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Hematological Fluctuations in parathyroid hormone in chronic kidney disease patients undergoing hemodialysis

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Abstract

Chronic Renal failure refer to notable functional and structural kidney abnormalities from a variety of causes. The most prominent are low calcium level and high phosphorus level in the blood. Several health problems, such as osteoporosis, atherosclerosis, and nervous system problems are result from. The present study aimed to determine the fluctuation in calcium and phosphor levels in CKD patients during hemodialysis and expected health consequences. Totally, 100 patients diagnosed clinically and biochemically with renal failure and subjected to dialysis in addition to 50 healthy adult volunteers total number of samples is 100. In terms of sex distribution, the patient group study included 60 males (60%) and 40 females (40%). The study's outcomes, found that 94% of the studied group had elevated parathyroid hormone concentrations after the dialysis session with a mean of (376.166pg/ml) The current study also noticed that CKD patients had a very significant rise in blood phosphorus levels when compared to the references values (>4.5 mg/dL). Approximately, 80% of Patients with chronic renal failure have high phosphorus levels versus 20 % within normal reference interval. On the other hand, 60% of patients have low calcium levels (<8.5 mg/dL). This study demonstrates a significant association between calcium and phosphor in parathyroid hormones, there is a strong direct relationship between high phosphorus levels (hyperphosphatemia) and increased parathyroid gland (PTH) activity in hemodialysis patients, as phosphorus retention and a deficiency of active vitamin D stimulate the gland to secrete more hormone, causing bone and cardiovascular complications. Dietary and therapeutic control of phosphorus is vital.

Keywords: Chronic renal failure, parathyroid hormone (PTH), hemodialysis

Introduction

Renal failure that has persisted for a long time, a progressive ailment, is characterized by functional and structural kidney abnormalities from a variety of causes. A decrease in kidney function is indicated by a higher estimated glomerular filtration rate (eGFR) (**Abdel & Shawky., 2023).**

Among the changes that occur In the body of kidney failure patients are low calcium level and high phosphorus level in the blood. These changes can lead to many health problems, such as osteoporosis, atherosclerosis, and nervous system problems.

Hemodialysis patients (HD) is defined as a decline in renal function over three months, as expressed through the assessment of a glomerular filtration rate (GFR) falling below the threshold of 60 mL/min per 1.73 m2 or a kidney damage marker (**Atif., 2016).** Chronic kidney disease indirectly impacts worldwide disorders and mortality by increasing the odds of at least five other leading causes of death. DM, malaria, HIV, hypertension, and cardiovascular disease (CVD). Using the Global Burden of Disease (GBD) as an illustration, it is estimated that there will be 1.2 million deaths each year, 19 million DALYs, and about the same number of years lost to reduced glomerular filtration rates. In addition, renal failure was the cause of death for 1.2 million people in 2015, up 32% from 2005. An estimated 2.3–7.1 million people with ESRD died in 2010 due to a lack of access to chronic dialysis (**Badiu., 2018**). Also, 1.7 million people are thought to die annually as a result of acute renal impairment **(Bichari *et al.*, 2020**). It's estimated that about five to ten million individuals are dying annually because of renal disease (**Dhillon-Jhattu *et al*., 2023).** Renal hemodialysis is a treatment option for people with end-stage renal disease (**Disease., 2023**).

The current study aimed to determine the variation of calcium and phosphor levels among CKD patients during hemodialysis and expected health consequences.

Materials and Methods

Research methodology and participants

An overall 100 patients were diagnosed and confirmed by a specialist physician. Other diseases that can cause a similar clinical picture to chronic kidney disease, like sepsis-infected double immune, catheter-critical, chest infection, hepatitis C, B infectious disease, hepatitis, and chronic liver disease, were excluded. The ages of participants in the study ranged from 20 to 63 years for both sexes. They were residences in Al-Kut city(Wasit province, Iraq) during the period from July to November (2024). In addition to 50 healthy were selected as a control group.

Laboratory evaluation included ionized calcium (reference range: 1.11–1.40 mmol/l) and serum phosphorus (reference range: 2.3–4.5 mg/dl), determined by automated methods. Serum iPTH (reference range: 10–65 pg/ml) was measured by chemiluminescence assay (DPC; Medlab, San Antonio, TX, USA).

Statistical analysis

GraphPad Prism Software was served to identify significant differences between the findings of study groups at $p<0.05$ throughout the one-way ANOVA and 95% confidence interval (95%CI).

Results and Discussion

The total number of study population is 100. Regarding the gender distribution, the group of patients included 60 males (60%) and 40 females (40%), distributed as shown in the figure in figure (1)

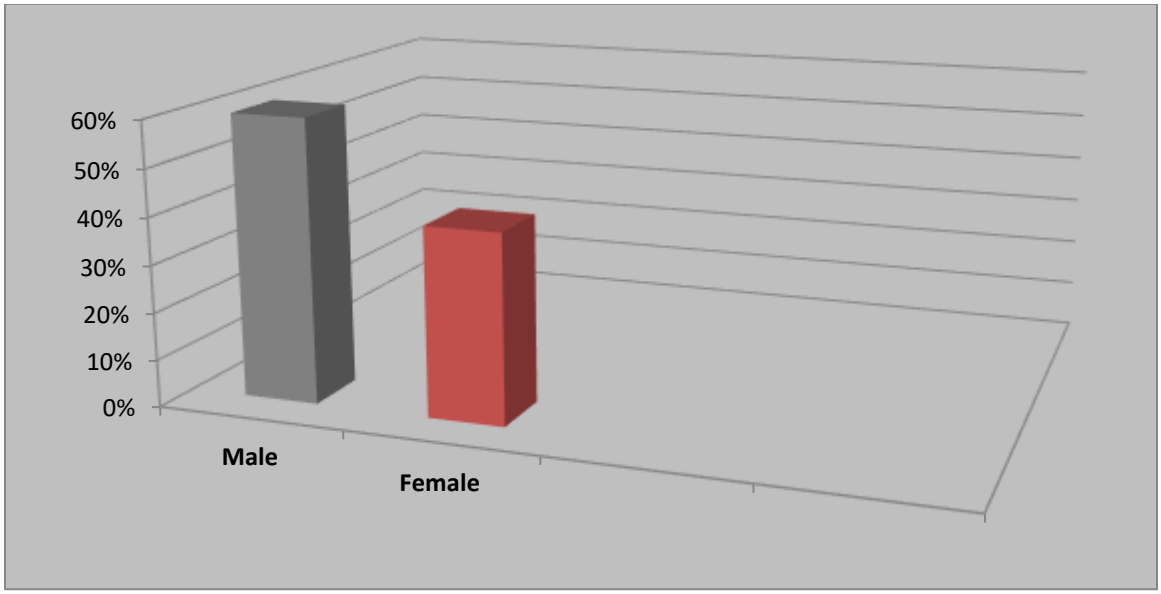


Figure : Sex distribution of the study groups.

Furthermore, the distribution of patients included in the study according to disease severity or disease stage was as detailed in figure 2

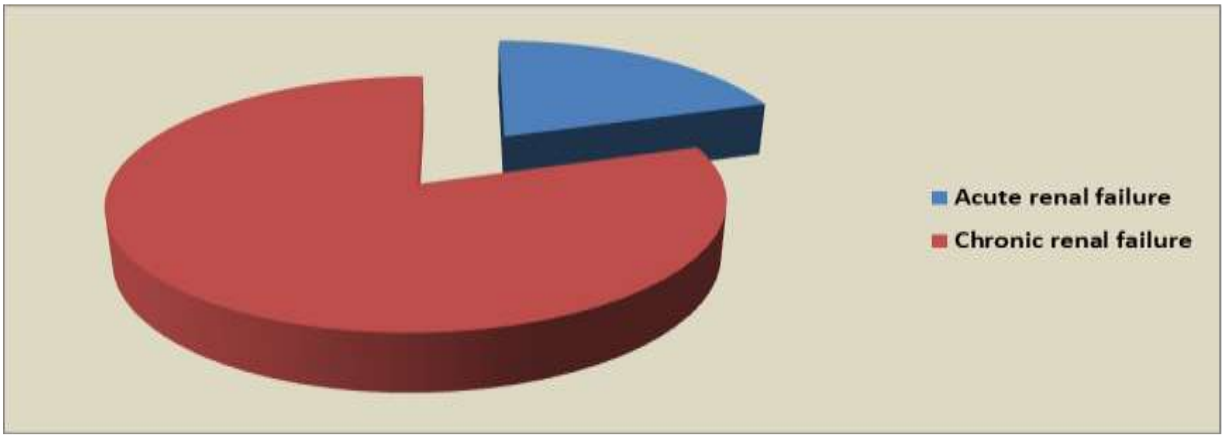


Figure 2 : Distribution according to the disease severity.

Subsequently, the findings were recorded a significant elevation in PTH hormones (376.166pg/ml) after the dialysis session in approximately 94% of the studied group in comparison with those as explained in figure (3).

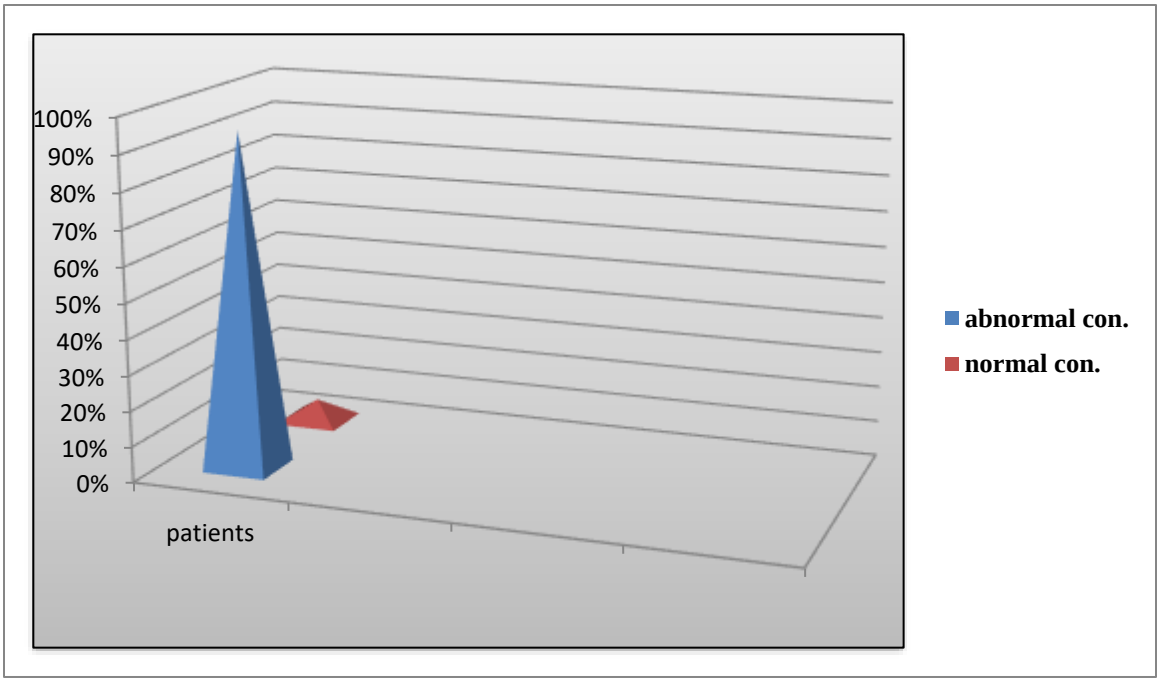


Figure 3: levels of Parathyroid hormone among the groups of study population.

This conformity with many previous prior investigation **(Ephraim & Jewell., 2021; Jacquillet & Unwin., 2019).** Increased PTH secretion is observed when there is a decrease in serum Ca levels, an increase in serum phosphorus levels, or a decrease in serum vitamin D levels. Conversely, elevated levels of blood calcium, or calcitriol, in the blood suppress PTH secretion. The decrease in serum calcium levels that occurs, as a result, stimulates the secretion of PTH and had a role in the development of secondary hyperparathyroidism. The factors involved in the reduced response of the target organs to PTH include downregulation (**Mohamed *et al.*, 2023**).

Furthermore, significantly ($p<0.0096$, 95% CI:53.25 to 176.5 pg/ml) was shown an elevation in values of blood phosphorus levels the CKD patients. Approximately, 80% of patients with chronic renal failure have high phosphorus levels versus 20 % within normal reference interval as shown in figure (4)

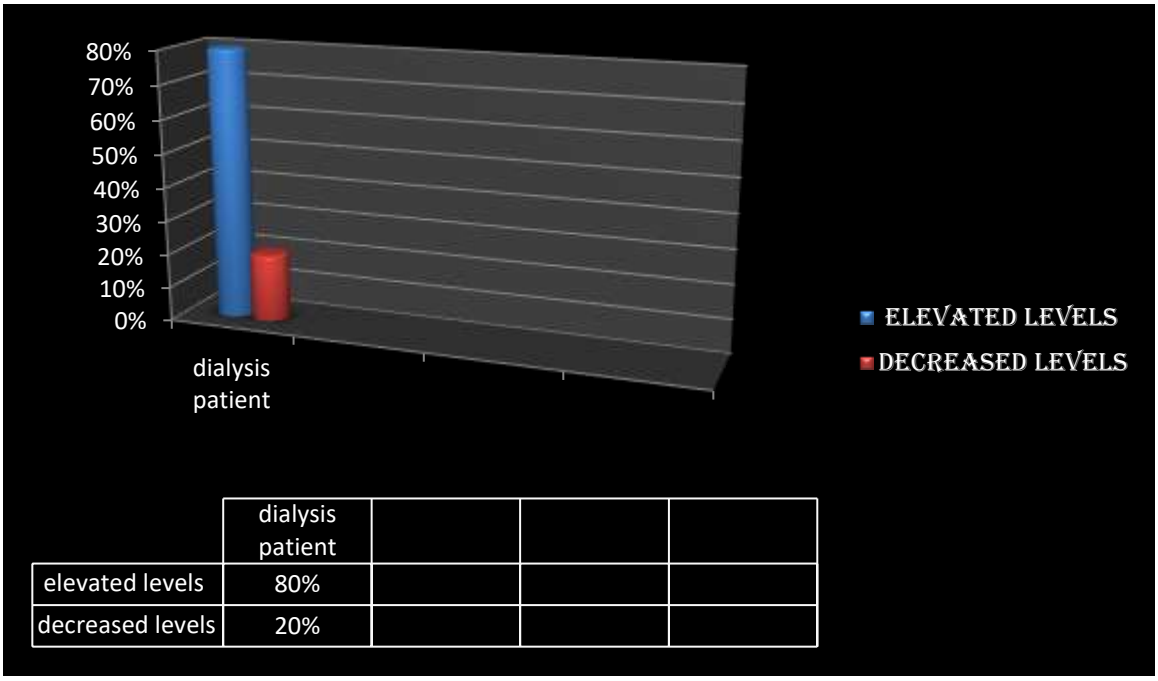
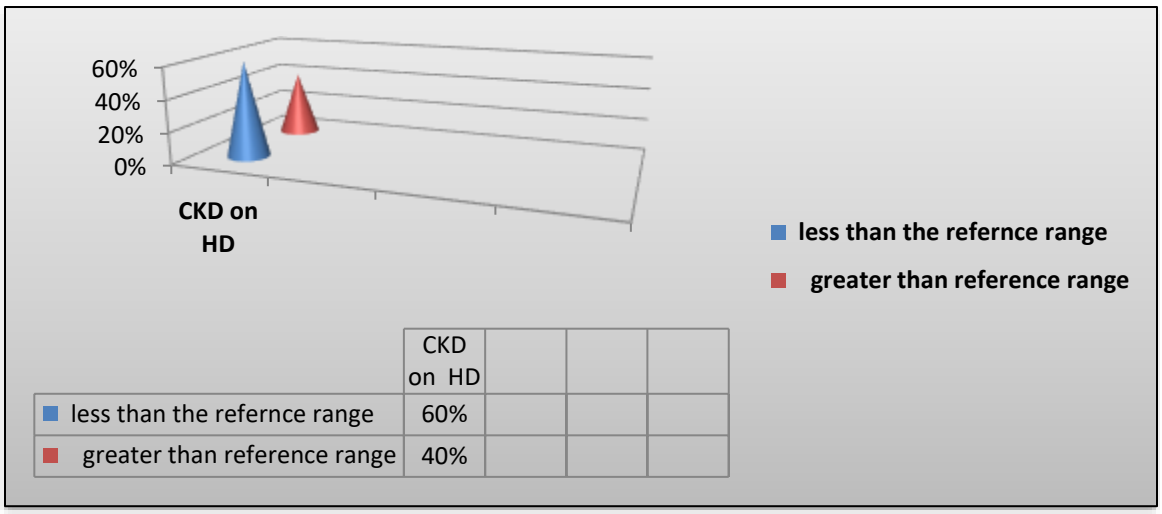


Figure 4: Percentages of the phosphorus among CKD patients on dialysis.

This findings is consistent with (**Raikou., 2021**), referred to many valid factors for chronic hyperphosphatemia in dialysis patients, including the following Phosphate elimination during a single hemodialysis session is only 800 - 1000 mg. As a result, dialysis three times a week is insufficient to eliminate the required daily intake of phosphorus (1,000 mg/d) for dialysis patients. On the other hand, 60% of patients have low calcium levels (<8.5 mg/dL). As detailed in the figure 5.



Figure(5): Percentages of the phosphorus among CKD patients on dialysis.

This finding agrees with (Wan *et al*., 2019), referring to that serum Ca concentrations are lower in renal failure patients and attributed this to an increase in serum Pi because serum Ca and Pi concentrations have an inverse relationship and any increase in one will result in a decrease in the other (**Yamada & Nakano., 2023**). Another possible explanation is a disturbance in vitamin D synthesis, which is caused by the kidney's failure to synthesize the active form of vitamin D (1,25-dihydroxycholecalciferol), which is very important for calcium absorption in the patient's intestine **(Yu *et al*., 2021).**

Conclusion

This study demonstrates a significant association between calcium and phosphor in parathyroid hormones, there is a strong direct relationship between high phosphorus levels (hyperphosphatemia) and increased parathyroid gland (PTH) activity in hemodialysis patients, as phosphorus retention and a deficiency of active vitamin D stimulate the gland to secrete more hormone, causing bone and cardiovascular complications. Dietary and therapeutic control of phosphorus is vital.

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