Axial splitting of the medial antebrachial cutaneous nerve facilitates second-stage elevation of basilic or brachial vein in patients with arteriovenous fistula

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We describe a novel surgical technique to facilitate the second-stage elevation of the basilic or brachial vein in patients with first-stage brachial-basilic or autogenous brachial-brachial arteriovenous fistula by axial splitting of the medial antebrachial cutaneous nerve (MABCN). Filaments of the MABCN typically traverse the anterior aspect of the basilic and brachial veins. The second-stage elevation/shelf superficialization of the basilic or brachial vein, so as not to cause an injury to the MABCN, requires division of these veins with transposition over the nerve branches and subsequent reanastomosis. Our method of axial splitting of the MABCN enables elevation and shelf superficialization of the basilic or brachial vein without the division and reanastomosis of the vein. Twenty-eight patients underwent this simplified elevation. The nerve perineurium was incised longitudinally, nerve fibers were divided intrafascicularly, and cutaneous nerve branches were retracted aside. The vein was elevated between the divided nerves. On discharge and at 1-month follow-up, only one patient complained of localized patch hypoesthesia as reported in a simplified neurologic assessment questionnaire and neurologic examination. (J Vasc Surg 2015;62:1353-6.)

The National Kidney Foundation Kidney Disease Outcomes Quality Initiative and AV Fistula First Breakthrough Coalition, National Vascular Access Improvement Initiative practice guidelines recommend the use of autogenous arteriovenous fistula (AVF) for hemodialysis over synthetic arteriovenous grafts.[1]

The possibility of using the basilic (brachial-basilic AVF [BBAVF]) or brachial (autogenous brachial-brachial AVF [ABBAVF]) vein as an arteriovenous access for hemodialysis was originally described in 1976 and 2004, respectively.[2,3] However, surgery requires superficialization, elevation, or transposition of the vein to make it accessible for hemodialysis. These can be performed as a single-stage or two-stage procedure.[3-6] Initially, the surgery was performed as a single-stage procedure. Many surgeons now perform the surgery as the two-stage procedure.[4-8] In most surgical descriptions of BBAVF or ABBAVF creation, special care is required to not injure the medial antebrachial cutaneous nerve (MABCN), which usually traverses over the basilic or deeper brachial vein.[4,5,8] In the one-stage procedure, transection of the basilic or brachial vein enables its positioning, tunneling, and elevation just under the skin and thus over the MABCN, followed by anastomosis with the brachial artery without the risk of nerve injury. The second-stage superficialization or elevation without transection of the vein and subsequent reanastomosis with the brachial artery may encounter the difficulty of how to avoid injury to the MABCN. Most published descriptions of second-stage basilic-brachial superficialization advise preservation of the nerve but do not describe how this should be done safely.[4,5,8]

In this manuscript, we present our novel and very simple surgical technique for a safe second-stage elevation and shelf superficialization of the basilic or brachial vein, preserving the continuity and functionality of the MABCN, without the need for transection and reanastomosis of the vein with the brachial artery.

METHODS

Twenty-eight patients were included in a single-center retrospective study performed between January 5, 2010, and December 28, 2013. All patients were referred for the formation of secondary or tertiary autogenous vascular access as all presented with a previous history of autogenous arteriovenous access formation; 12 were women and 16 were men. The average age was 64 years (range, 43-78 years). All of the patients were on hemodialysis for an average of 13 years (range, 8-19 years). All had previous history of attempted creation of radial-cephalic and brachial-cephalic fistulas and, in the subgroup that qualified for ABBAVF, brachial-basilic native fistulas.

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Seven patients were diabetic but without clinical symptoms of peripheral neuropathy. None of the patients presented with steal symptoms from prior access. In this cohort, 20 two-stage BBAVFs and eight two-stage ABBAVFs were performed. Arteriovenous access was created on the arm with suitable arterial and venous anatomy, regardless of functional dominance of the upper extremity.

Our novel modification of the standard surgical technique and informed consent were approved by the Institutional Review Board of the Foundation for the Development of Endovascular and Minimally Invasive Surgery (002/2013/CHN), and all patients gave informed consent.

All operations were performed as two-stage procedures, using the principles of the surgery that were described in detail previously.[3-6,9] During the first stage, the basilic or brachial vein was anastomosed with the brachial artery in end-to-side fashion (Fig 1). After a 4- to 6-week period of maturation, the vein was explored with one long incision. All venous tributaries were ligated, and the vein was elevated with the shelf superficialization technique to lie subcutaneously rather than being tunneled. The shelf superficialization technique means formation of an anterior shelf above the fascia to create the place for the fistula superficially but away from the incision.

The MABCN was identified (Fig 2). For purposes of the study in this series, we included only patients with MABCN traversing in front of the basilic or brachial vein (28 of 35 patients [80%]) and who underwent BBAVF or ABBAVF creation within the study period.

To enable elevation and shelf superficialization of the basilic or brachial vein without the need for its division and reanastomosis and yet to preserve the MABCN branches, we developed our own method of axial splitting of the MABCN proximally. In this setting, with surgical loupes (magnification of 2.0 at least), the perineurium of the MABCN was incised longitudinally using microforceps and microscissors. This enabled precise, intrafascicular division and separation of nerve fibers toward the axilla. Axial incision of the perineurium and then separation of nerve fibers in longitudinal projection minimized the risk of injury, including transverse interruption of the nerve's continuity. Isolated nerve branches, freed from the perineurium of the main trunk of the nerve, spontaneously gained an extra, tension-less length and tended to move aside. Separated cutaneous branches traversing the front aspect of the vein were therefore easily split from the main trunk of the MABCN and retracted laterally and medially (Fig 3). Then, the matured in situ basilic or brachial vein, ready for the second-stage access procedure, was elevated between the separated nerves (Fig 4). Closure of the fascia underneath the elevated vein (above the retracted-aside nerves) and secure placement of the vein in subcutaneous tissue completed the surgery (Fig 5). In each case, elevation and shelf superficialization were performed without division and reanastomosis of the vein.

In six cases of obese patients, our technique resulted in shortening of the overall vein length accessible for hemodialysis, but it was acceptable for the dialysis staff.

Fig 1. During the first stage, the basilic or brachial vein is anastomosed with the brachial artery in end-to-side fashion.

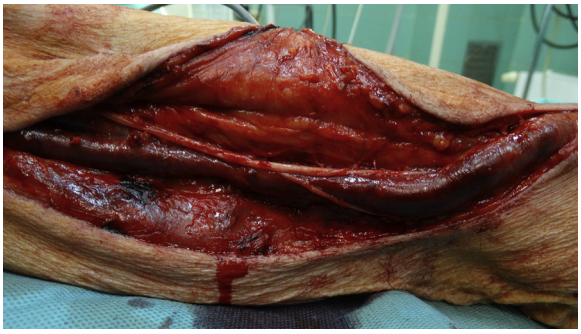

Fig 2. During the second stage, matured basilic or brachial vein is exposed, and the median cutaneous nerve of the forearm is identified.

Every patient completed a simple neurologic questionnaire about sensory and motor functions on the day of discharge and 1 month after surgery together with a basic physical neurologic examination by an independent neurologist. A simplified neurologic questionnaire was adapted from a questionnaire used for patients who underwent sural nerve graft harvesting with the method similar to our nerve-splitting technique.[10] The usually applied standardized Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire or the shortened version (QuickDASH) was not used because of its nonspecificity in relation to the possible neurologic complications of our technique.[11] The six modified, graded questions for the purpose of this study are listed in the Table. Patients returned completed questionnaires in all cases.

Evaluation of the long-term patency of vascular access was performed with the Kaplan-Meier analysis. The follow-up period ranged from 6 to 44 months. The follow-up visits of patients were performed on the day of discharge from the hospital, then 1 month after the second-stage surgery and at each intervention required to maintain the patency of the access.