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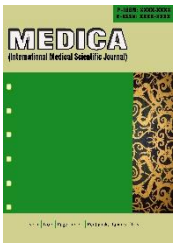

Differences in Bleed Sedimentation Rate and Hematocrit Values in Chronic Kidney Failure Patients Examined Before and After Hemodialysis at Tabanan Regional Hospital

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Abstrak

Chronic Kidney Disease (CKD) is a pathological condition that is irreversible and has various underlying causes. The diagnosis is based on structural or functional abnormalities of the kidneys, with the primary criterion being a glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m² for more than three months. Common symptoms include fatigue, loss of appetite, and muscle cramps. Management of CKD consists of two stages: conservative treatment aimed at slowing disease progression and renal replacement therapy, such as dialysis or kidney transplantation. Erythrocyte Sedimentation Rate (ESR) and Hematocrit (Hct) tests are important for detecting decreased erythropoietin production, which impacts red blood cell formation. The objective of this study was to examine the differences in ESR and Hct values in patients with chronic kidney disease before and after undergoing hemodialysis. The study employed a pre-experimental design using a One-Group Pretest-Posttest approach, involving a single experimental group without a control group. Measurements were taken both before and after the intervention. The results from 10 CKD patients at Tabanan Regional Public Hospital indicated that all respondents (100%) had elevated ESR levels both before and after hemodialysis. In contrast, Hct values decreased following hemodialysis, which is likely due to reduced erythropoietin production associated with CKD, leading to anemia. In conclusion, no significant difference was observed in ESR values before and after hemodialysis. However, there was a notable difference in Hct values, which declined after the procedure.

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1. INTRODUCTION

Chronic Kidney Disease (CKD) is a pathophysiological condition with multiple etiologies that is irreversible. It can be diagnosed based on structural abnormalities or functional impairment of the kidneys, commonly indicated by a glomerular filtration rate (GFR) of less than 60 mL/min per 1.73 m^2 lasting for more than three months. Elevated blood urea levels are indicative of impaired renal function and may lead to decreased erythropoietin production, resulting in anemia and subsequently lowered hematocrit levels. One of the primary methods to support CKD diagnosis involves evaluating serum urea and creatinine levels, as these compounds are exclusively excreted by the kidneys. In patients with kidney failure, hematocrit levels serve as a critical indicator for managing blood transfusions and erythropoietin (EPO) therapy (Nuroini, & Wijayanto, 2022).

CKD is a major global cause of mortality. In Indonesia, the 2018 Basic Health Research (Riskesdas) reported a CKD prevalence of 2%, with the highest regional prevalence found in Maluku at approximately 0.47%. In 2017, the number of CKD patients undergoing hemodialysis in Indonesia rose to 77,892, with a significant increase of 38.7% observed in Bali Province. According to the 2013 Riskesdas data, Bali had a CKD prevalence of 0.2%, with an estimated 1,200 new cases annually. Tabanan Regional Public Hospital (RSUD Tabanan), a government hospital in Bali, has provided hemodialysis services since 2002. As of December 2023, 301 stage 5 CKD patients at RSUD Tabanan underwent hemodialysis treatments twice a week, each lasting approximately four hours (Badan Penelitian dan Pengembangan Kesehatan, 2019).

Renal impairment can significantly affect a patient's overall health, often causing fatigue, loss of appetite, and leg cramps (Nuratmini, 2019). CKD is commonly caused by three main factors: diabetes mellitus, hypertension, unhealthy lifestyle, and glomerulonephritis (NKDEP, 2015). Treatments for CKD include hemodialysis, peritoneal dialysis, or kidney transplantation, with hemodialysis being more commonly used due to its faster mechanism compared to peritoneal dialysis (Arvianti, Septiani & Yansen, 2021). Management of CKD involves two phases: conservative treatment to slow disease progression and stabilize the patient, and renal replacement therapy through dialysis or transplantation, which represents the most definitive approach (Arvianti, Septiani & Yansen, 2021).

Hemodialysis functions as a kidney replacement therapy utilizing a semipermeable membrane to filter blood and remove metabolic waste, while correcting fluid and electrolyte imbalances between the blood and dialysate (Haryanti, & Nisa, 2015). The primary aim of hemodialysis is to eliminate protein metabolism waste and restore electrolyte balance (Wong & Sarjana, 2017). Hemodialysis therapy directly benefits patients by reducing CKD-related complications, removing uremic toxins, and maintaining fluid and electrolyte homeostasis (Amalia & Apriliani, 2021). Serum urea and creatinine levels are typically assessed before initiating hemodialysis to evaluate kidney function and determine the necessity of the procedure (Angraini, Harus & Asnindari, 2021).

The Erythrocyte Sedimentation Rate (ESR) in CKD patients is influenced by systemic conditions, particularly inflammation. Therefore, ESR testing complements physical examinations and medical history assessments in the clinical evaluation of CKD patients (Rahmawati, Listiana &]. Hematocrit testing, which measures the percentage of red blood cells in total blood volume, is also crucial. Declining kidney function reduces erythropoietin production, leading to decreased red blood cell counts and anemia, both of which can impact ESR results.

Monitoring ESR and hematocrit values is essential for identifying reduced erythropoietin production and impaired erythropoiesis in the bone marrow. A decrease in red blood cells is also reflected in hematocrit levels below normal ranges (Rosini, 2020).

The ESR in this study was measured using the Westergren method, which is recommended by the International Committee for Standardization in Hematology (ICSH) (Rustendi et al., 2022). Hematocrit levels were measured using an automated hematology analyzer, a method commonly used by healthcare professionals due to its speed and practicality compared to the macrohematocrit method, which requires larger samples and longer processing time (Ernawati, 2019).

Clinical laboratory services play a vital role in aiding physicians to establish diagnoses and monitor disease progression. Hematological testing, including ESR measurement, involves calculating the rate of red blood cell sedimentation in a specific time frame. Elevated ESR levels in CKD patients are often associated with renal inflammation, whereas normal ESR values suggest the absence of inflammation (Zainabiah, 2019).

According to prior research Hidayah, (2018), hematocrit levels in CKD patients undergoing hemodialysis reflect erythropoiesis in the bone marrow. A decline in red blood cells is commonly observed through decreased hematocrit values (Hidayah, 2018). Anemia in CKD patients undergoing hemodialysis may influence ESR results, typically presenting as elevated ESR levels (Yuniarti, 2021). Additionally, minor blood loss (approximately 1–2 cc) during each dialysis session and insufficient erythropoietin production contribute to anemia (Yuniarti, 2021]. This study aims to investigate the differences in ESR and hematocrit levels in chronic kidney disease patients before and after undergoing hemodialysis at RSUD Tabanan.

2. METHOD

This study employed a pre-experimental design, specifically the One Group Pretest–Posttest Design. In this design, only a single group is involved, functioning as the experimental group, without the use of a control group. Measurements were taken at two time points—before (pretest) and after (posttest) the intervention—to assess the changes that occurred as a result of the hemodialysis treatment. The hematological parameters under investigation were Erythrocyte Sedimentation Rate (ESR) and hematocrit levels, both of which were measured using blood samples collected in EDTA tubes from patients diagnosed with chronic kidney disease (CKD) undergoing hemodialysis therapy at RSUD Tabanan.

Primary data were obtained through laboratory examination of EDTA-treated blood samples to determine ESR and hematocrit values. Additional primary data were collected via structured interviews, which included demographic information such as the patient's name, sex, age, and frequency of hemodialysis treatments. Secondary data consisted of patient records from RSUD Tabanan, specifically those related to individuals receiving ongoing hemodialysis treatment for CKD. These records were used to support and validate the primary data collected.

The collected data were organized, recorded, and processed using the Statistical Package for the Social Sciences (SPSS). To determine the distribution of the data, the Kolmogorov–Smirnov test was applied. If the data were normally distributed (p-value > 0.05), the Paired Samples t-Test was used to assess the significance of differences between pretest and posttest results. If the data were not normally distributed (p-value < 0.05), the Wilcoxon Signed Rank Test was employed as a non-parametric alternative.

3. RESULTS

Table 1. Erythrocyte Sedimentation Rate (ESR) Before and After Hemodialysis.

Parameter	Minimum (mm/hr)	Maximum (mm/hr)	Mean (mm/hr)
ESR Before HD	30	132	102
ESR After HD	16	131	115

Table 1 illustrates the ESR values measured before and after hemodialysis. Prior to hemodialysis, ESR values ranged from 30 to 132 mm/hour, with a mean of 102 mm/hour. Following hemodialysis, the ESR values ranged between 16 and 131 mm/hour, with a mean value of approximately 115 mm/hour. These findings suggest a slight increase in the mean ESR post-dialysis, which may indicate the presence of inflammatory processes commonly seen in chronic kidney disease (CKD) patients undergoing hemodialysis.

Table 2. Hematocrit Values Before and After Hemodialysis

Parameter	Minimum (%)	Maximum (%)	Mean (%)
Hematocrit Before HD	16.6	35.1	18.5
Hematocrit After HD	15.1	32.3	17.2

Table 2 presents the hematocrit levels before and after hemodialysis. Hematocrit levels prior to dialysis ranged from 16.6% to 35.1%, with an average of 18.5%. After hemodialysis, hematocrit levels were observed in the range of 15.1% to 32.3%, with a mean of 17.2%. The observed decrease in mean hematocrit after dialysis may be attributed to factors such as fluid overload, erythropoietin deficiency, or dilutional effects, which are commonly associated with CKD and the hemodialysis process.

Table 3. Results of Normality Test Distribution

Sample	Significance (p-value)
ESR Before HD	0.524
ESR After HD	0.630
Hematocrit Before HD	0.648
Hematocrit After HD	0.277

Table 3 presents the results of the normality test (Kolmogorov–Smirnov test). All measured variables—ESR and hematocrit values before and after hemodialysis—show significance values greater than 0.05, indicating that the data are normally distributed. Therefore, parametric statistical tests are appropriate for analyzing these data.

Table 4. Results of Paired Sample t-Test

Variables	Significance (p-value)
ESR (Pre–Post HD)	0.684
Hematocrit (Pre–Post HD)	0.003

Table 4 shows the significance values obtained from the paired sample t-test used to assess differences in ESR and hematocrit levels before and after hemodialysis. The ESR shows a p-value of 0.684, indicating no significant difference pre- and post-treatment. In contrast, hematocrit levels yield a p-value of 0.003, which is statistically significant ($p < 0.05$). This suggests that hemodialysis has a significant effect on hematocrit levels in patients with chronic kidney disease.

DISCUSSION

Erythrocyte Sedimentation Rate (ESR) Before and After Hemodialysis

The examination of erythrocyte sedimentation rate (ESR) before hemodialysis showed values ranging from a minimum of 30 mm/hour to a maximum of 132 mm/hour, with a mean of 102 mm/hour. After hemodialysis, the ESR values ranged from a minimum

of 16 mm/hour to a maximum of 131 mm/hour, with a mean of 115 mm/hour. The observed increase in ESR values following hemodialysis among patients with chronic kidney disease (CKD) can be attributed to the patient's physiological condition, particularly the presence of inflammation and physical stress, which are known to elevate ESR levels. Conversely, a decrease in ESR may occur due to long-term use of certain medications that modulate inflammatory processes or other hematological factors (Yuniarti, 2021).

Hematocrit Levels Before and After Hemodialysis

The hematocrit levels before hemodialysis ranged from a minimum of 16.6% to a maximum of 35.1%, with an average of 18.5%. Post-hemodialysis, the hematocrit levels varied from a minimum of 15.1% to a maximum of 32.3%, with an average of 17.2%. The generally low hematocrit levels observed in CKD patients are primarily due to damage to the peritubular cells, which play a crucial role in the production of erythropoietin (EPO)—a hormone essential for erythropoiesis. As kidney function deteriorates progressively, the reduced synthesis of EPO results in anemia, commonly characterized by decreased hematocrit levels. In hemodialysis patients, hematocrit values may further decline due to hemodilution caused by an increase in fluid volume (Amalia & Apriliani, 2021).

Chronic anemia in CKD may also result from a variety of other factors, such as autoimmune disorders, post-transplant rejection, and nutritional deficiencies, particularly iron and folic acid. Additionally, there is a reported linear association between erythrocyte levels and glomerular filtration rate (GFR). Other contributing factors to anemia in CKD include shortened red blood cell lifespan, chronic inflammation, infections, hypothyroidism, severe hyperparathyroidism, aluminum toxicity, and hemoglobinopathies (Amalia & Apriliani, 2021)

Comparison of ESR and Hematocrit Values Before and After Hemodialysis

A comparison of ESR and hematocrit values measured before and after hemodialysis revealed significant differences. The ESR measurements before hemodialysis showed a range of 18.52% to 81.48%, representing the lowest and highest values in mm/hour. Similarly, the hematocrit levels before hemodialysis ranged from 32.11% to 67.89%, indicating substantial variability.

The changes in ESR and hematocrit values after hemodialysis suggest physiological responses related to chronic inflammation and kidney function deterioration. Elevated ESR after dialysis may reflect ongoing inflammatory processes, while persistently low hematocrit values support the presence of anemia due to reduced erythropoietin production. This hematological decline in CKD patients undergoing dialysis is largely due to impaired erythropoietin synthesis, resulting in reduced red blood cell production in the bone marrow. Chronic disease-related anemia is characterized by inflammation-induced suppression of iron absorption in the bone marrow, further exacerbating the decline in erythropoiesis and contributing to sustained anemia in CKD patients (Chairani, et al., 2020).

4. CONCLUSION

Based on the results of the study, it can be concluded that hemodialysis has a significant impact on hematocrit levels but does not significantly affect the erythrocyte sedimentation rate (ESR) in chronic kidney disease (CKD) patients. There was a decrease in the average hematocrit after hemodialysis, which indicates the presence of anemia which is common in CKD patients due to decreased erythropoietin production. Meanwhile, although there was an increase in the average ESR value after hemodialysis, this change was not statistically significant and likely reflects the ongoing chronic inflammatory process.

Therefore, routine monitoring of hematological parameters such as ESR and hematocrit is important as part of the clinical evaluation of CKD patients undergoing hemodialysis.

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