



Brachial Artery-Brachial Vein Arteriovenous Fistula: An Alternative to Prosthetic Graft Fistula

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Abstract

When superficial veins are not suitable, creating an Arteriovenous Fistula (AVF) using prosthetic graft was the following option. Prosthetic AVF has been associated with a shorter patency and a higher rate of complications comparing to autogenous AVF. Brachial artery-brachial vein fistula with transposition of the brachial vein has been proposed as an alternative to prosthetic fistula.

Although surgical experience with this fistula is still limited, many studies reported good patency and low complications rates. Better results have been achieved with the latest series and are secondary to a deep comprehension of the anatomical characteristics of the brachial vein and to the refinement of surgical techniques. The author reviewed the published studies related to this novel surgical procedure. In this article, he describes surgical techniques, analyzes complications, exposes comparative results with other procedures and suggests recommendations for the creation of this promising fistula in selected patients.

Keywords: Arteriovenous; Fistula; Brachial vein; Graf; Prosthesis

Introduction

Life expectancy of dialysis patients has increased. The quality of life and long-term survival depends primarily on providing a functional and durable arteriovenous (AV) access. Many patients out lived the AV access classical options in the upper extremities.

The National Kidney Foundation Dialysis Outcomes and Quality Initiative (KDOQI) guideline recommends:

- Autogenous access for Arteriovenous Fistulas (AVF)
- Autogenous arterio-venous fistulae (AVF) over tunneled central venous catheters and prosthetic materials used for arteriovenous grafts [1]
- Simple vs. complex fistulas

Patients with autogenous AVF live longer and have 5-8 fewer access complications and interventions. Surgery for creating these fistulas is a simple, safe outpatient procedure associated with a marked reduction in hospital admissions, emergency interventions and cost. Radial-cephalic AV fistula is the best choice for vascular access followed by brachial-cephalic AV fistula, brachial-basilic AV fistula with transposition of the basilic vein [2], prosthetic AV fistula at the upper extremities and finally complex fistula.

Materials and Methods

Creating an AVF using prosthetic material carries a high rate of morbidity and complications. The superiority of autogenous over prosthetic AVF has been well established. To avoid complications related to prosthetic graft use, a novel autogenous AVF has been suggested. The brachial artery-brachial vein AVF with transposition of the brachial vein (BAVF) has been proposed as a good alternative to prosthetic graft fistula. In this paper, the author reviewed the worldwide experience with this fistula. He analyses anatomical and surgical aspects of this procedure. He discusses comparative results and concludes proposing recommendations for the use of this fistula as angioaccess in selected patients.

Discussion

When adequate superficial veins of the upper limbs are unsuitable or not available, the next option is either prosthetic arteriovenous fistula at the upper extremities or brachial artery-brachial

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Table 1: Patency rate and complications rate of the published series of brachial artery-brachial vein fistula.

	Casey [7]	Lioupis [8]	Angle [9]	Elwakeel [10]	Dorobantu [11]	Jennings [12]	Kotsis [16]
No of patients	17	17	20	21	49	58	380
Mean follow-up (months)	8	12	14 ± 4	15.85 ± 9	18 ± 11.1	11 [2-31.7]	12
Maturation rate (4 weeks)	47%	65%	100%	66.60%	79.60%	89.60%	47% -100%
Patency rate (at 12 months)	40%	45.75%		75.85%		92.40%	24% - 77% primary
(at 24months)				55.39%		92.40%	
(at 37 months)					82.10%		
Hematoma	2			1	0	2	common
Infection	2			1	0	2	common
Steal syndrome	3		0	0	0	1	
Aneurysm	0			2	0		
Edema			0		34.60%	7%	common
Venous stasis		59%					

vein fistula with transposition of the brachial vein (BAVS).

Prosthetic fistulas allow rapid cannulation (Flixene) [3]. They have a higher rate of infection (0.023 vs. 0.007) and complications. Patency rate of these fistulas is shorter (65% to 75% at 1 year and 58% to 78% at 18 months) [4,5]. They require more surgical procedures to achieve the patency rate with autogenous grafts. Transposed AVF cumulative functional patency rates were superior compared with non transposed AVFs and prosthetic bridging grafts [5]. In children, the author demonstrated that primary and secondary patency rate was better with autologous (39 and 40.6 months) comparing to PTFE graft (3.75 and 4.75 months) [6].

Transposed autogenous access and autogenous access have higher primary patency rates than prosthetic access (74.6%, 56.2% and 40.2% respectively at 2 years). They have lower infection rates and require significantly less revisions than do prosthetic access [6]. Brachial artery-brachial vein fistula with transposition of the brachial vein has been proposed as an alternative autogenous to prosthetic fistula.

Pre-operative ultrasound mapping is required and a minimum brachial vein diameter for first stage AVF creation is 2.5 mm with a tourniquet in place.

Proximal radial artery is used for inflow when feasible. Otherwise, an anastomosis to the brachial artery is performed. Four to 6 weeks are allowed for this fistula to mature before construction of the second stage transposition using the matured brachial vein which must have a diameter 6 mm or above. The flow through the fistula must be more than 300 ml/min. An anterior transposition of the brachial vein is done and this vein is positioned superficially 3 mm to 4 mm below the skin. Harvesting the brachial vein which is a fragile vein with a small diameter and a thin wall and its transposition can be challenging for the surgeon and often more time consuming than transposition of other veins. The first series of brachial artery-brachial vein fistula with transposition of the brachial vein was reported by Casey et al. [7] and included 17 patients. Following this initial experience, larger series with longer term patency rate has been published [8-13] (Table 1).

A study comparing post operative course of a series of 190 patients who underwent brachio-cephalic and brachio basilic fistula (group 1) with two series of 21 and 49 patients who had brachial-brachial fistula (group 2) was conducted. Primary patency at one year was better for group 2 (75.85%) comparing to group 1 (56% for

brachio cephalic and 71% for brachio-basilic). A higher patency rate was also reported at 3 years for group 2 (82.1%) comparing to group 1 (40% for brachio-cephalic and 56% for brachio-basilic) [10,11,14,15].

Reviewing a series of 70 patients, Greenberg et al. [15] concluded that brachial-brachial fistula out-performed prosthetic access with respect to primary and functional patency in patients referred early without differences in overall complications [16].

The most recent results of brachial-brachial fistula were reported by Jennings et al. [12]. Their series included 58 patients. Brachial vein maturation was achieved in 89.6% of the patients. Brachial vein stenosis was observed in 7% of the patients. Primary patency rate was 52% at one year and 46.2% at 2 years, primary assisted rate was 84.9% at one year and 75.5% at 2 years and secondary primary rate was the highest reported in the literature for this procedure (92.4% at one and at 2 years). Understanding anatomical characteristics of the brachial veins, refining surgical techniques and gaining experience with this procedure allowed for increasing patency rate from 40% in the first series reported by Casey et al. [7] to as high as 92.4% in Jennings' series (Table 1) [7-12].

Kotsis et al. [16] reviewed 380 patients with brachial artery-brachial vein AVF published in many series in the literature. Maturation rate of the brachial vein at 4 weeks varied between 47% and 100%. Primary patency rate was observed in 24% to 77% of the cases. The most common complications were edema, infection and hematoma. Phams et al. [17] suggested in a recent paper that BAVF is a viable alternative to prosthetic graft AVF. The decision to perform BAVF must be weighed against the expected delay in functional maturation associated with these fistulas.

Brachial-brachial arteriovenous fistula is a suitable tertiary autogenous access when superficial venous system and the basilic veins are absent in patients with difficult access extremities. Harvesting brachial vein is challenging and time consuming. One-stage procedure was associated with inferior patency rate [18]. Most of the brachial-brachial fistulas were created with staged procedures. Most patients require intervention for access maturation or patency maintenance.

Although failure of maturation and early complications remain a concern, this fistula has good patency and low complication rates. Its construction can postpone the use of prosthetic grafts or long-term catheters by several years (essentially important for patients with a

very high risk of infection and in diabetic patients).

Because of the extended period for maturation of the brachial vein and the need for a longer time before cannulation, early planning and construction is required to avoid prolonged catheter use [13].

Conclusion

Brachial artery-brachial vein fistula should be incorporated into the arsenal of techniques that are routinely used by vascular access surgeons. It may represent a good alternative to AVFs with prosthetic graft, particularly for diabetic patients and patients with high risk for infection. Further, larger prospective larger cohort studies are required to confirm the low complication rate and the long term patency of this fistula.

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