Original Article

Brachiocephalic Arteriovenous Fistula through the Median Antecubital Vein for Hemodialysis

Elamaran Elamurugan, R Hemachandar

Abstract

Purpose: An option for patients who are unsuitable for radiocephalic fistula is brachiocephalic (BC) fistula. In such patients, we exploited the venous interconnections in the cubital fossa for median antecubital vein (MAV)-BC arteriovenous fistula (AVF) creation. In this article, we describe our experience in the creation of such technical variant of the BC fistula AVF, its success, and associated complications.

Materials and Methods: A retrospective review of such AVF created between September 2014 and August 2015 was done. The data collected included demographics, comorbidities, basic disease, operative details, patency, complications, and mortality.

Results: A total of 68 vascular access surgeries were done which included 26 (38.2%) BC AVF using the MAV. The mean cephalic vein diameter and mean flow rate were 7.18 mm and 1415 ml/min, respectively, 2 months after fistula creation. The primary and secondary failure rates were 3.87% and 7.69%, respectively. Complications included aneurysm (7.69%), edema (19.23%), hematoma (11.53%), and wound infection (2.5%).

Conclusion: Using reverse flow in the MAV is a safe and simple way to perform BC AVF before brachiobasilic AVF and grafts.

Key Words: Arteriovenous fistula, smooth loop arteriovenous fistula, vascular access

Introduction

The Kidney Disease Outcomes Quality Initiative (KDOQI) recommended that the order of preference for the placement of fistulae in patients with chronic kidney disease should be a forearm (radiocephalic) primary fistula, an elbow (brachiocephalic [BC]) primary fistula, a transposed brachial basilic vein fistula, followed by arteriovenous graft (AVG) of synthetic or biological material. In such patients, if the median antecubital vein (MAV) or median basilic vein has a favorable anatomy (>2.5 mm and connected to median cephalic vein), it can be used to construct a BC arteriovenous fistula (AVF) with reverse flow in that vein which has no valve. Our hypothesis is that this technique even with poor caliber of cephalic vein can increase the flow in the cephalic vein that is sufficient for maturation and cannulation for hemodialysis. A smooth loop is created from brachial artery to cephalic vein through the antecubital vein and by ligation of the distal cephalic vein, perforating vein, and the median vein of forearm. This technical variant has already been described by Pantea without results’ data.

Materials and Methods

We did a retrospective analysis of patients who underwent BC AVF through MAV creation in our institute between September 2014 and August 2015. Data collected include each patient’s preoperative evaluation, operative procedure, patency, failures, and complications. All patients underwent preoperative ultrasound during their initial clinical evaluation. Any successful AVF creation requires an arterial diameter of more than 2 mm and venous diameter of 2.5 mm. We exclude the patient with vein diameter <2.5 mm for creation of such AVF. Primary failure was defined as an AVF that did not mature or thrombose before the first successful cannulation for hemodialysis treatment. The definition includes (1) inadequate maturation, (2) early thrombosis, (3) failure of the first cannulation, and (4) other complications such as ischemia or infection. Secondary failure was defined as irreversible failure of the AVF, after it has been successfully used for hemodialysis.
Operative technique

Under local anesthesia, a transverse skin incision was made at about 1 cm above the elbow crease, centering with the brachial artery pulsation. The MAV (or median basilic vein) is dissected. The brachial artery is mobilized after dividing the bicipital fascia. A side-to-side anastomosis between brachial artery and median basilic vein or median cubital vein was done using 6-0 Prolene. The upper part of the median basilic vein was ligated to change the side-to-side anastomosis into a side-to-end anastomosis. Ligation of the perforating vein and venous tributaries form the forearm to the loop created, which is done to limit the risk of high-flow fistula [Figures 1 and 2]. The fistula was allowed 6 weeks for maturation.

A “back wall first” technique is used in all patients, similar to the method described by Tellis et al.[3] This involves initiating the suture in the mid portion of the back wall and using a running suture technique, closing the back wall from the inside of the anastomosis and then completing each corner. The front wall closure is completed with this same continuous running technique. This allows assessment of cephalic vein patency and detects a misplaced suture.

Results

Between September 2014 and August 2015, a total of 68 patients underwent AV access surgery [Table 1]. The most common site was BC AVF through MAV (38.2%) followed by the radiocephalic AVF at the wrist (25%). The other sites were BC AVF at elbow (23.5%), radio cephalic AVF at mid forearm (2.9%), proximal radial artery/median vein of forearm AVF (2.9%), and brachiobasilic AVF with transposition (1.5%). Only three patients (4.5%) underwent AVG surgery as they had no choice for native AVF. Lower limb AVF between posterior tibial and saphenous vein was done in one patient (1.5%) due to poor caliber of upper limb veins and unaffordability of the patient for AVG.

The 26 patients with BC AVF through MAV were included for further analysis. The mean age of patients was 50.78 ± 11.27 years with a range of 30–67 years. Males were 18 (69.2%) and females were 8 (30.8%). The mean follow-up duration was 6 months. The comorbidities include diabetes mellitus in 8 (30.76%), hypertension in 22 (84.61%), and malignancy in 2 (7.69%) patients.

The mean preoperative diameter of artery and vein was 4.89 mm and 2.85 mm, respectively. The mean cephalic vein diameter before the surgery and 2 months after the surgery was 1.95 mm and 7.18 mm, respectively. Immediate thrill was present in all the patients. The mean flow across AVF 2 months after creation was 1415 ± 734.01 ml/min ranging from 910 to 2800 ml/min.

The primary failure rate of AVF in our series was 3.8% due to thrombosis. The secondary failure rate was 7.69% due to aneurysm formation and thrombosis.

Complications include aneurysm and thrombosis (7.69%), edema (19.23%), hematoma (11.53%), and wound infection (2.5%). During follow-up, 4 (15.38%) patients died with functioning fistula, 6 (23.07%) patients were lost to follow-up, and 13 (50%) patients were continuing dialysis with BC AVF through MAV. None of the patients died due to the complications of AVF surgery.

| Table 1: Distribution of arteriovenous fistula |
|---------------------------|-----------------|
| Site of AVF               | Number of patients (%) |
| Radiocephalic AVF at forearm | 17 (25) |
| Radiocephalic AVF at mid forearm | 02 (2.9) |
| Proximal radial artery/median vein of forearm AVF | 02 (2.9) |
| Brachiocephalic AVF at elbow | 16 (23.5) |
| Brachiocephalic AVF through median antecebulital vein at elbow | 26 (38.2) |
| Brachiobasilic AVF with transposition | 01 (1.5) |
| Posterior tibial/saphenous vein AVF | 01 (1.5) |
| AVG | 03 (4.5) |
| Total | 68 |

AVF: Arteriovenous fistula, AVG: Arteriovenous graft
Discussion

As the life expectancy of hemodialysis patients has improved over years, many patients require multiple vascular access procedures over their lifetime. In addition, the long-term patency and complications of AVG are worse compared to AVF. Hence, it is prudent to preserve as many vessels possible and start using the distal vessels. In such scenario, the BC AVF through MAV provides an opportunity to sustain hemodialysis.

In patients with unsuitable cephalic vein at the forearm, the options are brachiobasilic fistula with transposition and AVGs, either autologous or synthetic. These types of vascular access have a few disadvantages, i.e., difficult to construct, requirement of second procedure for transposition, costs of graft, and associated infection. However, the presence of multiple interconnecting veins with anatomic variations in the cubital fossa allows for AVF creation with other veins such as median basilic vein, median cubital vein, and median vein of forearm.

The advantages include avoiding the need for superficialization of basilic vein in the arm. In none of our patients with BC AVF through MAV, a superficialization of basilic vein in the arm was needed. The main basilic vein is preserved and can be used for future AVF creation. Ligating the tributaries from forearm to the loop created including the perforating vein will prevent the development of high-flow and venous hypertension, and it will increase the flow in the cephalic vein.

The demographic profile of our series is similar to other studies, with diabetes as the most common cause of end-stage renal disease and mean age of around 50 years. The most common site of AVF in our study was using brachial artery (63.24%) followed by radial artery (30.88%). The strategies followed by us were using median basilic vein with caliber (>2.5 mm) adequate enough for Anastomosis, larger arteriotomy of 8–10 mm, and side-to-side anastomosis, which allowed for establishing increased blood flow across the anastomosis to aid maturation. Though the mean preoperative caliber of cephalic vein was less than the recommended 2.5 mm, using the above strategies resulted in dilatation of venous segment to 7.18 mm and mean flow rate of 1415 ml/min after maturation. KDOQI recommends venous segment diameter of at least 6 mm and flow rate of at least 600 ml/min for successful cannulation. Although we created a larger arteriotomy to enhance flow across fistula, none of our patients developed a vascular steal phenomenon.

All our patients underwent side-to-side anastomosis with proximal vein ligation and ligation of tributaries from forearm to the loop created. The advantages of creation of a side-to-side anastomosis are technical simplicity and uniform Wall Shear Stress profile, which would lead to reduced rate of intimal hyperplasia. In a study by O’Banion et al., side-to-side anastomosis with distal vein ligation has been found to be superior to end-to-side anastomosis in radiocephalic fistula in terms of early thrombosis, 6-month primary patency, and cannulation rates.

Primary failure rate (3.87%) was much lesser compared to rates in the current literature (15–30%), which includes both distal and proximal fistulas. However, the primary failure rates of distal fistulas are higher than proximal fistulas due to their small caliber and lower flow rates. Pramila and Biradar reported primary failure rates of 7% and 22.8% in brachial and radial arteries, respectively. The primary failure rates were radiocephalic AVF (39%), BC AVF (17%), and brachiobasilic AVF (18%) in a study by Gonzalez et al. Our primary failure rate (3.87%) of BC AVF through MAV is comparable to the above studies.

The complications of AVF surgery in our study was similar to that reported by ChecheriTa et al. Aneurysm resulted in secondary AVF failure in two patients (7.69%).

Conclusion

Our study supports the use of BC AVF through MAV in patients with favorable vein configurations at the elbow based on adequate blood flow rates, venous segment dilatation, low primary failure rates, and complication rate equivalent to those of other native fistulas. Based on our findings, we prefer native AVF before creating AVGs by utilizing the cubital fossa venous connections along with its variations.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. K/DOQI clinical practice guidelines and clinical practice recommendations 2006 updates haemodialysis adequacy peritoneal dialysis adequacy vascular access. Am J Kidney Dis 2006;48 Suppl 1:S1.
2. Pantea S, Bengulescu I. Smooth loop arterio-venous fistula. Chirurgia (Bucur) 2014;109:678-81.
3. Tellis VA, Veith FJ, Soberman RJ, Freed SZ, Gliedman ML. Internal arteriovenous fistula for hemodialysis. Surg Gynecol Obstet 1971;132:866-70.
4. Santoro D, Benedetto F, Mondello P, Pipitò N, Barillà D, Spinelli F, et al. Vascular access for hemodialysis: Current perspectives. Int J Nephrol Renovasc Dis 2014;7:281-94.
5. Gowda A, Pavan M, Babu K. Vascular access profile in maintenance hemodialysis patients. Iran J Kidney Dis 2014;8:218-24.
6. Konner K, Nonnast-Daniel B, Ritz E. The arteriovenous fistula. J Am Soc Nephrol 2003;14:1669-80.
7. Ahsan ZU, Waheed A, Zaeem FA, Nazir F. Arteriovenous fistulas constructed using side-to-side anastomosis with ligation...
and division of distal venous arm; a tertiary care hospital experience. J Vasc Access 2010;11:26-30.

8. O’Banion LA, Van Buren D, Davis JW. Radiocephalic fistulas for hemodialysis: A comparison of techniques. Am Surg 2015;81:341-4.

9. Al Shohaib S, Al Sayyari A, Waness A. Hemodialysis angioaccess choice and survival in a tertiary care Saudi Arabian center from 1993 to 2004. Nephrourol Mon 2011;3:69-73.

10. Pramila DR, Biradar S. A study of arteriovenous fistula failure in haemodialysis patients. Sch J Appl Med Sci 2014;2:336-9.

11. Gonzalez E, Kashuk JL, Moore EE, Linas S, Sauraia A. Two-stage brachial-basilic transposition fistula provides superior patency rates for dialysis access in a safety-net population. Surgery 2010;148:687-93.

12. ChecheriTa IA, TuTa LA, David C, Peride I, Niculae A, Geavlete BF, et al. An overview of permanent vascular access in hemodialyzed patients. Rom J Morphol Embryol 2015;56:27-31.