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Hemoglobin levels before and after hemodialysis in patients with chronic kidney disease

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Abstract

Chronic kidney disease refers to a progressive condition characterized by an irreversible decline in kidney function and generally requires hemodialysis therapy. This therapy can affect hemoglobin levels, which play an important role in oxygen transport and metabolic balance. This study aims to describe hemoglobin levels before and after hemodialysis in patients with chronic kidney disease. The study is a descriptive quantitative approach with a sample of 30 patients undergoing routine hemodialysis, selected using total sampling. Venous blood samples were collected before and after hemodialysis and analyzed using an automated hematology analyzer based on electrical impedance. The data were analyzed descriptively to characterize the distribution of hemoglobin levels and changes in hemoglobin levels during hemodialysis. The results indicated that most patients had hemoglobin levels below the reference value both before and after hemodialysis, with a tendency to decrease after hemodialysis. This pattern was observed across age groups and genders, suggesting that hemodialysis may contribute to changes in hemoglobin levels. These findings emphasize the importance of routine hematological monitoring in hemodialysis patients as part of clinical laboratory services to support early detection and management of anemia in chronic kidney disease.

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1. Introduction

Hemoglobin is the main component of erythrocytes, which transport oxygen from the lungs to tissues and carry carbon dioxide back to the lungs for excretion from the body. Adequate hemoglobin levels are significant for maintaining metabolic balance and organ function, including the kidneys, which require an optimal oxygen supply to perform filtration and regulate body homeostasis (Hall, 2015). Chronic kidney disease is a progressive and irreversible disorder of kidney function, characterized by a sustained decrease in glomerular filtration rate for 3 months or more. This condition leads to the accumulation of metabolic waste products and systemic complications, including anemia due to decreased erythropoietin production (Hinkle et al., 2022). Anemia in patients with chronic kidney disease is reported as a common clinical problem that contributes to a decline in quality of life and increased morbidity.

Hemodialysis becomes the most commonly used renal replacement therapy in patients with end-stage chronic kidney disease. This procedure aims to replace part of the kidney function through diffusion and ultrafiltration processes to remove toxic substances and excess fluid from the blood (Black & Hawks, 2009). Although effective in prolonging patient survival, hemodialysis can affect hematological parameters, particularly hemoglobin levels, through mechanisms such as blood loss during the procedure, hemodilution, and oxidative stress (Kidney International Supplements, 2012).

Several previous studies have reported differences in hemoglobin levels before and after hemodialysis, with a tendency for hemoglobin levels to decrease after dialysis. This condition can worsen anemia and affect patients' clinical status if not optimally monitored (Agustina & Wardani, 2019). Therefore, measuring hemoglobin levels before and after hemodialysis is important for evaluating therapy and planning patient management in patients with chronic kidney disease. This study aims to describe hemoglobin levels before and after hemodialysis in patients with chronic kidney disease. The results of this study are expected to strengthen clinical laboratory practices and support clinical decision-making in the care of hemodialysis patients.

2. Method

2.1 Research Design and Participants

The study used a descriptive observational design to describe hemoglobin levels before and after hemodialysis in patients with chronic kidney disease. The study was conducted at the Dharma Sidhi Main Clinic, Denpasar City, Bali. The study population comprised all patients with chronic kidney disease who underwent hemodialysis at the Dharma Sidhi Main Clinic during the study period. The sampling technique used was total sampling, so the entire population meeting the inclusion criteria was included as research subjects (Subhaktiyasa, 2024). The study included 30 patients. The inclusion criteria included patients with chronic kidney disease undergoing routine hemodialysis and willing to serve as research subjects. Patients with incomplete laboratory test data were excluded from the analysis.

2.2 Instruments and Data Collection

Data collection was performed using venous blood samples taken before and after hemodialysis. Blood samples were collected by health workers using Vacutainer tubes containing K2-EDTA anticoagulant to prevent blood coagulation. Hemoglobin levels were examined at the Dharma Sidhi Main Clinic laboratory using an automatic hematology analyzer. This automated method was chosen because it offers high precision and reproducibility in hematology parameter testing. The data collected consisted of hemoglobin level test results before and after hemodialysis for each patient, which were then systematically recorded in a data collection sheet.

2.3 Data Analysis

Data on hemoglobin levels before and after hemodialysis were analyzed descriptively. The analysis was performed by presenting the data in tabular form and calculating the mean hemoglobin level to illustrate changes after hemodialysis (Subhaktiyasa et al., 2025). This analysis focused on revealing patterns of change in hemoglobin levels.

2.4 Ethical Considerations

All data used is confidential and is used solely for research purposes. Patient identities are not included in the research report. Blood samples were taken as part of routine examinations for hemodialysis patients and did not pose any additional risk to the research subjects.

3. Results and Discussion

3.1 Results

A total of 30 patients with chronic kidney failure undergoing hemodialysis at the Dharma Sidhi Main Clinic were included in this study, with their characteristics presented in Table 1.

Table 1. Characteristics of respondents

Characteristic	Category	n	Percentage (%)
Age (years)	36-45	8	26.7
	46-55	7	23.3
	56-65	13	43.3
	>65	2	6.7
Gender	Man	18	60
	Female	12	40

Table 1 indicates that the 56–65 age group is the largest group undergoing hemodialysis, accounting for 43.3%, while the lowest proportion is found in the over-65 age group at 6.7%. By gender, male respondents were more numerous, with 18 (60.0%), compared to 12 female respondents (40.0%). Hemoglobin levels before and after hemodialysis are shown in Table 2.

Table 2. Hemoglobin levels before and after hemodialysis

	Before hemodialysis		After hemodialysis	
Hemoglobin level	n	Percentage (%)	n	Percentage (%)
Female				
High (>16)	0	0	0	0
Normal (12-16)	3	25	2	16.7
Low (<12**)**	9	75	10	83.3
Male				
High (>18)	0	0	2	11.1
Normal (14-18)	5	27.8	3	16.7
Low (<14)	13	72.2	13	72.2

Table 2 displays the distribution of hemoglobin levels before and after hemodialysis. Before hemodialysis in the female group (n = 12), 9 respondents (75.0%) had low hemoglobin levels, and 3 respondents (25.0%) were in the normal category. In the male group (n = 18), 13 respondents (72.2%) had low hemoglobin levels, and 5 respondents (27.8%) were in the normal category (Table 2). Meanwhile, after hemodialysis, in the female group (n = 12), 10 respondents (83.3%) had low hemoglobin levels, and 2 respondents (16.7%) were in the normal category. In the male group (n = 18), 13 respondents (72.2%) were in the low hemoglobin category, 3 (16.7%) in the normal category, and 2 (11.1%) in the high category. The average hemoglobin levels are shown in Table 3.

Table 3. Average hemoglobin levels before and after hemodialysis

Hemoglobin level	N	Mean	Min	Max
Before	30	13.04	10.2	18.0
After	30	12.94	10.0	19.5

Table 3 shows that the average hemoglobin level before hemodialysis was 13.04 g/dL, with a minimum value of 10.2 g/dL and a maximum value of 18.0 g/dL. After hemodialysis, the average hemoglobin level was 12.94 g/dL, with a minimum value of 10.0 g/dL and a maximum value of 19.5 g/dL.

3.2 Discussion

This study aims to describe changes in hemoglobin levels before and after hemodialysis in patients with chronic kidney failure. The findings show that most patients had low hemoglobin levels before undergoing hemodialysis and that, after the procedure, hemoglobin levels tended to decrease. The results confirm that hemodialysis has the potential to worsen the status of anemia in patients with chronic kidney failure.

The decrease in hemoglobin levels after hemodialysis is consistent with previous findings that reported a similar pattern in patients undergoing routine hemodialysis (Mustakilla & Handayani, 2023). This condition may be caused by, among other things, blood loss during dialysis, hemodilution from fluid administration, and hemolysis triggered by mechanical trauma and changes in osmolality during blood circulation through the dialysis machine. In addition, iron and essential micronutrient deficiencies, as well as recurrent microbleeding, contribute to impaired erythropoiesis in patients with chronic kidney disease (Portolés et al., 2021). Anemia in hemodialysis patients is multifactorial and requires a comprehensive management approach (Musallam & Taher, 2012).

The study's results also emphasize the importance of regularly monitoring hemoglobin levels before and after hemodialysis. This information is important in clinical decision-making, including evaluating the need for erythropoietin therapy, iron supplementation, and adjustments to the dialysis protocol to minimize blood loss. Interprofessional collaboration between medical staff, nurses, and laboratory analysts is crucial to ensure accurate interpretation of laboratory results and appropriate clinical follow-up (Lestari et al., 2024).

Respondent characteristics showed a predominance of older age groups and males, consistent with previous literature. Advanced age is a significant risk factor for chronic kidney disease due to decreased physiological function and increased comorbidity (Prasetya et al., 2024). The predominance of male patients is also in line with evidence that the progression of chronic kidney disease tends to be faster and more severe in men than in women, influenced by hormonal factors, cardiovascular vulnerability, and lifestyle differences (Soekiono et al., 2025). These findings provide relevant epidemiological context and strengthen the generalization of research results in the hemodialysis patient population.

4. Conclusion

Research demonstrates that chronic kidney disease patients undergoing hemodialysis tend to experience a decrease in hemoglobin levels after treatment, indicating that hemodialysis contributes to anemia. Multifactorial mechanisms, including blood loss, hemodilution, and impaired erythropoiesis, influence changes in hemoglobin levels. The findings provide insight into the dynamics of hematological parameters in hemodialysis patients and emphasize the importance of continuous hemoglobin monitoring as an integral part of clinical laboratory services and clinical decision-making. The results of this study support interprofessional collaboration in the management of anemia in patients with chronic kidney failure, at both the local and broader healthcare system levels. However, this study has limitations in terms of design and sample size. Further research is recommended using an analytical or longitudinal design with a larger sample size, involving additional hematological parameters such as hematocrit and iron status, and considering other clinical and therapeutic variables to deepen understanding and improve the quality of care for hemodialysis patients.

Conflict of Interest

The authors declare no conflict of interest.

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