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Association of platelet and hematocrit value with arteriovenous fistula (AVF) failure in hemodialysis patient at Bali Husada Cipta Canti, Bali, Indonesia

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ABSTRACT

Introduction: Hemodialysis is one of the renal replacement therapies used for end-stage renal disease (ESRD) patients. Arteriovenous fistula (AVF) is the preferred hemodialysis access type because it has better patency rates and fewer complications than other access types. However, around 31-61% of AVF fail to mature. An early AVF failure may be due to a lack of maturation or thrombosis, and late failure defines as a failure after successful use. Some factors that make AVF fail are injury of the endothelial wall or hypercoagulation. This study aimed to determine the association between pre-operative platelet and hematocrit value with AVF failure in BHCC Clinic Denpasar.

Method: This is an analytic cross-sectional study. The data were collected from medical records from all dialytic patients from January 2020-December 2020. Patients with inclusion criteria were collected. Patient with incomplete data was excluded. Data were analyzed using Chi-square analysis.

Results: Our study involved 34 patients, 21(61.8%) of them were male, and the mean age was 52.62 years (±10.77 SD). The AVF failure prevalence was 32.4% (n=11). We found no association between platelet value with AVF failure, with a p-value=0.411. There was an association between hematocrit value and AVF failure in hemodialysis patients with a p-value=0.032. Most of the patient was male and aged 45-60 with ESRD from the characteristic found.

Conclusion: There was an association between pre-operative hematocrit value and AVF failure in hemodialysis patients. There was no association between pre-operative platelet value with AVF failure.

Keywords: arteriovenous fistula, arteriovenous fistula failure, hemodialysis.
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INTRODUCTION

The increased prevalence of end-stage renal disease (ESRD) has led to a rise in the number of hemodialysis (HD) patients, the most common modality for renal replacement therapy.[1] Chronic renal failure is defined as kidney damage that occurs for more than or equal to three months either in the form of structural damage or abnormal function of the kidneys with or without a decrease in glomerular filtration rate (GFR). Abnormalities in renal structure or function (characterized by increased markers of renal injury or decreased GFR) present for more than three months with accompanying health implications.[2]

HD is a vital management option for ESRD patients. With adequate HD, patients can have a good quality of life.[3] HD is a treatment for ESRD that uses a machine to send the patient's blood through a dialyzer. The amount and blood pressure flowing to the dialyzer must be adequate; thus, it needs special access.[4] This special access is generally dialysis catheter or arteriovenous fistula (AVF). AVF is the preferred HD access type because it has better patency rates and fewer complications than other access types.[5]

AVF is defined as a failure if it cannot be used for HD. There are several definitions of failure from various literature. Primary AVF failure is the failure of AVF before its first successful cannulation. It includes inadequate maturation, thrombosis, failure of the first cannulation, and other complications such as ischemia or infection. Secondary failure is the permanent failure of AVF after adequate HD.[6] Early failure was defined as a fistula that never matured or could not be used for HD within three months of initiation. Late failure is a fistula failure after three months of initiation and is generally due to outflow stenosis.[7]

Sari et al. reported that older age (>50 years old) and type 2 diabetes mellitus had been reported to influence AVF failure.[8] Other risk factors contributing to AVF failure are cardiovascular disease, radiocephalic location of the fistula, small vascular lumen diameter, previous intravenous catheter insertion, and surgical technique.[9]

Hemoglobin levels, prothrombin

time (PTT), and activated partial thromboplastin time (APTT) also have a role in the failure of AVF, but the specific mechanism of these markers is still unclear.[9] In addition, the hematocrit level and the platelet-lymphocyte ratio also have a role in AVF failure. Sarioglu et al. found that the high platelet-lymphocyte ratio may support AVF stenosis and thrombosis.[10] Lano et al. conducted a study on mean platelet volume (MPV) in HD patients where they concluded that the incidence of vascular access dysfunction is high in patients with high MPV levels.[11]

Increased hematocrit levels will cause an increase in blood viscosity. This continuous increase in blood viscosity will cause an increase in arterial pressure. Increased blood viscosity will also activate blood-clotting cells, causing the formation of thrombus and embolism. Thrombus and embolism may contribute to AVF failure.[11] Therefore; this study aims to determine the association between pre-operative platelet and hematocrit value with AVF failure in Bali Husada Cipta Canti (BHCC) Clinic Denpasar.

METHOD

This study is an analytic cross-sectional study conducted in BHCC Clinic Denpasar. The data were collected from medical records from all dialytic patients from January 2020-December 2020. The total samples for this research are 34 patients using the total sampling technique. The inclusion criteria for this research are patients with ESRD who underwent AVF initiation in 2020 and patients who underwent pre-operative complete blood count examination, including hematocrit value and platelet count. The exclusion criteria used in this study are patients who moved to other HD units, death or having incomplete laboratory blood data. Data acquired were analyzed by Chi-square analysis. AVF failure is defined when AVF cannot be used for HD or HD stop when quick of blood (QB) is less than 200 mL/minutes or total blood rate less than 60 L after successful HD less than three months.

RESULT

There are 34 patients as samples in this research. **Table 1** shows the characteristic of the patient in this research. We found that most of the patient was male (61.8%), and the mean age was 52.62 years (±10.77 SD). Most patients are in the age 45-60 years group. The AVF failure prevalence was 32.4%.

Table 1. Characteristic of the patients

Variable	n (%)	Mean (±SD)
Gender		
Male	21(61.8%)	
Female	13(38.2%)	
Age (years)		52.62±10.77
<45	5(14.7%)	
45-60	20(58.8%)	
>60	9(26.5%)	
Platelet (per µL)		
<150.000	2(5.9%)	
150.000-400.000	29(85.3%)	
>400.000	3(8.8%)	
Hematocrit (%)		
<33	31(91.2%)	
33-36	2(5.9%)	
>36	1(2.9%)	
AVF		
Success	23(67.6%)	
Failure	11(32.4%)	

Table 2. Association of pre-operative platelet value with AVF failure

Platelet (x10³/µL)	Success (%)	Failure (%)	Total	p-value
<150	1(50%)	1(50%)	2(100%)	
150-400	19(65.5%)	10(34.5%)	29(100%)	0.411
>400	3(100%)	0(0%)	3(100%)	

Table 3. Association Hematocrit with AVF Failure

Hematocrit	Success (%)	Failure (%)	Total	p-value
<33%	23(74.2%)	8(25.8%)	31(100%)	
33-36%	0(0%)	2(100%)	2(100%)	0.032
>36%	0(0%)	1(100%)	1(100%)	

Tables 2 and **3** show the association between pre-operative platelet and hematocrit value. **Tables 2** found that most patients had platelet values of 150.000-400.000, and most had successful AVF initiation. Patients with a platelet value of less than 150.000 have an equal number of successes and failures in AVF initiation. All patients with platelet value more than 400.000 had successful AVF initiation. From chi-square analysis, we found that the p value for this association was 0,411. There was no association between pre-operative platelet value with AVF failure in this research.

In **Table 3**, we found that most of the patients had hematocrit values of less than 33%, and most of them got successful AVF initiation (74.2%). Eight patients got AVF failure with a hematocrit value of less than 33%. Of all patients with hematocrit, 33-36% and more than 36% had failure to AVF initiation. From chi-square analysis, we found that the p-value for this association was 0.032. It shows an association between pre-operative hematocrit values and AVF failure in this research.

DISCUSSION

There were 34 patients who underwent AVF initiation in this research. We used pre-operative platelet and hematocrit value from the medical record. We used this parameter because these two variables influenced the AVF failure. Our data found that the most successful AVF initiation had a platelet count of 150.000-400.000. From chi-square analysis, we found that

the p-value for this association was 0.411. There was no association between pre-operative platelet values and AVF failure. We suggest many factors influencing platelet value and making AVF initiation fail.

Sarioglu et al. found that a higher level of platelet lymphocyte ratio (PLR) can support the finding of stenosis and thrombosis in patients with AVF failure. The average platelet that makes thrombosis in a patient with AVF failure was 249.37±84.74 ($1x10^3/\mu L$).[10] Neointimal hyperplasia is the main reason for AVF stenosis and thrombosis. Studies have demonstrated that the main pathophysiology underlying neointimal hyperplasia and atherosclerosis was inflammation.[12-13] Platelets play a significant role in prothrombotic and proinflammatory events by contacting endothelium and inducing cytokine secretion. However, PLR was not found to be an independent predictor of AVF stenosis or thrombosis.[10] We suggest that comorbidities like diabetes mellitus lead to chronic inflammation and decrease endothelial elasticity. In addition, higher platelet levels cause thrombus in anastomose AVF and disturb AVF flow.

The platelet function can be rated by calculating the mean platelet volume (MPV). MPV can be used as a marker of platelet activity. Lano et al. found that AVF dysfunction was higher in patients with high MPV (p=0.001) and the risk of AVF failure is three times higher in patients with high MPV compared to low MPV.[11]

From the hematocrit value, we found an association between pre-operative hematocrit value and AVF failure with a p-value equal to 0.032. Most patients with a hematocrit of less than 33% had successful AVF initiation compared with patients with a hematocrit value of more than 36% who failed in AVF initiation. A higher hematocrit value is associated with thrombosis. The viscosity of the blood will increase due to higher hematocrit and affect blood flow. Increased blood viscosity increases arterial pressure, making the heart contract harder to flow blood throughout the body.[4,9] The disturbance of blood flow is one of the components of the Virchow triad, which is one of the thrombosis mechanisms. Two other factors that may predispose a person to the development of venous thrombosis are hypercoagulability and endothelial injury.[14] Platelet adhesion will increase as long as an increase of hematocrit. A higher hematocrit value made hypercoagulation in blood flow and triggered thrombus and AVF failure. There is no consensus on optimum hematocrit value for HD patients. Sarioglu et al. found that the average hematocrit value for thrombosis in AVF failure was 35.02±6.15%, but it was not significant from the statistic test (p-value 0.699).[10]

Our study had some limitations. First, the study was conducted retrospectively. Second, we do not collect comorbid patient data like diabetes mellitus, hypertension or cardiovascular disease; thus, we cannot assess them as the confounding variable. Another limitation was the relatively small sample size of the groups. A bigger sample size is needed to increase the external validity of the study

CONCLUSION

We found that most of our patient was male and 45-60 years old with ESRD. There was an association between pre-operative hematocrit value with AVF failure in HD patients. There was no association between pre-operative platelet value and AVF failure in HD patients.

ETHICAL CLEARANCE

The local ethical committee has approved this study.

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None

AUTHOR CONTRIBUTIONS

All authors contributed equally to this study and in this manuscript writing.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest regarding this study.

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