DOI: https://doi.org/10.53350/pjmhs20221611555

ORIGINAL ARTICLE

Prevalence of Adynamic Bone Disease among Hemodialysis Patients

MAZHARULHAQ[1], TALEAH TAHIR[2], AIMAL KHAN[3]
[1]*Assistant Professor Nephrology, Institute of Kidney Diseases Hayatabad, Peshawar*
[2]*Registrar Nephrology, Fauji Foundation Hospital, Rawalpindi*
[3]*Assistant Professor Nephrology, Northwest General hospital, Peshawar*
Corresponding author: Taleah Tahir, Email: taleah.tahir@gmail.com

ABSTRACT

Objective: Aim of current study is to determine the association of adynamic bone disease among patients of hemodialysis.
Study Design: Cross sectional
Place and Duration: Institute of Kidney Diseases Hayatabad Peshawar during the period from January 2021 to June 2021.
Methods: There were 82 patients of both genders had chronic kidney disease were presented. Patients on maintenance HD had their treatments administered by a Fresenius machine 4008S connected to a polysulfone membrane dialyzer and a dialysate solution comprising 32 mmol/L of bicarbonate and 1.75 mmol/L of calcium. All of the patients in the study had been on dialysis for over a year, and none of them had any signs of acute sickness or active liver disease. SPSS 22.0 was used to analyze all data.
Results: Mean age of the patients was 43.4±8.26 years and had mean BMI 22.4±6.30 kg/m^2. There were 48 (58.5%) males and 34 (41.5%) females. Mean duration of hemodialysis was 4.6±5.19 years. Frequency of DM was found in 24 (29.3%) cases. Frequency of vitamin D therapy was found in 55 (67.1%) cases. We found that 29 (35.4%) patients had adynamic bone disease and 21 (25.6%) cases had hyperparathyroidism. Significantly higher number of patients had bone pain among all cases.
Conclusion: We concluded in this study that the prevalence of adynamic bone disease was 35.4%. Among patients of ABD most were ages between 25-45 years and were males with severe bone pain.
Keywords: Hemodialysis, Diabetes Mellitus, Adynamic Bone Disease, Hyperparathyroidism

INTRODUCTION

Deterioration in kidney function over a protracted period of time is known as chronic kidney disease (CKD). As kidney function declines, those with chronic renal illness have a worsening of mineral homeostasis, namely of serum and tissue levels of calcium and phosphorus (Ca), in addition to circulating hormone levels like parathyroid hormone (PTH). These minerals and endocrine processes closely govern the formation of bone throughout development (bone modeling) and the preservation of bone structure and function in maturity (bone remodelling) [1].

Bone pain, fractures, bone deformities, myopathy, tendon rupture, and growth retardation are all symptoms that may arise from metabolic disturbances, and there is a growing body of data linking these conditions to an increase in mortality and morbidity. Long-term impacts on calcification of soft tissues may also result from these metabolic disturbances and/or their treatments. [2,3]

Bone biopsy with histomorphometric analysis is the gold standard for diagnosing the skeletal pathology associated with CKD.[2,3] The use of this diagnostic equipment calls for the expertise of skilled individuals. Unfortunately, our hospital is typical of the many others that lack sufficient numbers of appropriately qualified staff members. As a result, doctors can only detect bone illness and identify its form by indirect ways. [2]

Evidence suggests that determining parathyroid glands (PTH) levels can aid in the diagnosis of low and high turnover bone diseases. A meta-analysis [2] of PTH for the diagnosis of kidney and liver bone disease found that a lower PTH threshold level of 150-200 pg/ml has a responsiveness of 93% and a specificity of 77% for diagnosing hyper parathyroid bone disease, whereas an upper PTH threshold level of 60 pg/ml has a sensitivity of 70% as well as a specificity of 87% for diagnosing adynamic bone disease (ABD). Research by Qi et al. demonstrated that PTH levels over 450 pg/ml are significantly selected for increased turnover bone disease. [4].

One third, or 33.3%, of Egyptian dialysis patients suffer from renal bone disease, according to a recent countrywide survey [4-7]. Two-and-a-half percent of the children studied in a Polish investigation of renal bone disease in uremic patients had adynamic bone disease; thirty-seven percent had normal bone histology; two percent had osteomalacia; ten percent had mixed lesions; and twenty-four percent had hyperparathyroidism. The incidence rate of both CAPD and HD in children was identical [8]. In the Czech Republic, it was shown that 57% of uremia patients had damaged renal bones[9]. For example, 41.1% of Thais suffered from adynamic bone disease, 28.6% from hyperparathyroidism, 19.6% from a mixed type, 5.4% from a mild lesion, 3.6% from osteomalacia, and 1.8% from osteosclerosis[10].

Patients on hemodialysis for end-stage renal disease (ESRD) had a fourfold higher incidence of hip fractures compared to non-dialysis ESRD patients [11]. The histological findings of the several bone diseases associated with chronic kidney disease (CKD) are quite different from one another. Even though the illnesses that make up chronic kidney disease-mineral and bone disorders (CKD-MBD) have different mechanisms at play, they typically show similarly in the clinic [12]. Fragility fractures are the most common presenting symptom for patients with adynamic bone disease (ABD) and osteitis fibrosa cystica (OFC), two conditions characterised by abnormally high or poor bone turnover, respectively.

MATERIAL AND METHODS

This cross sectional study was conducted at Institute of Kidney Diseases Hayatabad Peshawar during the period from January 2021 to June 2021 and comprised of 82 patients. After receiving informed written consent, full demographic information of enrolled cases was recoded. This information comprised age, sex, BMI, and comorbidities. Patients who were younger than 12 years old or who did not offer any kind of written consent were disqualified from the study.

The ages of the patients included ranged from 12 to 60 years old. HD was conducted on a maintenance basis, with a 32 mmol/L bicarbonate and 1.75 mmol/L calcium dialysate solution, and a Fresenius machine 4008S, a polysulfone membrane dialyzer. Patients in the study had all been on dialysis for more than a year, and none of them exhibited any signs of acute sickness or evidence of active liver disease. Before starting dialysis, blood was collected to measure several biochemical markers. On the fully automated immunoanalyzer Elecys 2010, tests for serum intact parathyroid hormone (PTH) and osteocalcin were conducted using electro-chemiluminescence immunoassay (ECLIA) (Roche). Levels of iPTH 15–65 pg/ml and osteocalcin 11–43 ng/ml were considered normal.

Serum levels of albumin, alkaline phosphatase, calcium, and phosphate were measured using an automated chemistry analyzer (Cobas Integra 400 Plus) (Roche). This study determined that 35-129 IU/L, 8.8-8.5 mg/dL, and 2.7-4.6 mg/dL are all within the normal limits for blood whole alkaline phosphatase, overall calcium, and phosphate, respectively. The level of total serum

calcium was routinely readjusted. SPSS 22.0 was used for the data analysis.

RESULTS

Mean age of the patients was 43.4±8.26 years and had mean BMI 22.4±6.30 kg/m^2. There were 48 (58.5%) males and 34 (41.5%) females. Mean duration of hemodialysis was 4.6±5.19 years. Frequency of DM was found in 24 (29.3%) cases, 30 (36.6%) cases had hypertension, 28 (34.1%) cases had cardiovascular disease.(table 1)

Table-1: Detailed information of the enrolled cases

Variables	Frequency	Percentage
Mean age (years)	43.4±8.26	
Mean BMI (kg/m^2)	22.4±6.30	
Mean duration of Hemodialysis (years)	4.6±5.19	
Gender		
Male	48	58.5
Female	34	41.5
Other Diseases		
Diabetes Mellitus	24	29.3
Hypertension	30	36.6
Cardiovascular Disease	28	34.1

Frequency of vitamin D therapy was found in 55 (67.1%) cases. All of the patients in the study had high overall mean serum levels of iPTH, osteocalcin, alkaline phosphatase, and corrected total calcium. This was the case across the board. (table 2)

Table-2: Frequency of vitamin D therapy and laboratory findings among all cases

Variables	Frequency	Percentage
Vitamin D Therapy		
Yes	55	67.1
No	27	32.9
Laboratory Results		
Mean intact parathyroid harmone (iPTH) pg/ml	368.4±411.6	
Mean osteocalcin (ng/ml)	249.1±122.9	
Mean alkaline phosphatase (IU/L)	251.8±245.1	
Mean correct total calcium (mg/dl)	10.2±0.8	
Mean albumin (g/dl)	3.9±2.12	

We found that 29 (35.4%) patients had adynamic bone disease.(figure-1)

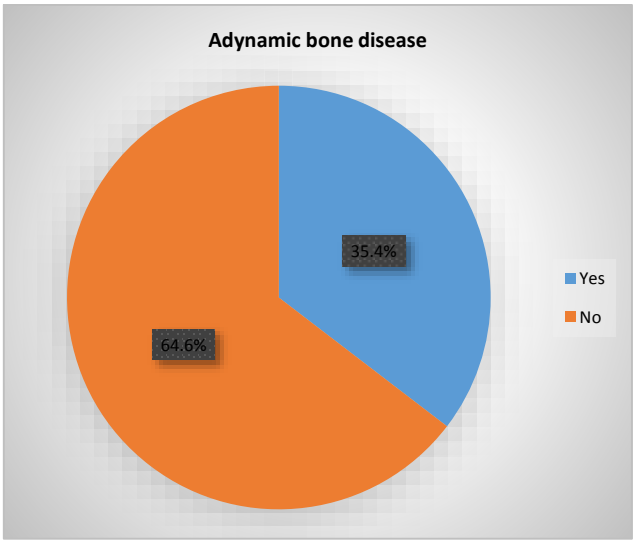

Figure-1: Frequency of ABD among all cases

Among 29 patients of adynamic bone disease majority were males and had age 25-45 years.(table 3)

Table-3: Gender and age of ABD cases

Variables	Frequency	Percentage
Gender		
Female	19	65.5
Male	10	34.5
Age		
15-24 years	6	20.7
25-45 years	20	68.96
>45 years	3	10.3

There were 21 (25.6%) cases had hyperparathyroidism and 61 (74.4%) cases had bone pain.(Figure 2)

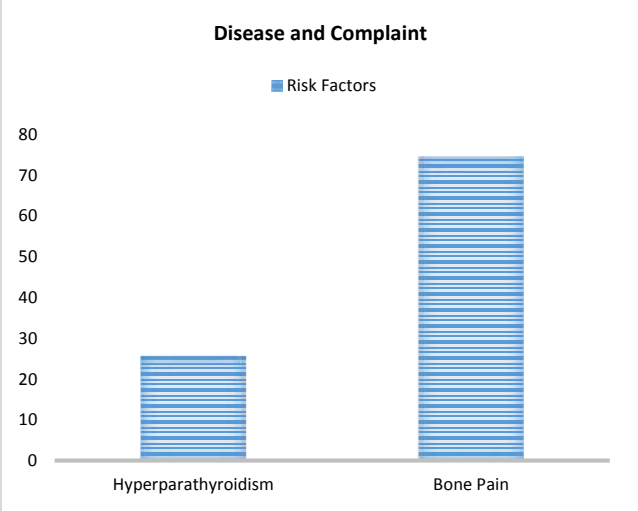

Figure-2: Association of hyperparathyroidism and bone pain among all cases

DISCUSSION

Renal bone disease can manifest itself in a variety of ways and in different patients, with a wide range of causes[13]. Common bone problems in persons with CKD include hyperparathyroidism (a condition characterised by abnormally high bone turnover) and low turnover bone abnormalities. These conditions may be distinguished from one another by measuring PTH levels in the blood[14]. As a result of its invasiveness, high cost, and overall complexity, bone biopsy has been phased out of clinical practise despite being the gold standard for identifying renal bone disease. [15]

In this study 82 patients of CKD of age 15-65 years were presented. Mean age of the patients was 43.4±8.26 years and had mean BMI 22.4±6.30 kg/m^2. There were 48 (58.5%) males and 34 (41.5%) females. Mean duration of hemodialysis was 4.6±5.19 years. Frequency of DM was found in 24 (29.3%) cases. Results were in-line with previous studies.[16,17] According to studies, ABD affects between 15 and 60 percent of dialysis patients. [18] Diabetics and hemodialysis patients are at increased risk for this condition. Over-suppression of the parathyroid gland by a combination of a high calcium diet and vigorous vitamin D administration has been implicated as a cause of ABD in some individuals. [18] Though there are no obvious symptoms, this syndrome is linked to an increased. In our study 29 (35.4%) patients had adynamic bone disease.[19]

Frequency of vitamin D therapy was found in 55 (67.1%) cases. All of the patients in the study had high overall mean serum levels of iPTH, osteocalcin, alkaline phosphatase, and corrected total calcium. This was the case across the board. There were 21 (25.6%) cases had hyperparathyroidism and 61 (74.4%) cases had bone pain. Hypocalcemia and hyperphosphatemia were found in

71% and 79% of patients with chronic renal failure, respectively, by Onyemekeihia at the University of Benin Teaching Hospital in Nigeria[20]. According to research conducted by Sanusi et al.[20], in Ilelfe, Nigeria, 59.3% of ESRD patients had hypocalcemia and 75.0% had hyperphosphatemia. Agarwal reports that hypocalcemia affects 49.6% of CKD stage 5 patients whereas hyperphosphatemia affects 41.8% of patients. [21] Another research from 2016 found that 89% of patients evaluated in Pakistan had ROD, with 32% having SHPT as the most frequent subtype, 27% having the mixed subtype, and 23% having dynamic bone disease. And the above-mentioned study's conclusions were practically at odds with our own.[22]

For example, 103 hemodialysis patients were involved in a recent study conducted in Libya, and the patients were divided into groups based on their levels of intact parathyroid hormone (iPTH). This led to the identification of ROD in 55.3% of the population. This study revealed that 29 people had hyperparathyroid bone disease and 28 people had adynamic bone disease (defined here as iPTH levels 60 pg/mL).[23]

It is imperative that doctors be more informed and prepared to deal with the issue of CKD. Patients with chronic diseases like diabetes and hypertension also benefit from education on their conditions. Caregivers should also be aware of how crucial it is to provide easy access to the resources needed for detecting and treating CKD.

CONCLUSION

We concluded in this study that the prevalence of adynamic bone disease was 35.4%. Among patients of ABD most were ages between 25-45 years and were males with severe bone pain.

REFERENCES

1 National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: Evaluation, classification, and stratification. Am J Kidney Dis 2002; 39 (Suppl 1): S1–S266

2 Eknoyan G, Levin A, Levin NW. Bone metabolism and disease in chronic kidney disease. Am J Kidney Dis 2003;42 Suppl: 1130-3

3 Massry S, Glassock R. Textbook of Nephrology. Vol. 2 .3rd edition. Williams& Wilkins. page 1457

4 Qi Q, Monier-Faugere MC, Geng Z, Malluche H. Predictive value of serum parathyroid hormone levels for bone turnover in patients on chronic maintenance dialysis. Am J Kidney Dis 1995;26(4):622-31

5 Gerakis A, Hutchison AJ, Apostolou T, Freemont A, Billis A. Biochemical markers for non-invasive diagnosis of hyper parathyroid bone disease and adynamic bone in patients on hemodialysis. Nephrol Dial Transplant 1996;11(12):2430-8

6 Daugirdas JT, Blake PG, Ing TS. Handbook of Dialysis. 3rd Edition. Lippincott. Williams & Wilkins

7 El-Moselhy, E. A. et al. Prevalence and risk factors of overt-and occult hepatitis C virus infection among chronic kidney disease patients under regular hemodialysis in Egypt. The Egyptian Journal of Hospital Medicine 61, 653-669 (2018).

8 Behets, G. J. et al. Bone histomorphometry before and after longterm treatment with cinacalcet in dialysis patients with secondary hyperparathyroidism. Kidney international 87, 846-856 (2015).

9 Udomkarnjananun, S. et al. Treatment of calciphylaxis in CKD: a systematic review and meta-analysis. Kidney international reports 4, 231-244 (2019).

10 Ahmed, H. A., Elzorkany, K. M., Yasein, Y. S. & Saif, A. F. A.-E. Prevalence of mineral bone disorders among hemodialysis patients in Menoufia Governorate, Egypt. Menoufia Medical Journal 30, 687 (2017).

11 Maravic M. Incidence and risk factors for hip fractures in dialysis patients. Osteoporos Int. 2014;1:159–165.

12 KDIGO clinical practice guideline for the diagnosis, evaluation, prevention, and treatment of chronic kidney disease-mineral and bone disorder (CKD-MBD). Chapter 4.3. Kidney Int. 2009;76(Suppl. 113):90–99.

13 Eknoyan, G., Levin, A. & Levin, N. W. Bone metabolism and disease in chronic kidney disease. American Journal of Kidney Diseases 42, 1-201 (2003).

14 Levey, A. S. et al. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. American Journal of Kidney Diseases 39, i-ii+ S1-S266 (2002)

15 Hafeez, M. et al. An evidence based assessment of most common risk factors of myocardial infarction: analysis from a local population. Biological and Clinical Sciences Research Journal 2020 (2020)

16 hmed HA, Elzorkany KM, Yasein YS, Abd-Elsattar Saif AF. Prevalence of mineral bone disorders among hemodialysis patients in Menoufia Governorate, Egypt. Menoufia Med J 2017;30:687-92

17 Buargub MA, Nabulsi MF, Shafeh TA. Prevalence and Pattern of Renal Osteodystrophy in Chronic Hemodialysis Patients: A Cross Sectional Study of 103 Patients. Saudi J Kidney Dis Transpl 2006;17:401-7

18 Eknoyan G, Levin A, Levin NW. Bone metabolism and disease in chronic kidney disease. Am J Kidney Dis 2003;42 Suppl: 1130-3

19 Block GA, Klassen PS, Lazarus JM, Ofsthun N, Lowrie EG, Chertow GM. Mineral metabolism, mortality and morbidity in maintenance hemodialysis. J Am Soc Nephrol 2004;15:2208-18

20 Sanusi, A., Arogundade, F., Oladigbo, M., Ogini, L. & Akinsola, A. Prevalence and pattern of renal bone disease in end stage renal disease patients in Ile-Ife, Nigeria. West African journal of medicine 29 (2010)

21 Agarwal, S. K. Assessment of renal bone mineral disorder in naïve CKD patients: a single center prospective study. Indian Journal of Nephrology 17 (2007).

22 Jat JA, Mal P, Kumar D. Renal osteodystrophy in end stage renal failure patients on maintenance haemodialysis. J Clin Exp Nephrol 2016;1(4):25.

23 Buargub MA, Nabulsi MF, Shafeh TA. Prevalence and pattern of renal osteodystrophy in chronic hemodialysis patients: a cross sectional study of 103 patients. Saudi J Kidney Dis Transpl 2006;17(3):401-407