRD group (44.6 ± 18.8) when compared with CKD group (52.7 ± 19.5).

Statistically significant (p-value = 0.021) increased HbA1C in CKD group (7.1 ± 2.3) when compared with ESRD group (6.4 ± 1.6).

Highly statistical significant (p-value < 0.001) decreased eGFR in CKD group (6.7 ± 3.0) when compared with CKD group (25.8 ± 17.6).

No statistical significant difference (p-value = 0.131) between studied groups (ESRD & CKD) as regard Hb, PLTs, urea, Ca and PTH.
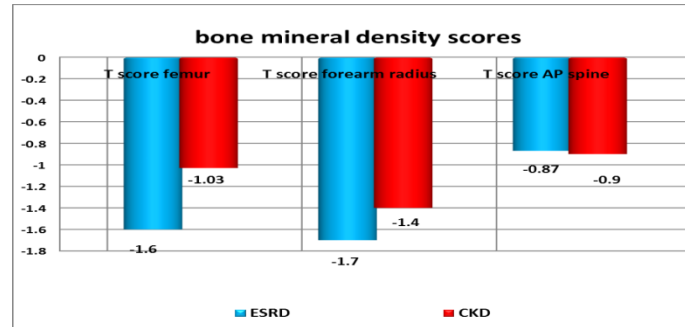

**Fig. 1:** comparison between studied groups as regard bone mineral density scores.

CKD group	T score femur		T score forearm		T score spine	
	R	p-value	R	p-value	R	p-value
Age	-0.33	0.01	-0.27	0.034	-0.18	0.176
Weight	0.33	0.01	0.24	0.061	0.35	0.005
Height	0.34	0.007	0.58	< 0.001	0.31	0.016
BMI	0.05	0.679	-0.15	0.266	0.08	0.565
WBCs	-0.06	0.641	0.01	0.93	-0.10	0.448
Hb	0.11	0.421	-0.04	0.788	-0.06	0.671
PLT	0.06	0.641	0.02	0.884	0.17	0.208
Creat	-0.41	0.001	-0.25	0.051	-0.16	0.216
Urea	0.21	0.1	0.32	0.012	0.25	0.059
ALB	0.47	< 0.001	0.38	0.003	0.44	< 0.001
Ca	-0.13	0.333	0.03	0.801	-0.35	0.007
PO4	0.06	0.638	0.17	0.188	-0.03	0.816
Ca X phos. product	0.04	0.763	0.19	0.145	-0.09	0.505
PTH	-0.14	0.283	0.01	0.913	-0.06	0.678
HbA1c	0.14	0.271	0.07	0.594	0.06	0.627
eGFR	0.43	0.001	0.30	0.02	0.20	0.128

Table 3: Correlation study between bone mineral density scores and other studied data in CKD group.

In this group there were:

Statistically significant (p-value = 0.01) Negative correlation (r = - 0.33) between T score femur and age.

Statistically significant (p-value = 0.01) Positive correlation (r = 0.33) between T score femur and weight.

Statistically significant (p-value = 0.007) Positive correlation (r = 0.34) between T score femur and height.

Statistically significant (p-value = 0.001) Negative correlation (r = - 0.41) between T score femur and creat.

Highly statistical significant (p-value < 0.001) Positive correlation (r = 0.47) between T score femur and ALB.

Statistically significant (p-value = 0.001) Positive correlation (r = 0.43) between T score femur and eGFR.

Statistically significant (p-value = 0.034) Negative correlation (r = - 0.27) between T score forearm and age.

Highly statistical significant (p-value < 0.001) Positive correlation (r = 0.58) between T score forearm and height.

Statistically significant (p-value = 0.012) Positive correlation (r = 0.32) between T score forearm and urea.

Statistically significant (p-value = 0.003) Positive correlation (r = 0.38) between T score forearm and ALB.

Statistically significant (p-value = 0.02) Positive correlation (r = 0.3) between T score forearm and eGFR.

Statistically significant (p-value = 0.005) Positive correlation (r = 0.35) between T score spine and weight.

Statistically significant (p-value = 0.016) Positive correlation (r = 0.31) between T score spine and height.

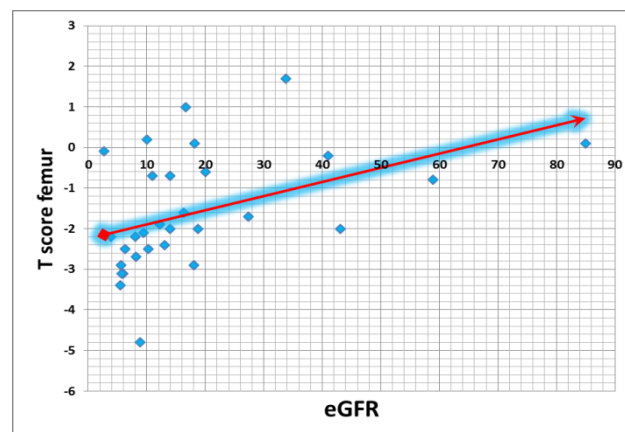Highly statistical significant (p-value < 0.001) Positive correlation (r = 0.44) between T-score spine and ALB.

Statistically significant (p-value = 0.007) Negative correlation (r = - 0.35) between T score spine and Ca.
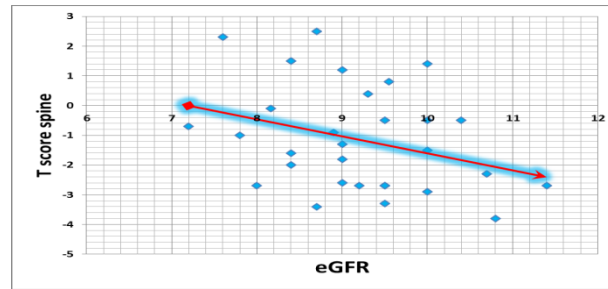
Fig. 4: Negative correlation between T score spine and eGFR in CKD group.
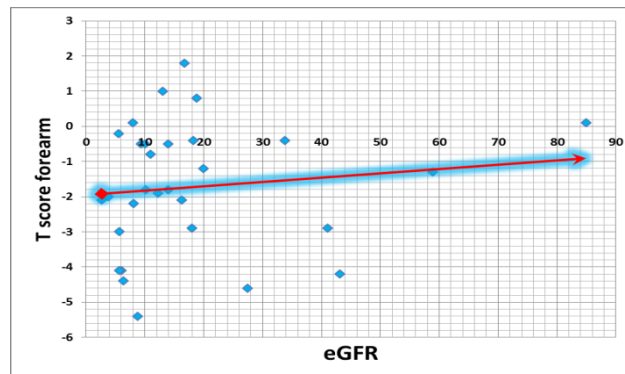
Fig. 5: Positive correlation between T score forearm and eGFR in CKD group.

Fig. 6: Positive correlation between T score femur and eGFR in CKD group.

DISCUSSION

A known risk factor for greater loss of bone mineral density and the development of osteoporosis is impaired renal function. [11]

According to the research, the prevalence of osteoporosis (OP) at the lumbar spine (LS) and the femoral site, respectively, ranges from 4 to 47% and 10 to 64%. [12]

In this study as regard ESRD group according to neck femur T-score, there were 18 normal cases, [30%], 17 osteoporotic cases [28.3%] and 25 cases with osteopenia [41.6%] while according to LS T-score, there were 31 normal cases [51.6%], osteoporosis in 12 cases [20%] and 17 cases with osteopenia [21.6%]

This came in according to polymeris et al., [13] who discovered that the LS had a prevalence of osteoporosis [T-score -2.5] of 14.3% and the femoral neck of 21.4%. Osteopenia [T score between -1 and -2.5] was observed in 32.1% of the same locations and 50% of cases, respectively. Osteoporosis is frequently found in individuals receiving hemodialysis, according to a more recent study by Slouma et al. [14] Among patients, osteoporosis affects 23% and osteopenia affects 45%. The current study's findings are in line with those of Avramovski et al., [12] who found that osteoporosis had a greater impact on the total hip (by 20%) than on the LS (by 9%).

However, Sit D et al., [15] who discovered that LS had the highest incidence of osteoporosis.

The prevalence of osteoporosis in pre-dialysis group is according to neck femur T-score, there were 30 normal cases, [50%], 16 osteoporotic cases [26.6%]

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and 14 cases with osteopenia [23.3%] while according to LS T-score, there were 30 normal cases [50%], osteoporosis in 18 cases [30%] and 12 cases with osteopenia [20%]. Also, according to forearm T score, there were 26 normal cases, [43.3%], 16 osteoporotic cases [26.6%] and 18 cases with osteopenia [30%] In support of this results some studies reported that osteoporosis begins to appear in the pre-dialysis period.[16]

According to our findings, CKD prevalence significantly reduces femoral BMD but not spine BMD. As the stage of CKD advances, osteoporosis (femoral site) is becoming more common in the pre-dialysis group. We discovered a statistically significant Positive association between the T score for the femur and the eGFR as well as the T score for the forearm. According to our study's coauthors Jin-Feng Huang et al., [17] In contrast to LS BMD, the prevalence of osteoporosis in FN exhibited a positive connection with the stage of CKD. Furthermore, there is a significant relationship between the stages of CKD, eGFR, and FN BMDs. Nickolas et al. [18] demonstrated that combining bone turnover markers (BTM) and BMD could improve the discriminatory power of DXA in patients with end-stage renal disease (ESRD). The T score of the femur and the eGFR exhibited a statistically significant positive connection in this investigation. among dialysis patients, between T score spine and eGFR. In keeping with this, Nickolas et al. [19] showed that eGFR and BMD loss are related. According to Myong et al., [20] Asian patients with CKD had BMD of the LS and FN that was strongly correlated with eGFR in stages 3 and 4. BMD was reported to decline in stages 3-5 in earlier research. [21] According to Chen et al., [22] patients with CKD had a spinal fracture prevalence that was comparable to that of the general population.

Our findings mostly corroborate this conclusion. In particular, we discovered that eGFR was not substantially correlated with LS BMD but was independently connected with FN, forearm, and CKD. The majority of earlier investigations have found that patients with CKD have lower BMDs. In conjunction with CKD, serum calcium, phosphate, and parathyroid hormone are frequently utilised as substitute indicators of high- or low-turnover bone disease. [23]

Secondary hyperparathyroidism caused BMD loss in CKD and ESRD patients[24]. Despite the fact that this analysis found a negative correlation between the various T score traits and serum calcium, phosphorus, and parathyroid hormone, the correlation did not reach a statistically significant level. PTH levels and BMD loss have been linked, however the results are inconsistent and mostly come from dialysis patients. The findings of Li Z concurred with those of Urena et al. [25], who discovered a negative correlation between iPTH and BMD in HD patients. Lower BMD was linked to the presence of advanced secondary higher serum PTH levels. [26]

In a similar setting, Polymers et al., [13] demonstrated that LS and femoral neck Z score strongly linked negatively with serum PTH. Higher PTH levels were linked to a higher risk of BMD loss, according to

Jadoul et al. Other investigations have demonstrated a correlation between lower GFR values and higher PTH levels and worse BMD across all locations. [28]

Ersoy et al., [29] on the other hand, showed that there was no correlation between PTH levels and any of the BMD indicators. Higher PTH levels and BMD assays showed no significant correlation, according to Fidan et al., [30].

This current study also agreed with Sit et al., [15] who demonstrated that BMD and BTM did not exhibit a statistically significant association

CONCLUSION

MBD are common features among CKD patients especially in late stages leading to Osteoporosis and fractures. Dual Energy X- Ray (DXA) could be utilized as efficient method for detection of the level of bone affliction in CKD patients and is essential for bone loss monitoring.

Conflict of interest : none

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