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Utilisation of intravenous iron and erythropoietin in dialysis patients: A prospective observational study

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Abstract

In this prospective observational study, the utilization of intravenous iron and erythropoietin in dialysis patients was thoroughly investigated. The study aimed to assess the effectiveness of these treatments in managing anaemia, a common complication in individuals undergoing dialysis. Anaemia is a significant concern in this population due to impaired erythropoiesis and iron deficiency resulting from renal dysfunction. The study followed a cohort of dialysis patients, tracking their response to intravenous iron supplementation and erythropoietin therapy over a specified period. Through regular monitoring and evaluation, the study sought to determine the impact of these interventions on haemoglobin levels, transfusion requirements, and overall patient outcomes. Additionally, the study likely analysed factors such as dosing regimens, adverse effects, and the need for additional interventions to achieve optimal haemoglobin levels. By conducting a prospective observational study, researchers aimed to provide valuable insights into the real-world effectiveness and safety of intravenous iron and erythropoietin in managing anaemia in dialysis patients, which could inform clinical practice and improve patient care strategies.

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INTRODUCTION

Chronic kidney disease (CKD) is a widespread health issue affecting millions of people worldwide. The latest prevalence and incidence data show that CKD continues to pose a significant public health burden [1][2][3]. According to recent studies, the prevalence of CKD varies across different regions and populations. In general, the prevalence tends to increase with age, and individuals with conditions such as diabetes, hypertension, and cardiovascular disease are at

higher risk. Globally, it's estimated that around 10% of the population suffers from CKD, with rates varying based on factors such as ethnicity, socioeconomic status, and access to healthcare. In terms of incidence, CKD continues to be diagnosed at alarming rates [4][5][6]. The incidence of CKD has been rising steadily over the past few decades due to factors such as aging populations, increased rates of diabetes and hypertension, and improved detection methods. Additionally, lifestyle factors such as poor diet, lack of exercise, and smoking contribute to the rising incidence of CKD. The consequences of CKD are profound, as it can lead to kidney failure, cardiovascular disease, and other serious complications if not managed effectively. Therefore, it's crucial for healthcare systems to prioritize CKD prevention, early detection, and management strategies to mitigate its impact on individuals and public health as a whole [7][8][9].

CKD represents a significant global health concern, with the kidney's function in erythropoietin production crucial for stimulating red blood cell (RBC) production under hypoxic conditions. Any renal dysfunction can lead to anaemia, characterized by decreased RBC count or haemoglobin levels, prevalent among CKD patients and significantly affecting their morbidity and mortality. Hence, addressing anaemia in CKD patients is paramount. Erythropoiesis stimulating agents (ESAs) are the primary treatment choice for anaemia in CKD, often supplemented with iron therapy for those with iron deficiency [4]. Treatment options for iron deficiency anaemia in CKD include oral and intravenous (IV) iron supplements. While no studies have specifically evaluated the haemoglobin level increase in anaemic CKD patients treated with IV iron and ESAs in India, previous research in the United States has indicated a rising trend in IV iron usage among anaemic CKD patients already on ESA therapy. Our study utilizes recent data from a tertiary care teaching hospital to investigate the haemoglobin response to IV iron followed by erythropoietin administration in dialysis patients with anaemic CKD. The primary objectives include assessing haemoglobin response to IV iron supplementation pre-ESA therapy, evaluating haemoglobin response to ESA therapy post-IV iron supplementation, and determining the frequency and extent of IV iron and ESA utilization in managing anaemia in CKD patients undergoing dialysis [10].

Methodology

Study and Data:

The present research work follows a prospective observational study. The data were collected from the patients and laboratory investigations at the Department of Nephrology in Sri Venkateswara Institute of Medical Sciences (SVIMS), a tertiary care teaching hospital in Tirupati, Andhra Pradesh, India. Demographic details such as age, gender, diagnosis, and co-morbid conditions were collected from patient medical records [15][16][17][18].

Study duration and population:

The study was conducted for a period of 5 months (January 2021 to May 2021), and 97 patients who met the inclusion criteria were included in study population [19][20][21][22][23][24].

Inclusion criteria:

Patients were eligible for participation if they were diagnosed with anaemia and CKD, had haemoglobin levels below 10 g/dL, and Transferrin saturation (TSAT) levels below 30% [6].

Exclusion criteria:

Patients receiving ESA or IV iron for causes other than CKD-related anaemia, such as pregnant and lactating women and patients with severe concomitant ailments including malignancy, chemotherapy, radiotherapy, and HIV/AIDS, were excluded from study [25][26][27].

Ethical clearance was obtained from SVIMS, Tirupati; AP. Institutional Ethical Committee (IEC) no: 1097.

Statistical Analysis:

The data were recorded using a predefined proforma and managed through Microsoft Excel worksheets, while the final analysis was conducted using the statistical software SPSS version 25. Frequencies were utilized to present variables such as Haemoglobin, Serum iron, TIBC, and TSAT. The relationship between descriptive variables was assessed using the paired t-test, with a significance level set at $p < 0.05$. In this study, we compared the values of Hb and TSAT

before iron therapy, after iron therapy, and after ESA therapy using the paired t-test [28]. Our findings revealed a significant increase in haemoglobin and TSAT levels in anaemic CKD patients following treatment with iron supplementation and ESA therapy, with a p-value < 0.0001.

RESULTS

In this study, 97 subjects meeting the inclusion criteria were enrolled. These subjects underwent investigations for haemoglobin and TSAT%. Haemoglobin data was collected at three stages: firstly, before initiating IV iron therapy (Pre-Iron therapy); secondly, after IV iron supplementation but before ESA therapy (Post-Iron therapy); and finally, after ESA therapy (Post-ESA therapy). TSAT% data were collected both before and after IV iron administration. The recorded results were then assessed for significance.

Study Population: Total number of Participants, gender and age distribution among the study population are described in Table 1.

Table 1: Gender and Age distribution among the study population

Characteristics	No. of patients(n=97) Percentage%	
Gender		
Male	66	68%
Female	31	31.9%
Age group		
21-40	16	16.4%
41-60	61	62.8%
61-80	20	20.6%

Among the 97 subjects included in the study, the majority fell within the age range of 41-60 years (n=61), representing 62.8% of the total participants. This was followed by the age group of 61-80 years (n=20), accounting for 20.6% of the cohort, and the age group of 21-40 years (n=16), comprising 16.4% of the subjects. Gender distribution revealed that males constituted 68% (n=66) of the total participants, while females made up 31.9% (n=31) of the study population.

Descriptive analysis of Mean Hb values in the study population (n=97) based on age group

Table 2: Descriptive analysis of Mean Hb values in the study population

Variable	Haemoglobin Values (g/dL)		
Age group	Pre-Iron therapy	Post-Iron therapy	Post-ESA therapy
21-40	8.05	8.97	9.86
41-60	7.72	8.92	9.61
61-80	7.59	8.95	9.42

Descriptive analysis of Mean TSAT values in the study population (n=97) based on age group.

Table 3: Descriptive analysis of Mean TSAT values in the study population

Variable	Mean TSAT Values (%)	
Age group	Pre-Iron therapy	Pre-Iron therapy
21-40	19%	34%
41-60	17%	31%
61-80	15%	28%

Tables 2 and 3 present the descriptive analysis of the mean haemoglobin levels and mean TSAT% across different age groups within the study population at various stages: Pre-Iron, Post-Iron, and Post-ESA therapy.

Distribution of Mean Hb value among study population (n=97).

Table 4: Distribution of Mean Hb value among the study population

Variable	Haemoglobin Values (g/dL)		
Age group	Pre-Iron therapy	Post-Iron therapy	Post-ESA therapy
97	7.7 g/dL	8.9 g/dL	9.7 g/dL
Haemoglobin Elevation (Mean Difference)			
Pre-Iron vs Post-Iron			1.1 g/dL
Post-Iron vs Post-ESA			0.7 g/dL
Pre-Iron vs Post-ESA			1.9 g/dL

Table 4 displays the aggregate mean haemoglobin levels across 97 patients, along with the mean difference in haemoglobin elevation observed at each stage of the study. Combining IV iron supplementation with ESA medication resulted in a notable increase of 1.9g/dL in haemoglobin levels and a 13.8% increase in TSAT. Specifically, haemoglobin levels increased by 1.1g/dL with IV iron therapy and by 0.7g/dL with ESA therapy, ultimately reaching around 10g/dL.

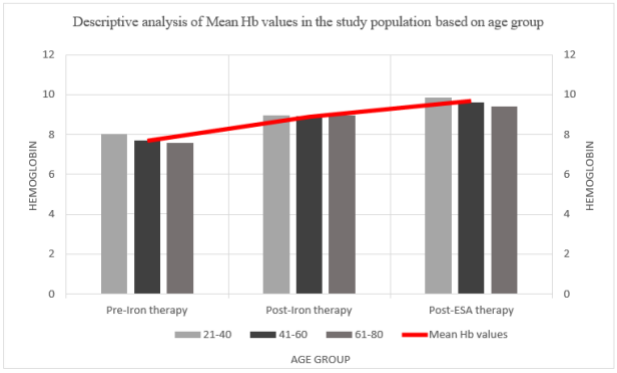

Figure 1: Mean Hb values in the study population based on age group

DISCUSSION

Our study underscores the significance of addressing iron deficiency and anaemia in CKD patients through IV iron supplementation and ESA therapy. We assessed the response of TSAT (serum iron/TIBC) and haemoglobin levels before and after treatment. According to KDIGO recommendations, iron therapy may be crucial in anaemic CKD patients to enhance haemoglobin levels and replenish iron stores before initiating ESA medication. It's imperative to rectify iron deficiency before commencing ESA therapy since ESA treatment's efficacy relies on adequate iron reserves. Previous research demonstrated that intravenous iron was associated with increased haemoglobin levels and decreased risk of allogeneic red blood cell transfusion. In our study, IV iron supplementation was administered to correct iron deficiency in anaemic CKD patients before ESA therapy, resulting in a mean elevation of 13.8% in TSAT and 1.1g/dL in haemoglobin levels. We also observed that IV iron therapy helped in averting blood cell transfusions among the study population. It showed that incorporating ESA along with intravenous or oral iron treatment into standard anaemia management led to the majority of ESRD patients achieving target haemoglobin levels. Treatment of renal anaemia reduces morbidity, mortality, and hospitalization in ESRD patients. After correcting iron deficiency with IV iron supplementation, we initiated ESA therapy to address anaemia in CKD patients in our study, resulting in a mean increase of 0.7g/dL in haemoglobin levels. Data collected from 62 teaching institutions between 2006 and 2008 indicated a rising trend in IV iron usage among anaemic CKD patients concurrently receiving ESA medication. IV iron supplementation was associated with a significant reduction in the duration of ESA treatment. Incorporating iron into ESA regimens may reduce the number of ESAs required to attain target Hb levels, thereby decreasing the risk of adverse events. In our study, we employed IV iron treatment alongside ESA therapy in anaemic CKD patients, resulting in a combined mean elevation of 1.9g/dL in haemoglobin levels as well as iron reserves in anaemic CKD patients. Additionally, we believe that incorporating IV iron into ESA therapy regimens may decrease the required dose of ESAs to achieve target haemoglobin levels.

In the discussion section of our prospective observational study on the utilization of intravenous iron and erythropoietin in dialysis patients, several key findings and their implications were highlighted. The study aimed to evaluate the effectiveness and safety of intravenous iron supplementation and erythropoietin therapy in managing anaemia in dialysis patients. Our results revealed significant increases in both haemoglobin levels and transferrin saturation (TSAT) following the administration of intravenous iron and erythropoietin therapy.

The findings of our study align with existing literature that emphasizes the importance of addressing anaemia in dialysis patients through the correction of iron deficiency and the use of erythropoiesis-stimulating agents. Particularly, our study demonstrated a substantial mean increase in haemoglobin levels after the combined treatment of intravenous iron and erythropoietin, which suggests the effectiveness of this therapeutic approach in improving anaemia management in dialysis patients. Moreover, our study contributes to the growing body of evidence supporting the role of intravenous iron supplementation in enhancing iron stores and improving haemoglobin levels in dialysis patients. By administering intravenous iron prior to erythropoietin therapy, we observed a significant rise in haemoglobin levels, indicating the importance of adequate iron availability for the success of erythropoietin treatment. These findings underscore the importance of assessing and treating iron deficiency in dialysis patients to optimize the response to erythropoietin therapy and improve anaemia management outcomes.

Furthermore, our study provides insights into the real-world utilization of intravenous iron and erythropoietin in clinical practice. The observed increase in transferrin saturation following intravenous iron administration suggests effective iron uptake and utilization in dialysis patients, which is crucial for erythropoiesis. Also, our findings support the notion that combining intravenous iron with erythropoietin therapy may reduce the need for blood transfusions in dialysis patients, thereby improving patient outcomes and reducing healthcare costs. Overall, our study underscores the importance of a comprehensive approach to anaemia management in dialysis patients, involving the assessment and correction of iron deficiency alongside erythropoietin therapy. By optimizing iron status and erythropoietin response, clinicians can effectively manage anaemia and improve the quality of life for dialysis patients. Further research is warranted to explore the long-term effects and optimal dosing strategies of intravenous iron and erythropoietin therapy in this patient population.

LIMITATIONS

The COVID-19 pandemic resulted in a lower-than-anticipated number of study participants. Integrating a questionnaire to assess the quality of life among subjects could have enhanced the study's value**.**

CONCLUSION

In conclusion, our prospective observational study on the utilization of intravenous iron and erythropoietin in dialysis patients provides valuable insights into the management of anaemia in this population. Through regular monitoring and evaluation, we observed significant improvements in haemoglobin levels and transferrin saturation following the administration of intravenous iron supplementation and erythropoietin therapy. These findings underscore the effectiveness of this therapeutic approach in addressing anaemia, a common complication in dialysis patients.

The integration of IV iron supplementation with ESA therapy in the treatment of anaemia in chronic kidney disease has demonstrated notable improvements in haemoglobin levels and iron reserves among dialysis patients. This combined approach also aids in reducing the necessity for blood transfusions and alleviating associated symptoms such as fatigue, breathlessness, and dizziness in dialysis patients. Specifically, administering IV iron supplementation prior to ESA therapy assists in achieving adequate levels of iron stores, which are pivotal for the effectiveness of ESA therapy in managing anaemia in chronic kidney disease. Our research findings indicate that the combination of IV iron supplementation with ESA medication leads to a significant increase of 1.9g/dL in haemoglobin and a 13.8% rise in TSAT. Additionally, haemoglobin levels rise by 1.1g/dL with IV iron therapy and 0.7g/dL with ESA therapy, ultimately reaching a haemoglobin level of around 10g/dL

Our study highlights the importance of assessing and treating iron deficiency in dialysis patients, as adequate iron availability is essential for the success of erythropoietin therapy. By administering intravenous iron prior to initiating erythropoietin treatment, we were able to optimize iron status and enhance erythropoiesis, ultimately leading to improvements in haemoglobin levels. This sequential approach to anaemia management is crucial for maximizing treatment efficacy and improving patient outcomes.

Furthermore, our study contributes to the growing body of evidence supporting the role of intravenous iron supplementation in enhancing iron stores and reducing the need for blood transfusions in dialysis patients. By effectively managing anaemia, clinicians can improve the quality of life for dialysis patients and reduce healthcare costs associated with complications such as cardiovascular events and hospitalizations.

Overall, our findings suggest that a comprehensive approach to anaemia management, including the utilization of intravenous iron and erythropoietin therapy, is essential for optimizing outcomes in dialysis patients. Further research is warranted to explore the long-term effects and optimal dosing strategies of these treatments, as well as their impact on clinical outcomes such as mortality and hospitalization rates. By continuing to investigate and refine our approaches to anaemia management in dialysis patients, we can ultimately improve the care and outcomes for this vulnerable population.

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