



## RADIO-MEDIAN CUBITAL / RADIOCEPHALIC ARTERIOVENOUS FISTULA AT ELBOW TO PREVENT VASCULAR STEAL SYNDROME ASSOCIATED WITH BRACHIOCEPHALIC FISTULA: REVIEW OF 210 CASES

Medical Science

Dr. Amarapilli  
Appalaraju

Dr. D. Hari Prasad\* \*Corresponding Author

Dr. Vanajakshi  
Jami

### ABSTRACT

**Aim:** Radiocephalic arteriovenous fistula (AVF) at wrist is the vascular access of choice for dialysis. In the absence of a suitable vein at the wrist, a brachiocephalic fistula at elbow is usually constructed. In order to avoid the complication of vascular steal syndrome associated with the brachiocephalic fistula, an alternative operative technique involving the creation of radio-median cubital vein / radiocephalic fistula at elbow was evaluated.

**Materials and Methods:** we Retrospective study Between June 2016 to June 2018, 210 patients underwent creation of radio-median cubital vein / radiocephalic AVF at elbow as a primary procedure or following failure of a fistula at the wrist. A transverse skin incision was made 4cm below the elbow crease, centering in line with the brachial artery pulsation. The median cubital vein / cephalic vein was anastomosed to the radial artery in end to side fashion. The surgical complications and patency of the fistulae were analyzed in the immediate and late postoperative period.

**Results:** Mean operative time was 52 min (45 to 60). There were no major intraoperative complications. Immediate patency and a palpable distal radial pulse were present in all the patients. Mean time to fistula maturation was 35 days (25 to 45). No patient developed a vascular steal syndrome at a follow-up of 24 months. Early fistula failure was seen in 9 (4.28%) patients whereas four (1.9%) fistulas failed at a later date. Pseudoaneurysm of the arterialized vein at the fistula site developed in only one (0.3%) patient.

**Conclusions:** The radio-median cubital vein / radiocephalic AV fistula at elbow is safe and is a better vascular access procedure for hemodialysis than brachiocephalic fistula because it leads to the dilatation of both the cephalic and the basilic veins with no incidence of vascular steal phenomenon in our experience. Patency and flow rates are similar to brachiocephalic fistula.

### KEYWORDS

AVF -Arteriovenous fistula, brachiocephalic, radiocephalic, radiomedian cubital

### INTRODUCTION:

Vascular access is the lifeline of a patient with end-stage chronic renal failure. Radiocephalic arteriovenous fistula (AVF) at wrist is the vascular access of choice for dialysis. In the absence of a suitable vein at the wrist, a brachiocephalic fistula at elbow is usually constructed. In order to avoid the complication of vascular steal syndrome associated with the brachiocephalic fistula, an alternative operative technique involving the creation of radio-median cubital vein / radiocephalic fistula at elbow was evaluated.

Brescia-Cimino radiocephalic arteriovenous fistula (RC-AVF) at the wrist remains the vascular access of choice for dialysis even today. When a RC-AVF is not possible due to poor quality veins or after failure of arteriovenous fistula at wrist, the usual solution is to construct a more proximal fistula, usually a brachiocephalic arteriovenous fistula (BC-AVF).<sup>[2]</sup> Other options are synthetic graft or transposed basilic vein AVF.<sup>[3]</sup> However, these three types of vascular access have a few disadvantages: i.e., difficult to construct, more prone to steal syndrome, distal arm swelling and infection.<sup>[3][4]</sup> The most troublesome complication of brachiocephalic fistula at elbow is vascular steal syndrome, which often necessitates the closure of the fistula. We describe an alternative operative technique to avoid the vascular steal syndrome, which consists of creation of radio-median cubital vein/radiocephalic fistula at the elbow instead of brachiocephalic fistula.

### MATERIALS AND METHODS:

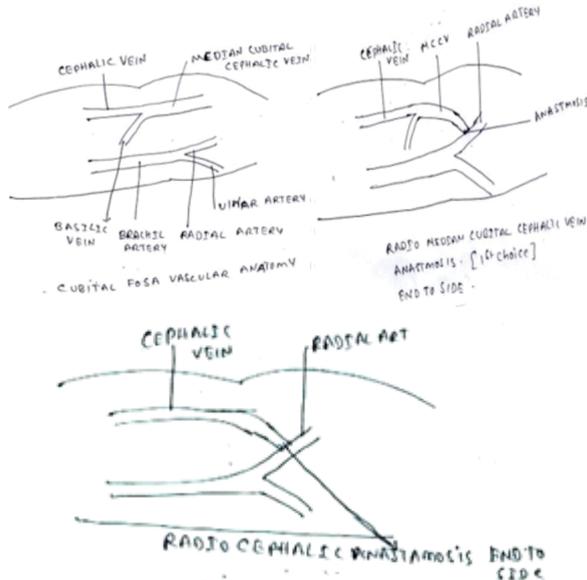
All patients referred for construction of AVF to our department were clinically examined by the operating surgeon for quality of the venous system of the upper limbs. Venous examination included inspection and palpation of the cephalic vein at the wrist and upper arm and the basilic vein at the elbow, after application of a tourniquet in the upper arm. Normal dual blood supply was confirmed by Allen's test. Duplex ultrasound scanning of the veins was performed when physical examination failed to disclose adequate vessels or there was uncertainty regarding the quality or continuity of the vein for

arteriovenous access. If a subclavian catheter had been inserted in the past, ultrasonographic assessment of the subclavian vein was mandatory to rule out any stenosis. All patients with poor quality veins at the wrist or patients in whom previous AVF at the wrist had failed were taken up for making a radio-median cubital vein / radiocephalic fistula at the antecubital fossa. All patients were taught active arm and hand exercises in the postoperative period to aid fistula maturation. A retrospective review of the data was done for all these patients.

### Operative procedure:

We always ensured that the patient was not dehydrated and his blood pressure was within normal limits. Whereas the skin incision in brachiocephalic fistula is a transverse incision in the elbow crease, the incision in radio-median cubital / radiocephalic fistula is about 4cm below the crease, centering over the brachial artery pulsation. Median cubital vein was dissected first and if found suitable, i.e., patent, distensible and of adequate length (> 2.0 cm) for an end to side anastomosis, only then the artery was dissected. If median cubital vein was not suitable, we dissected the cephalic vein in the lateral part of the wound. After disconnection, the vein was distended and flushed with heparinized saline solution. If the saline infusion was without resistance, only then the vein was selected for anastomosis. If veins were not suitable, the procedure was abandoned and artery was not exposed.

The brachial artery was exposed in the median cubital fossa and dissected until it bifurcates into the radial and ulnar arteries. At this junction, the radial artery is still superficial but the ulnar artery enters into deeper compartment. More often, we encounter only the radial artery at this level. Here, the median cubital vein bifurcates and becomes the cephalic and basilic veins. A tributary of this vein often joins the deep vein of the forearm posteriorly. This posterior branch is ligated. The median cubital vein is ligated distally, disconnected, tested for patency and distensibility and then anastomosed to the radial artery in end to side fashion using 7-0 prolene. Fistula patency was confirmed on table by presence of a palpable thrill and/or a bruit.



The surgical complications were analyzed in the immediate and late postoperative period. During follow-up, the patency of the fistulas was assessed by either palpation, auscultation or by using a Doppler probe.

Early fistula failure was defined as failure to access the vein for hemodialysis within three months. Delayed fistula failure was defined as those who were successfully accessed initially within three months, but failed at a later date.

The following parameters were studied: age, sex, laterality, comorbid conditions, any previous access failure, mean operative time, presence of distal radial pulse, immediate and late patency rates, the time to utilization for hemodialysis and early and late complications.

**RESULTS:**

Between June 2016 to June 2018, 210 patients underwent creation of radio-median cubital vein / radiocephalic AVF at elbow as a primary procedure or following failure of a fistula at the wrist. Mean age of the patients was 46 years (range 15- 75). Majority of the patients were males (6:1) with non-dominant left side being preferable (8.5:1). One hundred and sixty (76.19%) patients had a previous failed AVF at the wrist and 50 cases directly proceeded to elbow due to no feasible veins at wrist. 30 cases (14.28%) patients had diabetes mellitus as a comorbidity. Patients had a median follow-up of 14 months (6-24).

between June 2016 - June 2018

Mean age	46 years(15- 75 )
Mal:female	6:1
Lt vs rt	8.5:1
Previous wrist failure non acceptable veins	160(76%) 50(24%)
Diabetic	30(14.28%)
Follow up	14 months (6-24)
Median cubital cephalic 1st choice	180(86%)
Cephalic vein	30(14%)

	Anant Kumar et al <sup>11</sup>	Present study
Mean operative time(min)	55+/- 7.15	52 min (45to60)
Palpable distal radial pulse(%)	320	210
Immediate patency(%)	320	210
Early patency	304	201
Time to access for haemodialysis days	26+/-5.2	35(25-30)

All procedures were performed under local anaesthesia. Mean operative time was 52min(45 to 60). The median cubital vein could be used for the fistula formation in 180 (86%) patients. The remaining 30 patients in whom the median cubital vein was not suitable in terms of patency, distensibility or adequate length had the cephalic vein utilized for fistula formation. Intraoperative fistula patency was confirmed by the presence of a palpable thrill and/or an audible bruit. There were no major intraoperative complications. Immediate patency and a palpable

distal radial pulse were present in all the patients. Mean time to fistula maturation for it to be used for hemodialysis was 35 days (25-30). The cephalic vein was preferred for venous cannulation patients who underwent a radio-median cubital vein fistula because of its more superficial location and easy accessibility.

	Anant Kumar et al <sup>11</sup>	Present study
Number of patients	320	210
Age in years	14-64	15-75
Sex M:F	4:1	6:1
Previous access failure	272	160
Diabetes	80	30
Side Lt : Rt	7:1	8.5:1

No patient developed a vascular steal syndrome. Early fistula failure was seen in 9 (4.28%) patients whereas four (1.9%) fistulas failed at a later date. Pseudoaneurysm of the arterialized vein at the fistula site developed in 2 (0.9%) patient. Wound infection and thrombophlebitis were noted in 18 (8.5%) and 8 (3.80%) patients respectively. Partial wound dehiscence was seen in 4 (1.9%) patients, which required frequent dressings only. Patient had secondary haemorrhage was seen in 2 due to trauma.

Fistula failure	Anant Kumar et al <sup>11</sup>	Present study
Early	16(5%)	9(4.28%)
Late	8(2.5%)	4(1.9%)

	Anant Kumar et al <sup>11</sup>	Present study
Pseudoaneurysms at fistula site	1(0.3%)	2(0.9%)
Closure of fistula	16(5%)	2(0.9%)
Wound infection	20(6.5%)	18(8.57%)
Partial wound dehiscence	7(2.2%)	4(1.9%)
Thrombophlebitis	18(5.6%)	8(3.80%)

**DISCUSSION:**

Ever since the report of the first surgically created arteriovenous fistula for hemodialysis four decades ago, vascular access has remained the Achilles heel of patients on chronic haemodialysis. Arteriovenous fistula using autogenous vein remains the optimal vascular access for hemodialysis. The alternative techniques for hemodialysis, such as long-term central venous catheters and artificial shunts, result in a high rate of infection and thrombosis.<sup>[5],[6],[7]</sup> Brescia-Cimino radiocephalic arteriovenous fistula at the wrist remains the vascular access procedure of choice. However, in patients with poor quality distal veins or with failure of AV fistula at the wrist, other options need to be considered.

Vascular access for chronic haemodialysis should meet the following criteria: long-term patency rate, low complication rate and good acceptance by the patient.

Dixon *et al.*[8] had favored upper arm AV fistulas for higher patency rates. The group had found higher one-, three- and five-year patency rates in upper arm fistulas (71%, 57% and 57%) compared to forearm AV fistulas (54%, 46% and 36%) and grafts (54%, 28%, 0%), but upper arm AV fistulas required more interventions than forearm AV fistulas (1.0 versus 0.6 per access, respectively). Our study compares favourably with the published literature with regards to early and late patency rates (96% and 93.80% respectively), despite 15% of our patients being diabetic. The main causes of primary patency failure were poor condition of the veins and low arterial flow rate. It is important to stress that patients with chronic renal failure should not be dehydrated and/or in hypotension when a fistula is made.

Pseudoaneurysm of the arterialized vein at the fistula site developed in only two (0.9%) cases. This compares favourably with the 2% incidence reported by Zibari *et al.*[9]. Pseudoaneurysm at the fistula site required elective resection of the pseudoaneurysm with repair of the radial artery. There was a low incidence of postoperative wound infection (8.57%) and thrombophlebitis (3.80%), which resolved on conservative management in all patients.

Fistula closure was demanded by 2 (0.9%) patients due to trauma. The fistula was disconnected and radial artery repaired with 7-0 prolene.

Brachiocephalic fistula leads to dilatation of only the cephalic vein, whereas the radio-median cubital vein fistula leads to the dilatation of both the cephalic and basilic veins (through the median cubital vein), thus giving a choice of two arterialized veins in the arm for hemodialysis access. The time to access for hemodialysis was 25 - 30 days, which is comparable to the existing literature of

brachiocephalic and brachio basilic fistulae wherein only one vein was preserved for the purpose of early maturation. This is a major advantage over the brachiocephalic fistula.

Brachiocephalic fistulae can have high flow rates and hemodynamic complications, such as steal syndrome and high output cardiac failure, occur more commonly than in wrist fistulae. The incidence of vascular steal syndrome is extremely rare following radio-median cubital vein / radiocephalic fistula at the elbow (0% in our series) as against up to 20% with brachiocephalic fistula.<sup>[10]</sup> The vascular steal phenomenon following brachiocephalic fistula necessitates closure of the fistula. If it occurs in cases of radiocephalic fistula, it can simply be treated by ligating the radial artery distal to the anastomosis. Carpal tunnel syndrome and median nerve compression are also well-recognized complications of brachiocephalic AVF, most cases being secondary to vascular steal syndrome. Radio-median cubital vein / radiocephalic fistula at the elbow is a useful technique to avoid these serious complications as none of the patients in our series of more than 300 cases developed a vascular steal phenomenon. This is due to blood supply by the ulnar artery if the radial artery gets compromised.

This technique is associated with drawbacks, as the incision site is not very cosmetic and has poor healing as compared to the elbow crease incision used for brachiocephalic fistula. However, dilated veins at the elbow or just below it have similar cosmetic significance. Healing at the incision site was excellent in our series with only four (1.9%) patients having partial wound dehiscence. This procedure also requires a deeper dissection, which is technically more demanding.

### CONCLUSIONS:

In the absence of a suitable vein at the wrist, the radio-median cubital / radiocephalic arteriovenous fistula at the elbow is a safe and better vascular access procedure for hemodialysis than brachiocephalic fistula because it leads to the dilatation of both the cephalic and the basilic veins with no incidence of vascular steal phenomenon in our experience. Patency and flow rates are similar to brachiocephalic fistula. It is possible to create this fistula in the majority of the patients with minimal postoperative morbidity and long-term complications.

### REFERENCES:

1. Bresica MJ, Cimino JE, Apple K, Hurwich BJ. Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula. *N Engl J Med* 1966;275:1089-92.
2. Cascardo S, Acchiardo S, Beven EG, Popowniak KL, Nakamoto S. Proximal arteriovenous fistulae for haemodialysis when radial arteries are unavailable. *Proc Eur Dial Transplant Assoc* 1970;7:42.
3. National kidney foundation: Dialysis outcomes quality initiative. 1997. Available from: [http://www.kidney.org/professionals/doi/guidelines/doi\\_uptoc.html](http://www.kidney.org/professionals/doi/guidelines/doi_uptoc.html). [Accessed on April 12, 2007]
4. Fong IW, Chapellan JM, Simbul M, Angel J. Infection of arterio-venous fistulas created for chronic haemodialysis. *Scand J Infect Dis* 1993;25:215-20.
5. Quinton WE, Dillard D, Scribner BH. Cannulation of blood vessels for prolonged hemodialysis. *Trans Am Soc Artif Intern Organs* 1960;6:104-13.
6. Tannuri U. Vias de acesso vascular. In : Maksoud JG. *Cirurgia pediátrica*. 2 nd ed. Revinter: Rio de Janeiro; 2003. p. 87.
7. Mohaideen AH, Avram MM, Mainzer RA. Polytetrafluoroethylene grafts for arteriovenous fistulae. *N Y State J Med* 1976;76:2152-5.
8. Dixon BS, Novak L, Fangman J. Hemodialysis vascular access survival: Upper-arm native arteriovenous fistula. *Am J Kidney Dis* 2002;39:92-101.
9. Zibari GB, Rohr MS, Landrenau MD, Bridges RM, DeVault GA, Petty FH, et al. Complications from permanent haemodialysis vascular access. *Surgery* 1988;104:681-6.
10. Morris PJ. *Kidney transplantation: Principles and practice*, 5 th ed. Saunders: 2001. p. 60.
11. Anant Kumar, Mrigank S Jha et al Radio-median cubital / radiocephalic arteriovenous fistula At elbow to prevent vascular steal: *Indian journal of urology* 2017;23:261-264.