

Radio-medyan cubital arteriovenous fistula creation for hemodialysis access

Hemodiyaliz erişimi için radio-medyan kubital arteriyovenöz fistül oluşturulması

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ABSTRACT

Background: This study aims to present our institutional experience regarding radio-median cubital arteriovenous fistula (AVF) creation in patients unsuitable for standard radiocephalic fistula creation.

Methods: Radio-median cubital AVF was created in 66 patients (31 males, 35 females; mean age 49.6 years; range 22 to 77 years) who were unsuitable for standard radiocephalic fistula creation. The study was performed in a prospective manner. All patients were analyzed with duplex Doppler ultrasonography at postoperative 15th day and sixth month.

Results: Early postoperative complications -within postoperative 15 days- were observed in 10 patients (15.1%). At first follow-up on 15th day, 64 in 66 patients (97.0%) had patent AVF. At sixth month follow-up, 56 in 61 patients (91.8%) had patent AVF. Three patients (5.0%) with patent AVFs were not initiated on hemodialysis within six months. None of the patients had signs of steal syndrome within postoperative six months.

Conclusion: We achieved satisfactory results using radio-median cubital AVF creation technique in patients unsuitable for standard radiocephalic fistula creation. This technique may be a good alternative for patients with poor venous or arterial structure at the level of wrist.

Keywords: Arteriovenous fistula; median cubital vein; renal dialysis.

ÖZ

Amaç: Bu çalışmada standart radiosefalik fistül oluşturulmasına uygun olmayan hastalarda radio-medyan kubital arteriyovenöz fistül (AVF) oluşturulmasına dair kurumsal deneyimimizin sunulması amaçlandı.

Çalışma planı: Standart radiosefalik fistül oluşturulmasına uygun olmayan 66 hastada (31 erkek, 35 kadın; ort. yaş 49.6 yıl; dağılım 22-77 yıl) radio-medyan kubital AVF oluşturuldu. Çalışma prospektif olarak gerçekleştirildi. Tüm hastalar ameliyat sonrası 15. gün ve altıncı ayda dubleks Doppler ultrason ile incelendi.

Bulgular: Ameliyat sonrası erken komplikasyonlar -ameliyat sonrası 15 gün içinde- 10 hastada (%15.1) görüldü. On beşinci gündeki ilk takipte, 66 hastanın 64'ünün (%97.0) AVF'si patent idi. Altıncı ay takibinde, 61 hastanın 56'sının (%91.8) AVF'si patent idi. Arteriyovenöz fistülleri patent olan hastaların üçü (%5.0) altı ay içinde hemodiyalize başlatılmadı. Hastaların hiçbirinde ameliyat sonrası altı ay içinde çalma sendromu belirtisi yoktu.

Sonuç: Standart radiosefalik fistül oluşturulmasına uygun olmayan hastalarda radio-medyan kubital AVF oluşturulması tekniğini kullanarak iyi sonuçlar elde ettik. Bu teknik el bileği seviyesinde zayıf venöz veya arteriyel yapısı olan hastalar için iyi bir alternatif olabilir.

Anahtar sözcükler: Arteriyovenöz fistül; medyan kubital ven; renal diyaliz.



Vascular access has become increasingly important for patients with end-stage chronic renal failure (CRF) since access failure is linked to repeated hospitalization, increased treatment costs, and mortality.^[1-4] In recent years, there has been a worldwide trend towards the initial creation of arteriovenous fistulas (AVFs) to provide longer benefits and prevent complications in patients scheduled for future hemodialysis.^[5] However, the benefit of this “fistula first” approach is limited since the known risk factors for the failure of native AVFs remain a major issue, especially with regard to low primary patency rates. In fact, two studies have demonstrated that arterial diameter is the main predictor of patency when fistula creation is performed using the “fistula first” initiative.^[6,7]

Alternative surgical approaches may be considered in patients with previous AVF failure and in those with poor vascular structure unsuitable for a Brescia-Cimino radiocephalic fistula. Brachiocephalic AVF creation, the transposition of the basilic vein, and graft implantation have been widely used in spite of their technical disadvantages and complications,^[8] and the creation of radio-median cubital AVFs at the elbow level was proposed to be used to avoid such complications.^[9] Herein, we present our institutional experience regarding the use of the radio-median cubital AVF creation technique on patients for whom standard radiocephalic fistulas were not feasible.

PATIENTS AND METHODS

Our cross-sectional, prospective study was composed of 66 patients (31 males, 35 females; mean age 49.6 years; range 22 to 77 years) who underwent radio-median cubital AVF creation at a tertiary hospital between October 2011 and December 2013. The study participants were admitted to the Vascular Surgery Department after being referred by the Nephrology Department of the same hospital. Patients with advanced stage CRF who were scheduled for hemodialysis within the next six months and those with poor forearm venous or arterial structure at the level of the wrist met the study criteria, whereas patients who had undergone multiple vascular access surgery were not included along with those with aneurysmatic venous segments on the target arm and those with advanced heart failure. In addition, creating a radio-median cubital AVF was indicated when the diameter of the forearm vein was insufficient or when using the forearm venous plexus was not possible. In the end, out of 186 potential study participants, only the clinical data of the 66 patients who underwent radio-median cubital AVF creation was analyzed.

All of the patients underwent duplex ultrasonography (USG) of the upper limb vessels before the operation, and for 15 days prior to the surgery, no vascular access to the target arm was allowed. Additionally, the patients were closely monitored to prevent a hypotensive state and dehydration. Furthermore, all of the patients were also evaluated via duplex USG at the postoperative 15th day and sixth month. Functional patency was defined as achieving a flow of 250 ml/min and receiving a four-hour hemodialysis session. Early fistula failure was defined as hemodialysis access failure within two months of the surgery while delayed fistula failure was defined as a failure to continue the hemodialysis two months after the program was started.

All operations were performed using local anesthesia, and prophylactic antibiotics were given 30 minutes before the skin incision was made over the pulsation of the brachial artery 1-2 cm below the elbow crease. The median cubital vein was dissected first. If it was suitable for fistula creation (>2.0 cm in length and >5 mm in diameter), the radial artery was dissected beginning from its origin at the radial-ulnar bifurcation and continuing in a distal direction. Using silastic vessel loops, the vein and the artery were then brought close to each other. The vein was flushed with saline, and the tributary veins were ligated. All anastomoses were created via a continuous running 7/0 polypropylene suture in an end-to-side fashion, and after this was completed, fistula patency was confirmed by palpation of the thrill and bruits (Figure 1).

Statistical analysis

All statistical analyses were performed using the MedCalc version 14.12.0 for Windows statistical software program (MedCalc Software bvba, Ostend,

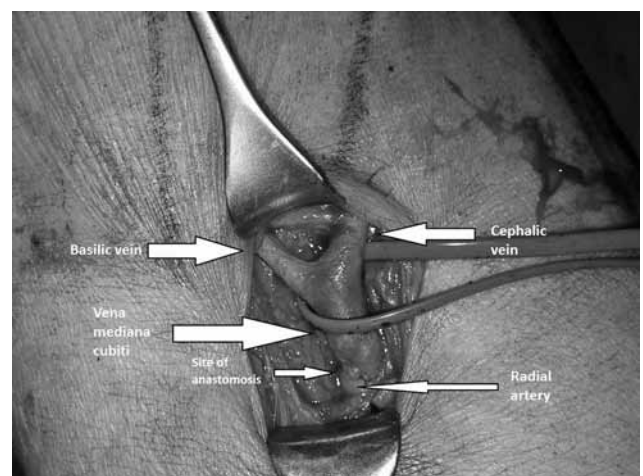


Figure 1. Operative view of the procedure.

Belgium). Visual histograms and analytical methods (Kolmogorov-Smirnov and Shapiro-Wilk tests) were used for determining normal distribution, and continuous variables were defined using mean ± standard deviation (SD). A *p* value of less than 0.05 was considered to be statistically significant.

RESULTS

The patient demographics are given in Table 1. Left radio-median cubital AVF creation was performed on 41 of the 66 patients while right AVF creation was performed on the remaining 25. Of the 66 patients, 46 had failed radiocephalic AVFs that had been created previously, and 20 of these had acutely thrombosed AVF veins which led to an initial thrombus removal. However, this did not achieve salvage.

The early complications are shown Table 2. The patients with acute venous thrombosis had to undergo a second operation to remove the blood clot. In this procedure, we incised the vein distally from the anastomosis site and removed the thrombus using a small-caliber Fogarty catheter. Afterwards, we dilated the median cubital and cephalic veins with saline flushing. Unfortunately, patency was not achieved in two patients who were also among those who had experienced previous radiocephalic AVF failure, and they received long-term hemodialysis catheters that were inserted via the internal jugular vein before being discharged. In addition, the patients with acute hemorrhage or hematoma in the early period also underwent a re-operation in which the leaks were repaired without repeating the anastomoses. Furthermore, the patients with arm edema benefited from conservative measures, including arm elevation and loose elastic arm stockings, while those with skin wound infections were appropriately treated with antibiotics and given proper care for this type of wound. By the 15th postoperative day, 64 of the 66 patients (97.0%) had a patent AVF.

Three out the 64 patients with patent AVFs were lost to follow-up at the postoperative sixth month.

Moreover, late complications occurred in five patients, four had AVF failure with thrombosed veins, and two had arm edema. Since the patients with AVF failure had no other suitable sites for AVF creation, no re-operation was performed, and they received a long-term hemodialysis catheter. Additionally, none of the patients had signs of steal syndrome at the six-month follow-up, and there was no infection, peripheral ischemia, venous aneurysms, or need for other re-operations. Furthermore, at that time, 56 out of 61 patients (minus the five with late complications) (91.8%) had a patent AVF, and overall sixth month patency was 56 out of 66 patients (84.8%). Moreover, three patients (5.0%) with patent AVFs did not undergo hemodialysis within the six months after their surgery.

DISCUSSION

We had satisfactory outcomes with radio-median cubital AVF creation in terms of early patency and low complication rates, and since 2011, this technique has become our standard of practice for patients who are not suited for radiocephalic AVF creation. Despite encountering occasional anatomic variations, the close proximity of the radial artery to the median cubital vein has allowed us to perform easy anastomoses, although initially this technique involved a steep learning curve. Since the majority of our patients had failed AVFs, the risk of failure would most likely have been even higher for their second AVFs because of their particular risk factors. In addition, since the patients in our study were not of an advanced age, we thought that they would benefit from long-term hemodialysis maintenance. Therefore, we preferred to use the median cubital vein because it allowed the cephalic and basilic veins to remain intact so that they could be used for hemodialysis access in future interventions.

We used the radio-median cubital AVF creation technique for patients with poor vascularity at the level of the wrist because it offered a variety of advantages. First, we used the radial artery as the arterial source and left the ulnar artery intact to ensure distal arterial flow and avoid the occurrence

Table 1. Baseline characteristics of the patients (n=66)

Parameters	n	%	Range
Age in years (range)		49.6	22-77
Gender (male/female)		0.88	
Diabetes mellitus	27	40.9	
Hypertension	38	57.5	
COPD	6	0.9	
Previous access failure	41	62.1	

COPD: Chronic obstructive pulmonary disease.

Table 2. Postoperative complications

Parameters	n	%
Acute thrombosis	6	0.9
Bleeding at operative site	5	0.7
Hematoma	2	0.3
Arm edema	3	0.4
Skin wound infection	1	0.1
Overall	10	15

of steal syndrome. Also, for the purpose of avoiding potential secondary complications that can occur due to increased distal venous pressure, we ligated the median cubital vein at its distal end. In minority of patients, performing the end-to-side anastomosis necessitated further liberalization of the median cubital vein, and this is a potential disadvantage associated with this technique. Therefore, it should be kept in mind that when employing radio-median cubital AVF creation, the incision should not be made much above the flexure crease of the elbow. Furthermore, by using the median cubital vein, both the cephalic and basilic veins could be supplied with an appropriate arterial blood flow. Moreover, none of the patients required the superficialization of the basilic vein during the follow-up period since the cephalic vein cannulation was successful in all of the patients with patent fistulas.

Recently, there has been an increasing trend towards the timely creation of AVFs in patients requiring hemodialysis access, and clinical practice guidelines strongly recommend the AVF approach since these fistulas have longer durability and are associated with lower morbidity and mortality.^[10,11] Moreover, a recent Canadian study demonstrated that patients who had AVFs more commonly achieved an optimal initiation of dialysis than those with central venous catheters.^[12]

However, failure of a previous AVF is a challenging problem that needs to be overcome to maintain the opportunity for renal replacement therapy. Previous studies have established that fistula failure is directly related to certain patient-related risk factors, including advanced age, female gender, diabetes mellitus (DM), hypertension, (HT) and the surgeon's experience level.^[13,14] A variety of options have been described for constructing new AVFs in patients who are not suited for the creation of a standard radiocephalic AVF. For example, some authors have justified the construction of proximal AVFs in patients who are already on hemodialysis,^[15,16] and using synthetic or autologous saphenous vein grafts in place of AV grafts may also be an option for patients with poor vascular structure.^[17] Alternatively, Son et al.^[18] reported that forearm basilic vein transposition was superior to forearm AVGs and upper arm AVFs with regard to two-year patency (30.2% vs. 10.3% at 24th month for forearm basilic vein transposition vs. AVG, respectively). In our study, we achieved somewhat better patency rates than they did (88.9% vs. 41.5%). Based on the available facts, we suggest that radio-median cubital vein AVF creation offers a good alternative to basilic vein transposition in patients who are unable to undergo radiocephalic AVF creation.

Since its first description by Gracz et al.^[19] in 1977, the technique for creating proximal forearm fistulas between the radial artery and a deep perforating branch of the cephalic vein has been subject to several modifications. Although upper arm AVFs allow for better flow so that patients can receive quality hemodialysis,^[20] they are also associated with a higher incidence of steal syndrome compared with forearm AVFs.^[21] In addition, upper extremity ischemia occurs in 4% of patients with AVFs,^[22] and this is associated with a high risk of a major disability.^[23] Moreover, the rationale for seeking an alternative to the brachial artery has been based on preventing dialysis access-associated steal syndrome (DASS), which is of particular importance for patients with certain risk factors like DM and female gender.^[23]

We believe that leaving the ulnar artery intact provides benefits by preserving an adequate blood flow to the distal extremity. A recent study by Vaes et al.^[24] demonstrated the importance of maintaining the ulnar artery flow in patients scheduled for revisional AVF surgery. In their study, the ulnar artery peak systolic velocity (PSV) was lower in the patients with distal ischemia than in the controls. In addition, they found that the mean ulnar artery PSV was significantly correlated with systolic index finger pressures, whereas the mean radial artery PSV was not.

Our study is not the first to report the outcomes of using the median cubital vein and the radial or ulnar artery for AVF creation. Ehsan et al.^[25] performed median cubital vein and radial or ulnar artery AVF surgery on 32 diabetic patients using a technique similar to ours and determined that steal syndrome occurred in only one patient who had an anatomical variation in the brachial artery. Furthermore, the one-year patency rate was 90.6% in their study.

More recently, Kumar et al.^[9] in a review of 320 patients who underwent forearm AVF creation reported that they used the median cubital vein in 260 patients (81%), but it was not suitable for 60 patients (19%). They also reported that the cephalic vein could be used for cannulation in 70% of the 224 patients who underwent median cubital vein anastomosis. In addition, they found that the fistula failure rate was low and that steal syndrome was not present in any of the patients in their series. Our results were compatible with those two studies. None of our patients reported an insufficient flow or low-quality hemodialysis at their follow-up visits, and their physical examinations revealed that the cephalic vein was successfully used for venous cannulation in all of our patients. Furthermore, the fact that median

cubital vein AVFs provide an adequate flow for hemodialysis was well established in a study by Chin et al.^[26] in which the intra-access blood flow of three different types of fistulas were similar.

In a meta-analysis by Al-Jaishi et al.,^[27] involving patients in the United States, the primary patency rates of all types of AVFs were reported to be 60% and 52% at the postoperative first and second years, respectively. These rates are much lower than our patency rate (84.8%) and those reported by Kumar et al.^[9] (95%) and Ehsan et al.^[25] (90.6%) for radio-median cubital vein AVFs. However, this should not be misinterpreted because our technique allows for high patency rates that can be generalized for all of the patient groups. The differences between the studies seems to arise from the fact that AVFs are created in 80% of the patients in Europe, whereas only 24% of patients receive AVFs as the initial access for dialysis in the United States.^[28] Therefore, we are of the opinion that our technique should be considered only in patients who are not suited for the creation of radiocephalic AVFs as well as for those with previous AVF failure. Although our study and others have shown satisfactory outcomes with regard to preventing distal extremity ischemia, this success has not yet been proven by comparative research.

The primary limitations of our study were the lack of a control group and the single-center setting. In addition, during follow-up, elective duplex USG could not be performed on all of the patients because of the high volume of patients at our outpatient clinic on that particular day. Furthermore, the follow-up time for our study was relatively short because the majority of the patients lived in distant regions of the country and did not respond to our invitation to participate.

Conclusion

We achieved satisfactory results using radio-median cubital AVF creation in patients who were not suited for standard radiocephalic AVF creation. Our patency rates were comparable to previous studies in which a similar technique was used and complications occurred at an acceptable rate. Since this technique offers a steep learning curve, we recommend that a prospective randomized study be performed by a team with experience in AVF surgery to verify our findings.

Declaration of conflicting interests

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