

Delayed Superficialization of Brachiobasilic Fistula

Technique and Initial Experience

C. M. V. Zielinski, MD; Sumeet K. Mittal, MD; Pete Anderson, MS; Judd Cummings, MS; Steve Fenton, MS; Julian Reiland-Smith, MD; J. T. Frock, MD; R. W. Dunlay, MD

Hypothesis: Angioaccess procedures for dialysis have varied patency rates with frequent need for intervention. A superficialized arteriovenous brachiobasilic fistula created as a 2-step procedure will have good long-term patency with minimal complication.

Design: Retrospective medical record review and patient interview.

Setting: Tertiary referral university hospital.

Patients: Twelve patients who underwent delayed superficialization of brachiobasilic fistula from September 1994 to April 2000.

Main Outcome Measures: Patency of fistula for dialysis, and major and minor complications, including revisions.

Results: Delayed superficialization of brachiobasilic fistula was performed in 12 patients. Fistulas have been used for a mean duration of 22.4 months (range, 10-59 months). Two patients required alternate access owing to thrombosis of brachiobasilic fistula.

Conclusions: The delayed superficialized brachiobasilic arteriovenous fistula has a good initial patency rate with minimal complications. It should be considered early in patients if radiocephalic fistula is unavailable.

Arch Surg. 2001;136:929-932

WHAT IS this? The dark ages!" is how Dr McCoy of the starship *USS Enterprise*, in their journey back in time to the late 20th century, described the medical care for the treatment of end-stage renal disease (ESRD). He gave a patient with ESRD a pill, and the patient jubilantly declared, "I have a new kidney!" This seems a utopian dream for the future; however, for now patients with ESRD require long-term dialysis until they can undergo transplantation. The success of long-term hemodialysis depends on reliable high-flow angioaccess.

Increasing longevity and improved medical care has increased the number of patients with ESRD. This coupled with the limited number of kidney donors causes an ever-increasing demand for long-term dialysis. The National Institutes of Health report a 7.8% increase in the number of Americans seeking treatment for ESRD per year, and among those patients, 70% require either hemodialysis or peritoneal dialysis.¹

The "native" radiocephalic arteriovenous fistula (AVF) first described by Bres-

cia et al in 1966 remains the gold standard and the most widely used initial procedure. However, in some patients the fistula cannot be created owing to sclerosis of the artery, sclerosis of small caliber veins, or failure to mature. Additionally, 30% of the fistulas fail within 3 years and require alternate vascular access.

Superficialized brachiobasilic fistula formed as a 1-step procedure first described by Dagher et al³ is widely used. It has a high patency and low complication rate.⁴ We present an alternate technique for the brachiobasilic fistula wherein the superficialization of the arterialized basilic vein is performed as a second procedure.

RESULTS

Twelve patients (8 women and 4 men) with a mean age of 48.4 years (age range, 17-76 years) underwent this procedure from September 1994 to April 2000 (**Table 1**). Five had right-sided and 7 had left-sided fistulas. Eight of the 12 patients are currently alive, and of these, 6 are being dialyzed using the superficialized fistula. One patient (patient 3) had a small hematoma that required

From the Department of Surgery (Drs Zielinski, Mittal, and Reiland-Smith), and the Department of Medicine, Division of Nephrology (Drs Frock and Dunlay), Creighton University School of Medicine (Messrs Anderson, Cummings, and Fenton), Omaha, Neb.

METHODS

All patients undergoing repeated AVF by a single surgeon (C.M.V.Z.) were reviewed to identify patients who had delayed superficialization of the brachio basilic fistula. Twelve patients underwent this procedure from September 1994 to April 2000. Data regarding prior procedures (dates of procedures under consideration, complications, and outcome) was noted from office charts. The dialysis center was contacted to find out the current status of the patients and fistula use. Patients were interviewed and asked about any symptoms such as coldness, numbness, paraesthesia, weakness, or swelling. Follow-up information was available for all patients.

SURGICAL TECHNIQUE

Anatomy

The basilic vein starts as a superficial vein of the forearm and communicates with the cephalic vein at the level of the cubital fossa (**Figure 1A**). It continues superiorly and medially in a relative superficial location for a short distance; however, it soon dives below the brachial fascia where it continues superiorly as the axillary vein. The basilic vein, brachial artery, and median nerve lie in the groove, medially, between the biceps and triceps, and the musculocutaneous nerve is in close proximity. The relative deep location and the close proximity of the aforementioned nerves make it unsuitable for repeated access in its native location.

First Procedure

The basilic vein and brachial artery are isolated through a curvilinear incision in the antecubital fossa. The communicating branch to the cephalic vein is ligated, as is the distal basilic vein. An end-to-side basilic vein to

brachial artery fistula is created (**Figure 1B**) using running 6-0 monofilament, nonabsorbable sutures, and the skin is closed with subcuticular stitches. This is usually performed using local anesthesia. An alternate temporary access device such as a Quentin catheter is placed if indicated. The maturation of the fistula is followed clinically by a palpable thrill or an audible bruit. Fistulograms were obtained on some patients prior to the second procedure.

Second Procedure

The patient returns to the operating room in approximately 6 to 8 weeks. The arm is positioned in an abducted position. The operating site includes the whole arm from the axilla down. The procedure can be performed using general or regional anesthesia. The arterialized basilic vein is palpated medial and superior to the cubital fossa, the incision is opened, and the basilic vein is mobilized starting approximately 1.5 cm above the arteriovenous anastomosis. A longitudinal incision is then made following the course of the basilic vein. Branches are ligated or sutured, and extreme care is taken to avoid traction or injury to the nerves. Mobilization is carried almost into the axilla. The vein is then divided distally near the AVF between atraumatic clamps, and the vein is delivered proximally. Using a tunneling device, a subcutaneous tract is created over the anterior upper arm from the cubital fossa to the axilla (**Figure 2**), and the mobilized vein is brought through it. The end-to-end anastomosis is performed using a 6-0 monofilament suture (**Figure 1C**). Care is taken to avoid any tension at the anastomosis or kinking in the axilla. The wound is closed in layers. Superficialized fistula can be used immediately, although we prefer to wait for 2 weeks allowing a fibrous tract to develop around the superficialized vein.

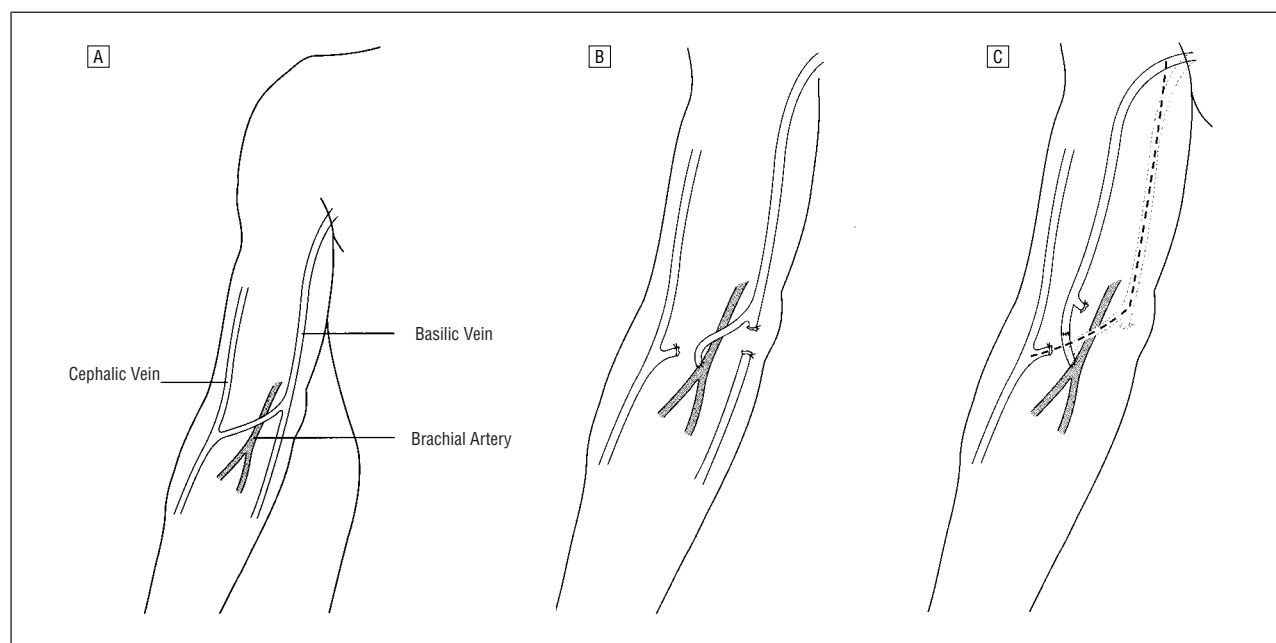


Figure 1. Schematic diagrams showing the normal anatomy (A) and the procedure. The basilic vein is anastomosed to the brachial artery (B). The arterialized basilic vein is superficialized and reanastomosed (C).

surgical evacuation after the first procedure. However, since superficialization, no other problems have occurred. Four patients have died owing to causes unrelated to the fistula or the surgical procedures (patients 1, 3, 4, and 6). Three had documented use of their fistula until death. One patient (patient 6) died within 2 weeks of the second procedure from an unrelated cause and the fistula was never used.

At 6 months' follow-up, 11 patients were alive, all with working fistulas (100% patency). Nine patients were followed up for more than 1 year. Of these, 8 (88.8%) had working fistulas. The mean duration of fistula use was 22.4 months (range, 10-59 months [not including patient 6]). Two patients' (9 and 11) fistulas clotted at 13 and 6 months, respectively; these patients had alternate hemodialysis access. Both were obese women with fistula clotting due to hematoma formation. In both cases, hematoma formation resulted from technical error of unrecognized back-wall puncture during dialysis. Two other patients complained of mild steal symptoms, but neither had severe pain or tissue loss to warrant any intervention. One of these patients reported symptoms only during dialysis.



Figure 2. Demonstration of tunneling device used to create subcutaneous tract for arterIALIZED basilic vein.

Native fistulas are superior to graft fistulas (**Table 2**⁴⁻⁹). The Brescia-Cimino radiocephalic fistula² first described in 1966 continues to be the procedure of choice. It has good long-term results with a patency of 70% to 80% and 57% to 65% for 1 and 3 years, respectively.⁵⁻⁷ Radiocephalic fistula has a low rate of distal steal and almost never results in high-output cardiac failure. However, in a subset of patients, especially the elderly population, sclerosis of the vascular system and the repeated trauma of punctures and indwelling catheters render the radial artery and the forearm veins unsuitable for AVF creation.⁶ In these patients and in patients with failed radiocephalic AVF, more proximal fistulas or prosthetic grafts are required.

Cascardo et al¹⁰ described a side-to-side brachial artery-cephalic vein fistula, which has largely been replaced by the end-to-side version. Gracz et al¹¹ describes an alternate brachiocephalic fistula by anastomosis between the perforating vein (vena mediana cubiti profunda) and the brachial artery. Bender et al⁶ report good results for this AVF with significantly higher patency than the wrist AVF. Patency rates for various AVFs have been summarized in Table 2.

The basilic vein is usually of greater diameter than the cephalic vein and is usually not accessed for venipuncture owing to its deeper location. This results in decreased intimal injury, which logically should transcend in improved fistula function. However, the basilic vein in its native location is inaccessible for repeated angioaccess and is in close proximity to the median and the musculocutaneous nerves. Dagher et al^{3,4} describe the subcutaneous transposition of the basilic vein to overcome these problems. The procedure entails a separate subcutaneous tract for the vein with arteriovenous anastomosis in the end-to-side fashion after superficialization.

Table 1. Results of Superficialized BrachioBasilic Fistula

Patient No./ Sex	Date of Superficialization	Age, y	Date Fistula Last Used	Complications	Use, mo	Comments
1/F	9/17/94	52	3/14/98	None	42	Died 3/17/98 with a functioning fistula
2/F	4/12/95	41	In use	Delayed healing of finger, laceration 2 y after the procedure	59	No problems, now well healed
3/M	12/20/95	65	12/15/96	Hematoma evacuation after the first procedure	12	Died 12/15/96, no problems after superficialization
4	10/9/96	61	4/12/97	None	6	Died 4/14/97
5/F	11/27/96	17	In use	None	39	
6/F	4/16/97	71	Never used	None	0	Died 5/21/97
7/M	2/9/98	76	In use	None	25	
8/F	7/30/98	48	In use	None	19	
9/F	9/16/98	63	9/12/99	None	13	Hematoma/thrombosis
10/F	10/21/98	21	In use	Cold fingers with numbness during dialysis	16	No problems when not undergoing dialysis
11/F	3/10/99	26	9/15/99	Mild steal syndrome symptoms	6	Obese patient, started using fistula within 2 d of superficialization, hematoma/thrombosis
12/M	5/20/99	40	In use	None	9	

Table 2. Patency Rates for Commonly Used Arteriovenous Fistulas (AVFs)

Type of AVF	Author*	No. of Patients	1 Year, %	3 Years, %
Radiocephalic	Bender et al ⁶	56	76	65
	Cantelmo et al ⁷	111	69	57.3
Brachiocephalic	Elcheroth et al ⁵	52	75	60
	Cantelmo et al ⁷	31	74.6	
Brachioperforating vein	Bender et al ⁶	31	93	80
	Elcheroth et al ⁵	91	80	75
Brachio basilic (superficialized)	Dagher ⁴	176	75	70 (8 y)
	Elcheroth et al ⁵	80	78	53
	Cantelmo et al ⁷	68	70	57.2
	Present study	12	88.8	
Synthetic graft	Bender et al ⁶	17	69	62
	Tordoir et al ⁹	24	74	59
	Munda et al ⁹	67	67	43 (4 y)

*For Elcheroth et al, the actual percentages were not given and have been approximated from the cumulative patency table.

Alternatively, as described by Knootz and Helling¹² and Barnett et al,¹³ the arteriovenous anastomosis is formed first and then the vein is mobilized from its subfascial location. The brachial fascia is then closed below the vein, rendering it superficialized. Both these procedures are essentially the same with a single arteriovenous anastomosis, and the veins are readily available for repeated percutaneous access. Dagher⁴ reported a 75% and 70% patency rate at 1 and 8 years, respectively. Knootz and Helling¹² reported using this fistula only after an average of 6 to 7 other AVF procedures had failed. In their series, 12 of 14 fistulas were usable during a 1- to 32-month period, and the remaining 2 failed to mature.

Our technique has similar end results as described by Dagher et al,³ the difference being that the vein is allowed to arterialize before transposing it to a superficial tract at the time of the second procedure. The procedure has the disadvantage of having 2 anastomoses: arteriovenous and venovenous. This has not adversely affected our patency rates. We believe that the arterialized vein is likely to be sturdier and hence can be mobilized more easily with decreased vascular trauma. This may be reflected in higher long-term patency rates. In our study, the patency rate is 100% at 6 months and 89% at 1 year. Mean duration of use is 22.4 months (range, 10-59 months). This is better than currently reported for any angioaccess series. Only patients who had arterialization of the basilic vein after the first procedure were included. The patients who, for whatever reason, did not have adequate arterialization were automatically excluded and could have positively influ-

enced the results. According to the operating surgeon, there were no such cases. We use this procedure if a radiocephalic fistula is either unusable owing to thrombosis or fails to mature, or cannot be created owing to poor quality of vessels or body habitus (eg, extremely obese). Ours is a small series with limited follow-up, and more experience is needed prior to determining the expected longevity of these fistulas. However, the good results do indicate that this should be done prior to using prosthetic grafts or using the lower extremity for dialysis access.

The delayed superficialized brachio basilic AVF has a good initial patency rate with minimal complications. It should be considered early in patients if radiocephalic fistula is unavailable. At present we recommend that the basilic vein (if used) should be superficialized by a second procedure for easy access.

Corresponding author and reprints: C. M. V. Zielinski, MD, Department of Surgery, Creighton University School of Medicine, 601 N 30th St, Omaha, NE 68131 (e-mail: deepeter@creighton.edu).

REFERENCES

1. Morbidity and mortality of renal dialysis: an NIH consensus conference statement: Consensus Development Conference Panel. *Ann Intern Med.* 1994;121:62-70.
2. Brescia MJ, Cimino JE, Appel K, Hurwicz BJ. Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula. *N Engl J Med.* 1966;275:1089-1092.
3. Dagher FJ, Gelber R, Ramos E, Sadler J. The use of basilic vein and brachial artery as an A-V fistula for long term hemodialysis. *J Surg Res.* 1976;20:373-376.
4. Dagher FJ. The upper arm AV hemoaccess: long term follow-up. *J Cardiovasc Surg.* 1986;27:447-449.
5. Elcheroth J, De Pauw L, Kinnaert P. Elbow arteriovenous fistulas for chronic haemodialysis. *Br J Surg.* 1994;81:982-984.
6. Bender MHM, Bruyninckx CMA, Gerlag PGG. The brachiocephalic elbow fistula: a useful alternative angioaccess for permanent hemodialysis. *J Vasc Surg.* 1994;20:808-813.
7. Cantelmo NL, LoGerfo FW, Menzoian JO. Brachio basilic and brachiocephalic fistulas as secondary angioaccess routes. *Surg Gynecol Obstet.* 1982;155:545-548.
8. Tordoir JH, Herman JM, Kwan TS, Diderich PM. Long-term follow-up of the polytetrafluoroethylene (PTFE) prosthesis as an arteriovenous fistula for haemodialysis. *Eur J Vasc Surg.* 1988;2:3-7.
9. Munda R, First MR, Alexander JW, Linnemann CC Jr, Fidler JP, Kittur D. Polytetrafluoroethylene graft survival in hemodialysis. *JAMA.* 1983;249:219-222.
10. Cascardo S, Acchiardo S, Beven EG. Proximal arteriovenous fistulae for haemodialysis when radial arteries are unavailable. *Proc Eur Dial Transplant Assoc.* 1970;7:42-46.
11. Gracz KC, Ing TS, Soung LS, Armbruster KF, Seim SK, Merkel FK. Proximal forearm fistula for maintenance hemodialysis. *Kidney Int.* 1977;11:71-74.
12. Koontz PG, Helling TS. Subcutaneous brachial vein arteriovenous fistula for chronic hemodialysis. *World J Surg.* 1983;7:672-674.
13. Barnett SM, Waters WC III, Lowance DL, Rosenbaum BJ. The basilic vein fistula for vascular access. *Trans Am Soc Artif Intern Organs.* 1979;25:344-346.