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A comparison of brachial artery-brachial vein arteriovenous fistulas with arteriovenous grafts in patients with poor superficial venous anatomy

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ABSTRACT

Objective: The autogenous arteriovenous fistula (AVF) has been shown to be superior to the arteriovenous graft (AVG) with respect to cost, complications, and primary patency. Therefore, the National Kidney Foundation Disease Outcomes Quality Initiative guidelines recommend reserving AVGs for patients who do not have adequate superficial venous anatomy to support AVF placement. The brachial artery-brachial vein arteriovenous fistula (BVAVF) has emerged as an autologous last-effort alternative. However, there are limited data comparing BVAVFs and AVGs in patients who are otherwise not candidates for a traditional AVF.

Methods: Patients who received a BVAVF from July 2009 to July 2014 were compared with those who received an AVG during the same period. At our institution, BVAVF and AVG are only performed in patients with poor superficial venous anatomy. Patient demographic data, operative details, and subsequent follow-up were collected. BVAVFs were performed with a two-stage approach, with initial arteriovenous anastomosis, followed by delayed superficialization or transposition. Our primary outcome measure was primary functional assisted patency at 1 year. Patients lost to follow-up were excluded. A subgroup analysis was also performed for patients in whom the BVAVF or the AVG was their first hemodialysis access surgery.

Results: During the study period, 29 patients underwent BVAVF and 32 underwent AVG. There were no differences in age, gender, or presence of diabetes between the two groups. The median days to cannulation from the initial operation were 141 (interquartile range, 94-214) in the BVAVF group and 29 (interquartile range, 14-33) in the AVG group ($P < .001$). Fewer patients required interventions to maintain or re-establish patency in the BVAVF group than in the AVG group (10% v. 44%; $P < .01$). The 1-year primary patency was greater for BVAVF (62% vs 25%; $P < .01$); however, there was no difference in the functional assisted primary patency rates at 1 year (45% vs 25%; $P = .1$). Subgroup analysis demonstrated greater 1-year primary functional assisted primary patency (52% vs 19%; $P < .05$) in patients without prior access surgery.

Conclusions: The BVAVF is a viable alternative to the AVG in patients with inadequate superficial venous anatomy, especially in access-naïve patients. The decision to perform BVAVF must be weighed against the delay in functional maturation expected compared with AVG. (J Vasc Surg 2016;■:1-8.)

The National Kidney Foundation Dialysis Outcomes Quality Initiative (NKF-DOQI) has set forth guidelines to minimize the number of patients with central venous catheters (CVCs) while maximizing the number of patients with functional hemodialysis (HD) accesses.[1] Because of their superior patency, fewer complications, lower associated costs and lower mortality, the Fistula First Initiative has recommended that at least 65% of current HD accesses be autogenous arteriovenous fistulas (AVFs).[1-9] However, AVFs are classically avoided in patients with inadequate superficial venous anatomy because of the risk of nonmaturation, and an arteriovenous graft (AVG) is often performed instead.

In an attempt to further increase the prevalence of autogenous HD access, Bazan and Schanzer[10] described the use of the brachial vein as the outflow for an AVF. Since that first described experience of a brachial artery-brachial vein arteriovenous fistula (BVAVF), a number of studies have demonstrated varied results for its rates of patency and complications.[11-18] Few studies have compared the BVAVF directly with the AVG. In addition, whether one should perform a BVAVF or an

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AVG as the initial access in access-naïve patients with inadequate superficial venous anatomy is not well defined. We hypothesized that in patients with inadequate superficial venous anatomy, outcomes after a BVAVF would be superior to those with an AVG, especially in access-naïve patients.

METHODS

The Harbor-University of California, Los Angeles Medical Center Institutional Review Board approved this study. The approval included a waiver of patient consent because the study was retrospective, would not affect patient care prospectively, and contained only deidentified data.

Study design. The study included all consecutive patients who underwent a BVAVF or an AVG between July 2009 and July 2014. Our policy is that the BVAVF is the fourth-line AVF option (after radiocephalic, brachiocephalic, and brachiobasilic), and is thus only performed when superficial veins are inadequate. Similarly, AVGs are also reserved for patients with inadequate superficial venous vasculature as determined by preoperative physical examination, duplex ultrasound (US) imaging, or intraoperative vein measurement. Thus, all patients in this study demonstrated poor superficial venous anatomy. In general, we require a minimum cephalic or basilic vein diameter of 2.5 mm to perform an AVF.

In addition, AVGs are also used in patients who are already supported with HD or those who will likely require HD earlier than an AVF would be able to mature. However, the ultimate decision about whether to perform a BVAVF or an AVG in patients with poor superficial venous anatomy is at the discretion of the attending surgeon. Patient histories, operative details, and data from subsequent follow-up in vascular surgery and nephrology clinics were collected. Patients lost to follow-up were excluded.

Technical notes. All BVAVFs were performed in two stages, with formation of the anastomosis at the initial surgery and subsequent transposition after 4 to 6 weeks. BVAVFs were determined to be mature if they had a minimum intraluminal diameter of 6 mm and demonstrated a flow of 600 mL/min on duplex ultrasound imaging. BVAVFs were transposed using two different methods: one using a longitudinal incision along the upper arm, with placement of the transposed vein in a newly created subcutaneous pocket 3 to 4 mm from the skin, and the other more common method using a similar incision but with transection, tunneling, and reanastomosis of the vein at the level of the prior anastomosis. In both instances all venous tributaries are ligated and divided. We require a minimum brachial vein diameter of 2.5 mm verified by direct measurement as well as the ability to accommodate a 2.5-mm dilator after dilation with heparinized saline. Anastomoses are performed in an end vein-to-side artery fashion with a minimum arteriotomy of 6 mm.

Our standard AVG is performed exclusively using a polytetrafluoroethylene (PTFE) graft. The decision whether to use a 4-mm to 7-mm tapered PTFE graft is at the discretion of the attending surgeon. AVGs are performed from the brachial artery to the brachial, basilic, and axillary veins. Forearm AVGs are fashioned in a looped configuration, whereas all upper-arm AVGs are tunneled straight.

Patients are seen 1 to 2 weeks after their initial BVAVF and AVG operations, and for BVAVFs, are also seen 4 to 6 weeks from anastomosis creation to evaluate for superficialization or transposition. In the setting of any complications, patients are seen earlier, either urgently in clinic or in the emergency department. BVAVF patients are also seen for follow-up 1 to 2 weeks after their second-stage surgery. Patients were subsequently monitored by nephrology and at their respective HD centers and were only seen by vascular surgery again if any complications arose.

Definitions. Functional patency was defined as the ability to cannulate the access site, maintain a minimum flow of 400 mL/min, and complete a session of HD in <4 hours. Primary assisted patency was defined as the period beginning with fistula creation to the time of first thrombosis, or "thrombosis-free access survival." This interval included any interventions required to maintain access patency. Primary functional assisted patency was defined as the period beginning with first functional cannulation to the time of first thrombosis, also including any interventions required to maintain flow. Functional secondary patency was defined as the period beginning with first functional cannulation to the time of abandonment. Primary failure included those accesses that did not mature, those that thrombosed early, and those that experienced significant complications requiring abandonment of the access before use. These definitions are consistent with those set forth in the vascular surgery literature by Sidawy et al[19] and Huijbregts et al.[20]

Outcomes of interest. Our primary outcome was 1-year primary functional assisted patency. Secondary outcomes included 1-year primary assisted patency, 1-year secondary functional assisted patency, and complications. The complications included were vascular steal syndrome, hematoma, upper extremity edema, and wound infection. All patients lost to follow-up were excluded.

Statistical methods. Data were analyzed using SAS 9.3 (SAS Institute Inc, Cary, NC) and Epi Info 7, build 7.1.5.2 (Centers for Disease Control and Prevention, Atlanta, Ga) software. Continuous variables were analyzed using the Student *t*-test, but in the presence of significant variance, the Kruskal-Wallis test was used instead. Categoric