ORIGINAL ARTICLE

Correlation of Serum Parathyroid Hormone with Hemoglobin Levels among Patients Undergoing Maintenance Hemodialysis

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ABSTRACT

Background: Anemia is a common complication in chronic kidney disease which is associated with a reduced quality of life and an increase in morbidity and mortality along with high financial burden.
Objective: To assess the correlation of serum intact parathyroid hormone with hemoglobin levels among patients undergoing maintenance hemodialysis.
Methodology: This cross-sectional study was conducted at Dialysis Unit, Jinnah Hospital/Allama Iqbal Medical College Lahore from 1st December 2022 to 30th June 2023. Sixty patients undergoing maintenance hemodialysis were enrolled. All patients underwent venepuncture by taking 3 ml of the blood using aseptic measures and sample was sent to pathology for the estimation of serum parathyroid hormone and hemoglobin levels as per manufacturer's guidelines.
Results: There were 60% males and diabetes was present in 40% patients. The mean age was 45.92±14.88 years, mean body mass index was 30.40±28.83 kg/m^2, mean number of dialysis sessions was 2.53±0.50, mean serum parathyroid hormone was 605.56±390.30 and mean hemoglobin level was 7.72+2.05. Spearman rank correlation showed significant (P=0.046) correlation between serum parathyroid hormone and hemoglobin level.
Conclusion: There was significant correlation was observed between serum intact parathyroid hormone with hemoglobin levels among patients undergoing maintenance hemodialysis.
Keywords: Hemodialysis, Chromic kidney disease, Serum intact parathyroid hormone, Hemoglobin levels

INTRODUCTION

Anemia is generally defined as hemoglobin of less than 13.0g/dL in men and less than 12.0g/dL in premenopausal women.[1] The anemia associated with chronic kidney disease (CKD) is classified as normocytic normochromic hypoproliferative anemia. The condition frequently occurs with CKD and leads to worse health results and higher death rates.[2] The condition arises from glomerular filtration rate (GFR) values that decrease below 60 mg/ml. The anemia remains uncommon in kidney patients when their GFR surpasses 80 mL/min/1.73 m2. The anemia condition becomes more intense when GFR continues to decrease.[3]

Gender and hematopoietic responses to iron deficiency comprise the main factors influencing anemia development. When we discuss anemia we are describing one of the common CKD associations which produces adverse clinical effects.[4] Research studies have produced conflicting evidence about erythropoiesis-stimulating agent therapy for anemia in CKD patients because these medicinal agents may reduce patient survival rates and increase disease severity.[5] Doctor Richard Bright established the connection between anemia and CKD as a medical fact for the first time exactly 170 years ago.[6] The development of kidney disease results in progressively higher anemia rates so that almost every stage 5 CKD patient experiences this condition.[7] The condition of anemia which arises from chronic renal disease typically reduces patient quality of life then elevates their risk for cardiovascular issues and mental impairment as well as hospital admissions and mortality.[8]

Anemia from chronic renal disease develops from several causes with the main accepted reason being reduced erythropoietin (EPO) hormone production from the kidneys for stimulating red blood cell production.[9] Research shows that reduced erythropoietin production occurs coincidently with hypoxia-inducible factor down regulation which controls erythropoietin gene expression.[10] Uremia and folate along with vitamin B12 deficiencies cause RBC deformity which leads to hemolysis while uremia itself may result in iron deficiency and dysfunctional platelets that produce bleeding. Blood loss from

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hemodialysis occur only rarely.[1]

The occurrence rate of renal replacement therapy (RRT) depends on the combination of end-stage renal disease (ESRD) creating factors incidence and prevalence together with early chronic kidney disease detection practices and strategies to prevent ESRD development. The identification of patients with declining eGFR and high proteinuria levels and hospital-acquired kidney injuries enables planned initiation of RRT which reduces the number of patients starting RRT as emergencies.[11] All patients who will develop end-stage renal disease together with their caregivers require comprehensive physical and psychological support while having immediate access to essential knowledge regarding treatment pathways. Preventative measures for dialysis complications include maintaining functioning catheters and fistulas to stop the need for temporary access leading to sepsis or thrombosis and bleeding and ultimately faster mortality rates. When patients receive education, they tend to select home dialysis therapy because it provides societal advantages combined with reduced costs and maintains a higher quality of life. The educational programs should start during stage 4 CKD because patients require enough time and mental capacity to understand their choices about RRT and learn necessary preparation steps.[12]

In 2010, approximately 2.5 million people worldwide received chronic RRT, with high absolute rates in North America and maximum prevalence in Taiwan and Japan. The population receiving RRT maintains track through the national and local dialysis registries which collect data about rates and clinical outcomes and standard dialysis procedures across the country.[13] These systems offer hospital information in addition to safety and quality assessment reports while providing clinical research resources to patients choosing dialysis. Socio-cultural along with socioeconomic factors influences choice of dialysis. Both ESRD occurrence rates and the incidence of CKD show higher numbers in the African American population while the White population reports higher CKD cases. The leading causes of ESRD burden are diabetes mellitus (45%) and hypertension (30%) together with polycystic kidney disease, obstructive nephropathy and glomerulonephritis as uncommon contributors.[14] Women face elevated risks for the development of CKD yet men tend to be at higher danger of ending in ESRD. Customers from racial minorities

encounter healthcare barriers because their financial situation affects their insurance options and their income status. The kidney disease prevalence among Indigenous people in Australia and New Zealand and Nations from Canada and the United States remains high while their access to transplantation services is restricted which leads to reduced patient outcomes.[15]

The US National Kidney Foundation launched the Kidney Disease Outcomes Quality Initiative (K/DOQI) international guidelines during 2003 to establish serum intact parathyroid hormone (iPTH), calcium (Ca), and phosphorus (P) targets for decreasing the CKD-MBD-related death rate. Data showed that achieving this total HD treatment duration guideline proved difficult to execute because it could not be sustained.[7,8] The launch of the new CKD-MBD guideline from KDIGO came after their initial recommendation. According to the guideline providers should keep serum iPTH values somewhere between two and nine times higher than the highest normal measurement values.[9] The increased understanding of CKD-MBD occurred after this guideline launch but the overall strength of evidence rating for this iPTH recommendation is only C since the research remains uncertain of mortality outcomes at different serum iPTH levels.[16]

The rationale of this study is to determine the correlation of intact parathyroid hormone with hemoglobin levels in patients of maintenance hemodialysis. The variations in the existing literature make this correlation in conclusive. Therefore, further studies are needed further explore the correlation. Thus, this study will generate more evidence regarding the role of parathyroid hormone in anemia among patients undergoing haemodialysis and will highlight the management of these hormone levels in the treatment of anemia helping in evidence based management and improving the outcomes in these patients.

MATERIALS AND METHODS

This was a cross-sectional study conducted at Dialysis Unit, Jinnah Hospital Lahore from 1st December 2022 to 30th June 2023 and 60 patients were enrolled. Patients of both genders, aged 18-75 years undergoing maintenance hemodialysis at nephrology ward were included. All patients suffering from anemia due to other chronic diseases determined by history and medical records, suffering from Bleeding disorders determined by bleeding and clotting profile and pregnant women determined on history were excluded. All patients underwent venepuncture by taking 3 ml of the blood using aseptic measures and sample was sent to pathology for the estimation of serum parathyroid hormone and hemoglobin levels as per manufacturer's guidelines. Data was entered and analyzed through SPSS-21. Pearson correlation was applied to check the correlation between serum intact parathyroid levels and hemoglobin levels taking p value <0.05 as statistically significant.

RESULTS

There were 60% males and 40% female patients. Diabetes was present in 24 (40%) patients while it was not present in 36 (60%) patients. The mean age was 45.92±14.88 years, body mass index was 30.40±28.83 (kg/m^2), number of dialysis sessions was 2.53±0.50, serum parathyroid hormone was 605.56±390.30 pg/mL and hemoglobin level was 7.72±2.05 (g/dL) [Table 1-2]. Spearman rank correlation showed significant correlation between serum parathyroid hormone and hemoglobin level having p-value = 0.046 (Table 3).

Table 1: Demographic information of the patients (n=60)

Variable	No.	%
Gender		
Male	36	60.0
Female	24	40.0
Diabetes		
Yes	24	40.0
No	36	60.0

Table 2: Descriptive statistics of the patients (n= 60)

Variable	Mean±SD
Age (years)	45.92±14.88
Body mass index (kg/m$_2$)	30.40±2.88
Number of dialysis sessions	2.53±0.50
Serum parathyroid hormone (pg/mL)	605.56±390.30
Hemoglobin level (g/dL)	7.72±2.05

Table 3: Spearman rank correlation of serum parathyroid hormone and hemoglobin level

Variable	Statistics	Serum parathyroid hormone (pg/mL)	Hemoglobin level (g/dL)
Serum parathyroid hormone	Correlation Coefficient	1	0.259*
	Sig. (2-tailed)		0.046
	N	60	60
Hemoglobin level	Correlation Coefficient	0.259*	1
	Sig. (2-tailed)	0.046	
	N	60	60

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

DISCUSSION

Chronic kidney disease (CKD) represents a significant global health burden, with end-stage renal disease (ESRD) requiring long-term renal replacement therapy such as maintenance hemodialysis (HD). Among the myriad complications associated with ESRD, two of the most clinically impactful are anemia and secondary hyperparathyroidism (SHPT), both of which significantly contribute to increased morbidity and reduced quality of life in dialysis patients. Anemia in CKD is multifactorial, primarily driven by reduced erythropoietin production, iron deficiency, inflammation, and bone marrow suppression. Simultaneously, disturbances in mineral metabolism, particularly elevated levels of serum parathyroid hormone (PTH), are a common complication of CKD-mineral and bone disorder (CKD-MBD).[14,15] This study showed that diabetes affected 40% of patients because diabetes mellitus stands as a well-recognized cause of CKD worldwide. The study subjects maintained a mean age of 45.92±14.88 years which matches the ESRD patient demographics in developing countries since patients commonly develop advanced kidney disease because they receive delayed diagnosis together with restricted access to preventive care.[16] According to previous studies and findings the patient pool mainly consisted of male patients who accounted for 60% of the total population. The patients in our study presented with an elevated mean serum PTH level of 605.56±390.30 pg/mL which indicated secondary hyperparathyroidism as a significant complication of CKD brought on by phosphate retention alongside hypocalcemia and decreased vitamin D synthesis. The anemia situation in this patient group was confirmed by the significantly low mean hemoglobin measurement at 7.72±2.05 g/dL.[17]

Serum parathyroid hormone (PTH) mound to hemoglobin (Hb) levels in dialysis patients at a mild yet measurable degree in direct correlation. This stands against previously documented inverse PTH-Hb relationships. Medical science once accepted that patients with chronic kidney disease and elevated PTH levels presented with anemia because of bone marrow fibrosis combined with reduced erythropoietin responsiveness. Hemodialysis patients demonstrated a systemic relationship between intact PTH levels and anemia, but no direct link was found according to Shavgulidze et al.[11] The analysis of Baradaran and Nasri[12] found an opposite pattern between PTH and Hb measurements which indicates that elevated PTH could lead to development of anemia in CKD patients. The positive correlation identified in the current study may be influenced by various factors, including differences in patient demographics, dialysis protocols, or the management of secondary hyperparathyroidism (SHPT). Recent advancements in SHPT treatment, shown efficacy in controlling PTH levels without significant adverse effects. A phase 3 study demonstrated that upacicalcet effectively reduced iPTH levels in hemodialysis

patients, with a significant proportion achieving target PTH concentrations.[17] Improved management of SHPT may mitigate its impact on erythropoiesis, potentially explaining the observed positive association between PTH and Hb levels.[18]

Furthermore, the complexity of anemia in CKD patients involves multifactorial etiologies, including iron deficiency, inflammation, and nutritional status. The variables may confound the relationship between PTH and Hb levels, necessitating comprehensive assessments in future research. This study brings to light essential connections regarding how renal failure patients manage mineral metabolism with their anemia condition.

CONCLUSION

There was significant correlation was observed between serum intact parathyroid hormone with haemoglobin levels among patients undergoing maintenance haemodialysis.

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