



## Case Report

# An Alternative Needling Site for Hemodialysis—Retrograde Brachiocephalic AV Fistulas: A Case Series

Usman Khalid, Szabolcs Horvath, Elaine Saunders, Lynn Davies, Rhys Morris, Mohamed A. Ilham, Michael R. Stephens

*Vascular Access Service, Department of Nephrology & Transplant Surgery, Cardiff & Vale University Health Board, University Hospital of Wales, Cardiff, United Kingdom*

Establishing a patient with a functioning arteriovenous fistula (AVF) remains a challenge for vascular access surgeons. The presence of venous branches directing flow away from the main outflow vein in a brachiocephalic fistula may be one of the reasons for their failure to mature, and often these are ligated. When not ligated, “retrograde flow” may occur and develop into an “unorthodox” fistula. At the Cardiff & Vale University Health Board, 331 brachiocephalic fistulas were created for hemodialysis access over a 3-year period. Five male patients were identified, with a median age of 69 years, who had, as a result of proximal cephalic vein stenosis/occlusion, developed a functioning mature fistula within a distal branch/forearm vein that eventually drains via the basilic vein. Moreover, the flow rates within these new fistula outflow veins were comparable to functioning conventional brachiocephalic fistulas. These retrograde brachiocephalic fistulas that have been inadvertently/accidentally created appear to be successful in providing stable vascular access for hemodialysis. These cases are an interesting find, as such branches often would have been ligated at the time of fistula creation. When creating an AVF between the brachial artery and the median cubital vein, consideration should be given to not ligating the below elbow cephalic vein.

*Key words:* Brachiocephalic AV fistula – Retrograde flow – Hemodialysis access

The presence of venous side branches that direct flow away from the main outflow vein in a brachiocephalic arteriovenous fistula (BC AVF) is thought to be one of the reasons for their failure to

---

Corresponding author: Usman Khalid, MRCS, Vascular Access Service, Department of Nephrology & Transplant Surgery, Cardiff & Vale University Health Board, University Hospital of Wales, Cardiff CF14 4XW, United Kingdom.  
Tel.: +44 2920 743772; Fax: +44 2920 746 661; E-mail: usman.khalid@doctors.org.uk

mature.<sup>1</sup> Surgeons often identify and ligate these branches at the time of fistula creation. We describe 5 cases where such branches that had not been ligated developed into mature fistulas via retrograde flow, precipitated by occlusion/stenosis in the main outflow cephalic vein.

## Methods

Details of all vascular access operations are recorded prospectively by the vascular access team and coding staff and held locally in a secure electronic database. The Cardiff & Vale University Health Board provides a regional vascular access service for South East Wales. This database was retrospectively reviewed to identify cases of retrograde BC AVFs over the last 3 years.

## Results

At the Cardiff & Vale University Health Board, 772 new forearm and arm fistulas were created between April 1, 2011 and March 31, 2014 for vascular access in renal dialysis patients. Of these, approximately 331 (43%) were BC AVFs. We identified 5 patients with BC AVFs who had, as a result of proximal cephalic vein stenosis or occlusion, developed a functioning mature fistula within a distal branch/forearm vein that eventually drains via the basilic vein (Figs. 1 and 2). All of these fistulas were end-to-side anastomoses between the median cubital vein and the brachial artery. In our surgical practice, if the median cubital vein is patent, this is often used for anastomosis to the brachial artery. To minimize the dissection around the outflow vein (and therefore reduce the risk of future fibrosis), the main cephalic vein may not be exposed during the surgery. This would be the reason for not ligating the side branching veins in the initial formation of the BC AVFs. None of these patients experienced any symptoms or signs of venous hypertension or hand swelling. Maturation of these fistulas was determined by experienced vascular access specialist nurses. There have been no complications from using these retrograde BC AVFs.

### Case 1

A 69-year-old right-handed man with stage V chronic kidney disease (CKD) secondary to obstructive uropathy and pyelonephritis underwent a left BC AVF, which matured and was used successfully for dialysis initially. He was a smoker with

peripheral vascular disease. Three months later, it was noted that there was stenosis in the main (proximal) cephalic vein. He underwent technically successful fistuloplasty and resumed dialysis for another 27 months. Following this, the same portion of the vein developed re-stenosis; however, a second fistuloplasty was of limited success, and the vein occluded 10 months later. Following occlusion of the main cephalic vein, flow diverted into a branch going to the forearm with retrograde flow. This branch matured into a fully functional fistula, which has now been used successfully for 17 months.

### Case 2

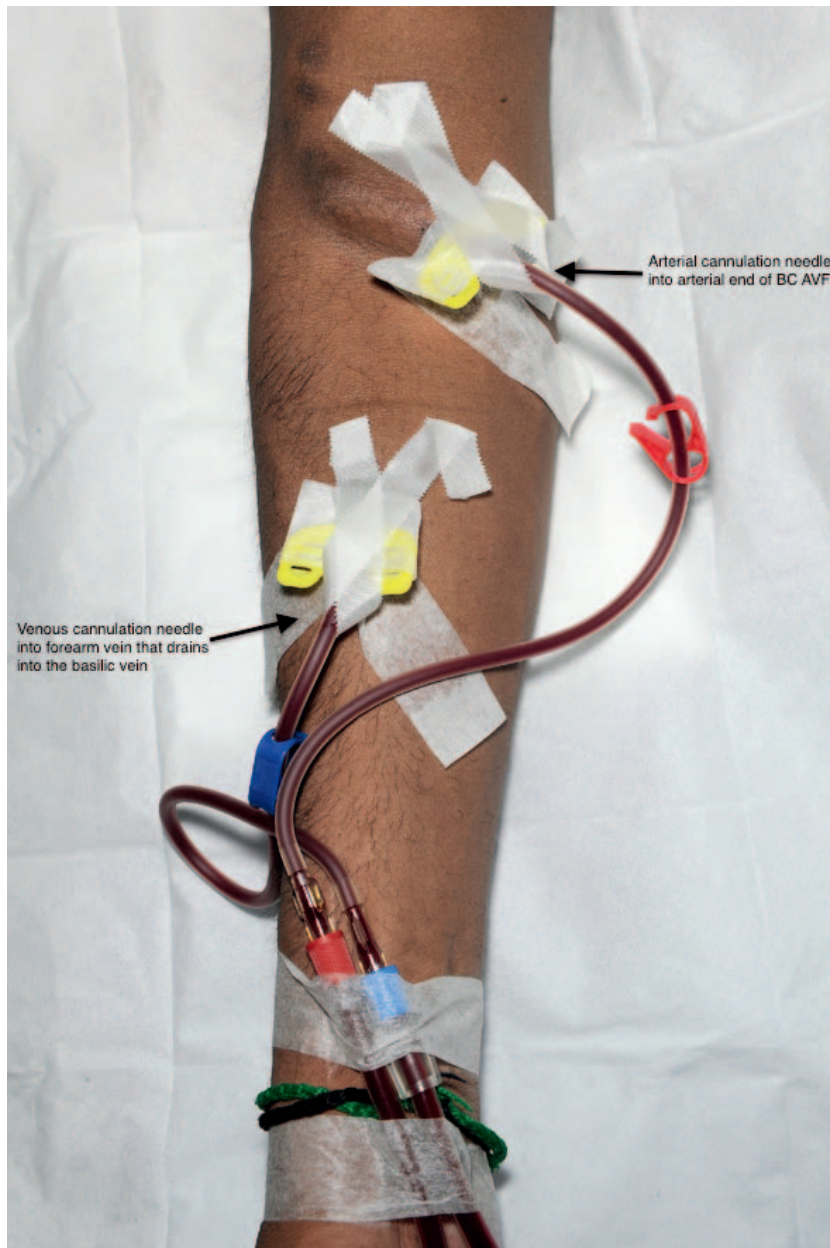
A 48-year-old right-handed man with CKD of unknown etiology who had been on hemodialysis for 3 years, with 4 previous unsuccessful attempts at establishing autologous vascular access, underwent a right BC AVF. He was a smoker with no peripheral vascular disease. This fistula successfully matured and was used for dialysis despite the presence of several large lateral branches from the main cephalic outflow vein. Nine months later, there was decreasing flow within the main (proximal) outflow vein with eventual occlusion, and flow was maintained via the lateral branches. An attempted fistuloplasty of the proximal cephalic vein was unsuccessful. A month later, 1 of the lateral branches matured via retrograde flow into a functioning AVF, which has now been successfully used for dialysis for 7 months.

### Case 3

A 78-year-old right-handed man underwent a left BC AVF (cause of renal failure: drug-induced interstitial nephritis; dialysis via central venous catheter for 5 months), which successfully matured and was used for dialysis. He was a nonsmoker with no peripheral vascular disease. Five months later, the proximal cephalic vein developed stenosis, no attempt was made at fistuloplasty, and it was noted that retrograde flow developed within the distal cephalic vein in the forearm. This retrograde AVF was used successfully for dialysis for another 5 months before it thrombosed.

### Case 4

A 71-year-old right-handed man underwent a left BC AVF (end-stage renal failure [ESRF] cause: glomerulonephritis and hypertension; predialysis),

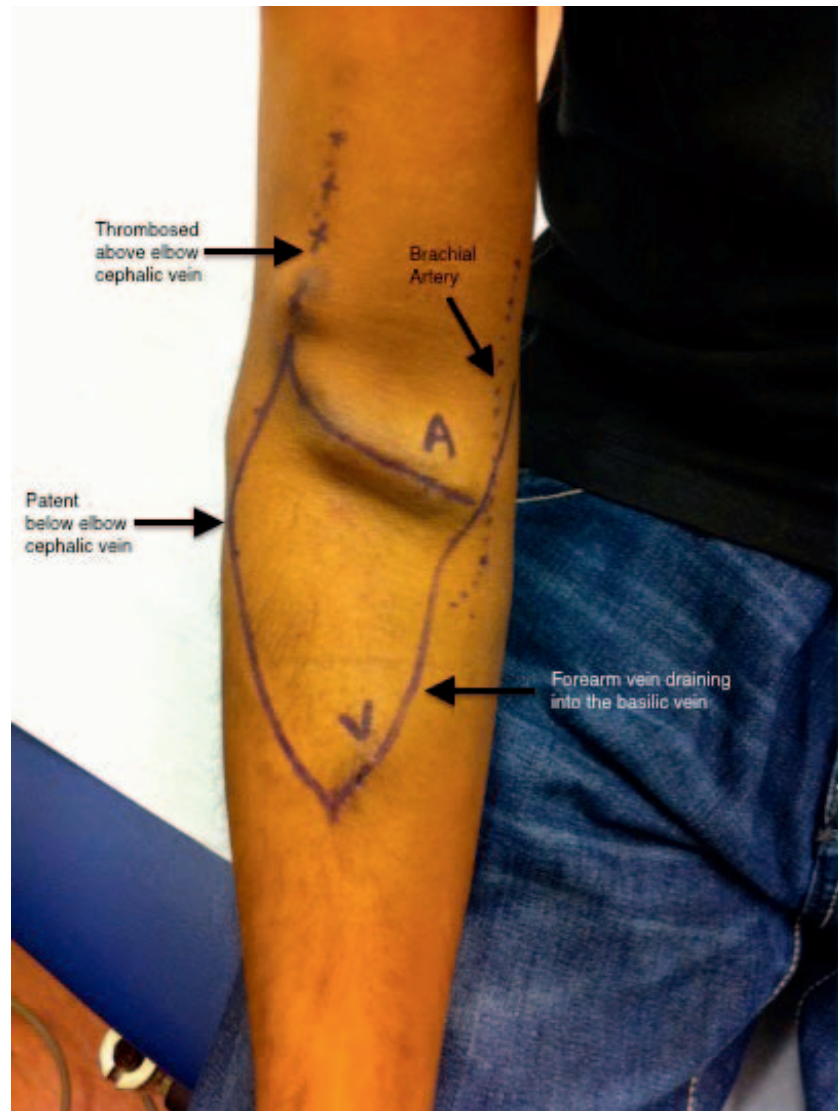


**Fig. 1** Photograph demonstrating the placement of arterial (A) and venous (V) needles for the retrograde BC AVF.

which matured and was used successfully for dialysis. He was a nonsmoker with no peripheral vascular disease. He developed a mild degree of “steal syndrome” symptoms 16 months later, which improved with conservative measures. At this point, it was also noticed that he had developed significant retrograde flow into the distal cephalic vein in the forearm that was better than the flow within the main (proximal) cephalic vein. Because of the markedly better flow rates within the distal forearm cephalic vein, it was successfully used for dialysis. Twenty-seven months later, it is still fully functional.

#### Case 5

A 69-year-old right-handed man underwent a left BC AVF (ESRF cause: membranous nephropathy; predialysis). He had peripheral vascular disease, but he was a nonsmoker. This matured and was successfully used for dialysis for 3 years but subsequently thrombosed. An attempt to form a right BC AVF was not successful, and he temporarily received dialysis by means of a central venous catheter. Five months later, the left below elbow cephalic vein was noted to have developed into a mature AVF and attempts to cannulate and use for



**Fig. 2** Photograph demonstrating the anatomy of the AVF on a patient.

dialysis were successful. This has since been successfully used for dialysis for the last 25 months.

## Discussion

Establishing a patient with a functioning AVF remains a challenge for the vascular access surgeon. Fistula formation is a complex vascular remodeling process leading to augmentation of the vessel wall structure and flow within it.<sup>2</sup> Fistula failure is often a multifactorial process consisting of problems in arterial inflow, venous outflow, and presence of accessory venous tributaries.<sup>1</sup>

Although guidelines (from Dialysis Outcomes and Practice Patterns Study and National Kidney Foundation kidney disease outcomes quality initiative [NKF-K/DOQI]) suggest that selective obliteration

of major venous side branches can be used in an attempt to enhance maturation of AVF,<sup>3,4</sup> the evidence for this practice is limited. Indeed, collateral/accessory venous tributaries have been shown to be solely responsible for only between 3% and 12% of immature AVFs.<sup>5,6</sup> Nevertheless, many surgeons feel that these accessory venous branches lead to a hindrance in fistula maturation of the main outflow vein and may selectively obliterate significant venous branches either surgically or percutaneously. When creating brachiocephalic AVFs, surgeons often identify and ligate the distal/below elbow cephalic vein for the same reasons.

Many surgeons ligate any significant side branches of the outflow vein at the time of a fistula creation to avoid delays in maturation due to shunting of blood into these side branches. By not ligating these

branches, it may result in a longer period before maturation of the fistula. Conversely, ligating such branches has the potential to increase the incidence of steal syndrome. In our surgical practice, if the median cubital vein is patent, this is often used in the creation of a BC AVF, and therefore side branches of the cephalic vein may not be encountered for ligation.

With these retrograde BC AVFs, there is a potential increased risk of developing venous hypertension and exhibiting the signs and symptoms of venous hypertension and limb swelling. However, the patients in this case series did not experience any such symptoms or display any such signs.

The present observational study shows that not ligating such branches may prove to be advantageous for some patients. The retrograde flowing brachiocephalic fistulas described here have provided successful access for hemodialysis, and cannulation has not been problematic. Once these fistulas are assessed and the sites for cannulation are identified, they can be easily cannulated by the usual skilled hemodialysis team. These cases are an interesting find, as often such branches would have been ligated at the time of fistula creation.

## Conclusion

When creating an AVF between the brachial artery and the median cubital vein, consideration should be given to not ligating the below elbow cephalic vein, as this may prove to be a useful outlet should the above elbow portion thrombose in the future.

## References

1. Dixon BS. Why don't fistulas mature? *Kidney Int* 2006;**70**(8): 1413–1422
2. Roy-Chaudhury P, Spergel LM, Besarab A, Asif A, Ravani P. Biology of arteriovenous fistula failure. *J Nephrol* 2007;**20**(2): 150–163
3. National Kidney Foundation-Dialysis Outcomes Quality Initiative. NKF-DOQI clinical practice guidelines for vascular access. *Am J Kidney Dis* 1997;**30**(4 Suppl 3):S150
4. Saran R, Dykstra DM, Pisoni RL, Akiba T, Akizawa T, Canaud B *et al*. Timing of first cannulation and vascular access failure in haemodialysis: an analysis of practice patterns at dialysis facilities in the DOPPS. *Nephrol Dial Transplant* 2004;**19**(9):2334–2340
5. McLafferty RB. Techniques to enhance arteriovenous fistula maturation. *Perspect Vasc Surg Endovasc Ther* 2009;**21**(1):41–45
6. Beathard GA, Arnold P, Jackson J, Litchfield T, Physician Operators Forum of RMSL. Aggressive treatment of early fistula failure. *Kidney Int* 2003;**64**(4):1487–1494