

Outcomes of antecubital perforating vein-radial artery arteriovenous fistula for hemodialysis: Gracz fistulas

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ABSTRACT

Objectives: In this study, we present our midterm results of arteriovenous fistulas constructed with the antecubital perforating vein and radial artery.

Patients and methods: In this single-center, retrospective study, a total of 62 patients (27 males, 35 females, mean age 59±13.5 years; range, 34 to 77 years) who underwent antecubital perforating vein-radial artery arteriovenous fistula at Istanbul Medeniyet University, Göztepe Training and Research Hospital between January 2017 and January 2019 were analyzed. Complications, primary failure, primary patency, and secondary patency rates were evaluated at 6, 12, 18, and 24 months.

Results: The mean follow-up was 25 (range, 19 to 28) months. Primary arteriovenous fistula failure was seen in seven patients (11.2%). The primary patency rates during follow-up were 79.3% at six months, 67.7% at 12 months, 53.2% at 18 months, and 35.4% at 24 months. The secondary patency rates were 82.2% at six months, 75.8% at 12 months, 69.3% at 18 months, and 54.8% at 24 months.

Conclusion: Construction of an arteriovenous fistula with the antecubital perforating vein and radial artery is a feasible method with acceptable patency rates. This type of arteriovenous fistulas has also a lower complication rate, particularly for steal syndrome.

Keywords: Neosinus; pericardial patching; right ventricular outflow tract stenosis.

The radiocephalic arteriovenous fistula (AVF) is widely recommended as the first choice for hemodialysis vascular access in patients with end-stage renal disease.^[1-4] A native AVF should be created before a prosthetic graft is attempted. For the first time, Gracz et al.^[5] described to creating a native AVF by anastomosing the antecubital perforating vein to the brachial artery. Bender et al.^[6] and Konner et al.^[7] reported modifications of the Gracz fistula. In all reports concerning this type of access, brachial artery was usually preferred, whereas the radial artery was used less frequently.^[5] The Gracz fistula with the radial artery should be a favorable option for patients with complete destruction or abnormalities of the superficial forearm veins with heavily calcified distal radial artery and with occluded distal radiocephalic AVFs.^[8]

In this study, we present our experience in creating Gracz fistula formed by anastomosis of the antecubital perforating vein to the radial artery in an end-to side fashion.

PATIENTS AND METHODS

This single-center, retrospective study was conducted at a referral vascular access center of Istanbul Medeniyet University, Göztepe Training and Research Hospital between January 2017 and January 2019. A total of 73 patients in whom a Gracz AVF was created by antecubital perforating vein and radial artery were screened. Inclusion criteria were as follows: age between 18 and 80 years, the presence of a complete destruction or abnormalities of the superficial forearm veins, heavily calcified distal radial artery, and occluded distal radiocephalic AVF. Pediatric cases

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and those with a previous antecubital vascular access operation were excluded. Finally, a total of 62 patients (27 males, 35 females, mean age 59 ± 13.5 years; range, 34 to 77 years) who met the inclusion criteria were included in the study. In all patients, vessels were evaluated preoperatively with ultrasonography (USG) by the surgeon, and a proximal radial artery diameter of ≥ 2 mm and an antecubital perforating vein diameter of ≥ 2 mm under tourniquet were deemed appropriate for Gracz fistula. Arteries were also assessed using the modified Allen's test to prevent postoperative hand ischemia. A written informed consent was obtained from each patient. The study protocol was approved by the Istanbul Medeniyet University, Göztepe Training and Research Hospital Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

All operations were performed under local anesthesia using 1% lidocaine. A 5 to 6-cm transverse incision was made in the median forearm, 1 to 3-cm distal to the antecubital crease. The antecubital perforating vein, which was usually a deep branch of median cubital or cephalic vein, was exposed, ligated at its deep portion, and mobilized. The vein was flushed with heparinized saline only, and systemic heparin was not used. Then, the proximal radial artery was prepared, and the vessel loop was placed around the artery. All anastomoses were performed with the end of the antecubital perforating vein to the side of the radial artery (Figure 1). The distal part of the median cubital or cephalic vein was ligated to prevent possible hand edema. All patients were discharged either on the same day or first postoperative day with prescribed acetylsalicylic acid (100 mg) only. If needed, a second additional superficialization procedure was performed three to four weeks later for arterialized basilic vein in patients in whom no eligible upper arm cephalic vein

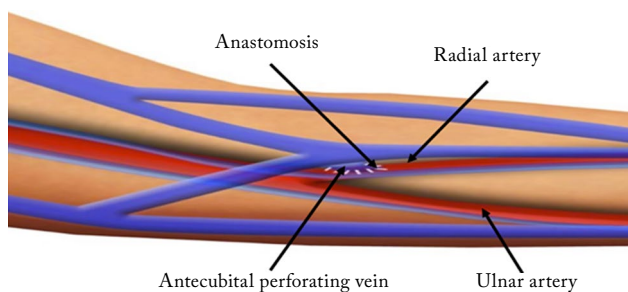


Figure 1. Illustration of end-to-side anastomosis between antecubital perforating vein and radial artery.

or enough long cubital veins were present for needling. All patients were followed in the outpatient setting and AVFs were evaluated with USG at 6, 12, 18, and 24 months. Patients who were lost to follow-up, had kidney transplantation, or died during the follow-up period were excluded from the analysis. The primary outcome of the study were primary failure, primary patency, and secondary patency rates. Primary failure was defined as immediate AVF failure as indicated by the loss of bruit or thrill within 15 days. Patency was determined clinically by the presence of a thrill or bruit and also by the flow in the vein part of the fistula visualized on USG. Primary patency was defined as the interval from the time of AVF creation, until any intervention or surgery to maintain or re-establish the patency. Secondary patency was defined as the interval from the time of access placement until access abandonment, including all performed surgical and endovascular interventions.

Statistical analysis

Statistical analysis was performed using the SPSS for Windows version 15.0 software (SPSS Inc., Chicago, IL, USA). Descriptive data were expressed in mean and standard deviation (SD) and median (min-max) values, while categorical data were expressed in number and frequency. The Kaplan-Meier analysis was used to calculate the patency rate of AVFs. A p value of <0.05 was considered statistically significant.

RESULTS

Of the patients, diabetes mellitus was seen in 42 (67%), hypertension in 45 (72%), congestive heart

Demographic parameters	n	%
Female	35	56
Diabetes mellitus	42	67
Hypertension	45	72
Congestive heart failure (EF <40%)	4	6.4
Peripheral vascular disease	17	27
Previous failed arteriovenous fistula	29	46
Ipsilateral catheter	3	4
Contralateral catheter	34	55

failure with an ejection fraction of <40% in four (4.8%), peripheral vascular disease in 17 (27%), previous failed AVF in 29 (46%), ipsilateral catheter in three (4%), and contralateral catheter in 34 (55%) patients (Table 1).

Primary AVF failure was seen in seven patients (11.2%), and all of them were caused by thrombosis. Three patients (4.8%) who were lost to follow-up, two patients (3.2%) who underwent successful kidney transplantation, and six patients (9.6%) who died during follow-up were excluded from the study.

In nine patients (14.5%) with a functioning fistula, the antecubital venous part was too short for needling and, therefore, a basilic vein superficialization procedure was performed as a second-stage intervention. Early hematoma and bleeding were seen in five patients (8.6%) and only two of them required re-intervention. Seroma developed in two patients (3.2%) and healed during follow-up. Mild wound infection was detected in one patient (1.6%) which healed with oral antibiotics. None of the patients developed steal syndrome or ischemic monomelic neuropathy. Aneurysms and

pseudoaneurysms were seen in eight patients (12.9%) which were repaired by aneurysmorrhaphy repair techniques. Stenosis and occlusion at the fistula tract were detected in three patients (4.8%). Two of them developed juxta-anastomotic stenosis which was treated with percutaneous transluminal angioplasty, and one patient had central vein occlusion with hand edema. In this patient, the lesion was unable to be corrected using endovascular salvage techniques and, therefore, the AVF was ligated due to increasing severe edema at the extremity. The primary failure rate and complications during follow-up were summarized in Table 2.

Table 2 Primary failure and complications during follow-up		
Follow-up period	n	%
Primary failure	7	11.2
Vein superficialization procedure	9	14.5
Hematoma and bleeding	5	8.6
Seroma	2	3.2
Wound infection	1	1.6
Steal syndrome	0	0
Ischemic monomelic neuropathy	0	0
Aneurysm and pseudoaneurysm	8	12.9
Stenosis and occlusion at fistula tract	3	4.8

Table 3 Patency outcomes of the AVFs		
	Primary patency	Secondary patency
	%	%
6 months	79.3	82.2
12 months	67.7	75.8
18 months	53.2	69.3
24 months	35.4	54.8

AVF: Arteriovenous fistula.

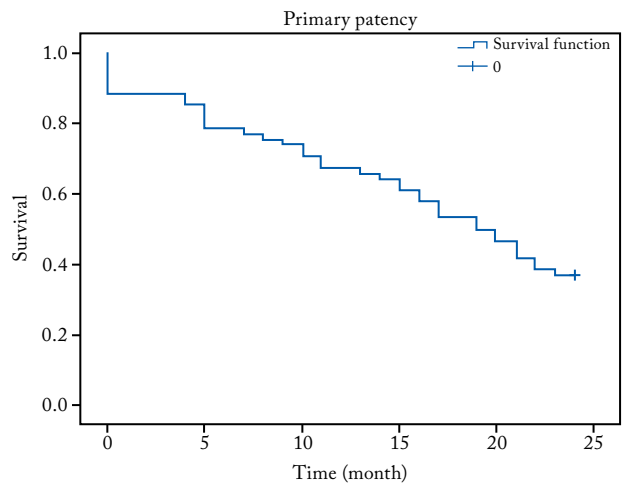


Figure 2. Kaplan-Meier survival analysis of primary patency rates for arteriovenous fistulas.

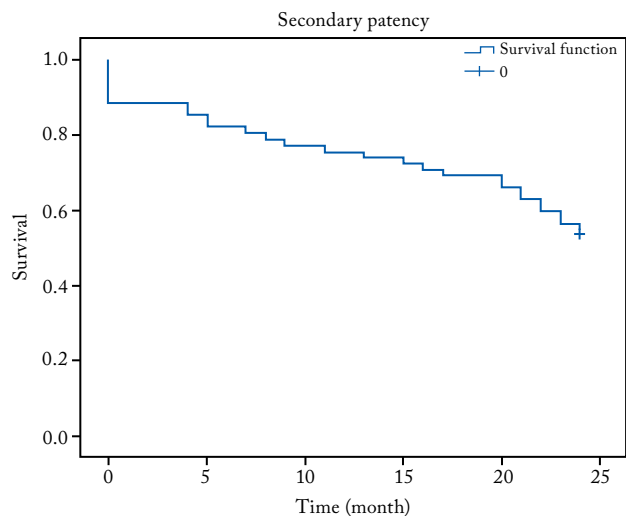


Figure 3. Kaplan-Meier survival analysis of secondary patency rates for arteriovenous fistulas.

The primary patency rates during the follow-up period were 79.3% at six months, 67.7% at 12 months, 53.2% at 18 months, and 35.4% at 24 months. The secondary patency rates were 82.2% at six months, 75.8% at 12 months, 69.3% at 18 months, and 54.8% at 24 months. The follow-up patency rates are given in Table 3. The Kaplan-Meier analysis of the primary patency and secondary patency is shown in Figure 2 and Figure 3, respectively.

DISCUSSION

Arteriovenous fistula at the wrist region is the most recommended type of vascular access, and antecubital area fistulas created with anastomosis of veins to particularly radial artery are good access options.^[9] Our study showed the feasibility of AVF construction between the antecubital perforating vein and proximal radial artery with acceptable primary and secondary patency rates up to 24 months. Our patency results are consistent with other published reports using the cubital perforating vein and radial artery for AVF creation.^[6,8] In the study by Weyde et al.,^[8] the AVF between the antecubital perforating vein and radial artery had primary patency rates of 47% at one year and 43% at two years with cumulative patency rates of 67% at one year and 56% at two years.

In another study, Elcheroth et al.^[10] reported the cumulative patency rates of antecubital perforating vein-brachial artery fistulas as 80.3% at one year and 68.0% at four years. In this study, the patency results are higher than our patency rates. The use of brachial artery instead of radial artery is the probable explanation of this fact and the radial artery has a smaller diameter and slower blood flow, compared to the brachial artery. In contrast, using brachial artery also provoked steal syndrome and hand ischemia as reported in the study, which did not develop in any of our patients. In the literature, acute or chronic ischemia symptoms have been reported in up to 20% with brachial artery-based access procedures and 2% with radial artery procedures, and also nearly half of the patients with the brachial artery required interventions due to severe hand ischemia.^[11,12]

The blood flow through the AVF is limited by anastomosis width and diameter of the fistula vein, making anastomosis with brachial artery may produce steal syndrome or cause hyperkinetic blood flow with a possibility of circulatory insufficiency. That is the exact reason of why Konner^[13] advised AVF creation

with proximal radial artery at the antecubital region, particularly for diabetic patients with probability of peripheral circulatory insufficiency. In our study, we observed no symptoms of steal syndrome even in diabetic and older patients.

Our method for harvesting and preparing the antecubital perforating vein was relied on ligating the vein at the connection point with deep veins without any damage to the deep vein circulatory system. Using this method may prevent severe hand edema during hemodialysis and during future vascular access attempts.

The modest-flow AVFs constructed with the radial artery offer a lower risk for patients with congestive heart failure and should be preferred for particularly in older patients.^[14] These modest-flow AVFs are also more likely to remain asymptomatic without severe edema in patients with central venous occlusion or stenosis, as the existing collateral venous return is usually enough for the flow.^[15] It is speculated that the vein wall shear stress is directly related to the high flow and turbulence and, thus, lower flows may decrease neointimal hyperplasia in the veins with less turbulence and pressure.^[16] In our study, stenosis and occlusion at the AVF tract were rare and two juxta-anastomotic stenoses and one central vein occlusion were noted.

The origin and the proximal part of the radial artery is usually free from occlusive vascular disease.^[14] This advantage gives a few more vascular access options via the proximal radial artery as anastomosed with the proximal cephalic vein or antecubital perforating vein. This type of AVFs provide a more accessible cannulation length compared to typical brachiocephalic fistulas. In brachiocephalic AVFs, the possible cannulation length may be shortened by rotating the vein to the brachial artery.

Nonetheless, the single-center, retrospective design with a small sample size are the main limitations to the present study. In addition, we were unable to evaluate the results of Gracz AVFs created with the perforating antecubital vein and brachial artery in this study.

In conclusion, arteriovenous fistulas constructed with the antecubital perforating vein and radial artery is a feasible method with acceptable patency and low complication rates, particularly for steal syndrome. The arteriovenous fistula creation failure at the wrist

region in the distal part of the forearm may cause a dilemma regarding the second site selection for another access. The arteriovenous fistula creation through the antecubital vein may be the second choice, when the forearm vasculature is exhausted. In such cases, antecubital perforating vein-radial artery arteriovenous fistulas should be kept in mind with low complications before creating an arteriovenous fistula through the brachial artery.

Declaration of conflicting interests

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