

## Follow-up evaluation of snuffbox arteriovenous fistula as an alternative site for hemodialysis - a case series in a lower-middle country



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### ABSTRACT

**Introduction:** The preferred vascular access for hemodialysis in chronic kidney disease patients is the arteriovenous fistula (AVF). It is recommended to create AVFs as distally as possible. The snuffbox, situated at the far end of the wrist, is infrequently utilized for AVF insertion due to the prevalent smaller vessel calibers.

**Case:** This case series involves seven patients with chronic kidney disease scheduled for first AVF placement in the snuffbox region, with an average age of 56.71 years. All patients showed an average radial artery caliber of 20.3mm, a mean peak systolic velocity of 67.14 cm/s, and a cephalic vein caliber of 22.7mm, according to preoperative vascular ultrasound. The AVF placement involved an end-to-side anastomosis. All patient demonstrated anastomosis clinical maturation, the primary patency rate was 86%. Follow-up Doppler examinations revealed that patients achieving functional patency had an average caliber of 5.22mm and an average flow rate of 810.65 ml/s.

**Conclusion:** SAVF are created less frequently due to predominantly smaller vessel caliber. However, it can be a viable alternative site for fistula implantation. Vascular mapping is required to ensure that both vessels have minimum 2 mm caliber. Maturation in SAVF have comparable results with the other sites.

**Keywords:** snuffbox, arteriovenous fistula, fistula maturation.

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### INTRODUCTION

Patients with chronic kidney disease (CKD) require adequate vascular access for hemodialysis (HD). Vascular access for hemodialysis can be divided into two categories: arteriovenous access, consisting of arteriovenous fistula (AVF) or arteriovenous graft (AVG), and central venous catheter (CVC). Among these options, the clinical practice guidelines in 2019 recommend AVF as the preferred choice due to better outcomes.<sup>1,2</sup> AVFs have significantly reduced infections, hospitalizations, catheter failure, central venous stenosis, mortality, and overall costs compared to grafts or catheters. Despite the longer maturation time, AVFs exhibit patency rates of 3-5 years, while grafts typically last 1-2 years.<sup>3</sup> The epidemiology study in Southeast Asia and South Asia, shows that in the group of upper-middle and higher-income

countries, 43% of patients had unplanned initiation of HD, and 35% of them used AVFs. Among the prevalent HD patients in this group, a significant majority (68.7%) received HD through an AVF. On the other hand, in lower and lower-middle-income countries, 70% of patients had unplanned HD initiation, with non-tunneled central vein catheters (non-TCC) being the dominant in 70% of incident HD cases. In this group, a lower percentage (24.5%) of incident HD patients had AVFs, and only 8% of prevalent HD patients received HD through an AVF.<sup>4</sup>

AVFs are surgical connections between arteries and veins used in hemodialysis. The Society of Vascular Surgery advises placing the access as distal as possible to preserve future central access on the proximal area, especially in patients expected to have prolonged durations of HD.<sup>2</sup> The anatomical snuffbox, a triangular

area located in the distal radial artery, has gained recognition as a valuable site for creating AVF since it was first described in 1969. Snuffbox AVF (SAVF) serves as an alternative to the radiocephalic AVF technique for most distal cannulation that followed by ulnarbasilic AVF or forearm loop AVG.<sup>2,5</sup> The superficial veins in the forearm are highly compliant, meaning that the vein caliber is influenced by local intravenous pressure, which correlates with the level of activity performed.<sup>6</sup> In principle, a vein caliber of less than 1.6-2.5 mm is associated with a high incidence of AVF failure. Superficial venous blood vessels in the lower arm generally follow a gradual taper pattern, where, as a trend, the more distal a vessel is, the smaller its caliber becomes. The cephalic vein in the wrist area ranges between 1.9 mm and 2.1 mm in the forearm.<sup>7</sup> The limited vessel lumen has resulted in the

infrequent establishment of snuffbox AVF as a hemodialysis access point.<sup>5</sup> This study presents the experience of performing snuffbox AVF for hemodialysis access, which is rarely done in Indonesia due to the infrequent fulfillment of the minimum criteria for vessel caliber.

## CASE SERIES

The researchers are seeking a population of patients with a history of chronic kidney disease scheduled for AV shunt (AVF) placement in the snuffbox area, and these patients must meet specific criteria. Inclusion criteria comprise patients who already have a central venous catheter (CVC) in place and are in good health. Preoperative vascular ultrasound mapping (USG) has been performed, indicating a cephalic vein caliber  $\geq 2$  mm and radial artery caliber  $\geq 2$  mm, with the additional absence of arteriosclerosis, stenosis, or thrombosis in both vessels. Patients are expected to have systolic blood pressure below 180 mmHg and diastolic blood pressure below 120 mmHg before surgery. Anticoagulant and antiplatelet use is advised to be discontinued at least 3 days before the operation. The exclusion factor is patients with preoperative vascular ultrasound results showing a caliber of both vessels  $< 2$  mm after tourniquet placement or issues such as arteriosclerosis, stenosis, or thrombosis. Patients with history of amputation or peripheral arterial disease in upper extremities, heart failure with ejection fraction (EF)  $< 20\%$  and pregnant patients are also excluded from this study.

As seen in [Table 1](#), our study comprised seven patients, including three males and four females, with an average age of 56.71 years. These individuals were scheduled for the immediate implantation of a permanent vascular access. All patients had a history of receiving dialysis twice a week using a Central Venous Catheter (CVC) and were classified with chronic kidney disease (CKD) stage V. Additionally, all patients had a medical history of hypertension, and four of them also had diabetes.

[Table 2](#) shows preoperative until postoperative data. Vascular ultrasonography was performed on the left and right arms before surgery, with special attention to the snuffbox region. The radial

**Table 1. Baseline characteristics of the patients**

No of SAVF	7
No of successfully cannulated SAVF	7
Age (average), years	56.71
Male gender	3
Female gender	4
Risk factor of	
Diabetes	4
Hypertension	7
Atherosclerosis	1
Preoperative hemodialysis	7
Previous placement of AVF/AVG	0

arteries in this area have an average caliber of 2.03 mm with strong pulses, where one patient was found to have arteriosclerosis during the examination. It was found that the mean arterial peak systolic velocity (PSV) was 67.14 cm/s. Furthermore, none of these individuals had vein thrombosis or stenosis, and the mean caliber of the cephalic vein was determined at 2.27 mm. In addition, there was an average of 1.7 cm between the artery and vein and 1.69 cm between the skin's surface and the blood vessels.

All patients were in good health on the day of the surgery, with no documented problems prior to the procedure. Their preoperative blood pressure ranged between 140/69 to 202/113. An arteriovenous fistula placement with end-to-side anastomosis was performed ([Figure 1](#)). The placement of Snuffbox Arteriovenous Fistula (SAVF) using the end-to-side anastomosis technique allows for the visualization of the distal end of the cephalic vein and the radial artery. After the operation, the doctor assessed the patency of the wrist anastomosis by auscultation, where bruit was detected, and palpation revealed a thrill sensation ([Figures 2 and 3](#)). Patients were discharged with antibiotics, pain relievers, and acetylsalicylic acid, and a follow-up appointment was scheduled for 2 weeks post-operation.

All patients showed no complaints two weeks post-surgery, and their surgical incisions were clean, dry, and devoid of infection. Auscultation revealed bruit, and palpation detected a thrill sensation in all patients at a distance greater than 2 cm from the anastomosis. At the six-week evaluation, all patients (100%) demonstrated bruit and thrill at a distance

exceeding 6 cm, indicating clinical maturation. However, one of them (14%) had bruit and thrill but hadn't reached 6 cm and didn't achieve functional patency. All six patients (86%) were deemed eligible to use their fistula for vascular hemodialysis access and achieved primary patency. However, a follow-up ultrasonography examination was scheduled for them.

In the subsequent ultrasound examination conducted a week later, only 5 patients (71.4%) attended. One patient with primary patency failure was excluded from reporting ultrasound data. Doppler ultrasound evaluations of the remaining patient (4 of 7, 57%) revealed that the average caliber of the cephalic vein at the neck of the anastomosis and the proximal neck, approximately 2 cm from the postoperative wound, was 2.7 mm and 5.22 mm, with an average volume flow of 810.65 ml/s ([Figure 4](#)). Meanwhile, at a distance of 6 cm from the postoperative wound, the average caliber of the cephalic vein was 5.55 mm, with an average volume flow of 655 ml/s ([Figure 5](#)). No thrombus was found in any of these cases. In one patient with functional maturation failure (14%), occlusion was observed in the cephalic vein in the distal part of the antibrachial region, approximately 5 cm from the anastomosis, where collateralization and dilation of collateral veins on the medial side were found.

## DISCUSSION

The need for hemodialysis therapy is increasing due to the high incidence of CKD worldwide. The incidence of CKD ranges from 8.5% to 9.8%, with the majority of the population located in Asia.<sup>8</sup> Data from the National Basic Health

Research in 2018 in Indonesia indicates an increasing trend in the incidence of CKD. Another research study in 2009 showed that patients with risk factors such as hypertension and diabetes mellitus had a CKD prevalence rate of 12.5%.<sup>9</sup> All our patients had hypertension, and some had diabetes. Hypertension is a significant risk factor associated with an increased incidence of CKD, as evidenced by studies indicating a higher hazard ratio (HR) in patients with systolic blood pressure (SBP) >130 and 160mmHg.<sup>10</sup> Moreover, male patients with hypertension have a greater incidence of chronic kidney disease (CKD) and end-stage renal disease (ESRD), whereas female patients with diabetes had a higher incidence.<sup>11,12</sup>

In patients with CKD requiring hemodialysis therapy, the use of AVF is more favorable compared to others, where the rates of thrombosis and infection, implantation and maintenance cost, and mortality are lower than those with AVG and catheter options. However, in the female population, patients with diabetes risk factors, and elderly patients, the patency of hemodialysis access can be reduced.<sup>2,3</sup> AVF is created through the anastomosis of an artery and a vein, with the goal of promoting vein arterialization and subsequent growth of the output vein.<sup>1,13</sup> According to the Kidney Disease Outcome Quality Initiative (KDOQI) guidelines in 2006, the primary placement of fistulae should adhere to a peripheral-to-central sequence which starts with a wrist and elbow radio-cephalic fistula, elbow brachio-cephalic fistula, and then transposed brachio-basilic fistulae. In the ideal case, the radiocephalic fistulae sequence begins with a snuffbox fistula, followed by a wrist fistula, distal forearm, mid-forearm, proximal forearm, and finally, an elbow radiocephalic fistula.<sup>13</sup>

The wrist radiocephalic fistula has advantages in preserving more proximal vessels for potential future access. Additionally, it has a low incidence of vascular steal, and if maturation is successful, this anastomosis has minimal infection and thrombosis rates.<sup>14</sup> However, due to its distal location, it results in a lower blood flow rate compared to other types of fistulae. This is associated with a relatively high primary failure rate of

62.5% and a moderate secondary patency rate of 66%.<sup>13,15</sup>

The preoperative examination is mandatory and involves a physical examination and duplex ultrasonography evaluation.<sup>2,13,16</sup> The physical examination of the arteries and veins in our patients was within normal limits. Vascular ultrasound mapping is essential to ensure that the vessels intended for anastomosis meet the criteria for AVF placement.<sup>17,18</sup> According to several studies, vein evaluation entails determining the vein's depth from the skin, compressibility, tortuosity, diameter, and presence of collateral veins. The vein caliber should ideally be at least 2 mm, and ideally more than 2.5 mm. In the meantime, systolic flow velocity, calcification, excellent and forceful pulsation, and the anticipated minimum caliber of 2 mm are evaluated in the arteries.<sup>16-18</sup> Furthermore, it is advised to measure superficial veins with a tourniquet or graduated pressure cuff, particularly for blood vessels of a small size. This is done to determine the vein's compressibility and to raise the number of patients who can be placed with an AVF.<sup>19,20</sup>

All of our patients meet the requirements for the implantation of an AVF in the snuffbox region. In the study by Hull et al., the median caliber of the radial artery in the snuffbox was found to be 2.5mm (1.5-4.1 mm), while the median caliber of the vein was 2.3mm (1.1-3.18 mm), with a distance between vessels of approximately 1.3 mm.<sup>18</sup> However, it was noted that only 47.6% of patients were considered suitable for SAVF placement, with the majority having small vessel sizes or vessels spaced too far apart.<sup>18</sup> Another vascular mapping study indicated that the average vein size at the wrist was 1.9 mm and 2.1 mm in the forearm.<sup>7</sup> The results of both of them are similar to the findings in our research, where the mean caliber of the artery, vein, and distance between vessels was 2.03 mm, 2.27 mm, and 1.69 mm, respectively.

The SAVF anastomosis in our cases was performed using an end-to-side technique, as it is considered easier to perform and results in fewer complications compared to the side-to-side anastomosis.<sup>2</sup> Additionally, it is mentioned that end-to-side anastomosis has a lower rate of AVF

complications, including distal swelling, necrosis, or ulceration.<sup>21</sup> A study by Mozzafar et al. indicated that side-to-side anastomosis and end-to-side anastomosis have comparable rates of primary AVF failure within 6 months, with no significant difference.<sup>22</sup>

A fistula is considered mature if it meets the criteria of the "Rule of 6s," which was introduced in 2006. The criteria for the "Rule of 6s" include maturation within 6 weeks, indicated by a vein caliber of at least 6 mm, a minimum vein depth of 6 mm, blood flow exceeding 600ml/min, and a minimum distance of 6cm from the anastomosis.<sup>2,3,13,23</sup> Successful maturation is defined as the AVF being successfully used with a needle, allowing the removal of the initially used CVC catheter for hemodialysis.<sup>24</sup> Our patient selection criteria mandated a minimum artery and vein caliber of 2 mm, and within six weeks we have 86% maturation rate. Early primary failure in distal AVF is often, particularly in the first month following the formation of the fistula.<sup>15</sup> In the study related to snuffbox AVF, Wolowczyk et al. reported an early primary failure rate of 11% within the first 24 hours, while other research reported rates of 1.6-6% failure within the first month.<sup>25-28</sup> The lower failure rates are attributed to the majority of studies imposing a prerequisite for snuffbox placement with arteries and veins of a caliber around 3 mm.<sup>27-28</sup> On the other hand, patients who did not experience clinical or functional maturation within six weeks were reported to be 6-8% and one of our patients (14%) experienced functional maturation failure.<sup>25,29</sup>

Surgeons typically need to conduct a follow-up 2 weeks after fistula creation to check wound healing and the potential for early complications, including thrombosis, immaturity, infection, ischemic nerve damage, and edema. The examination should focus on venous outflow and arterial inflow, while also assessing the presence of accessory or collateral veins and stenosis, which are often associated with AVF immaturity.<sup>2,23</sup> Doppler ultrasound can be performed starting from 4 weeks post-operation to assess vessel caliber and flow, with estimates ranging between 4-5mm and a flow of 400-500ml/min.<sup>2,23</sup> Recent research by Hakim et al. indicates that the

**Table 2. Preoperative and Postoperative Data**

No	1	2	3	4	5	6	7	Mean
Name	Mrs. SH	Mrs. MI	Mr. SM	Mrs. SR	Mrs. CS	Mr. Th	Mr. WR	
Age	45	65	59	54	64	69	41	56.71
Gender	female	female	male	female	female	male	male	
	<b>Pre-operative vascular ultrasound on snuffbox area</b>							
Radial artery, caliber (mm)	2	2	2.3	1.9	2	2	2	2.03
Arteriosclerosis	no	no	no	no	soft plaque	no	no	
Aneurism	no	no	no	no	no	no	no	
Stenosis	no	no	no	no	no	no	no	
Peak systolic velocity (cm/s)	75	81	61	59	78	60	56	67.14
Cephalic vein, caliber (mm)	2.2	2.9	2.1	2	2.4	2.3	2	2.27
Thrombus	no	no	no	no	no	no	no	
Stenosis	no	no	no	no	no	no	no	
Distance from skin (cm)	1.3	3.4	1.1	1.3	1.6	1.5	1.7	1.7
Distance between artery and vein (cm)	1.6	2.95	2.62	0.5	2.8	0.6	0.8	1.69
	<b>Pre-operative data</b>							
Blood pressure pre-surgery	189/100	153/91	153/97	150/80	140/69	202/113	184/115	
Physical examination								
Arterial system	regular, strong	regular, strong	regular, strong	regular, strong	regular, strong	regular, strong	regular, strong	
The character of peripheral pulse	strong						strong	
Allen test	negative	negative	negative	negative	negative	negative	negative	
Venous system								
Edema on upper extremity	no	no	no	no	no	no	no	
Presence of collateral veins	no	no	no	no	no	no	no	
Risk factor of heart failure with low EF	no	no	no	no	no	no	no	
Risk factors of hypertension	yes	yes	yes	yes	yes	yes	yes	
Risk factors of diabetes	no	yes	no	yes	yes	yes	no	
	<b>Post-operative data</b>							
Surgery methods				end to side anastomosis				
Blood pressure post-surgery	173/105	164/97	162/95	155/91	130/90	185/115	175/101	
Presence of bruit and thrill	presence	presence	presence	presence	presence	presence	presence	
Location of AVF (left or right hand)	left	left	left	right	left	right	left	
History of CVC placement on the ipsilateral side	no	no	no	no	no	no	no	
Surgery duration (min)	50	60	30	45	50	60	50	49.28
	<b>2 weeks follow up</b>							
Presence of bruit and thrill, distance (cm)	>2 cm	>2 cm	>2 cm	>2 cm	>2 cm	>2 cm	>2 cm	
Post operative complications	no	no	no	no	no	no	no	
	<b>6 weeks follow up</b>							
Presence of bruit and thrill, distance (cm)	>6 cm	>6 cm	>6 cm	<6 cm	>6 cm	>6 cm	>6 cm	
Post operative complications	no	no	no	vein occlusion	no	no	no	
	<b>Post-operative vascular ultrasound on snuffbox area</b>							

	2 cm from anastomosis						6 cm from anastomosis					
Cephalic vein, caliber (mm)	N/A <sup>1</sup>	3.6	N/A <sup>1</sup>	2.5	2.6	2.5	2.1	2.7 <sup>2</sup>				
Neck of anastomosis	N/A <sup>1</sup>	8.5	N/A <sup>1</sup>	3	4.1	4.3	4	5.22 <sup>2</sup>				
Proximal neck	N/A <sup>1</sup>	1779.1	N/A <sup>1</sup>	110	457	442.5	564	810.65 <sup>2</sup>				
Cephalic vein, volume flow (ml/s)	N/A <sup>1</sup>	none	N/A <sup>1</sup>	None	none	none	none	none				
Thrombus	N/A <sup>1</sup>	7.9	N/A <sup>1</sup>	3.5	5.5	4.3	4.5	5.55 <sup>2</sup>				
Cephalic vein, caliber (mm)	N/A <sup>1</sup>	1344.2	N/A <sup>1</sup>	59.4	536.6	290.2	449	655 <sup>2</sup>				
Cephalic vein, volume flow (ml/s)	N/A <sup>1</sup>	none	N/A <sup>1</sup>	None	none	none	none	none				
Thrombus	N/A <sup>1</sup>		N/A <sup>1</sup>									

<sup>1</sup>The data is not available due to limitations caused by the distant location of the patients (different cities), resulting in their absence during the ultrasound examination  
<sup>2</sup>The flow value was obtained by calculating the average from the available patient data, excluding the data from patient number 4 who had primary patency failure.  
 \*Abbreviation: AVF (arteriovenous shunt), CVC (central vein catheter), EF (ejection fraction)

presence of one or more components in the Rule of 6 criteria significantly suggests the potential success of fistula maturation. Among the existing criteria, the chance of maturation is the highest when the criteria for flow and venous depth are met, while the criteria for vein caliber have the least impact.<sup>23</sup> In our patient follow-up, Doppler examination from 4 patients indicated an average flow rate of 810.65 ml/s at 2cm and 655 ml/s at 6cm from the anastomosis, with average diameters of 5.22 mm and 5.55mm, respectively. Nevertheless, one patient experienced a failure in maturation due to the twisting of the cephalic vein approximately 5cm from the anastomosis and the development of collateral veins, necessitating the placement of a new AVF, which was performed on the ipsilateral elbow.

Complications associated with the placement of AVF include ischemic steal syndrome, venous hypertension, thrombosis, and infection, with thrombosis being the most prevalent issue and a significant factor influencing the functional aspects of the fistula.<sup>25,30,31</sup> Although other complications are relatively uncommon, Letachowicz et al. found that 19% of patients with SAVF experienced early thrombosis, necessitating the revision and reconstruction of the fistula in a more proximal location.<sup>32</sup> Factors contributing to early thrombosis include prolonged hypotensive periods, technical errors, obstruction in proximal blood vessels, and small caliber lumens.<sup>32,33</sup> The incidence of pseudoaneurysms and heart failure in the snuffbox group is

lower than in the forearm group, with pseudoaneurysm development associated with repeated punctures at the same site.<sup>27,33,34</sup> Other studies indicate that distal edema occurred in 9.7% of patients, which could be resolved by ligating the distal part of the cephalic vein.<sup>14</sup> As far as our observation goes, up to 3 months post-operation, we did not encounter any early complications in all six of our patients.

The documented study of SAVF placement in 1982 showed that 86% of patients had a good patency rate ranging from 6 to 60 months.<sup>14</sup> Other studies reported primary patency rates for SAVF patients of 61-87% at one year, around 53-58% at two years, and 45-87% within three years.<sup>25-33</sup> Several significant risk factors are considered to increase the primary failure rate of fistula, including a history of diabetes, ischemic heart disease, and



**Figure 1.** Arteriovenous fistula placement with end-to-side anastomosis.



**Figure 2.** The process of creating a SAVF anastomosis.

stroke, the procedure of placing a snuffbox for the second time, age over 70 years, and vein diameter less than 2 mm, as indicated by various studies. All these factors can be summarized in the DISTAL score, where an increase in the score indicates a trend of decreasing primary patency.<sup>29</sup> Additionally, there are other factors to take into account, such as gender, indications of atherosclerosis, history of smoking and peripheral vascular disease, which should be considered in the planning of access.<sup>25,29,32,33,35</sup> In our patient cohort, one individual with diabetes did not experience adequate maturation. Thus, based on our observation over 3 months,



**Figure 3.** Anastomosis results show the cephalic vein distended by the flow from the radial artery.

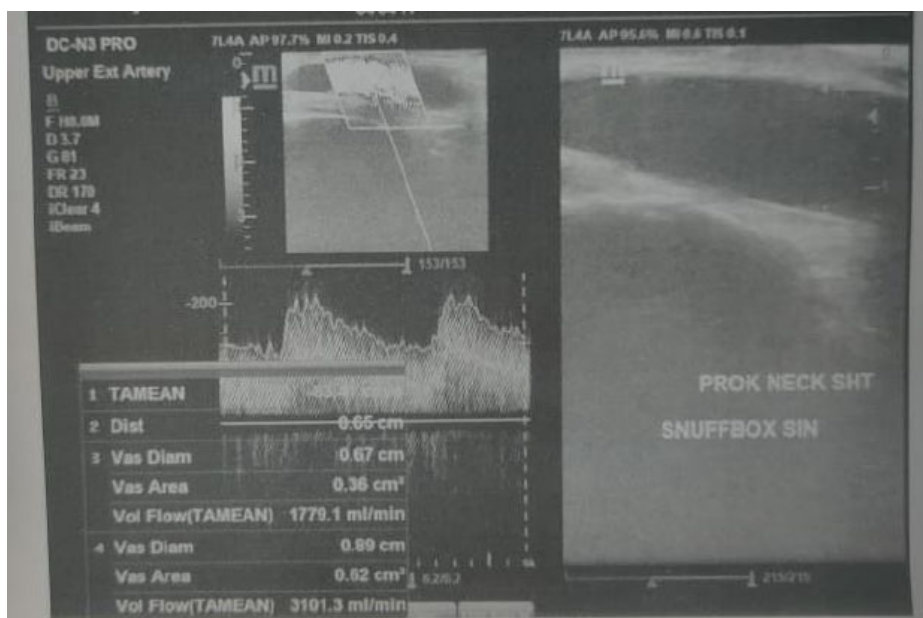
we can state that our study has a primary patency rate of approximately 86%. The other DISTAL criteria were not relevant in our study since all subjects were below 70 years old, had their snuffbox placement for the first time, and had a sufficient average vein diameter. As we know risk factors such as diabetes and female gender are significantly related to low patency and maturation rates of AVF, patients with diabetes have a 0.4 times higher potential for fistula failure compared to non-diabetic individuals as diabetes can hinder AVF maturation by disrupting the balance of Nitric Oxide (NO) and promoting atherosclerosis.<sup>25,26,29,32,36,37,38</sup> Women with smaller veins, it is advised to consider more proximal fistulas, particularly in the non-dominant hand.<sup>37,38</sup> Furthermore, the discovery of subclavian or central vein occlusion contributes to the increased incidence of fistula failure, especially in patients with a history of CVC placement on the ipsilateral side.<sup>26</sup>

Several studies comparing AVF placement in the snuffbox to the wrist have demonstrated that there is no significant difference in maturation and patency rates between these two groups.<sup>27,32,34,36</sup> There are no significant differences in immediate postoperative patency, the time required for maturation, and blood flow volume between both groups.<sup>32,34</sup> Additionally, primary patency rate, secondary patency

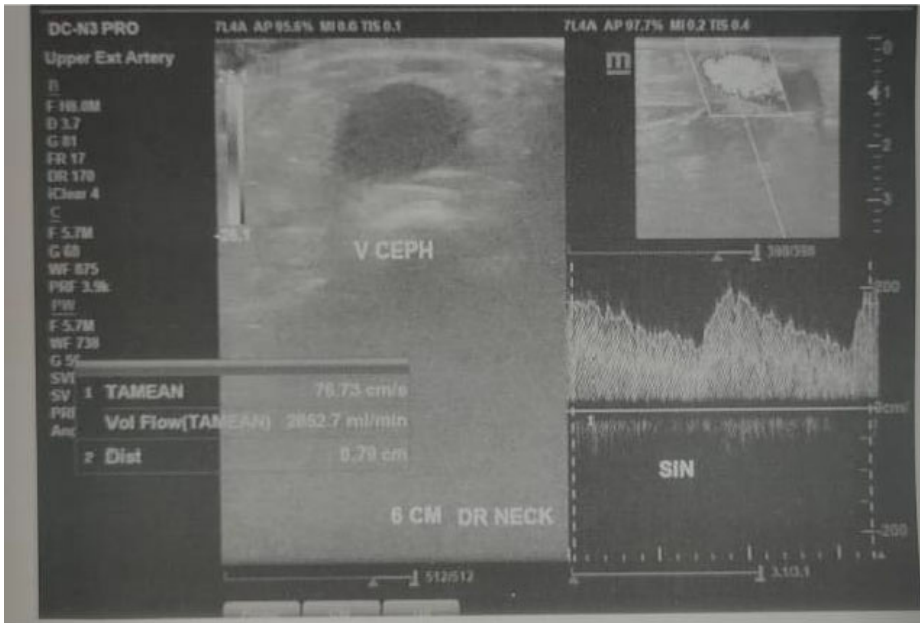
rate, primary functional patency rate, and secondary functional patency rate are equal between them.<sup>27,29,32</sup> Proximal access does correlate with more postoperative complications.<sup>28,31</sup> Wrist and snuffbox fistulas are noted to experience a significantly lower incidence of ischemic steal, approximately five times less, compared to more proximal fistulas. The larger artery caliber results in a more frequent incidence of heart failure in proximal AVF.<sup>25,28,33</sup> Additionally, there is no discernible difference in the occurrence of venous engorgement, infection, and arm swelling between them.<sup>25,27,33,34</sup>

Therefore, placement of a SAVF gives several advantages, the proximity of the radial artery to the cephalic vein, typically less than 5 mm, along with their parallel arrangement, simplifies the anastomosis process.<sup>14,18,25,28,32</sup> This reduces the need for extensive mobilization and transposition of blood vessels during the procedure, leading to less surgical dissection, lower risk of infection, and minimal complications especially steal syndrome and heart failure.<sup>14,18,25,26,28,32,33</sup> The strategic location of the snuffbox, at the distal end, preserves the proximal vein for potential future arterialization and fistula placement.<sup>29,33</sup> It's crucial to exercise careful patient selection and employ the appropriate surgical technique for the successful placement of a Snuffbox AVF.<sup>25-27,29</sup>

Our study has an advantage as it is the first to documented SAVF placements in Indonesia. Furthermore, we can offer information for vascular mapping to evaluate the structure and viability of upper extremity vessels in Indonesia, as well as data for additional research on the SAVF. However, we have some limitations. First, there were limitations in recalling patients to undergo postoperative vascular mapping due to the relatively far distance between them to our center. Secondly, we performed preoperative vascular mapping with ultrasound by directly examining vessels at specific points in the snuffbox, forearm, and elbow; instead of tracing from distal to proximal. This approach has a drawback where the anatomical structures of blood vessels may be tortuous, leading to some stenosis and collateralization of vessels. Thirdly, this is preliminary study



**Figure 4.** The Doppler ultrasound examination after the sixth-week follow-up of the patients.



**Figure 5.** The Doppler ultrasound examination after the sixth-week follow-up of the patients.

conducted at our center, so we currently lack further data regarding primary and secondary patency rates after 3 months.

**CONCLUSION**

SAVF are created less frequently due to predominantly smaller vessels caliber. However, it can be a viable alternative site for fistula implantation. Rigorous patient and surgical procedure selection, including location, are essential. Vascular mapping is required to ensure that both vessels have minimum 2 mm caliber. Maturation in SAVF have comparable results with the other sites.

**ETHICS APPROVAL**

This study has been approved with ethical approval from the Faculty of Medicine, Public Health, and Nursing Universitas Gadjah Mada with ethical clearance reference number KE/FK/1934/EC/2023

**AUTHORS CONTRIBUTION**

Conceptualization, methodology, formal analysis, data curation, visualization, writing-original draft, writing-review and editing, project administration, supervision: Yunanto Kurnia

Conceptualization, validation, supervision, writing-original draft, writing-review, and editing: Trianingsih

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**DATA AVAILABILITY STATEMENTS**

The article’s data will be shared with the corresponding author upon reasonable request.

**CONFLICT OF INTEREST**

The authors declare that there is no conflict of interest.

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