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ORIGINAL ARTICLE

Variations in Serum Iron Profile, in Pre and Post Hemodialysis Patients of Chronic Renal Failure

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ABSTRACT

Objective: To determine the variations in iron profile in pre- and post-hemodialysis patients with chronic renal failure.

Material and methods: This cross-sectional study was conducted at the physiology department with the collaboration of the urology department of Liaquat University Hospital Hyderabad, from April 2021 to September 2021. Patient of either gender with chronic kidney disease between the ages of 18- and 50-years undergoing hemodialysis were included. Blood samples were collected using serum tubes to analyze the iron profile before and after dialysis. Changes in hematological parameters were evaluated by comparing pre and post data. All data were recorded in a proforma and entered into the SPSS 26.0 version for the purpose of analysis.

Results: A total of 167 patients were studied; their mean age was 43.23+12.90 years. Out of all study subjects 61.1% were males and 38.9% were females. The mean duration of dialysis was 13.40 ± 2.88 months. As per the pre- and post-serum iron profiles, the average serum iron level, serum ferritin level, and serum TIBC were statistically insignificant (p- >0.05).

Conclusion: In conclusion, the iron levels before dialysis were observed to be higher than after dialysis, and the average levels of serum ferritin and total iron binding capacity (TIBC) were found to be higher after dialysis, albeit statistically insignificant.

Keywords: Hemodialysis, serum iron, ferritin, TIBC

INTRODUCTION

Chronic kidney disease (CKD) is a worldwide public health issue that is associated with a significant burden and high cost of care, particularly in developing nations.[1] It is a condition in which the kidneys progressively lose their function over time. Hypertension, diabetes and glomerulonephritis are the primary factors that contribute to the development of chronic kidney disease.[2] The staging of chronic kidney disease is determined by assessing the estimated (eGFR) and the existence of kidney damage, with the condition being divided into five different stages. CKD is a modern-day silent epidemic, with studies indicating that up to 16% of the adult population may be affected by this condition.[3] According to reports, the prevalence of CKD in Pakistan is age-specific, with 43.6% of the elderly population and 10.5% of the younger population affected by this condition.[4] CKD seems to be a disorder that can have numerous causes and is characterized by a gradual and permanent decrease in kidney function due to the slow degradation of renal parenchyma.[5] CKD can eventually lead to mortality if sufficient numbers of nephrons become affected.[5] Hematological abnormalities are widespread in CKD because of a relative shortage or reduction in erythropoietin (EPO) production, in addition to other variables such as enhanced hemolysis, inhibition of bone marrow erythropoiesis, and blood in the urine and blood loss gastrointestinal tract.[5,6] There is a correlation between the severity (stages) of kidney impairment and the prevalence of anemia, with the prevalence increasing as the condition progresses. The prevalence of anemia can range approximately 1% during Stage II of chronic kidney disease to nearly 100% in end-stage renal disease.[6] Individuals with CKD experience both absolute and functional iron deficiency. Absolute iron deficiency is characterized by a significant decrease or absence of iron stores, while the physiological deficiency of iron is characterized by sufficient iron stores but inadequate accessibility of iron to be integrated into early-stage red blood cell precursors. This is primarily caused by elevated levels of hepcidin. A correlation has been found between anemia in individuals with chronic kidney disease and a higher probability of both morbidity and mortality. People who have chronic kidney disease who are in the pre-dialysis stage may be at risk for developing iron deficiency anemia due to malnutrition because anorexia is a typical symptom in these patients, along with restrictive dietary requirements. The link between anemia and mortality rates may be influenced by the extent of the anemia.[7] Studies have shown that there can be variations in iron profile in pre- and post-hemodialysis patients with CRF. Prior to hemodialysis, many CRF patients have low levels of iron in their blood, due to a combination of factors such as reduced iron absorption and increased iron loss through urine or blood loss during dialysis. However, after hemodialysis treatment, iron levels can often increase in CRF patients due to the iron supplementation provided during the treatment. The increase in iron can lead to an improvement in hemoglobin levels, which can alleviate anemia symptoms and improve overall health outcomes for the patient. However, it is important to monitor the iron profile of CRF patients undergoing hemodialysis, as both iron deficiency and excess can have negative consequences on the patient's health. The purpose of this study is to compare the pre and post iron profiles of patients with chronic renal failure who were on hemodialysis.

MATERIALS AND METHODS

This cross-sectional study was conducted in the physiology department, and data were collected from urology department I at Liaquat University Hospital Hyderabad. The study lasted six months, from April 2021 to September 2021. Patients between 18 and 50 years of age, of both genders, and undergoing hemodialysis due to chronic kidney disease were included. Patients don't want to agree to participate in the study; patients with thalassemia or other endocrinology disorders and pregnant women were excluded. Written consent was obtained from all the patients. Complete clinical examinations were carried out. Blood samples were taken before and after the dialysis with anticoagulant and serum tubes for serum iron profile investigations like serum iron level, serum ferritin level, and serum TIBC. Both pre and post hematological parameters were compared to see the alteration in the serum iron profile. All iron profile tests were performed by senior pathologists with at least 5 years of experience. All the data were entered in the proforma. All the data were entered and analyzed using SPSS 26 version.

RESULTS

A total of 201 participants were enrolled in the study. The A total of 167 patients were analyzed in this study, with an average age of 43.23+12.90 years. The majority of the patients were male (61.1%), while the rest were female (38.9%). The most common

causes of renal failure were diabetes mellitus and hypertension, followed by post-partum hemorrhage (4.8%), stones (3.6%), and a small gallbladder (1.2%). The average duration of dialysis was 13.40+2.88 months, the average temperature was 98.01+0.52 °F, the mean pulse rate was 83.79+5.99, and the average body weight was 58.38+13.23 kg. Weekly episodes of dialysis are presented in table.1

The iron level before dialysis was higher than after dialysis, but the average levels of serum ferritin and TIBC were higher after dialysis. However, the average levels of serum iron, serum ferritin, and serum TIBC before and after dialysis were not significantly different based on statistical analysis (p->0.05). Table.2

Table 1: Demographic and clinical characteristics of the patients n=167

Variables		Statistics	
Age	Mean+SD	43.23+12.90 years	
	Minimum	18 years	
	Maximum	50 years	
Gender	Male	102	61.1%
	Female	65	38.9%
	Total	167	100.0%
Causes of renal failure	Diabetes	34	20.4%
	Hypertension	80	47.9%
	Postpartum haemorrhage	08	04.8%
	Hypertension + diabetic	37	22.2%
	Stone	06	03.6%
	Small size gallbladder	02	01.2%
Weekly episode of dialysis	1	40	24.0%
	2	121	72.5%
	3	06	03.6%

Table 2: Comparison of serum iron profile in pre and post dialysis n=167

Variables	Paired Samples Statistics				
	Mean	Std. Deviation	Mean differ.	Correlation	Sig.
Pre serum Iron	146.54	520.91	29.20096	-.030	0.581
Post serum Iron	117.34	424.07			
Pre serum ferritin	1311.41	3462.59	178.03510	.105	0.630
Post serum ferritin	1133.38	3661.58			
Pre serum TIBC	211.62	58.83	-331.05377	.078	0.154
Post serum TIBC	542.68	2993.87			

DISCUSSION

Patients with chronic renal failure undergoing hemodialysis may also experience variations in their serum iron profile before and after the procedure. This is because chronic renal failure can lead to disturbances in iron metabolism and hemodialysis can affect the balance of iron levels in the body. This study has been done to investigate the changes in the iron profile of chronic renal failure patients before and after hemodialysis. In this study the most common causes of renal failure were diabetes mellitus and hypertension, followed by post-partum hemorrhage. In the comparison of this study, Ali M et al[8] reported that the presence of renal impairment was found to have a substantial correlation with hyperglycemia as well as hypertension. During the course of the trial, 71.3% of individuals were determined to have diabetes.[8] In another study by Nazzal Z et al[9] reported that the those who have diabetes are at an increased risk for developing CKD. It has been established that an increased risk of having CKD is associated with co-morbid hypertension, smoking, and advanced age.[9] In the study by Salman M et al[10] also found consisting findings regarding risk factors. In the case of diabetes, elevated levels of glucose in the bloodstream can cause harm to the tiny blood vessels within the kidneys, resulting in a medical condition known as diabetic nephropathy. Over time, diabetic nephropathy can lead to the buildup of scar tissue in the kidneys, which can impair their ability to filter waste and fluids from the blood. This can eventually lead to kidney failure. In fact, diabetes is the leading cause of CKD, accounting for nearly half of all cases. For individuals with CKD, controlling blood sugar levels and blood pressure are crucial for slowing down the progression of the disease and reducing the risk of complications. This may involve lifestyle changes, such as adopting a healthy diet and increasing physical activity, as well as medication management.

In this study the level of iron was higher before dialysis compared to after dialysis, the average levels of serum ferritin and TIBC were found to be higher after dialysis. However, statistical analysis indicated that there was no significant difference in the average levels of serum iron, serum ferritin, and serum TIBC before and after dialysis (p-value >0.05). In the comparison of this Kamal NM et al[11] observed reduced levels of serum iron, TIBC, and transferrin saturation (TSAT) in individuals with CKD and undergoing hemodialysis, while serum ferritin levels were found to be higher in comparison to the control group. The elevated levels of ferritin may be a result of functional iron deficiency and reticuloendothelial blockade associated with this condition. On the other hand, ISHAQ S et al[12] conducted study on pediatric population and they observed that a significant prevalence of excess iron was observed in pediatric patients with CKD who were undergoing regular hemodialysis, and there was a direct correlation between the severity of CKD and the occurrence of iron overload. In the line of this series, Abd Alla MB et al[13] reported that, in their study hemodialysis patients who received regular blood transfusions had noticeably elevated levels of serum iron and serum ferritin compared to hemodialysis patients who did not receive regular blood transfusions. The differences between the two groups were statistically significant, with p-values of 0.000 and 0.01, respectively. In the study by Deori R[14] and colleagues observed a statistically significant rise in total iron binding capacity (TIBC) in individuals diagnosed with CKD (p-< 0.05) and on the other hand, CKD subjects had significantly lower levels of serum iron compared to the control group.[14] Bashir BA et al[15] reported that the out of thes patients who were administered intravenous iron, 31 individuals (62%) had an increase in their ferritin levels. Although, they did not found significant difference was found in the total iron binding capacity (TIBC) and unsaturated iron-binding capacity (UIBC) in comparison to the control group, indicating a lack of statistical significance.[15] Other studies also found elevated levels of serum ferritin observed in patients diagnosed with chronic kidney disease (CKD).[16,17] In the comparison of our findings Verma R et al[18] reported that in a sample of 70 patients, the percentages of individuals with low hemoglobin levels were 80%, while 40% had a decreased ferritin level, 34.3% had a decreased iron level, and 37.14% had an increased total iron binding capacity (TIBC). Iron profile variations in pre and post hemodialysis patients with chronic renal failure (CRF) have been a topic of debate in the literature. Different studies have reported conflicting results on the iron status of hemodialysis patients, and this can be attributed to the differences in selection criteria and sample size. One of the most significant controversies in the literature is the interpretation of serum ferritin levels in hemodialysis patients. While some studies have reported elevated serum ferritin levels in hemodialysis patients, others have reported lower levels. This discrepancy can be attributed to the acute-phase response induced by hemodialysis, which can lead to an increase in serum ferritin levels. Moreover, differences in sample size and selection criteria can also contribute to the conflicting results in the literature. Studies with small sample sizes may not accurately reflect the general population, while studies with different selection criteria may not be comparable. Current study had also several limitations like limited sample size which can limit the generalizability of the findings and affect the power of the analysis, lack of correlation with blood transfusion rate, which can significantly affect the iron status of hemodialysis patients and hemodialysis patients with CRF often have different underlying etiologies of renal failure and comorbidities, which can make it challenging to draw definitive conclusions about the iron status of hemodialysis patients. However future large-scale studies should consider addressing these limitations to provide more robust and generalizable findings.

CONCLUSION

In conclusion, the iron levels before dialysis observed to be th higher than after dialysis, the average levels of serum ferritin and total iron binding capacity (TIBC) were found to be higher after dialysis, albeit statistically insignificant. The relationship between iron profile and hemodialysis in patients with chronic renal failure (CRF) is complex and still not fully understood. Overall, understanding the variations in iron profile in pre and post hemodialysis patients with CRF is crucial for proper management of iron deficiency or overload in this population. Further research is needed to clarify the relationship between hemodialysis and iron profile and to establish optimal management strategies for CRF patients.

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