

## Case Report

# Giant Brachial Aneurysm after Arteriovenous Fistula Ligation: A Review of the Different Surgical Approaches

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## Keywords

Brachial artery aneurysm · Arteriovenous fistula ligation · Graft

## Abstract

The aim of this paper is to describe the case of a patient successfully treated for left brachial arterial aneurysm occurring 15 years after renal transplantation and consequent 8 years after arteriovenous fistula (AVF) ligation. We describe our experience and our surgical approach. A 45-year-old man presented to our attention for a large pulsatile formation on the volar face of the left forearm, which he reported to have enlarged in the last year. He had a history of chronic renal impairment in 2000, then AVF for dialysis was realized, and he was finally addressed to kidney transplantation in 2004. In 2011 the AVF was ligated. We observed absence of radial pulse and direct flow on the ulnar artery; a large pulsatile formation was evident along the course of the left brachial artery, associated with forearm venous dilatation. Doppler ultrasound showed fusiform aneurysm of the brachial artery with 3.5 cm diameter and longitudinal extension of 5 cm up to the brachial bifurcation. We removed the brachial aneurysm, with a venous bypass on the ulnar artery. The patient was discharged in good general condition on the second postoperative day. At 1- and 6-month follow-up he had complete recovery with

graft patency, without any neurological impairment and with a good esthetic result. An open surgical repair with great saphenous vein interposition seems to be the best choice in terms of patency and perioperative morbidity.

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## Introduction

Brachial aneurysms after arteriovenous fistula (AVF) ligation are quite rare, their incidence is reported around 5–8% in operational fistula [1], and if left untreated they can lead to thrombosis and upper limb ischemia [2–4]. Several hypotheses are described, but etiology remains unknown.

The aim of this paper is to describe the case of a patient successfully treated for left brachial arterial aneurysm occurring 15 years after renal transplantation and 8 years after AVF ligation. We describe our experience and our surgical approach.

## Case Report

A 45-year-old man presented to our attention for a large pulsatile formation on the volar face of left forearm, which he reported to have enlarged in the last year (Fig. 1). At examination, we observed absence of radial pulse and direct flow on the ulnar artery at continuous-wave Doppler, and a large pulsatile formation was evident along the course of the left brachial artery, associated with forearm venous dilatation. Further Doppler ultrasound (DUS) examination showed a fusiform aneurysm of the brachial artery with a maximum diameter of 3.5 cm and longitudinal extension of 5 cm up to the brachial bifurcation, with thrombus formation, which partially occluded the brachial artery lumen and the origin of the radial artery, which was completely occluded. The cephalic vein after AVF was patent and dilated. The patient had a history of chronic renal impairment “failure” caused by glomerulonephritis in 2000, then AVF for dialysis was realized in other institution, and finally he was addressed to kidney transplantation in left iliac fossa in 2004. In 2011 the AVF was ligated with suture on the radial artery and the dilated cephalic vein was left in place. A DUS examination performed in 2018 showed patency of the brachial artery with a diameter of 3.5 cm and patency of the ulnar and radial artery up to the wrist. He also had a computed tomography scan without media contrast, which confirmed the DUS report.

Considering the presence of the diffuse thrombus in the brachial artery and the occlusion of the radial artery occurring in the last year, we decided to remove the brachial aneurysm with a venous bypass on the ulnar artery. The left great saphenous vein (GSV) was studied at DUS and resulted suitable as a graft. The patient was treated under general anesthesia. We first exposed the brachial artery that appeared tenaciously adherent to the surrounding tissues from the midarm to its bifurcation with a bilobed appearance, and satellite brachial veins were collapsed and flattened by the aneurysm. The radial artery was occluded at its origin, and the ulnar artery was soft and pulsating, suitable for bypass anastomoses. Then a proximal portion of about 20 cm of GSV was removed in the left groin. The radial artery was ligated at the origin. An aneurysmal section of the brachial artery of about 15 cm was removed. End-to-

end anastomosis between the venous graft and the brachial artery and the ulnar artery was realized with running polypropylene 6/0 sutures (Fig. 2). The entire aneurysmal cephalic vein was then removed. The patient was discharged in good general condition on the second post-operative day.

One-month control ultrasound showed complete resolution of the aneurysm and graft patency. Clinical examination showed normal upper limb motility, direct flow on the distal ulnar artery, without any neurological impairment, with a good esthetic result. At 6-month follow-up the patient had complete recovery, without any further complications (Fig. 3).

## Discussion

The history of aneurysmal brachial formation after AVF ligation is still unclear. Teixeira et al. [5] hypothesize an upregulation of vasodilator agents, degradation of elastic fibers and amounts of calcium and phosphate deposition due to dialysis, activation of a proinflammatory process in immunosuppression and corticosteroid long-term therapy, and increased resistance of the vessel wall after ligation of the AVF. Others hypothesize that arterial flow in AVF produces an increase in wall stress and a decrease in wall thickness [6]. The alteration of the vascular wall in our patient may have been caused by the long period of dialysis and AVF ligation around 8 years before. The patient presented to our attention without any complications or neurological or vascular impairments, except for asymptomatic radial artery occlusion and presence of the pulsating mass and venous dilatations on the right forearm. Accurate examination of the arm with DUS gave us relevant information, such as the size and the presence of thromboembolic material in the aneurysm and in the distal radial artery, with high risk of thromboembolic and ischemic complications. The patient needed surgical treatment to avoid any possible severe complication, mainly represented by arterial thrombosis, as suggested also by other reports [7, 8]. We preferred an open surgical repair approach with aneurysmectomy and interposition of the GSV, which has been demonstrated to be the treatment of choice in terms of good patency and perioperative morbidity [2, 5, 6, 9–15] as well as reduction of infection in patients treated with immunosuppressive therapy [16]. Several groups have described the validity of the GSV as a graft, with excellent results in terms of patency and absence of complications after intervention [2, 5, 6, 9–15]. One case of arteriomegaly proximal to the GSV has been described and was managed with DUS surveillance [17]. Surgeons generally used the GSV when the aneurysm was very long or when the upper limb vein was not suitable for use [11].

Other authors used the cephalic or basilic ipsilateral vein, with the aim to reduce incisions and, therefore, the duration of the procedure with consequent lower morbidity [18], and to preserve leg veins for future procedures in the arms or other vascular reconstructions [5, 19–21]. One aneurysmal degeneration was described after aneurysmectomy and interposition of basilic vein, which was treated with interposition of another ipsilateral arm basilic vein, and one posttraumatic thrombosis that remained untreated due to absence of symptoms [22]. Marzelle et al. [2] described two progressions of pathology after basilic vein interposition bypass that needed secondary polytetrafluoroethylene (PTFE) bypass and one patient treated with allograft which occluded at 12 months.

When the GSV has to be preserved in patients with cardiovascular risk factors or when it is not suitable as a conduit in chronic venous insufficiency or when other veins are unavailable, a PTFE graft can be used. Several authors used PTFE grafts and showed that a prosthetic graft was a valid alternative; in their individual cases the autologous veins were unavailable [2, 5, 12, 22–25]. No complications were described after PTFE grafts.

Resection of an aneurysmal artery with end-to-end anastomosis is described in two reports [3, 22]. It is reserved for cases of short aneurysm extension, as otherwise there can be wall tension, and in cases where the diameter of the artery remains similar. Table 1 summarizes case reports and series describing treatment for aneurysms after AVF ligation. To the best of our knowledge there are no cases of endovascular therapy for this group of patients.

### Conclusions

According to this review of the therapy of aneurysmal artery after AVF ligation, open surgical repair with GSV interposition seems to be the best choice in terms of patency and perioperative morbidity. In our case the patient presented with radial artery occlusion, so prompt treatment was necessary to avoid further occlusions. Aneurysmectomy and GSV graft bypass proved to be a good option, with no complications observed during surgery or at 6-month follow-up.

### Statement of Ethics

Informed consent for publication was obtained from the patient. The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

### Disclosure Statement

The authors have no conflicts of interest to declare.

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### Author Contributions

All authors participated in the clinical care and assembling of data and contributed to the intellectual content and the writing of the case report. They all actively reviewed and edited the content.

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**Fig. 1.** Perioperative mapping.



**Fig. 2.** **a** Complete isolation of the ulnar artery and aneurysm. **b** Aneurysm exclusion, great saphenous vein bypass.



**Fig. 3.** Six-month control.

**Table 1.** Summary of cases reports in the literature

First author	Year	Patients	Years after ligation	Symptoms	Type of repair	Complications	Follow-up, months
Anastasiadou	2019	1	12	painful, pulsatile mass	ipsilateral CV	none	1, 6, 12
Cleveland	2015	1	4	median neuropathy	ipsilateral CV	none	NR
Teixeira	2017	10	NR	6 localized pain and pulsatile mass; 3 subacute ischemia/microembolization, 1 acute ischemia/aneurysm thrombosis	6 GSVG; 2 ipsilateral CV; 1 ipsilateral BV; 1 PTFEG	1 postoperative hematoma; 1 anastomotic stenosis	69
Sapienza	2014	1	15	acute pain, swelling, distal microembolization	contralateral vein graft	none	15
Dinoto	2012	1	13	pain, paresthesia, pulsatile mass	1 PTFEG	none	6
Orhan	2019	1	10	pain, swelling, paresthesia	1 GSVG	none	24
Mestres	2014	12	3, 2, 7	6 pain; 1 distal embolization	3 CV; 4 BV; 2 saphenous vein; 2 direct ligation; 1 end-to-end	1 reoperation; 1 degeneration; 1 posttraumatic thrombosis; bypass	8.6
Marzelle	2012	10	NR	pain, subacute ischemia, contained rupture, swelling, pain, median nerve compression, pain and swelling	2 no intervention; 2 GSVG; 5 PTFEG; 1 allograft	6 none; 2 aneurysmal; 1 occlusion	20.3
Marconi	2015	1	12	none	PTFEG	none	60
Kordzadeh	2015	2	1	blue finger, painful hands, pain, paresthesia	PTFEG; GSVG	none; none	18; 18
Ferrara	2016	1	NR	swelling and mild paresthetic symptoms	BV	none	1
Garza	2013	1	NR	pain, paresthesia	GSVG	none	6
Murphy	2010	1	11	pain, swelling	CV	NR	12
Hale	1994	1	3	distal emboli	GSVG	NR	NR
Nguyen	2001	1	8	paresthesias, digital emboli	GSVG	none	NR
Eugster	2003	1	7	distal emboli	GSVG	NR	NR
Battaglia	2006	1	13	swelling, mild pain	PTFEG	NR	NR
Ventura	2006	1	NR	pain	PTFEG	NR	NR
Sultana	2007	1	17	distal emboli, subjective coldness	axillary artery, GSVG	NR	12
Chemla	2010	5	NR	swelling, pain; none; swelling, pain; swelling, pain; none	end-to-end; GSVG; end-to-end; GSVG; end-to-end	none	14
Murphy	2010	1	11	swelling, pain	CV	none	12
Basile	2011	1	9	swelling, pain	GSVG	none	1
Khalid	2014	3	5; 6; 20	pain, pulsatile mass; paresthesias, distal emboli, pain, pulsatile mass	GSVG; GSVG; ligation	2 none; 1 arteriomegaly	6 weeks; 6; 12
Keuter	2006	1	NR	pain, swelling, claudication	GSVG	none	postoperative

BV, basilic vein; CV, cephalic vein; GSVG, great saphenous vein graft; NR, not reported; PTFEG, polytetrafluoroethylene graft.