

Exploring the association between hemoglobin, hematocrit, neutrophil-to-lymphocyte ratio, and platelet-to-lymphocyte ratio with erectile dysfunction in chronic kidney disease patients undergoing hemodialysis: A cross-sectional study

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Summary *Erectile dysfunction (ED) is one of the complications in male patients with end-stage chronic kidney disease (CKD). Renal replacement therapy may improve general conditions and thus improve erectile function. This study aims to determine changes in erectile dysfunction in end stage CKD patients who underwent hemodialysis, focusing on changes in laboratory parameters.*

This cross-sectional study was conducted from March to April 2024 at the Hemodialysis Unit of Wangaya General Hospital. The subjects were male patients with end-stage chronic kidney disease (CKD) who were undergoing hemodialysis and met the specific inclusion and exclusion criteria. Erectile function was assessed using the International Index of Erectile Function (IIEF-5) and the Erection Hardness Score (EHS). Laboratory parameters, including hemoglobin, hematocrit, neutrophil count, neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR) were recorded.

Twenty-two subjects were included in this study. The prevalence of ED before starting hemodialysis and after a period of at least 3 months of hemodialysis was 28.3% and 86.4% respectively. A statistically significant difference was observed in the IIEF-5 scores of patients before and after hemodialysis ($p = 0.001$). Significant differences were observed in the erection degree before and after hemodialysis based on IIEF-5 ($p = 0.001$) and EHS ($p = 0.001$). There was a significant correlation between erection degree assessed by IIEF-5 and hemoglobin, hematocrit, NLR and PLR; and erection degree assessed by EHS and hemoglobin, hematocrit, and PLR, (all $p < 0.05$).

In conclusion, there is a deterioration in erectile function in patients undergoing hemodialysis compared to their condition before hemodialysis. There was significant correlation between hemoglobin, hematocrit, NLR, and PLR and erectile dysfunction.

KEY WORDS: *Erectile dysfunction; Erection hardness score; Hemodialysis; International index of erectile function-5; Laboratory parameters.*

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INTRODUCTION

Erectile dysfunction (ED) is a common sexual dysfunction that occurs as a complication in male patients with end-

stage chronic kidney disease (CKD)(1). It is defined as the inability to attain and maintain an erection of sufficient duration and rigidity for satisfactory sexual intercourse (2, 3). End-stage CKD requires renal replacement therapy, such as kidney transplantation or dialysis. These therapies are expected to improve both the general condition and erectile function of patients. Hemodialysis is one form of dialysis therapy (1, 4). The prevalence of ED in patients undergoing hemodialysis reaches 90% (5). It is therefore important to consider ED in the care of hemodialysis patients, as it significantly affects their quality of life (6). This study aims to determine changes in erectile function in end-stage CKD patients who underwent hemodialysis, focusing on changes in laboratory parameters.

MATERIALS AND METHODS

This is a cross-sectional study conducted from March to April 2024 at the *Hemodialysis Unit of Wangaya General Hospital, Denpasar - Bali*. Subjects were male patients with end-stage CKD who underwent hemodialysis twice a week. Inclusion criteria were being male patients with end-stage (CKD), aged 45-65 years, being married and having sexual partners, undergoing hemodialysis for at least 3 months, and consenting to participate in the study. Exclusion criteria were use of sexual performance enhancing drugs, history of genital surgery, history of neurological disease such as stroke, history of benign prostatic hyperplasia. Based on this criteria, 22 subjects were included in this study.

Data were collected through interviews and from medical records. Subjects were assessed for erectile function using the 5-item version of *International Index of Erectile Function (IIEF-5)* and the *Erection Hardness Score (EHS)*. Subjects were given IIEF-5 and EHS questionnaires to assess erectile function before the first session of hemodialysis and after the last session of routine hemodialysis (at least 3 months).

Laboratory parameters were collected from medical records during hemodialysis, and included hemoglobin, hemat-

ocrit, neutrophil count, *neutrophil-to-lymphocyte ratio* (NLR), and *platelet-to-lymphocyte ratio* (PLR).

The *neutrophil-to-lymphocyte ratio* (NLR) and *platelet-to-lymphocyte ratio* (PLR) were utilized as biomarkers to assess systemic inflammation. Inflammation is known to impair endothelial function and promote prothrombotic events. Given that endothelial dysfunction is a key factor in the pathogenesis of erectile dysfunction, these inflammatory markers were evaluated to investigate their potential association.

Wilcoxon sign-rank was used to compare difference erectile function (score and degree of erection) before the first session of hemodialysis and after undergoing routine hemodialysis for at least 3 months. Given that the normality assumption was found to be violated in the distribution of our data, Spearman's rho test was used to analyse correlation of erection degree (based on IIEF-5 and EHS) and laboratory parameters (hemoglobin, hematocrit, neutrophil count, NLR, and PLR). A p value of < 0.05 was considered statistically significant. All data analyses were performed using Statistical Package for the Social Sciences (SPSS version 27.0; Armonk, NY: IBM Corp).

RESULTS

The characteristics of the 22 subjects included in this study were presented in Table 1. The mean age of the par-

ticipants was 52.77 years, and the mean duration of hemodialysis was 39.4 months. The comorbid condition found in the majority of participants was hypertension. The average IIEF-5 score was 21.7 before hemodialysis and 14.09 during hemodialysis. A significant difference (p = 0.001) was observed between the IIEF-5 score before and during hemodialysis.

Based on IIEF-5, there were 6 participants (27.3%) who had erectile dysfunction before hemodialysis and 19 participants (86.4%) who had erectile dysfunction during hemodialysis, as shown in Table 2.

There was a significant difference between the erection degree before and during hemodialysis based on IIEF-5, with p = 0.001.

Table 2.

Comparison of erection degree before and after hemodialysis based on IIEF-5.

Erection degree (based on IIEF-5)	Before hemodialysis n (%)	After hemodialysis n (%)	P value
No ED	16 (72.7%)	3 (13.6%)	0.001
Mild	3 (13.6%)	6 (27.3%)	
Mild-moderate	2 (9.1%)	5 (22.7%)	
Moderate	0	1 (4.5%)	
Severe	1 (4.5%)	7 (31.8%)	

Table 1.

Characteristics of participants.

Characteristic	Mean ± SD
Age	52.77 ± 5.50
Hemodialysis period (months)	39.41 ± 47.46
IIEF-5 score ^a	14.09 ± 7.02
Erection degree (IIEF-5) ^a	
No erectile dysfunction	3 (13.6%)
Mild	6 (27.3%)
Mild-moderate	5 (22.7%)
Moderate	1 (4.5%)
Severe	7 (31.8%)
Erection degree (EHS) *	
0	3 (13.6%)
1	2 (9.1%)
2	9 (40.9%)
3	7 (31.8%)
4	1 (4.5%)
Hypertension	
Yes	20 (90.9%)
No	2 (9.1%)
Diabetes mellitus	
Yes	9 (40.9%)
No	13 (59.1%)
Cardiovascular disease	
Yes	9 (40.9%)
No	13 (59.1%)
Laboratory values	
Hemoglobin (g dL-1)	10.39 ± 1.52
Hematocrit (%)	31.76 ± 5.05
Neutrophil count (103 uL-1)	6.12 ± 4.13
Neutrophil to lymphocyte ratio (103 uL-1)	4.06 ± 4.20
Platelet to lymphocyte ratio (103 uL-1)	134.76 ± 63.58

^a Score and degree of erection after patients underwent routine hemodialysis.

Table 3 displays erection degree based on EHS. Based on EHS, there were 14 participants (63.6%) with score 4 before hemodialysis and there were 9 participants (40.9%) with score 2 during hemodialysis. There was a significant difference between the erection degree before and during hemodialysis, as measured by the *Erection Hardness Score* (EHS), with p = 0.001.

Table 3.

Comparison of erection degree before and after hemodialysis based on Erection Hardness Score (EHS).

EHS	Before hemodialysis n (%)	After hemodialysis n (%)	P value
0	1 (4.5%)	3 (13.6%)	0.001
1	0	2 (9.1%)	
2	2 (9.1%)	9 (40.9%)	
3	5 (22.7%)	7 (31.8%)	
4	14 (63.6%)	1 (4.5%)	

There was a significant correlation between the erection degree during hemodialysis based on IIEF-5 and hemoglobin (p = 0.013, r = 0.518), hematocrit (p = 0.016, r = 0.508), NLR (p = 0.038, r = -0.444), PLR (p = 0.041, r = -0.439) (Table 4).

There was a significant correlation between the degree of erection during hemodialysis based on EHS and hemoglobin (p = 0.013, r = 0.522), hematocrit (p = 0.012, r = 0.523), PLR (p = 0.017, r = -0.502) (Table 4).

Table 4.
Correlation of erection degree before and after hemodialysis (based on IIEF-5 and EHS) and laboratory values.

Laboratory values	Erection degree (based on IIEF-5)		Erection degree (based on EHS)	
	Correlation coefficient	P value	Correlation coefficient	P value
Hemoglobin	0.518	0.013	0.522	0.013
Hematocrit	0.508	0.016	0.523	0.012
Neutrophil	-0.196	0.383	-0.144	0.523
NLR	-0.444	0.038	-0.419	0.052
PLR	-0.439	0.041	-0.502	0.017

NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio.

DISCUSSION

The prevalence of erectile dysfunction (ED) in patients before hemodialysis was 28.3%, which increased to 86.4% after hemodialysis. This rise in prevalence is consistent with the finding of *Gorsane et al.*, who reported an increased from 8.4% to 91.6%(5). Similarly, *Warli et al.*, found a high prevalence of ED, with 90.5% of patients undergoing hemodialysis experiencing the condition (1). In this study, there was a significant difference in the IIEF-5 scores of patients before and after hemodialysis (p value = 0.001), which were lower after hemodialysis (14.09 ± 7.02) compared to before hemodialysis (21.77 ± 4.86). Additionally, significant difference was observed between the degree of erection based on EHS, with p -values of 0.001. *Gorsane et al.* found that 79.1% of participants experienced reduced erectile function during hemodialysis, and noted that patients with preserved diuresis were able to maintain better erectile function (5). Similarly, the study by *Stolic et al.* reported a significant difference in IIEF-5 scores between patients with preserved diuresis, who had better scores compared with those without preserved diuresis (7). Endothelial dysfunction due to vascular problems explains the worsening of erectile dysfunction in hemodialysis patients (5). The presence of residual renal function in dialysis patients can help reduce the risk of cardiovascular disease, and control blood pressure and anemia. Additionally, preserved residual kidney function is known to enhance the effectiveness of dialysis (7).

Different results were reported in a study by *Savadi et al.*, which found an increase in erectile function scores in patients before their first hemodialysis session compared to after 6 months of hemodialysis (8). Conversely, the study by *Duarsa et al.*, observed an increase in the IIEF-5 score in patients before and after hemodialysis, although he found no significant difference in the degree of erectile dysfunction (9).

The causes of erectile dysfunction are not solely vascular. Erectile dysfunction in hemodialysis patients can also result from psychological effects (9, 10). There is a positive correlation between anxiety and the incidence of ED in both hemodialysis and CAPD patients (1). In addition, depression has also been identified as a risk factor for ED in hemodialysis patients (11). In end-stage CKD, the causes of depression are often related to multiple losses, such as the loss of kidney function, diminished well-

being, changes in family and work role, and concerns about the future (10). Depression can lead to decreased sexual desire, lowered self-esteem, and reluctance to engage in pleasurable activities, so it may be a psychological cause of erectile dysfunction (11). This study did not address psychogenic factors, which could be a limitation. In this study, there was a significant correlation between haemoglobin and haematocrit and erectile dysfunction based on IIEF-5 and EHS scores (Hb: $p = 0.013$ and $p = 0.013$; Hct: $p = 0.016$ and $p = 0.012$). The correlation between haemoglobin and haematocrit and erectile dysfunction was also found in other studies(12-14). This may be because anemia can worsen the general condition and cause asthenia in patients with end-stage CKD (10, 13). However, there was no association between haematocrit and erectile dysfunction in other studies(15, 16). Erectile dysfunction is an early sign of systemic problems that can lead to cardiovascular disease. Exposure to atherogenic risk factors leads to endothelial dysfunction and contributes to the development of atherosclerosis. Atherosclerosis affects all vessels, but the onset of symptoms varies depending on the diameter of the affected artery. Inflammation plays an important role in the initiation and progression of atherosclerosis. Endothelial dysfunction is also a key factor in the pathogenesis of erectile dysfunction. Low-degree subclinical inflammation can impair endothelial function and induce prothrombotic events. In recent years, NLR and PLR have been utilized as biomarkers of subclinical inflammation (17, 18). This study also found correlation between erection degree to NLR and PLR levels. These results are consistent with studies by *Pakpahan et al.* and *Sambel et al.* (17, 19).

DECLARATIONS

Ethical approval: We obtained ethical approval for this study from Health Research Ethics Committee Wangaya General Hospital, Bali, Indonesia. The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Availability of data and material: The datasets during the current study are available from the corresponding author on reasonable request. Due to privacy concerns, individual participant data cannot be made publicly available. However, aggregated data supporting the findings of this study are included within the article.

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In conclusion, erectile function deteriorates in patients undergoing hemodialysis compared to their condition before starting treatment. There is correlation between hemoglobin, hematocrit, NLR, and PLR and erectile dysfunction. Anemia may contribute to erectile dysfunction, and endothelial dysfunction due to inflammation (as measured by inflammatory biomarkers) may associate to erectile dysfunction in hemodialysis patients and has the potential to be used as a biomarker.

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