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Relationship Between Quick of Blood with Arteriovenous Radiocephalic And Brachiocephalic Fistula to Blood Urea Nitrogen (BUN), Creatinine Serum, Neutrophil to Lymphocyte Ratio (NLR), And Hemoglobin in Patients Hemodialysis

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ABSTRACT

Chronic kidney disease (CKD) is a chronic disease with a high prevalence worldwide. In 2017, an estimated 1.2 million people died from CKD globally. There are 713,783 CKD sufferers (0.38%) in Indonesia aged 15 years who have been registered nationally. Hemodialysis (HD) is one of three renal replacement therapies for managing CKD. Adequate vascular access is required in patients undergoing HD. Vascular access is ideal if it causes minor complications when used for hemodialysis. Arteriovenous fistula (AVF) is a common vascular access used during HD. The main options for AVF are radiocephalic (RC) and brachiocephalic (BC) fistula, with their respective advantages and disadvantages. This cross-sectional study compares QB in patients with RC and BC fistula and with hematological parameters pre and post-HD. There were 18 RC subjects and 18 BC subjects involved in this study. Subjects were then examined for hematological parameters and QB before and after HD. The results of this study showed that QB in the RC group was not significantly different from the BC group (p=0.126). The mean comparative test showed that the levels of Hb, BUN, and SC were significantly different before and after HD both in the RC group (p=0.005; p=<0.001; p=<0.001) and BC (p=0.001; p =<0.001; p=<0.001). The correlation test results showed that QB only correlated with SC pre-HD levels (p=0.030; r=0.361). Multivariate tests showed that the decrease in BUN levels with AV fistula BC was higher than with RC (p=0.015). This study proves that QB is unrelated to the type of AV fistula used, but QB is positively correlated with serum creatinine levels in patients undergoing HD. BC fistula were also found to lower BUN levels better than RC fistula.

Keywords: brachiocephalic; radiocephalic; quick of blood; hemodialysis

INTRODUCTION

The prevalence of CKD worldwide is among the highest among other chronic diseases. The meta-analytic study conducted by Hill et al. (2016) showed that the majority of CKD stages 1 to 5 was 13.4% and the prevalence of CKD stages 3 to 5 was 10.6% worldwide.[1]. This number is much higher than diabetes which is estimated at 8.2% of the world's population[1,2].

In 2017, an estimated 1.2 million people died from CKD globally, with the global all-age mortality rate due to CKD increasing to 41.5% compared to 1990, which was only 35.2%[3]. CKD is also found to be more common in women than in men[1,4].

Hemodialysis (HD) in CKD patients requires adequate vascular access. Vascular access is ideal if it causes minimal complications when used for hemodialysis. Arteriovenous fistula (AVF) is a commonly used way to maintain vascular access during HD. To reduce morbidity and mortality in patients, adequate HD is essential. The marker of hemodialysis adequacy is Kt/V, which is the ratio of urea clearance and HD time to the volume of urea distribution in the body. Kt/V can be modified by dialyzer efficiency, dialysis duration, dialysis frequency, dialysate flow rate (Qd), and dialyzer blood flow rate (quick of blood; Qb).[5].

Quick of blood (Qb) is the amount of blood that can flow per minute (mL/minute). More toxic substances can be removed from the body if the amount of blood flowing (Qb) increases. Some literature states Qb for each patient can be determined from the lumen size of the catheter used, the patient's weight, and vascular access during hemodialysis.[6,7]. Thus, proper Qb regulation is essential to achieve optimal clearance in the implementation of hemodialysis.

Qb and AV fistula are known to be associated with hematological parameters. However, the results needed to be more consistent, and the data were minimal. Until now, there has been no research that discusses the relationship between the type of AV fistula and hematological variables, so the authors are interested in conducting research with the title "Relationship Between Qb and AVF RC and BC on BUN, SC, NLR, and Hb in Patients Undergoing Hemodialysis." This research is expected to be helpful in cardiovascular thoracic surgery as a basis for determining the optimal use of AV fistula in hemodialysis patients.

MATERIALS AND METHODS

Materials

This study is an analytic observational study with a cross-sectional design to observe the relationship between arteriovenous (AV) fistula and Quick of Blood (QB), Blood Urea Nitrogen (BUN), Serum Creatinin (SC), Neutrophil-to-lymphocyte ratio (NLR), and hemoglobin (Hb) post hemodialysis in patients undergoing hemodialysis at Prof. dr. IGNG Ngoerah General Hospital, Denpasar. Inclusion Criteria: 1) Patients aged over or equal to 18 years at the time of hemodialysis and AV fistula insertion procedure, 2) Patients undergoing hemodialysis and AV fistula insertion procedure who were treated at Prof. dr. IGNG Ngoerah General Hospital, Denpasar, 3) Patients who do hemodialysis with a duration of 3-4 hours per time and with a frequency of 2-3 times per week, 4) Complete patient data in the medical record. Exclusion criteria are for patients who are incomplete in the medical record. This research has received ethical approval from Udayana University Denpasar.

Data analysis

Data analysis was performed using SPSS for Windows version 23.0 software. Using the Shapiro-Wilk method for normalities, bivariate analysis using independent T-test analysis if the data is usually distributed normal and the data is not normal will be analyzed using the Mann-Whitney Test. Pearson's test is used with simple linear regression analysis to test the correlation between variables if they are typically distributed. If the distribution is not normal, then it is carried out. The multivariate analysis uses multiple linear regression tests for numerical variables. The p-value is considered significant if p <0.05

RESULTS

In this study, 36 research subjects were used, consisting of patients who underwent AV fistula RC (radiocephalica) and AV fistula BC (brachiocephalic) groups with the same number in each group, namely 18 people. Table 3 describes the essential characteristics of the research subjects in Table 1.

TABLE 1: Basic characteristics of research subjects.

Variable	Types of AV fistula		P value
	Radiochepalic (n=18)	Brachiocepalic (n=18)	
Age (years)(Mean±SD)	48.11±11.07	46.61±18.74	0.772
Quick of blood (ml/min) (Mean±SD)	198.55±23.18	210.88±24.00	0.126
Gender (n, %)			
Man	13 (56.5%)	10 (43.5%)	0.488
Woman	5 (38.5%)	8 (61.5%)	
Liver disease (n, %)	2 (40.0%)	3 (60.0%)	1,000
Congestive heart failure (n, %)	2 (66.7%)	1 (33.3%)	1,000
Chronic kidney failure (n, %)	18 (50.0%)	18 (50.0%)	-
COPD (n, %)	0 (00.0%)	0 (00.0%)	-
Asthma (n, %)	0 (0.00%)	1 (100.0%)	1,000
Diabetes mellitus (n, %)	3 (33.3%)	6 (66.7%)	0.443
HIV (n, %)	0 (00.0%)	0 (00.0%)	-
Cerebrovascular Disease (n, %)	1 (100.0%)	0 (0.00%)	1,000
Malignancy (n, %)	0 (00.0%)	0 (00.0%)	-
Immunosuppressant drugs (n, %)	0 (00.0%)	0 (00.0%)	-

*Significant (p<0.05)

Blood laboratory characteristics used in this study were hemoglobin (Hb), neutrophils, lymphocytes, neutrophil-to-lymphocyte ratio (NLR), blood urea nitrogen (BUN), and serum creatinine (SC) levels which were examined in initial conditions before testing hemodialysis and also after hemodialysis. The results of the normality analysis of Hb, lymphocytes, BUN, and SC were found to be expected, so the mean comparison test between groups on variables used the independent sample T-test. In contrast, the normality test results were abnormal on the neutrophil and NLR variables using the Mann-Whitney test. The results of the average comparison test of the two groups before hemodialysis was carried out can be seen in Table 2.

TABLE 2: An overview of the characteristics of blood laboratory results before hemodialysis.

Variable	Types of AV Fistula		Average difference	IK95%	P value
	RC (n=18)	BC (n=18)			
Hb	10.21±2.20	9.79±1.57	0.41	-0.88-1.71	0.519[a]
Neutrophils	4.18±1.26	3.63±1.09	0.54	-0.25-1.34	0.174[b]
Lymphocytes	1.34±0.41	1.40±0.40	-0.05	-0.33-0.22	0.694[a]
NLR	3.27±1.12	2.94±1.76	0.33	-0.67-1.33	0.117[b]
BUN	72.93±21.26	60.05±17.46	12.87	-0.30-26.06	0.055[a]
SC	12.89±3.76	12.63±3.90	0.26	-2.33-2.86	0.839[a]

*Significant (p<0.05); [a]analysis with Independent T-test; [b]analysis by Mann-Whitney test.

All laboratory results between the two groups did not differ significantly, so the comparison was only from the post-test (post-hemodialysis) in this study. The results of the normality analysis showed that the Hb variable had a normal distribution using the independent sample T-test. In contrast, using the Mann-Whitney test, the neutrophil, lymphocyte, NLR, BUN, and SC variables had an abnormal distribution. The results of the mean comparison test of the two groups before hemodialysis was carried out can be seen in Table 3.

TABLE 3: An overview of the characteristics of blood laboratory results after hemodialysis.

Variable	Types of AV Fistula		Average difference	IK95%	P value
	RC (n=18)	BC (n=18)			
Hb	10.87±2.42	10.94±2.25	0.77	-1.65-1.51	0.930[a]
Neutrophils	4.01±1.06	3.72±1.55	0.28	-0.49-1.07	0.334[b]
Lymphocytes	1.34±0.56	1.34±0.41	-0.003	-0.33-0.33	0.580[b]
NLR	3.30±1.12	3.03±1.49	0.26	-0.63-1.16	0.296[b]
BUN	21.30±8.42	14.90±6.34	6.39	1.34-11.44	0.018*[b]
SC	4.97±1.75	4.15±1.55	0.82	-0.30-1.94	0.117[b]

*Significant (p<0.05); [a]analysis with Independent T-test; [b]analysis by Mann-Whitney test.

The data obtained was then carried out with a comparative test before and after hemodialysis. Table 4 shows the paired comparative test data on the laboratory results of the subject group with the RC-type AV shunt. Table 5 shows paired comparative test data on the laboratory results of the subject group with AV shunt type BC.

TABLE 4: Comparative test before and after hemodialysis in patients with RC type AV shunt.

Variable	Pre HD	Post HD	Difference	CI 95%	P value
	Mean ± SD	Mean ± SD			
Hb	10.21±2.20	10.87±2.42	-0.66	-1.09-(-0.22)	0.005[a]*
Lymphocytes	1.34±0.41	1.34±0.56	0.001	-	0.913[b]
Neutrophils	4.18±1.26	4.01±1.06	0.17	-0.17-(-0.51)	0.316 [a]
NLR	3.27±1.12	3.30±1.12	-0.27	-0.44-0.39	0.892 [a]
BUN	72.93±21.26	21.30±8.42	51.63	43.48-59.77	<0.001[a]*
SC	12.89±3.76	4.97±1.75	7.92	-	<0.001[b]*

*Significant (p<0.05); [a]analysis by paired sample T-test; [b]analysis by Wilcoxon test.

TABLE 5: Comparative test before and after hemodialysis in patients with type BC AV shunt.

Variable	Pre HD	Post HD	Difference	CI 95%	p.s
	Mean ± SD	Mean ± SD			
Hb	9.79±1.57	10.94±2.25	-1.14	-1.72-(-0.56)	0.001a*
Lymphocytes	1.40±0.40	1.34±0.41	0.05	-0.04-0.14	0.251a
Neutrophils	3.63±1.09	3.72±1.24	-0.08	-	0.794b
NLR	2.94±1.76	3.03±1.49	-0.93	-	0.647b
BUN	60.05±17.46	14.90±6.34	45.14	38.35-54.94	<0.001a*
SC	12.63±3.90	4.15±1.55	8.48	-	<0.001a*

*Significant (p<0.05); [a]Analysis by paired sample T-test; [b]Analysis by Wilcoxon test.

The data obtained from the two groups were then analyzed for the correlation between the Qb variable and the results of blood laboratory tests both before and after hemodialysis.

The results show that Qb is significantly correlated only with the variable SC (p=0.030) with a weak correlation coefficient (r=0.361). Meanwhile, no significant correlation was found for other variables (Table 6)

TABLE 6: Correlation between Qb and pre and post-hemodialysis laboratory results.

Variable	*Quick of Blood*(n=38)	
	r	p-value
Pre hemodialysis		
Hb	0.152	0.375
Neutrophil	0.136	0.428
Lymphocytes	0.163	0.342
NLRB	-0.017	0.923
BUNA	0.189	0.270
Sca	0.361	0.030*
Post hemodialysis		
Hb	0.314	0.063
Neutrophil	0.146	0.397
Lymphocytes	0.132	0.443
NLRB	-0.003	0.986
BUNb	0.024	0.889
SCb	0.198	0.248

*Significant (p<0.05); analysis with Pearson Correlation Test; analysis with the Spearman Correlation Test.

The test results for differences in the mean laboratory parameters before and after HD showed significant differences in the Hb, BUN, and SC variables in either AV fistula RC or BC. A comparative analysis of post-HD laboratory parameters found that BC-type AV fistula was more effective than RC in reducing BUN levels.

To determine the effect of AV fistula type BC on the laboratory parameters of HD patients, a multivariate analysis is required to ensure that this effect truly independently causes a decrease in BUN levels (Table 7).

TABLE 7: Results of multivariate analysis.

Variable	B	std. Error	t	p-value	IK95%
AV fistula type BC with post-HD Hb levels					
Constant	10,803	1,232	8,766	<0.001	8.29-13.30
AV fistula	0.069	0.779	0.088	0.930	-1.5-1.65
AV fistula type BC with BUN Post HD levels					
Constant	27,695	3,930	7,048	<0.001	19.70-35.68
AV fistula	-6,393	2,485	-2,573	0.015*	-11.44-(-1.34)
AV fistula type BC with SC Post HD levels					
Constant	5,794	0.874	6,632	<0.001	4.01-7.57
AV fistula	-0.822	0.553	-1,488	0.146	-1.94-0.30

*Significant (p<0.05).

DISCUSSION

The mean age of the subjects in this study was 48.11±11.07 years for AVF RC access and 46.61±18.74 years for AVF BC access. When viewed from several similar studies, this study has different results from previous studies, which stated that the average age of the subjects was 63.2 ± 15 years[8]. Nonetheless, there are studies with research results similar to this study which state that the age group of 40-59 years is the majority at 36.2%, followed by the age group of 60 years at 33.2%.[9]. However, in the bivariate test, there was no significant relationship between the age of the subject and the type of AVF (p>0.05), where the results of this study are in line with the study of Wuwu et al., 2021 with a value of p=0.228[10].

Furthermore, the average Qb in this study was 198.55 ± 23.18 ml/minute on AVF RC access and 210.88 ± 24.00 ml/minute on BC access, and there was no significant relationship between the results of the bivariate test (p> 0.05). The results of this study were similar to other studies, which obtained an average Qb of 197.8 ± 23.4 ml/minute for AVF BC access and 193.3 ± 32.0 ml/minute for AVF RC access. There was no significant relationship (p=0.716).[10]. Most subjects in this study were male, and there was no meaningful relationship. The majority of male subjects were also found in other studies[8]and supported by other studies, which showed a significant relationship between gender and AVF access with p=0.021[10].

The patients in this study were patients undergoing hemodialysis due to chronic kidney disease, the occurrence of pathological changes in the structure and function of the kidneys, which have lasted more than three months, with the following criteria: a decrease in the glomerular filtration rate (GFR) of less than 60 ml/minute/1.73 m2 with or without markers of kidney damage. In this study, patients undergoing hemodialysis were differentiated based on the AV fistula access used, namely RC and BC. They were compared to determine the best pass-through analysis performed on blood markers and Qb.

The patients involved in this study sample were found to have comorbidities such as liver disease, congestive heart failure, history of asthma, diabetes mellitus, and cerebrovascular disease. However, there was no significant relationship between the patient's disease characteristics. Based on the study's results, there was no history of chronic kidney failure, COPD, HIV, malignancy, and the use of immunosuppressant drugs in the patients. This is similar to other studies which state that most hemodialysis patients experience hypertension, atherosclerosis, and diabetes mellitus[10].

Furthermore, when viewed from the comorbidity of the study sample, chronic hepatitis C is associated with higher cardiovascular-related liver disease and all causes of death in hemodialysis patients.[11]. Non-diabetic hemodialysis patients with Nonalcoholic fatty liver disease (NAFLD) have significantly higher mtDNA copy numbers and glutathione peroxidase (GPx) levels compared to patients without NAFLD[12]. Congestive heart failure is a comorbid condition in chronic kidney failure patients undergoing hemodialysis. Most patients with chronic renal failure experience a decrease in diuresis, which can lead to fluid retention.[13]

In patients with renal failure, asthma develops after one year of hemodialysis treatment. Asthma attacks are exclusively associated with hemodialysis. The use of acetate can trigger asthma attacks in hemodialysis patients[14]. Associated with diabetes mellitus in hemodialysis patients has been associated with the pathogenesis of nephropathy. Protein denaturation due to high glucose levels, intraglomerular hypertension, and hyperglycemia will cause glomerular abnormalities. The glomerular basement membrane undergoes changes accompanied by a proliferation of mesangial cells[15]. Chronic renal failure is an independent risk factor for developing the cerebrovascular disease, minimal vessel disease, manifesting in various phenotypes ranging from cavities to microbleedings.[16]. Hemodialysis patients have white matter disease and cerebral atrophy than controls without known kidney disease. Hemodialysis patients also have a high prevalence of unrecognized infarction[17].

This study did not find a significant correlation between Qb and BUN, NLR, and Hb levels pre- and post-hemodialysis. There was no significant correlation between Qb and post-hemodialysis SC levels, but there was a substantial correlation between Qb and pre-hemodialysis SC levels. One factor that needs to be considered in determining dialysis therapy in patients is an increase in BUN levels[18]. Dialysis patients with lower BUN levels (<70 mg/dL) have a lower mortality rate compared to patients with higher BUN levels (150 mg/dL) who have recently received dialysis[19]. Adjusted AUC to predict one-year and five-year mortality showed that pre-hemodialysis BUN levels were more accurate than post-hemodialysis ($p < 0.0001$)[20].

If one looks at the incidence of decreased SC levels, a near-normal decrease in CKD patients was found to occur after dialysis[21]. Decreased excretion of creatinine in the blood is associated with the risk of kidney failure and mortality in patients with CKD[22]. The results of Erwinsyah's research, 2014 showed no significant relationship between the Qb value and the post-hemodialysis decrease in urea in CKD patients undergoing hemodialysis (p = 0.799). There was no meaningful relationship between the Qb value and the post-hemodialysis decrease in creatinine in CKD patients undergoing hemodialysis (p = 0.100)[23].

Significant reductions in red blood cells, Hb levels, and hematocrit percentage occurred in patients with decreased eGFR (<60 mL/min/1.73 m2) when compared to patients with normal kidney function[24]. Hemodialysis-induced release of hemoglobin in the pathogenesis of endothelial dysfunction experienced by patients with end-stage renal disease. Approaches that oxidize free plasma hemoglobin may restore nitric oxide (NO) bioavailability and potentially benefit vascular function.[25].

Patients with CKD have an increased NLR compared to healthy individuals[26]. NLR levels were significantly higher in peritoneal dialysis patients when compared to hemodialysis patients. Simple NLR calculations can predict inflammation in patients with end-stage renal disease[27]. Higher NLR in hemodialysis patients is associated with cardiovascular risk factors and mortality[28].

NLR is an inexpensive and easily accessible inflammatory marker whose role in cardiovascular disease has been studied extensively recently. The neutrophil-lymphocyte ratio has been shown to predict cardiac arrhythmias and short- and long-term mortality in patients with acute coronary syndromes. This correlates well with risk prediction models for acute coronary syndromes such as the GRACE and SYNTAX scores. Higher NLRs are associated with frequent congestive heart failure decompensation and long-term death. The neutrophil to lymphocyte ratio also appears to have a prognostic role in patients undergoing transaortic valve replacement and developing valvular heart disease. However, the science of inflammatory biomarkers was elucidated decades ago,[29]. A meta-analysis also supports this by concluding that a high NLR is associated with coronary artery disease, acute coronary syndrome, stroke, and composite cardiovascular events.[30].

High NLR values are clinically associated with an increased risk of cardiovascular events in patients with COVID-19. This makes NLR a potential biomarker for predicting cardiovascular events in the current COVID-19 pandemic[31].

Regarding the relationship of Quick of Blood (Qb) to the type of AV fistula used in this study, there was no significant difference in mean blood pump rate between patients using AV fistula RC and BC with p=0.126. The results of this study follow the research of Wumu et al. (2021), which involved 25 patients undergoing hemodialysis procedures. In this study, there was no significant difference in the average rate of pumping blood in patients using AV fistula BC and RC access, both before and after venoplasty (p>0.05).[10]. However, in the study of Berman et al., (2008) found a significant difference in average access to functional and non-functional AVF BC and RC. This study found that the average QB in patients with access to helpful AVF BC vs. functional RC was 404.1 ± 40.4 vs. 144.3 ± 21.8. However, statistically, there was no data available stating that the mean difference was found to be statistically significant[32] in patients undergoing hemodialysis, greater vascular access with faster blood pump rates to be able to carry out toxin clearance in the hemodialysis procedure more quickly. Compared to AVF RC access, AVF BC access has a larger venous lumen size with a faster blood pumping rate. On the other hand, AVR RC access has advantages over AVF BC in the form of ease of formation and effectiveness for subsequent fistula formation.[33,34]. However, in this study, there was no significant difference in the mean, so it is necessary to carry out further investigations regarding this finding.

Anemia is a common complication of chronic kidney disease. Although the optimal target hemoglobin concentration in CKD patients is still controversial, *European Best Practice Guidelines*(EBPG) recommends that the target hemoglobin level be determined individually, considering the sex, age, ethnicity, activity, and comorbidities of each patient[35]. Based on research conducted by Bal et al. (2018) who analyzed the hemoglobin levels of 190 patients undergoing hemodialysis, found that hemoglobin variability was significantly lower in patients in the "high stable" group, namely the group whose hemoglobin levels had remained at high levels for the last 6 months, compared to other groups. In addition, the variability of hemoglobin levels in hemodialysis patients is also said to be related to the patient's age. Platelet count, and associated with the number of these patients admitted to the hospital.[36]. In this study, it was found that patients at Prof. dr. IGNG Ngoerah General Hospital before undergoing hemodialysis had an average Hb of 10.00 ± 1.90 g/dL and an average after hemodialysis of 10.90 ± 2.30 gr/dL (p <0.001). These results are under a study conducted by Nishiwaki et al. (2019), who investigated changes in Hb levels and post-hemodialysis Hb levels and their relationship to the patient mortality rate within one year. This study found that the average Hb after hemodialysis had increased compared to the Hb before hemodialysis[37].

Blood urea nitrogen (BUN) is the amount of urea nitrogen in the blood. The liver produces urea in the urea cycle as a waste product of protein digestion. In humans, the daily excretion of urea in the urine is about 30 g. Urea is excreted not only by glomerular filtration but also by secretion from the renal tubules[38]. BUN levels in CKD patients will increase due to decreased blood urea excretion. This study found that the BUN levels of patients at Prof. dr. IGNG Ngoerah General Hospital experienced a significant reduction after hemodialysis (p<0.001).

This finding is in line with research conducted by Decker et al., which stated that the BUN concentration decreased after 4 hours after hemodialysis; this was due to the increased clearance of urea in the blood after hemodialysis.[39]. Shamsadini et al. also found similar results in that they studied patients with chronic renal failure who had had a history of hemodialysis for more than one year. In addition to BUN levels which were found to decrease significantly after hemodialysis, serum creatinine levels also declined considerably after hemodialysis (p<0.05)[40]. Serum creatinine levels (serum creatinine, SC) in this study were found to have significantly reduced with levels before hemodialysis of 12.76 ± 3.78 mg/dL and decreased to 4.56 ± 1.68 mg/dL after hemodialysis (p <0.001). These results align with the findings of Amin et al., who found a decrease in SC levels after hemodialysis[21].

The neutrophil-lymphocyte ratio (NLR) may serve as a surrogate biomarker for systemic inflammation in chronic kidney disease (CKD), in addition to C-reactive protein (CRP). This study showed no significant difference in NLR before and after hemodialysis (p=0.604). What can be an explanation for neither increasing nor decreasing NLR is that in the study subject, only one person had cardiovascular disease. This was explained in a study by Zhu et al. who stated that the NLR value was higher in hemodialysis patients with cardiovascular disease than in patients without cardiovascular disease[41]. The survey by Malhotra et al. demonstrated that NLR was a strong and independent predictor of cardiovascular disease severity and mortality in the general population.[42]. Azab et al. also found that NLR was correlated with the worsening of kidney function in diabetic patients[43].

This study also showed that there was a significant reduction in BUN levels, as well as SC, after hemodialysis in both the RC and BC AV shunt groups. The multivariate test results showed that the AV shunt BC could lower BUN levels better than the AV RC shunt (p=0.015).

This research is not free from limitations or research limitations. The rules found in this study were that the QB values obtained in subjects with RC or BC had been regulated in such a way by the hemodialysis nurse staff. This resulted in researchers being unable to intervene further regarding the QB value in each hemodialysis patient at Prof. dr. IGNG Ngoerah General Hospital. This is also one of the reasons the QB values in RC and BC in hemodialysis patients at Prof. dr. IGNG Ngoerah General Hospital are not significantly different. The cross-sectional study design also played a role in the weaknesses of this study. This causes the QB value and laboratory parameters to be obtained only at one time and cannot describe the development of the subject's condition from time to time in detail.

CONCLUSION

There was no significant relationship between Quick of Blood and type of AV fistula; quick of blood was significantly related to serum creatinine after hemodialysis, and the kind of AV fistula was related considerably to BUN after hemodialysis in patients undergoing hemodialysis Prof. dr. IGNG Ngoerah General Hospital, Denpasar.

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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