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ORIGINAL ARTICLE

Prevalence of Bone Mineral Disorder in Hemodialysis patients: A Single Centered Study of Local Population

AZHAR NASIM[1], ZAHID RAFIQUE[2], ALI TALAL[1], AURANGZEB AFZAL[3], ASMARA ASRAR[4]
[1]*Senior Registrar Nephrology, Department of Nephrology, Services Hospital, Lahore*
[2]*Associate Professor & Head of Department of Nephrology, Services Institute of Medical Sciences, Services Hospital Lahore*
[3]*Assistant Professor of Nephrology, Department of Nephrology, Services Institute of Medical Sciences, Services Hospital, Lahore*
[4]*Consultant Nephrologist, Department of Nephrology, Services Hospital, Lahore*
Correspondence to Dr. Zahid Rafique, Email: drzahid33@yahoo.com

ABSTRACT

Background: Mineral homeostasis deteriorates when kidney function diminishes, manifesting as variations in blood and tissue levels of calcium and phosphate, followed by the change in circulating parathyroid hormone (PTH). Mineral bone disorders (MBD) are a clinical illness caused by chronic renal disease that expresses as a systemic impairment of mineral and bone metabolism.
Aim: To find out prevalence of bone mineral disorders in hemodialysis patients presenting in Nephrology Ward, SIMS. Lahore
Methodology: This observational analysis included a total of 88 patients, who were on dialysis at the nephrology department of SHL for the period of more than six months. The study was conducted from 17 September 2021 to 10 March 2022 after the approval of the ethical review board of the Department. According to their blood PTH levels, the patients were split into three groups: those with PTH levels less than 150 pg/ml (low bone turnover), those with PTH levels between 150 and 300 pg/ml (normal bone turnover), and those with PTH levels greater than 300 pg/ml (high bone turnover).
Results: The prevalence of bone mineral disorder was 87.5% in hemodialysis patients presenting at the nephrology department, in which prevalence of high turnover bone disorder was 73.9% whereas the prevalence of low turnover bone disorder was 13.6%. In the early dialysis period (0.5-5 years) the prevalence of bone mineral disorders was more prominent as compared to the patients on dialysis for more than 5 years.
Conclusion: There was a high prevalence of bone mineral disorders, in which patients with high turnover were found to be more prevalent. Similarly, patients in the early years of dialysis are more prone to develop bone mineral disorders. Thus, we should keep these findings in mind while doing the follow up and adjust the medication accordingly.
Keywords: Bone Mineral Disorders, Low Turnover Bone Disorders, Hyper Para Thyroid Disorder, Prevalence of Disease

INTRODUCTION

Chronic kidney disease (CKD) is characterized by a gradual decline of renal function over months or years. Mineral homeostasis degrades when renal function decreases, resulting in variations in serum and tissue concentrations of phosphorus and calcium (Ca) [1]. Change in calcium levels is followed by the altered concentration of parathyroid hormone (PTH). Both early bone development during growth (bone modelling) and bone shape and function during maturity are regulated by these mineral and endocrine processes, a process also known as bone remodeling [2].

Mineral bone disease is a clinical disease linked to CKD defined by abnormalities of calcium, phosphorus, PTH and vitamin D metabolism. This also included anomalies in bone turnover, mineralization, linear development, and strength [3,4].

Renal insufficiency–associated with secondary hyperparathyroidism including phosphorus retention (hyperphosphatemia) as renal glomerular filtration rate decreases, as well as a decrease in calcitriol levels as metabolically active renal mass decreases, are the major factors in the pathogenesis of CKD mineral bone disorder [5,6].

The renal bone disease affects 33.3% of dialysis patients in Egypt, according to a nationwide study[7]. A study of renal bone disease in uremic patients in Poland found that 27% of the children had the adynamic bone disease, 37% had normal bone histology, 2% had osteomalacia, and 10% had mixed lesions, and 24% had hyperparathyroidism. Children on continuous ambulatory peritoneal dialysis (CAPD) and hemodialysis (HD) had the same prevalence[8]. Renal bone damage was shown to be prevalent in 57% of uremia patients in the Czech Republic[9]. In Thailand, 41.1% had adynamic bone disease, 28.6% had hyperparathyroidism, 19.6% had a mixed type, 5.4% had a moderate lesion, 3.6% had osteomalacia, and 1.8% had osteosclerosis[10].

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According to 1209 bone biopsies from five different countries in Ibero America. low turnover osteomalacia and mixed uremic osteodystrophy were found to be more frequent in Brazil, Uruguay, and Argentina as compared to Portugal and Spain. whereas the predominant hyper-parathyroid bone conditions were most common in Portugal and Spain. Renal bone disease was found in 24.4% of people in skeletal research in Singapore[11]. The most common bone disease with chronic renal failure undergoing continuous ambulatory peritoneal dialysis in Turkey was high turnover renal osteodystrophy (47%) followed by low turnover bone disease (29%) and mixed renal osteodystrophy (3%)[12]. Extra-skeletal calcification has recently been a topic of concern due to CKD's irregular mineral and bone metabolism, as well as the treatments utilized to repair these abnormalities. Despite the significant frequency of mineral bone disorders (MBDs) in CKD patients, evidence on MBD in Pakistani CKD patients is scarce.

The objective of current analysis is to find out the prevalence of bone mineral disorder in local population on hemodialysis.

METHODOLOGY

This study was conducted at the Nephrology department of services, hospital Lahore from 17 September 2021 to 10 March 2022 A total of eighty-eight participants were included. This study was approved by the ethical committee of the nephrology unit of Services Hospital Lahore. Patients of age ranging from 18 years to 60 years who were on hemodialysis for more than 6 months were included. Both male and female gender was recruited for the study, whereas the patients suffering from an acute infection, malignant condition, hypo or hyperthyroid diseases and recent onset of ischemic heart disease were excluded from the study. That variable such as age, gender, duration of dialysis, parathyroid hormone, and calcium and phosphorous levels were recorded from the medical record of the patients. MBD was diagnosed in the study, subjects using MBD-related laboratory markers such as PTH, Ca, phosphorus, and alkaline phosphatase levels in the blood. According to their blood PTH levels, the patients were split

into three groups: those with PTH levels less than 150 pg/ml (low bone turnover), those with PTH levels between 150 and 300 pg/ml (normal bone turnover), and those with PTH levels greater than 300pg/ml (high bone turnover). The continuous data were presented as mean and standard deviation while frequencies were used for categorical data. We considered a p-value less than 0.05 statistically significant by using software SPSS version 25.

RESULTS

The research involved a total of 88 patients. The prevalence of bone mineral disorder was determined to be 87.5% in our data set, with high turnover bone disorder being 73.9% and low turnover bone disorder being 13.6% (Fig. 1). The participants' mean age was 44.3 years, with a standard deviation of 14.6 years and 54.5% of them were men.

The maximum number of low turnover was seen in patients having age greater than 50 years, and high turnover bone disorder in the age group 31 to 50 years. Females are more prevalent in low turnover MBD, and males were more prevalent in High turnover MBD. Patients having a Middle socioeconomic status were more in number both in high and low MBD. Similarly, the patients are more prone to have bone mineral disorder in the initial years of the start of their dialysis (Table 1). Low calcium levels were found in 33% of low turnover bone disorders in patients on hemodialysis and 89.2% of patients having elevated phosphate levels in high turnover bone disorders (Fig. 2).

Fig. 1: Distribution of bone mineral disorders

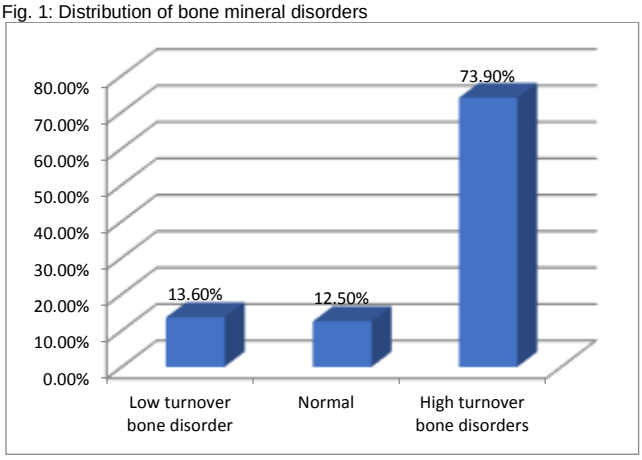

Fig. 2

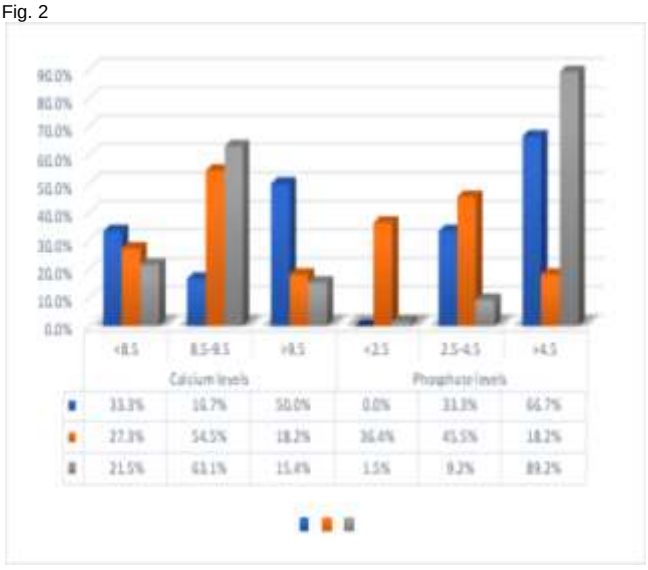

Table 1: Distribution of Age, Gender, Socio-economic status and Duration of dialysis among different types of Bone mineral disorders:

		Bone mineral disorders		
		Low BMD =12	Normal =11	High BMD=65
Age (Years)	15-30	3 (25.0%)	3 (27.3%)	15 (23.1%)
	31-50	4 (33.3%)	4 (36.4%)	27 (41.5%)
	> 50	5 (41.7%)	4 (36.4%)	23 (35.4%)
Gender	Male	5 (41.7%)	6 (54.5%)	37 (56.9%)
	Female	7 (58.3%)	5 (45.5%)	28 (43.1%)
Socio-economic status	Low	2 (16.7%)	3 (27.3%)	28 (43.1%)
	Middle	8 (66.7%)	7 (63.6%)	33 (50.8%)
	High	2 (16.7%)	1 (9.1%)	4 (6.2%)
Duration of dialysis (Years)	0.5-5	8 (66.7%)	8 (72.7%)	44 (67.7%)
	5.1-10	2 (16.7%)	3 (27.3%)	12 (18.5%)
	> 10	2 (16.7%)	0 (0.0%)	9 (13.8%)

DISCUSSION

The kind and type of renal bone disease differ from one patient to the next, and numerous variables may be to blame[13]. High turnover hyperparathyroidism and low turnover bone abnormalities are the two most common bone diseases in people with CKD. The amount of PTH in the blood is thought to be a good screening tool for separating these two disorders[14]. Despite being the gold standard for diagnosing renal bone disease, bone biopsy has been phased out in clinical practice due to its invasive nature, high expense, and general complexity[15,16]. As a result, bone turnover serum markers have been used to monitor bone turnover in people with chronic renal disease (CKD)[17]. As a result, blood PTH level has risen to the top of the list of noninvasive methods for detecting renal bone disease. For patients with stage 5 CKD, the K/DOQI recommendations stated that PTH should be maintained in a target range of 150 to 300 pg/ml[18]. According to the laboratory criteria utilized in this investigation, 65(73.9%) patients had hyper parathyroid bone disease (PTH >300pg/ml) and 12(13.6%) patients had the low turnover bone disease (PTH 150 pg/ml), for a total prevalence of 87.5% among our patients.

Incomparable research conducted in Libya by 28.1% of patients exhibited laboratory evidence of hyper parathyroid bone disease, whereas 27% had the low turnover bone disease, resulting in a total incidence of renal osteodystrophy of 55.3%[19]. Hyperparathyroidism was identified in 39.4% of individuals with CKD stage 5 according to Agarwal [20]. In an Indian investigation, Jabbar et al. reported hyperparathyroidism in 60% of their CKD stage 4 and 5 patients, utilizing an PTH threshold of more than 300 pg/ml for both stages[21]. In 2013 Indian research, Jabbar et al. found that 61% of patients had hyperparathyroidism [22]. Sanusi et al. found that 11.8% of patients with ESRD had secondary hyperparathyroidism in Ile-Ife, Nigeria[23]. Seck et al. discovered that 57 patients (out of a total of 118) had the high turnover disease (secondary hyperparathyroidism) and 22 cases had a low turnover bone disease in Senegal[22].

Hypocalcemia and hyperphosphatemia were found in 21.6 and 77.3% of the patients in this study, respectively when considered total study population. Study from different population showed different results. The University of Benin Teaching Hospital in Nigeria, where Onyemekeihia discovered hypocalcemia and hyperphosphatemia in 71 and 79% of chronic renal failure patients, respectively[22]. Sanusi et al. found hypocalcemia and hyperphosphatemia in 59.3% and 75% of ESRD patients, respectively, in Ilelfe, Nigeria[22]. Hypocalcemia was found in 49.6% of patients with CKD stage 5 while hyperphosphatemia was found in 41.8%, according to Agarwal[19].

Hypocalcemia was identified in 28% of patients with CKD stage 5 and hyperphosphatemia in 50%, according to LaClair et al. [24]. In comparison to Agarwal's data from India, the Western data indicated a lower frequency of hypocalcemia, although both exhibited a significant prevalence of hyperphosphatemia in CKD stage 5. In comparison to Agarwal's findings, our study found a substantially greater prevalence of hypocalcemia and hyperphosphatemia. Valson et al., found that 66.3% of people

were hypocalcemic and 59% were hyperphosphatemic [25]. Our study had some limitations a well. Bone biopsy was not performed to evaluate anomalies in bone turnover, mineralization, volume, linear growth, or strength. In the absence of a bone sample, classification of bone disease is at best speculative. As a result, it would be preferable to describe the biochemical aspects of MBDs in the context of bone biopsy findings.

CONCLUSION

There was a high prevalence of bone mineral disorders, in which patients with high turnover were found to be more prevalent. Similarly, patients in the early years of dialysis are more prone to develop bone mineral disorders. Thus, we should keep these findings in mind while doing the follow up and adjust the medication accordingly.

Conflict of interest: Nil

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