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Risk factors associated with the incidence of Arteriovenous (AV) shunt stenosis in Chronic Kidney Disease (CKD) patients on hemodialysis



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ABSTRACT

Background: Arteriovenous (AV) shunt stenosis is a significant complication in chronic kidney disease (CKD) patients undergoing hemodialysis with AV shunt access. The risk factors associated with this event are still not fully understood. This study aims to identify factors associated with the incidence of AV shunt stenosis in CKD patients undergoing dialysis.

Methods: A cross-sectional study was conducted involving 236 patients undergoing hemodialysis at Dr. Saiful Anwar General Hospital, Malang. Risk factors analyzed included age, gender, diabetes mellitus, hypertension, obesity, and AV shunt location.

Results: Bivariate analysis using the Chi-square test showed significant associations between stenosis and age ($p=0.020$), gender ($p=0.001$), diabetes mellitus ($p=0.001$), and hypertension ($p=0.031$). However, obesity ($p=0.608$) and AV shunt location ($p=0.552$) were not significantly associated. Logistic regression analysis indicated that diabetes mellitus increased the risk of AV shunt stenosis by 2.46 times (95% CI: 1.42-4.26), hypertension by 2.05 times (95% CI: 1.06-3.96), and age above 60 years by 1.93 times (95% CI: 1.10-3.37).

Conclusion: Diabetes mellitus, hypertension, advanced age, and smoking are key risk factors for AV shunt stenosis in CKD patients undergoing dialysis.

Keywords: AV Shunt Stenosis; Chronic Kidney Disease; Hemodialysis; Risk Factors.

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INTRODUCTION

In patients with end-stage renal disease (ESRD), renal replacement therapy is a necessity to sustain the patient's life.¹⁻⁵ Approximately 98% of patients with end-stage renal disease undergo hemodialysis therapy, making it the most commonly used renal replacement therapy modality globally, including in Indonesia.⁶⁻¹¹ This high rate of hemodialysis utilization is due to the limited availability of kidney donors for transplantation as well as various obstacles in the implementation of Continuous Ambulatory Peritoneal Dialysis (CAPD).^{3,11-15} To undergo hemodialysis, patients require adequate vascular access, one of which is through an arteriovenous (AV) shunt or arteriovenous fistula (AVF). Compared to other methods, such as central venous catheters, AV shunts are preferred as they provide more stable vascular access and lower

failure rates during routine hemodialysis therapy.^{1,4}

Although an AV shunt is a recommended vascular access, complications such as AV shunt stenosis are common. In several recent studies, it was reported that stenosis accounted for approximately 30%-57.8% of all complications of AV shunt use, emphasizing the importance of early monitoring and intervention to maintain vascular access patency.^{11-13,16} Narrowing of the vessel lumen due to AV shunt stenosis is usually triggered by proliferation of the inner lining of the vessel (intima) and impaired endothelial function.¹⁻⁵ Several risk factors have been associated with the incidence of AV shunt stenosis, including advanced age, diabetes mellitus, hypertension, obesity, and the location of AV shunt insertion. These factors may affect AV shunt patency through various mechanisms, including vascular changes due to chronic inflammation, increased

systemic blood pressure, metabolic disturbances, as well as mechanical factors from the AV shunt insertion site.⁶⁻⁸

This study aims to analyze the risk factors that contribute to the incidence of AV shunt stenosis in CKD patients undergoing hemodialysis at RSUD Dr. Saiful Anwar Malang. By understanding the main risk factors, it is hoped that more effective prevention strategies can be carried out to maintain optimal vascular access and improve the quality of life of CKD patients.

METHODS

The design of this study is cross-sectional, which allows analysis of the relationship of risk factors at one specific point in time. Samples were selected using a consecutive sampling technique until at least 97 subjects were enrolled in each group. The study was conducted in the Inpatient

Room of Dr. Saiful Anwar Hospital, Malang. The study was conducted from November to December 2024. This study has received approval from the Health Research Ethics Committee of RSUD Dr. Saiful Anwar Malang with permit number 400/380/K.3/102.7/2024. Data were obtained from medical records, including patient history of diabetes, hypertension, smoking status, AV shunt location, and other demographic and clinical characteristics.

The study population was patients diagnosed with chronic renal failure who routinely underwent HD using AV shunt access, who experienced AV shunt stenosis, and who did not experience AV shunt stenosis. With inclusion criteria, namely: 1) Patients diagnosed with Chronic Kidney Disease, (2) Patients undergoing routine HD, (3) Patients installed AV shunt access, (4) Patients signed informed consent and Exclusion criteria in the population are (1) Patients who experience Thrombosis as evidenced by the results of Doppler ultrasound, (2) Patients who cannot be reached and found. Chronic Kidney Disease (CKD) patients were diagnosed with AV shunt stenosis if there was a luminal narrowing of more than 50% of the normal diameter, confirmed by angiographic evidence, accompanied by clinical signs such as the inability of the AV fistula to provide an adequate blood flow rate (Qb) to achieve a Kt/V of 1.4.

Data analysis was performed using SPSS. Chi-Square test was conducted to assess the association of Risk Factors with the occurrence of AV shunt stenosis and followed by Multivariate (Logistic Regression) to determine which variables play a role or influence the incidence of stenosis.

RESULTS

This study involved a total of 236 patients who met the inclusion and exclusion criteria. **Table 1** shows that the average age of patients was 53.30 years old, with the youngest age being 20 years old and the oldest being 80 years old. Then, in the age group, there were 158 patients (66.9%) aged < 60 years, and 33.1% of patients aged more than equal to 60 years. For gender, there were 51.3% female patients

Table 1. Characteristics of Research Data.

Characteristics	Stenosis (n=126)	Without Stenosis(n=110)	Total (n)
Men, n (%)	49 (38.90)	66 (60.00)	158 (48.70)
Woman, n (%)	77 (61.10)	44 (40.00)	121 (51.30)
Ages (years) (meanSD)	55.95±11.78	53.85±11.78	53.30±11.78
Duration of CKD (years), n (%)			
< 1	44 (34.90)	51 (40.50)	68 (28.80)
1-3	42 (33.30)	35 (27.80)	85 (36.00)
>3	40 (31.70)	40 (31.70)	83 (35.20)
Duration of AV Shunt (years), n (%)			
< 1	37 (29.40)	41 (32.50)	111 (47.00)
1-3	38 (30.20)	48 (38.10)	108 (45.80)
>3	51 (40.50)	37 (29.40)	17 (7.20)
Primary Patency (years), n (%)			
< 1	81 (64.29)	0 (0.00)	0 (0.00)
>1	45 (35.71)	0 (0.00)	0 (0.00)
Comorbidities, n (%)			
Diabetes Mellitus	59 (46.80)	29 (26.40)	88 (37.00)
Hypertention	108 (85.70)	82 (74.50)	190 (80.50)
Obesity	37 (29.40)	29 (26.40)	66 (28.00)
Location of AV Shunt, n (%)			
Radiocephalic	65 (51.60)	61 (55.50)	126 (53.10)
Braciocephalic	61 (48.40)	49 (44.50)	110 (46.60)

Table 2. Bivariate Analysis of the Relationship between Risk Factors and the Incidence of AV Shunt Stenosis.

Risk Factor	Stenosis AV shunt				P	Odds Ratio (OR)
	Case		Control			
	n	%	n	%		
Age (Years)					0.020*	
>=60	50	39.7	28	25.5		1.93
<60	76	60.3	82	74.5		0.52
Gender					0.001*	
Female	77	61.1	44	40.0		2.36
Male	49	38.9	66	60.0		0.42
Diabetes Mellitus	59	46.8	29	26.4	0.001*	2.46
Without Diabetes Mellitus	67	53.2	81	73.6		0.41
Hypertension	108	85.7	82	74.5	0.031*	2.05
Without Hypertension	18	14.3	28	25.5		0.49
Obesity	37	29.4	29	26.4	0.608	1.16
Without Obesity	89	70.6	81	73.6		0.86
Location of AV Shunt					0.552	
Radiocephalic	65	51.6	61	55.5		0.86
Brachiocephalic	61	48.4	49	44.5		1.17

*Statistically significant if p-value is less than 0.05

and 48.7% male patients (Table 1). For patients with Diabetes, out of 236 study samples, there were 37.3% of patients who had Diabetes Mellitus, and 62.7% of other patients did not have Diabetes Mellitus. For patients with hypertension, there were 80.5% of patients who had hypertension, and 19.5% of other patients did not have hypertension. For the smoking history of 236 research samples, there were 26.7% of patients smoked, and 73.3% of other patients did not smoke. For a history of obesity, there were 28.0% of patients who were classified as obese, and 72.0% of other patients were classified as not obese (Table 2). For AV shunt location of the 236 study samples, there were 53.4% of patients with AV shunt location in Radiocephalic and 46.6% of other patients with AV shunt location in Brachiocephalic based on the distribution results. In the hemodialysis duration variable, 28.8% of patients underwent HD <1 year, 36.0% for 1-3 years, and 35.2% >3 years, with no significant difference in distribution ($p = 0.334$). Similarly, for the duration of AV shunt insertion, 38.6% < 1 year, 34.3% 1-3 years, and 27.1% >3 years, with the test results showing no significance ($p = 0.094$) (Table 3 and Table 4).

The results of the Chi-Square test showed a significant positive relationship between the age factor and the incidence of AV shunt stenosis (OR 1.93; $p = 0.020$), indicating that increasing age is associated with a risk of 1.93 times increased risk of AV shunt stenosis. Likewise also with female gender has a positive relationship with the results (OR 2.35; $p = 0.001$), where women have a risk of 2.35 times experiencing AV shunt Stenosis. Diabetes and Hypertension had a positive relationship as well, with a value for diabetes (OR 2.46; $p=0.001$) and Hypertension (OR 2.05; $p=0.031$), which shows patients with Diabetes have a risk of 2.35 times and Hypertension 2.05 times experiencing AV shunt Stenosis compared to patients who do not have Diabetes and Hypertension.

Logistic regression analysis was continued to determine the relationship between several independent variables and the incidence of AV shunt stenosis. It was conducted at the same time to determine the independent variable that had the most influence on the dependent variable.

Table 3. Logistic Regression of Risk Factors on the Incidence of AV Shunt Stenosis.

Risk Factors	P	OR	95% CI for EXP (B)	
			Lower	Upper
Age	0.021*	2.20	1.13	4.28
Genders	0.296	0.68	0.03	1.40
Diabetes Mellitus	0.006*	2.43	1.28	4.61
Hypertension	0.016*	2.65	1.20	5.84

*Note: Backward Stepwise Method (Likelihood Ratio) was performed to identify independent factors that influence the incidence of AV shunt stenosis, and statistically significant if p-value less than 0.05; OR: Odds Ratio; CI: Confidence Interval

Table 4. Logistic Regression of the Relationship between Risk Factors and the incidence of AV Shunt Stenosis in step 2

Risk Factors	P	OR	95% CI for EXP (B)	
			Lower	Upper
Age	0.018*	2.22	1.15	4.30
Diabetes Mellitus	0.006*	2.44	1.29	4.61
Hypertension	0.017*	2.59	1.19	5.63

*Notes. Final model (step 4) Logistic regression analysis, which shows that Age, Diabetes Mellitus, Hypertension, and Smoking have a significant relationship with the occurrence of AV shunt stenosis and statistically significant if the p-value is less than 0.05; OR: Odds Ratio; CI: Confidence Interval

Logistic regression using the Backward Stepwise (Likelihood Ratio) method was performed to identify independent factors that influence the incidence of AV shunt stenosis. In the final model (Step 2), it was found that age ≥ 60 years (OR=2.22; 95% CI: 1.15-4.30; $p=0.018$), patients with diabetes (OR=2.44; 95% CI: 1.29-4.61; $p=0.006$), and hypertension (OR=2.59; 95% CI: 1.19-5.63; $p=0.017$), were factors associated with the incidence of AV shunt stenosis.

DISCUSSION

The results showed that advanced age had a significant association with the incidence of AV shunt stenosis ($p = 0.020$; OR 1.93; 95% CI: 1.10-3.37). This is consistent with the study of Miller et al., who reported a higher rate of fistula maturation failure in elderly patients, which was 53.5% in patients >65 years compared to 30% in the <65 years age group.⁹ Decreased maturation in the elderly is believed to be related to increased comorbidities, such as peripheral vascular disease, that can inhibit blood flow to the AVF and interfere with the maturation process.¹⁰

In addition to age, diabetes mellitus also showed a significant association ($p = 0.001$; OR 2.46; 95% CI: 1.42-4.26). This finding is supported by Ismail's (2022) study in Indonesia, which showed that 46% of AVF stenosis patients had diabetes, compared to 24% in the patent fistula group.¹⁰ Similar results were also reported by Gao (2022). A multicenter prospective study by Yoshida (2021) found that diabetes increased the risk of access failure by 49% post-intervention.¹³ The pathophysiological mechanisms include endothelial dysfunction, pro-thrombotic conditions, and increased extracellular matrix deposition contributing to intimal hyperplasia.^{11,12} Hypertension as a risk factor was also significant ($p = 0.031$; OR 2.05; 95% CI: 1.06-3.96). Gao (2022) noted that 54% of patients with stenosis had a history of hypertension, compared to 31% in the patent fistula group.¹² The meta-analysis of Bai et al. (2022) showed that hypertension increased the risk of AVF complications by approximately 21%.¹⁴ Hypertension is believed to contribute to vascular wall changes, including impaired endothelial function and blood flow

dynamics, which ultimately accelerate the formation of excess tissue (hyperplasia) and narrowing of the vascular lumen.¹²⁻¹⁶

CONCLUSION

This study showed that age ≥ 60 years, diabetes mellitus, and hypertension had a significant association with the incidence of AV shunt stenosis in chronic kidney disease patients undergoing hemodialysis. These findings emphasize the importance of identifying modifiable risk factors to prevent vascular access complications and improve hemodialysis adequacy. In contrast, obesity and AV shunt location showed no significant association in this study. Therefore, it is recommended that future studies use a prospective or longitudinal design, involve a wider population through a multicenter approach, and consider multivariate analysis to eliminate confounding factors that may affect the results and provide a broader picture.

ETHICS CONSIDERATION

This study was approved by the Health Research Ethics Commission of RSSA with license number 400/380/ K.3 /102.7/2024.

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CONFLICT OF INTEREST

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

AUTHOR CONTRIBUTION

AFH and NK conducted data collection. The study design and methodology were conceptualized and developed by AG. AF performed data analysis and interpretation. All authors contributed to the writing, critical revision, and final approval of the manuscript.

REFERENCES

- Zarantonello D, Rhee CM, Kalantar-Zadeh K, Brunori G. Novel conservative management of chronic kidney disease via dialysis-free interventions. *Curr Opin Nephrol Hypertens*. 2021;30(1):97-107. doi:10.1097/MNH.0000000000000670.
- Xie Y, Bowe B, Mokdad AH, Xian H, Yan Y, Li T, et al. Analysis of the Global Burden of Disease study highlights the global, regional, and national trends of chronic kidney disease epidemiology from 1990 to 2016. *Kidney Int*. 2018;94(3):567-581. doi:10.1016/j.kint.2018.04.011.
- Bello AK, Levin A, Lunney M, Osman MA, Ye F, Ashuntantang GE, et al. Status of care for end stage kidney disease in countries and regions worldwide: international cross sectional survey. *BMJ*. 2019;367:l5873. doi:10.1136/bmj.l5873.
- Sebayang ANO, Hidayat NA. Arteriovenous shunt as the best hemodialysis access in chronic kidney disease (CKD) patients: a literature review. *J Indones Vasc Access*. 2021;1(1):1-3. doi:10.51559/jinava.v1i1.6.
- Lv JC, Zhang LX. Prevalence and Disease Burden of Chronic Kidney Disease. *Adv Exp Med Biol*. 2019;1165:3-15. doi:10.1007/978-981-13-8871-2_1.
- Zhang F, Li J, Yu J, Jiang Y, Xiao H, Yang Y, et al. Risk factors for arteriovenous fistula dysfunction in hemodialysis patients: a retrospective study. *Sci Rep*. 2023;13(1):21325. Published 2023 Dec 3. doi:10.1038/s41598-023-48691-4.
- Takahashi EA, Harmsen WS, Misra S. Endovascular Arteriovenous Dialysis Fistula Intervention: Outcomes and Factors Contributing to Fistula Failure. *Kidney Med*. 2020;2(3):326-331. doi:10.1016/j.xkme.2020.02.004.
- Gameiro J, Ibeas J. Factors affecting arteriovenous fistula dysfunction: A narrative review. *J Vasc Access*. 2020;21(2):134-147. doi:10.1177/1129729819845562.
- Miller CD, Robbin ML, Allon M. Gender differences in outcomes of arteriovenous fistulas in hemodialysis patients. *Kidney Int*. 2003;63(1):346-352. doi:10.1046/j.1523-1755.2003.00740.x.
- McGrogan D, Al Shakarchi J, Khawaja A, et al. Arteriovenous fistula outcomes in the elderly. *J Vasc Surg*. 2015;62(6):1652-1657. doi:10.1016/j.jvs.2015.07.067.
- Ismail MT, Hariawan H, Wardhani Y, Puspitasari M, Artayasa IPA, Ramadhan G, et al. Prevalence and Risk Factors of Arterio-Venous Fistula Obstruction on Patient with Chronic Kidney Disease. *Acta Cardiol Indones*. 2022;7(2):23-28. doi:10.22146/jaci.v7i2.3511.
- Gao M, Wang J. Risk Factors of Arteriovenous Fistula Stenosis of Patients with Maintenance Hemodialysis. *Evid Based Complement Alternat Med*. 2022;2022:2968122. doi:10.1155/2022/2968122.
- Yoshida M, Doi S, Nakashima A, Kyuden Y, Kawai T, Kawaoka K, et al. Different risk factors are associated with vascular access patency after construction and percutaneous transluminal angioplasty in patients starting hemodialysis. *J Vasc Access*. 2021;22(5):707-715. doi:10.1177/1129729820959934.
- Zhang Y, Yi J, Zhang R, Peng Y, Dong J, Sha L. Risk Factors for Arteriovenous Fistula Thrombus Development: A Systematic Review and Meta-Analysis. *Kidney Blood Press Res*. 2022;47(11):643-653. doi:10.1159/000526768.
- Indonesian Renal Registry. 13th Annual Report of Indonesian Renal Registry 2020. Jakarta: Perhimpunan Nefrologi Indonesia; 2020.
- Arifin F. Hubungan Stenosis Arteriovenous Fistula dengan Kejadian Trombosis pada Pasien Penyakit Ginjal Kronik yang Menjalani Hemodialisis [Skripsi]. Palembang: Universitas Sriwijaya; 2023.



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