



# Iatrogenic Brachial Artery Pseudoaneurysm Repair in a Patient with Prior Distal Revascularization and Interval Ligation Procedure

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## Abstract

Distal revascularization with interval ligation (DRIL) is a proven method to resolve symptoms of ischemia related to dialysis access.

We present the management of patient with a large brachial artery pseudoaneurysm as an unusual complication in a patient who had previously undergone a DRIL procedure for ischemia. Inadvertent access of the brachial artery bypass occurred during routine dialysis, resulting in a five centimeter brachial artery pseudoaneurysm. Surgical repair of the pseudoaneurysm was performed with a re-operative brachial artery bypass resulting in patency of the fistula and revascularization of the hand. Risk factors and management options for this unusual complication are discussed.

## Case Presentation

The patient is a 56 year old female who had undergone a distal revascularization with interval ligation (DRIL) procedure twelve months after arteriovenous fistula creation. Her initial access was a right arm basilic vein transposition with arterial inflow from her brachial artery. At the time of the DRIL procedure, she was experiencing severe hand pain at rest without tissue loss. Her body mass index (BMI) was 38kg/m<sup>2</sup>. Pulse volume examination revealed a 50 mmHg pressure gradient in the right hand with compression of the fistula. Saphenous vein was used for the DRIL procedure with the proximal anastomosis situated 8 cm proximal to the fistula. Ligation of the right brachial artery was performed with serial silk ties buttressing a metallic clip. The patient’s post operative course was uncomplicated with resolution of symptoms and continued use of the fistula for dialysis.

Eighteen months later, the brachial artery bypass was inadvertently cannulated during a routine dialysis session. This resulted in an immediate hematoma and pain. Further attempts at dialysis were aborted, and the patient was sent home from the dialysis facility with a hemostatic pressure dressing over the site.

The hematoma failed to resolve and the fistula had a diminished thrill. Fistulogram was obtained and demonstrated poor flow secondary to an outflow stenosis, in addition to a large arterial pseudoaneurysm (Figure 1). CT angiogram of the right arm demonstrated a 5.0 cm pseudoaneurysm with compression of the AV fistula prompting vascular surgery consultation (Figure 2).

The patient was taken to the operating room for surgical repair. The arterial bypass from the prior DRIL procedure was exposed proximal and distal to the pseudoaneurysm. The patient was fully anticoagulated with heparin. Using reversed saphenous vein, the pseudoaneurysm was repaired using interposition grafting with end to end anastomoses proximally and distally. The thrombus within the pseudoaneurysm was manually evacuated with external compression. The remnant autogenous conduit was not excised. Interim dialysis was continued using a tunneled dialysis catheter. The patient’s post operative course was complicated by nausea secondary to severe gastroparesis. She was treated with intravenous Reglan with resolution of her symptoms. She was discharged to home on post operative day six.

Post operative CT angiography confirmed patency of the bypass, exclusion of the pseudoaneurysm, and preservation of the fistula (Figure 3). A high grade stenosis seen in axillary portion of the basilic vein transposition fistula was treated with balloon venoplasty, with subsequent cannulation of the access for dialysis. One year later, both her access and her bypass remain functional and patent. The authors obtained permission for publication from the patient.

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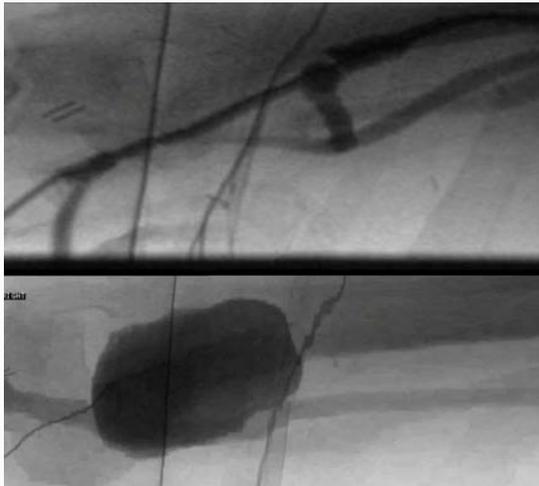
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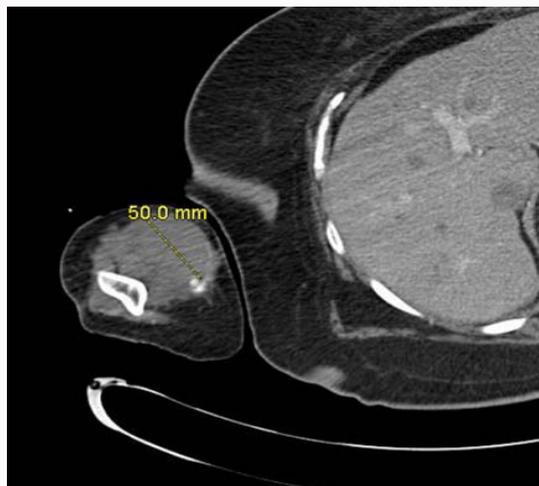
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**Figure 1:** Top image: Fistulogram imaging of the basilic vein transposition fistula. Faint opacification of the pseudoaneurysm is seen on the left. The venous outflow stenosis is not seen in this image. Bottom image: Magnified image of the flow channel of the pseudoaneurysm originating from the arterial bypass.



**Figure 2:** CT angiography confirming the size and location of the brachial pseudoaneurysm.

## Discussion

The incidence of end stage renal disease (ESRD) has shifted over the last decade. It's incidence increased in the 1990s and early 2000s, leveled off in the first decade of 2000, and then decreased between 2010 and 2011 [1]. It is estimated there are 700,000 patients in the United States currently on hemodialysis [2]. Despite a strikingly high (20%) annual mortality on all hemodialysis patients reported by Collins et al. [3] in 2010, a more recent report suggests that improvements in health care delivery have resulted in enhanced survival in dialysis patients [4].

Dialysis access associated steal syndrome (DASS) is a complication of arteriovenous (AV) access surgery where the imbalance between the low-resistance outflow in the venous system and the high resistance outflow in arterial circulation results in forearm or hand ischemia [5]. DASS can affect 10-20% of AV access constructions and can develop in the immediate post operative period or insidiously [6,7]. With improved survival in dialysis patients as suggested by Van



**Figure 3:** CT angiography after repair. The revised arterial bypass is patent, supplying inline flow to the hand. Green arrow: Ligated native brachial artery. Blue arrow: Venous outflow stenosis. The venous stenosis was subsequently treated with balloon venoplasty.

Walraven et al. [8], it may be observed that DASS may also increase over time. In our case, our patient developed symptoms of DASS twelve months after her initial dialysis access was created. Symptoms of DASS range from coolness of the extremity to neurological deficits (parasthesias or weakness), ischemic rest pain, digital ulceration, or digital gangrene.

A classification system for DASS has been previously described by Sidawy et al. [9]. This classification system has three grades. Grade 1 DASS (mild) is associated with few symptoms other than a cool extremity, and requires no treatment. Grade 2 DASS (moderate) manifests with intermittent ischemia during dialysis, and intervention is usually required. Grade 3 (severe) presents with ischemic pain at rest and/or tissue loss, and intervention is mandatory [9].

The diagnosis of DASS is largely clinical, based on accurate history and physical examination. Adjunctive testing which may confirm the diagnosis includes: duplex ultrasound of the arterial inflow, ultrasound of the access with and without compression, pulse volume recordings of the access with compression and arteriography-either catheter based or with CT imaging [10].

Numerous surgical or catheter based interventions for the management of DASS have been described. These include: treatment of arterial inflow obstruction, banding of the access, revision using distal inflow, proximalization of arterial inflow, ligation of the access, radial artery ligation, embolization of venous outflow branches and the DRIL procedure [11,12]. More recently, the DRIL procedure is increasingly being recognized as the preferred method of treatment in DASS [13]. While results have been varied, most success occurs in those patients with early steal.

Secondary complications of the DRIL procedure have been reported. Some of these include failure to resolve symptoms or subsequent thrombosis of the arterial bypass component [14]. Arterial pseudoaneurysm related to inadvertent puncture of the brachial artery bypass is an unusual complication of a surgical repair for DASS. Factors that may increase this risk include: multiple operations with failed AV access on the ipsilateral arm (resulting in erroneous tactile feel by the staff cannulating the access), central venous stenosis increasing the pulsatility of the access (making the

access and the bypass difficult to distinguish), access that lies medially on the arm, obesity, ipsilateral arm swelling and inexperienced staff at the dialysis center,

Options for management of arterial pseudoaneurysms include observation, thrombin injection, and placement of a covered stent graft or open repair. Options for open repair include direct repair, patch angioplasty or interposition grafting with autogenous or prosthetic conduit.

In this patient, we opted for interposition grafting based on the size and location of the pseudoaneurysm. The authors felt that covered stent placement would not result in long term patency. Furthermore, covered stent placement was felt to be inappropriate given the pseudoaneurysm's proximity to the elbow. Thrombin injection would place the extremity at increased risk for ischemia and would not resolve compression of the AV access.

Other factors that may have contributed to the inadvertent access in this patient include the length of the transposed vein at the time of the original access surgery and her morbid obesity. A shorter segment of transposed vein and an obese upper extremity resulted in the access lying medially in the arm. This, coupled with a subsequent outflow stenosis resulted in increased pulsatility in the access, may have led to difficulty distinguishing it from the bypass component of the DRIL procedure. Taken together, these factors may have resulted in the erroneous cannulation with subsequent pseudoaneurysm formation in this patient.

To minimize the risk of improper cannulation, patients who undergo a DRIL procedure should be carefully followed for central or venous outflow stenoses, which could lead to increased pulsatility. Upper extremity swelling or persistent bleeding after decannulation are highly suggestive of a venous stenosis and should warrant further investigation. In these patients, the authors would suggest early intervention if a venous outflow stenosis is found.

Herein, this case report presents the management of an unusual complication of a DRIL procedure for DASS. Predisposing factors for this complication include previous ipsilateral failed access, central venous stenosis, access located on the medial aspect of the proximal arm, edema and dialysis staff experience. Heightened surveillance for central stenosis, routine duplex surveillance of the access and arterial bypass and staff education should be collectively used to manage this specific subset of dialysis patients.

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