

## Mineral Derangement and Bone Diseases in Uremic Patients on hemodialysis in Ibn-Sina Hemodialysis Center / Diyala

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### Abstract

**Background:** Chronic kidney disease is an international public health problem affecting 5–10% of the world population. As kidney function declines, there is a progressive deterioration in mineral homeostasis, with a disruption of normal serum and tissue concentrations of phosphorus and calcium, and changes in circulating levels of hormones.

**Objective:** To determine the severity of bone and mineral disease in chronic renal failure and how efficiently controlled by drugs and hemodialysis procedure in Ibn sina dialysis center.

**Patients and Methods:** A case control study was carried out among 75 patients with chronic kidney disease (stage5) on regular hemodialysis in Ibn Sina dialysis center. Blood was taken before dialysis session and measurements of serum calcium, phosphorus, serum alkaline phosphatase, protein and albumin levels, Serum parathyroid hormone and VIT D3 were determined. and another group of 25 normal peoples from surrounding area.

**Results:** The mean parathyroid hormone level was 145.62pg/ml, with 57.33% having normal acceptable rang of parathormone level, 41% of patients having hyperparathyroidism and 1.33% having hypoparathyroidism. There was no significant correlation between serum PTH and dexa scan. Hypocalcemia was found in 52% of patients, 33% with hypercalcemia patients . There was a significant correlation found between Hypocalcemia and dexa scan results. Majority of patients had high serum phosphate levels (54.6%).and normal phosphate level in 40% while the hypophosphatemia result 5.33% and mean phosphate level is2.24 mmol/l.Total serum protein mean is 61.51 a 37.33% of them had hypoproteinemia and 62.66 %of them had normal serum protein. Also our results show 97, 33%of uremic patients have low vit D While 2.33% have normal level of serum vit D. There was a significant correlation between dexa scan and vit D level, calcium, alkaline phosphatase, female gender, smoking and body mass index.

**Conclusion:** The current study demonstrated that we can predict the chronic kidney diseases- Metabolic bone disorder from mineral scores before potentates the diagnosis by dexa scan.

**Keywords:** Metabolic bone disorder, dexa scan, chronic kidney disease

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## Introduction

Chronic kidney disease (CKD) is a world-wide public health problem, with increasing prevalence[1]. It is associated with a number of abnormalities in mineral metabolism viz. hypocalcemia, hyperphosphatemia and abnormalities in vitamin D metabolism that result in functional calcitriol deficiency[2,3,4]. The major consequences of disordered mineral metabolism in CKD are secondary hyperparathyroidism (SHPT), metabolic bone disease including renal osteodystrophy and vascular calcification[4,5,6]. These include parathyroid hormone (PTH), 25-hydroxyvitamin D (25(OH)D), 1,25-dihydroxyvitamin D (1,25(OH)2D), and other vitamin D metabolites, fibroblast growth factor-23 (FGF-23), and growth hormone. Beginning in CKD stage 3, the ability of the kidneys to appropriately excrete a phosphate load is diminished, leading to hyperphosphatemia, elevated PTH, and decreased 1,25(OH)2D with associated elevations in the levels of FGF-23. The conversion of 25(OH) D to 1,25(OH)2D is impaired, reducing intestinal calcium absorption and increasing PTH [4,5,6]. The treatment with vitamin D, reduction of PTH levels and clearance of phosphate are all beneficial to the bone after hemodialysis (HD). However, bone loss still remains an important problem due to post HD factors such as filter size and dialysate fluid type used, persistent HPT, and other metabolic and acid-base disturbances [7].

The therapeutic strategies for alleviation of post HD bone disease include, low dose of calcium, vitamin D, calcimimetic agents,

bisphosphonates and, to a lesser extent, calcitonin, good nutrition and avoidance of analgesic and steroid[8].

Despite the knowledge of existence of mineral disorders after hemodialysis, there are no studies describing the pattern of the disorder among hemodialysis patients in Diyala /Iraq. Aim of this study to determine the levels of bone mineral metabolism parameters among HD patients attending renal clinics at Baquba Teaching Hospital, IBN -Senna center.

### Specific objectives

1-To determine the serum levels of calcium, phosphate and intact parathyroid hormone among HD patients in IBS center.

2-To determine the relationship between bone biochemical parameters and dxa scan of bones at hip and spine areas.

### Patients and Methods

Study Design: It is a case control study. Study Area: Ibn- Sina hemodialysis Center (ISC) at the Baquba teaching Hospital, Diyala/Iraq. Study Population: HD patients of 20 years and above who have signed an informed consent. Study Duration: Enrollment was done from September 2016 to April 2017. Sample Size: 75 of HD patients on regular hemodialysis in Ibn Sina dialysis center 51 of them were males and 24 females aged between 20 and 78 years were studied and another 25 randomly chosen controlled normal peoples in the same territory was taken to compare results regarding dxa scan. And the size determined accordingly[9]. Patients were those with end stage renal disease (ESRD) on regular HD

for 4 hours, three times a week, irrespective to etiology. All dexa scan were done within 2 hours before or after a dialysis session. Inclusion criteria: HD patients who are at least 3 months on HD programme and are on follow up at ISC hemodialysis in BTH. Patients 20 years old aged patients and above who have signed an informed consent. Exclusion criteria: Patients who have a bone diseases for other reasons that may affect the results.

A printed questionnaire was used to collect data from recruited patients. Data consisted of Socio-demographic data including age, gender and dwell area. Information on smoking, alcohol intake, drugs. Medical history for possible etiology of kidney disease, time on dialysis program, since HD started and current medications were recorded

### Laboratory Methods

About 5ml of blood was drawn before the session of hemodialysis in sterile plain tube for creatinine, urea, calcium, phosphate, total serum protein, vit D3, Alkaline phosphatase, albumin and intact PTH. The measurements of serum creatinine, albumin, calcium and phosphate were determined using automated clinical chemistry analyzer (cobas 400 plus) in IBN-Sina center laboratory, while serum PTH assays were performed in Baquba teaching hospital main laboratory using Enzyme Linked Immuno Sorbent Assay (ELISA) (Cobas e 411). Selective measurement of the (mainly) intact parathyroid hormone permits direct ascertainment of the secretory activity of the

parathyroid gland (10-11). The results were analyzed after daily calibration using standard calibration methods and materials and tests assayed against controls. The glomerular filtration rate (GFR) was estimated using the MDRD formula (12)  $eGFR = 32788 \bar{\gamma} \text{ Serum Creatinine}^{-1.154} \times \text{Age}^{-0.203} \times (1.212 \text{ if Black}) \times (0.742 \text{ if Female})$  the formula was calculated using a free internet-based clinical equation calculator [13].

Total serum calcium was corrected for serum albumin using the equation: Corrected Calcium =  $\text{Ca} (40 - \text{measured serum albumin}) \times 0.02 + \text{measured serum calcium}$ . (A typical correction is that for every 1g/l that the albumin concentration is below 40g/l, the calcium concentration is 0.02mmol/l below what it would be if the albumin concentration was normal). All patients sent to Dexa scan unit in Baquba Teaching Hospital were weight, height, gender obtained and dexa scan is done for lumber spine and hip area. It is done by dexa DMS group -stratos court model (France made) and software programme for Turkish ethnicity because nearest area to Iraqi ethnicity and share similar features and habits. Each one takes a report by the technician on it.

### Statistical analysis

Data cleaning was performed at the end of data entry and analysis performed using SPSS version 20.0 software. The characteristics of the participants were summarized into means/medians and proportions for continuous and categorical variables respectively. eGFR, creatinine,

serum calcium, phosphate, vit D, total serum protein, serum albumin, alkaline phosphatase and PTH were analyzed and presented as means and medians where appropriate. DEXA scan for all patient and controlled were also done and T\_score for hip and spine area measured were classified as normal, Osteopenia and osteoporosis. Furthermore, calcium, phosphate and PTH were categorized according to patients with low, normal and high levels and presented as proportions. The relationship between bone biochemical parameters and dexa scan results was measured using Pearson correlation coefficient (r) and spearman s correlation coefficient, and linear regression coefficient

(β). The levels of PTH, calcium and phosphate were correlated with duration of dialysis, age of the patients was compared between groups using a nova test. All statistical tests were performed at 5% level of significance (95% confidence interval).

### Results

Most of our patients are male (58%) with wide distribution of age at presentation but most of them between 50-70 (58%) and smokers constitute (33%) most of them are overweight (54.7%) possibly fluid overload. Most of them are medium class regarding socioeconomic state (64%) and living in urban area (54.7%) and small numbers are alcoholic (8%) Table (1).

**Table (1):** Socio -demographic data of study population.

Gender		BMI	
male	51(68%)	normal	23(30.7%)
female	24(32%)	overweight	40(54.7%)
<b>Age</b>		obese	11(14.7%)
20-20	5 (6.7%)	<b>residence</b>	
30-39	11(14.7%)	rural	34(45.3%)
40-49	12(16%)	urban	41(54.7%)
50-59	27(36%)	<b>Socioeconomic state</b>	
60-69	17(22.7%)	low	22(29.3%)
70-79	3(4%)	medium	48(64%)
<b>Smoking</b>	25(33.3%)	high	5(6.7%)
<b>Alcohol</b>	6(8%)		

More than (50%) are on HD for more than 2years which indicate good survival rate among them as shown in Table (2).

**Table (2):** Patient clinical characteristics.

Period of dialysis (month)	
1-3	1(1.3%)
4-6	3(4%)
7-12	13(17.3%)
13-24	20(26.7%)
More than 24	38(50, 7%)

Our result showed high incidence of hypertension among patients (81%) whether primary cause or secondary to CKD ,diabetes present as cause of uremia in (33.3%) chronic

GN in (9.3%) yet geneto urinary infection and renal stone are present in (33.3%),(26.7%) respectively Table(3).

**Table (3):** Past and present disease and possible causes of chronic kidney disease.

Disease	Present
Hypertension	61(81.3%)
diabetes	25(33.3%)
Genitourinary	25(33.3%)
Renal stone	20(26.7%)
Unknown cause	12(16%)
Chronic GN	7(9.3%)
Bone disease	4(5.3%)
fracture	3(4%)
Polycystic disease	2(2.7%)

Most of our patients are on regular treatment of calcium carbonate (93%) calcitriol (one alfa) (93%) and all of them receive erythropoietin supplement and iron

(100%).significant number have history of abuse of steroidal and non-steroidal drugs (33.3%) (80%) respectively as shown in Table(4).

**Table (4):** Shown the drug administration (past and present drugs).

Drug history	Present
steroid	25(33.3%)
NSAID	60(80%)
Ferro folic acid	75(100%)
Calcium carbonate	70(93%)
Calcitriol(one alfa)	70(93%)
Sevelamer	5(7%)
Epirax(erythropoietin)	75(100%)

Most of our patients have normal PTH (66.6%) but elevated level present in only (57.33%) and increase level of PTH in (41.33%).regarding calcium level majority have low calcium (52%) and normal calcium level in 46.6.phosphate are high in (55%) and normal in (40%).alk.phosph are normal in

(66.6%) but elevated level present in only (30.6%).VIT D are low in almost all patients (97.3%).most of patients have low TSP and low Albumen (62.66%) (74.66%) respectively Table (5).

**Table (5):** Biochemical characteristics of the study population.

	<b>hypo</b>	<b>normal</b>	<b>hyper</b>	<b>mean</b>
PTN	1 (1.33%)	43(57.33%)	31(41.33%)	145.62 (± 255.16)
Calicium	39 (52%)	35 (46.6%)	1 (1.33%)	2.2 (± 0.2)
Phosphate	4 (5%)	30 (40%)	41(55%)	2.4
Alk. Phosphatase	2(2.6%)	50(66.6%)	23(30.6%)	123.23
Vit D	73(97.3%)	2(2.66%)		38.3
Total serum protien	47(62.66%)	28(37%)		61.51
Serum albumen	56(74.66%)	19(25.33)		30.11

Dexa scan showed that nearly half (46.66%) of patients have osteoporosis (26.66%) Table (6). patients have osteopenia and only quarter have

**Table (6):** Dexa scan results in study population.

	<b>Normal</b>	<b>Osteopenia</b>	<b>Osteoporosis</b>
Dexa scan total	20 (26.66%)	35 (46.66%)	20 (26.66%)
Dexa scan hip	27 (32%)	37 (49.33%)	11 (14.66%)
Dexa scan spine	33 (44%)	25 (33.33%)	17 (22.66%)

The osteopenic changes in hip and spine are associated with mild derangement in biochemical markers and osteoporotic changes are associated with severe derangement of markers. As shown in Tables (7).

**Table (7):** Pearsson correlation between dexa scan and calcium.

		<b>T. Score HIP</b>	<b>T_score SPINE</b>	<b>Calcium</b>
<b>T. Score HIP</b>	Pearson Correlation	1	.680**	-.275-*
	Sig. (2-tailed)		.000	.017
	N	75	75	75
<b>T_score SPINE</b>	Pearson Correlation	.680**	1	-.273-*
	Sig. (2-tailed)	.000		.018
	N	75	75	75
<b>calcium</b>	Pearson Correlation	-.275-*	-.273-*	1
	Sig. (2-tailed)	.017	.018	
	N	75	75	75

There is no significant correlation between parathrmon level and serum ca level among the study population as shown in Table (8).

**Table (8):** Spearman s rho correlation between PTH level and serum ca level.

		PTN	Ca
Spearman's rho	_PTN	Correlation Coefficient	1.000
		Sig. (2-tailed)	.
		N	75
	Calcium	Correlation Coefficient	.190
		Sig. (2-tailed)	.103
		N	75

There is a significant correlation between PTH level and PO4 level and no significant correlation between po4 and ca, or vit D as shown in Table (9).

**Table (9):** Spearman s rho correlation between phosphate level and parathyroid hormone, vit D, and calcium.

Spearman's rho		PTN	VIT D	CA	PO4
PO4	Correlation coefficient	.340**	.001	-.107	1.000
	Sig. (2-tailed)	.003	.994	.361	.
	N	75	75	75	75

There is a very significant correlation between vit D level and dexta results in both hip and spine area as shown in Table (10).

**Table (10):** Correlations Vitamin D T score spine and hip.

		T.Scor HIP	T_score SPINE	Vit D
T. Score HIP	Pearson Correlation	1	.680**	-.577**
	Sig. (2-tailed)		.000	.000
	N	75	75	75
T_score SPINE	Pearson Correlation	.680**	1	-.329**
	Sig. (2-tailed)	.000		.004
	N	75	75	75
vitD	Pearson Correlation	-.577**	-.329**	1
	Sig. (2-tailed)	.000	.004	
	N	75	75	75

\*Correlation is significant at the 0.01 level (2-tailed).

There is a great predictable value that can be obtained from mineral analysis for patient with mineral and bone diseases and used as a good indicator for follow up of them prior to do dexta scan and can be depend on these

biochemical markers as screening tests to evaluate the bone mineral diseases especially when dexta scan is not available in some peripheral hospitals or areas as shown in Table (11).



**Table (11):** Spearman s rho correlation between mineral score (biomarkers) and dexa scan  
Correlations between mineral score and dexa scan.

		Mineral Score	Dexa scan	
Spearman's rho	Mineral Score	Correlation Coefficient	1.000	
		Sig. (2-tailed)	.000	
		N	75	
	Dexa scan	Correlation Coefficient	.861**	1.000
		Sig. (2-tailed)	.000	.
		N	75	75

There is a very significant Anova regression between mineral (biomarkers) and dexa scan

results for future relation and it is dependable Table (12).

**Table (12):** Anova a regression between the mineral score and dexa scan results.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	13.395	1	13.395	183.615	.000 <sup>b</sup>
Residual	5.325	73	.073		
Total	18.720	74			

## Discussion

The chronic kidney disease is a worldwide public health problem associated with high morbidity and mortality [14]. Secondary hyperparathyroidism after HD has been reported even in the presence of excellent HD [15]. In this study, CKD on HD programme, calcium, phosphorus and PTH considerably normalized in majority of the patients.

### Age distribution

The mean ages of our patients 54.5yrs ,the common age groups affected 50-59 y are 27(36%),then age group 60-69 y were 17(22.7%).there is significant correlation between age and hyper tension (p=.040)and with BMI(p=.000 ).

Our study is agree by a study done by others 54.5 and 50.0 years respectively [16]. In our study ,the Anova table between age

groups and biochemical markers is highly significant(p- value= .002) while not within the same age groups but only for the PTH .There was a statistically significant relationship between increased age of the patients as well as duration of dialysis and a high PTH level (p<0.001).

A study done by Sidney Klawansky, et al., showed that there are links between osteoporosis increased mortality, possibly reflecting links of low BMD with poor nutritional status and vascular calcification[16].

### 4.2. Gender

In our study, males made up the majority of the patients with 51 (68%) and females 24(32%)this goes with other study done in Africa (Nigeria, Senegal and Burkina Faso) have also reported a male preponderance



among patients with ESRD (19).this is due to many causes one of them the common causes of uremia are DM and hypertension which more in male than in female The mean(SD) of PTH in males were 149.5(+252.2) while in females is 137,3.(+266.1)The vitamin D in males with mean of 39.59(+13.27) and in females 34.73(+8.632).Ca in males with mean 2.002(+.888) were as in females was 2.054(+.377).the po4 was 2.25(+1.45)and 2.1(+1.44) in male and females respectively while alkaline phosphatase nearly equal with 123.4(+90.48) and 122.9(+79.27)for them respectively. The T-score mean in males is -1.27 SD and for females -1, 62 SD similar to what was reported in other studies[13,17,18, ].Which agree with many studies. In one study by M Asaka, H Iida, M FUJITA, K IZUMINO, M TAKATA, H SETO, and S SASAYAMA, female was inversely correlated with BMD with age, but not in male HD patients [20]. Which may be due to hormonal changes and exercise reduction with chronic diseases. Female gender has also been linked as an independent risk factor.

#### 4.3. BMI

The majority of patients in our study were overweight This possibly because many patients have fluid overload and didn't reach the dry weight The higher level of PTH mean was with overweight group 176.5 (+308.5) and lowest with normal weight 94.44(+127.6) also major reduction of vit D occur in over weight group 35.11(+8.46) beside highest po4 mean 2.36 (+1.52) and lowest in normal weight group for both 41.84(-

+13.93), 2.01(+1.188) respectively. The alkaline phosphatase follow the same manner for over weight is highest but lowest mean values in obese 136.2(+103.2) and 80.18(+34.91) .The T-score reduction is also associated with overweight group with mean of -1.556 (+.946).

There is no significant Anova correlation between BMI with PTH,Ca,po4 and age but high significant with alkaline phosphatase( p value = .005) and T-score values(p value =.0048) in Duncan test for means correlations .and also significant person s correlation between BMI and sex(p value = .0020) and very significant with DM(p =.000 ) which are similar to other studies results. There was a statistically significant relationship between increased age of the patients as well as duration of dialysis and a high PTH level (p<0.001) [18].

The study by Bess et al.,showed there is a positive correlation between body weight and BMD in the general population [22]. Similarly, several studies demonstrated that the body size relates with BMD also in CKD and ESRD patients [24; 25; 26].A study done in Turkey among renal HD, low BMI values and decreased 25OH vitamin D levels were found to be a main risk factors for loss of bone mineral density [27]. Priyanka et al reported a positive correlation between BMI and bone mineral density in spine and femur. Longer CKD duration prior to HD showed greater loss of BMD in the femur[28].

In general body mass index (BMI) associates with BMD or bone mass as measured by DEXA and the BMI is a

predictor of BMD also in ESRD patients [29]. Thus, not surprisingly, body weight and BMI were primary responsible factors for BMD variation, osteoporosis and fractures (30.31).

### **Socio economic status**

In present study, the patients were distributed as medium status in 48 ((61.33%) low status 22(29.33) and high status in 5(6.6%) and this show only significant Duncan test correlation with p04 mean ( $p=.002$ ) but no significance with PTH, ca, vit D, or T-score. Similar results were seen in another study [32].

This agree the study done by Catherine O Stehman-Breen, Donald J Sherrard, Astier M Alem Daniel L Gillen Susan R Heckbert, Craig S Wong, Adrienne Ball, and Noel S Weiss [30].

### **Hypertension and diabetes mellitus**

Hypertension in my study was present in 61 (81%) patients distributed as males 44 (58.7%) and females 17 (22.7%) followed by diabetes mellitus in 25 (33.33%) patients distributed as males 18(24%) and females 7(9.3%) patients. There is no significant correlation between hypertension and other (ca, PTH, po4, vit D, T-score. Serum albumin nor with Alp). There is no significant Pearson s correlation between hyper tension and age ( $p$  value=.235)) while the significant person s correlation is between the DM and age ( $p$  value=.040). And with vit d ( $p=.007$ ).

This is in contrast to the studies done in Japan and Iran done by Pieter E, Kathleen C, Dirk K et al. Where diabetes was reported as etiology of kidney disease in 26.5% and

78.6% of the study subjects respectively while in Iran hypertension was reported in 23.6% [33,34]. In Europe and United States, diabetic nephropathy constitutes about 50% of the causes of ESRD while in Africa the predominant causes are hypertension and CGN thesis higher than our study.

Presentation of ESRD in Africa is often late and diagnosis prior to presentation is often inaccurate without the recognition of renal failure by the referring unit. In a study of Nigerian patients, the etiology of renal failure was undetermined in 62% and of the remaining patients whose etiology was ascertained, hypertension accounted for 61% which is agree with our study, while in diabetes mellitus for 11% and CGN for 5.9% (102)is lower than our study.

Other associated diseases (genitourinary Renal. Stones, bone diseases. Fractures), Steroid and NSAID drugs: There is significant ANOVA correlation between urinary diseases and phosphate ( $p=.067$ ) and between renal stones and serum albumin ( $p=.078$ ).also between NSAID and s.albumen ( $p=.091$ ).

### **Hyperparathyroidism**

In present study which comprised of 75 ESRD on HD ,hyperparathyroidism was found in 31 (41.33%) patients, and the majority were having normal acceptable value of PTH 43(57.33%) with mean(+SD) of 145.6(+255.16) at a total values while distributed as highest level with 192.5(-+320.6) for duration of dialysis of 4 -6 months and 31.64(+38.38)the lowest for 7-12 months duration of dialysis with only 1

(1.33%) has hypoparathyroidism. There is no significant correlation by anova tables between the groups of duration of dialysis in parathyroid levels but there is significant between the same group of duration of dialysis ( $p=0.018$ ).

The mean of PTH for males were 149.5(-+252.6) and for the females 137.3(-+266.1) and the highest in age group 30-39 yrs. were 416 pg./ml and lowest in age group of 70-79ys 10.05 pg./ml with significant correlation by Anova table between age group ( $p$  value=0.002). There is no significant between the means of age groups by the Duncan test.

The prevalence of HPT in a cross-sectional study done by Madhumati et al [35] among 106 renal hemodialysis who were at least 6 months duration belonging to CKD stag 5 was 66%. Which is higher than our study. Similar cutoff levels for defining hyperparathyroidism were used i.e. PTH>65pg/ml. We found no correlation between HPT and duration, time on dialysis and eGFR which is similar to what was reported by Mathumati et al., Gholamhossein reported hyperparathyroidism (PTH>60pg/ml) in 7.1% of the study population 3 months duration and was associated with a mean SD of 54  $\pm$  18.68 months compared to a mean SD of 14.26  $\pm$  8.34 months ( $p < 0.001$ ) in those with post HD PTH of  $\leq$ 60pg/ml. Though our patients with elevated PTH had been on dialysis for a longer time (median duration 5 months) to HPT compared to those with normal PTH (median duration 12 months) or low PTH (median duration 10

months), the difference was not statistically significant.

The prevalence of hyperparathyroidism in current study was like to that among CKD patients who were not yet on dialysis attending clinic at KNH done by Armando Torres, Aurelio PR, Maria TC et al, where 21.6% of the study population had HPT. These results suggest a persistence of hyperparathyroidism after starting regular HD program. Pre HD hyperparathyroidism has been associated with persistent hyperparathyroidism after HD [13].

A shorter time of non-dialysis prior to HD (between diagnosis and HD) may reduce the risk of persistence hyperparathyroidism after. Secondary hyperparathyroidism has been associated with metabolic bone disease which manifests as bone pain and skeletal fractures [36]. In the EVOLVE study, the use of calcimimetic agent cinacalcet in patients with moderate- to – severe secondary HPT who were undergoing hemodialysis, did not significantly reduce the risk of death or major cardiovascular events [36].

However, 1 year after HD resolution of hyperparathyroidism is not complete in 50% of HD patients. Duration of dialysis, parathyroid gland size and development of nodular/ or monoclonal hyperplasia of parathyroid gland are the most important possible factors responsible for HPT[37].

#### **Calcium level**

Almost half 39 (52%) of our study population had hypocalcemia with mean calcium levels of 2.02 mmol/l. Male were 29(38.7%) and females 10(13.3%), there are

35 patients (46.6%) have normal calcium level distributed as 22(29.3%) males and 13(17.3%) females with mean ca level of 2.22 and only one female has hypercalcemia(1.33%. we found no significant correlation between age group nor duration of dialysis with hypocalcemia.

We found significant correlation between hypocalcemia and estimated T\_score and no with BMI. Only 1(1.33%) of our patients had hypercalcemia as it has been reported in other studies with hypercalcemia ranging from 3%- 21% [33].

In the early post HD period serum calcium has been reported to follow a biphasic pattern with an immediate post HD decline followed by a significant increase. A low pre hemodialysis PTH has been found to be a predictor of severe Hypocalcemia post HD although no significant correlation between the level of ca and PTH [33]. Other study (34) reported a higher prevalence of low turnover bone disease (50.9%) of the patients with biochemical evidence of mineral bone disease, than a higher turn-over disease among CKD pre-dialysis patients attending clinic at KNH. This might help explaining presence of hypocalcemia in our population (we find 2 of normally controlled person from 25(8%) having hypocalcemia only without any other mineral or dexta abnormality) which mean that our dexta scan is a reliable test in assessment study. The effect of corticosteroids on serum calcium levels as a previous medication history among study population can never be ignored.

In this studies where hypercalcemia was reported among HD 1(1.33%) factors that were HPT and longer duration of dialysis [20]. Calcium was the major regulator of the parathyroid at the levels of secretion, gene expression and cell proliferation. Studies have shown hypocalcemia to cause a profound increase in parathyroid cell proliferation, PTH gene expression and subsequent PTH synthesis [38]. Hypocalcemia among CKD patients undergoing hemodialysis has been related with increased mortality especially in the presence of hyperphosphatemia and elevated PTH levels [37]. All 100% patients were on calcium supplements regularly despite having different calcium level because our patient compliance is less than other population and a bad minded about hemodialysis programme and poor patients and nutritional and gastrointestinal complication of uremia. In this study vitamin D levels were low determined and thus a correlation with low serum calcium levels in this population could be ascertained [11].

#### **Phosphate level**

In my study, nearly as half as 41 (54.6%) of renal HD patients had high serum phosphate had high serum phosphate distributed as male 27(36%) and females 14(18.66%) with highest level in age group30-39yrs2.5 (-+1.488) with mean of and lowest level at age group of70-79 yrs. with means of 1.46 (-+.99011) Only 4 (5.33%) patients equally distributed 2 male and 2female gender (2.7%) were found to have hypophosphatemia and another 30 (40%)

patients with males of 22(29.33%) and females 8 (8.33%) having normal phosphate level. No significant correlation was found between serum phosphate and different age groups or duration of dialysis, sex, but significant with PTH ( $p=0.035$ ). Also Ca and dEXA scan results were not associated with significant correlations with either higher or lower levels of serum phosphate.

Serum phosphorus levels are usually elevated prior to renal dialysis and decrease rapidly following HD to within or below range for patients with normal kidney function in the first few post HD months [40].

#### **Vitamin D**

The results in my study were 73(97.33%) have vit D deficiency and 2(2.33%) of patient were normal. There is very significant ANOVA correlation between vit D and t-score ( $p=0.000$ ) and also by persons correlation also ( $p=0.000$ ) and for both hip and spine areas. But not with phosphate ( $p=0.088$ ) nor with calcium which is compatible with other studies in world. This study results are going with that done by Grahame J Elder (51) but not agree by study in Japan by K Nakatsuka and Y Nishizawa. Vitamin D supplementation reduces serum PTH levels and improves bone strength.

#### **DEXA (T-score) results**

The results of our study, the dEXA scan as a whole show 20 (26.66%) of patients with normal BMD, and 35(46.6%) with osteopenia BMD, and 20(26.66%) of them having osteoporotic BMD and no fractures in between but there is considerable difference

in BMD between the hip area t-score and spine area t-score.

#### **a. The hip t-score**

Shows that 27(32%) were normal BMD with mean (SD)  $-0.218$  ( $+0.9856$ ) 37(49.33%) had osteopenia with mean  $-1.736$  ( $+0.2938$ ) and 11(14.66%) of them with osteoporosis with mean  $-2.958$  ( $+0.370$ ). The osteopenia of hip associated with lower values of PTH, PO<sub>4</sub>, Ca while osteoporotic hip associated with highest elevation of PTH, ALP and po<sub>4</sub> but with lowest most values of Ca, VIT D, total serum protein and albumin [39]. There is significant correlation in ANOVA table between hip t-score and PTH ( $p=0.000$ ) and with serum albumin ( $p=0.000$ ) while no significant correlation with PTH in Duncan test nor with albumin level. In Spearman rho there is very significant correlation between hip T-score and serum albumin ( $p=0.000$ ) and with alkaline phosphatase ( $p=0.004$ ) and also with total serum protein ( $p=0.000$ ) and no significant correlation with Ca or po<sub>4</sub>.

#### **b. In spine T-score**

Appeared 33(44%) with normal BMD with mean (SD)  $-0.581$  ( $+1.145$ ), 25 (33.33%) osteopenia with mean of  $-1.760$  ( $+0.4500$ ) and 17 (22.66%) osteoporosis BMD with mean of  $-1.385$  ( $+0.857$ ). The osteoporotic spine lower derangement in PTH, PO<sub>4</sub>, VIT D, and ALP elevations, were as osteoporotic spine associated with highest derangement in PTH, PO<sub>4</sub> and ALP elevations and lowest value hypocalcemia. There is significant statistical correlation between spine T-score and serum calcium, total serum protein, albumin and



alkaline phosphatase with ( $p=.003$ ), ( $p=.005$ ), ( $p=.000$ ), ( $p=.006$ ) by anova test respectively. It is not clear whether peripheral or central bone, or cortical or trabecular bone, are to be preferred for the evaluation of BMD in CKD patients.

### Conclusions

1-This study demonstrated that elevated serum PTH levels are present even after HD and are associated with many factors for bone diseases. It also showed presence of low PTH levels though the prevalence is lower than those reported in the CKD counterpart. This may indicate continuing presence of a dynamic bone disease if PTH levels are used as surrogate markers for bone turnover.

2-Hypocalcemia was present in almost half of HD as opposed to hypercalcemia reported in other studies. This may be as a result of higher prevalence of a dynamic bone disease in our CKD patients. Hypocalcemia was associated with relatively older patients and was not correlated with duration of dialysis.

3-Nearly half of our patients had serum phosphorus levels within reference ranges.

4-There is great predictable value can be obtained from mineral analysis for patient with mineral and bone diseases and used as a good indicator for follow up of them without need to do dexa scan and can be depended on these biochemical markers as screening tests to evaluate the bone mineral diseases especially when dexa scan is not available in some peripheral hospitals or areas.

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