

A technique for the salvage of megafistulas allowing immediate dialysis access

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ABSTRACT

Objective: Almost two million individuals are undergoing renal replacement therapy worldwide, with hemodialysis being the common form. Many factors influence the primary patency of an arteriovenous fistula (AVF), including vessel size, fistula flow rates, cannulation practice, and thrombotic tendencies. Excess dilation of the AVF, resulting in the development of a megafistula, is a complication that can result in a need for AVF revision and subsequent failure.

Methods: The charts of patients who underwent autogenous AVF revision because of the development of a megafistula with aneurysmectomy and vein transposition by a single surgeon during a 7-year period from 2009 through 2016 were reviewed. A technique is described in which after aneurysmorrhaphy, the repaired venous component of the AVF is transposed through a new tunnel while the vein is rotated 90 degrees. This allows the AVF to be accessed immediately, making placement of a tunneled dialysis catheter unnecessary.

Results: There were 102 patients included in the study, with follow-up ranging from 7 to 95 months. In our cohort, 92 of the 102 revised AVFs (90.2%) maintained primary functional patency. Of the 102 patients who underwent this revision technique, there were 10 fistulas that subsequently failed after a mean of 29 months. There were only seven patients who experienced recurrent fistula dilation requiring repeated aneurysmectomy.

Conclusions: We describe a technique for management of the development of a megafistula that uses only autogenous tissue and, perhaps most important, eliminates the need for temporary dialysis catheter placement. (*J Vasc Surg* 2018;■:1-6.)

End-stage renal disease is a chronic illness that uses significant resources within health care systems. Almost two million individuals are undergoing renal replacement therapy worldwide, with hemodialysis being the most common form.¹ As the average length of time spent on dialysis increases, it is more important than ever to manage dialysis access appropriately to increase the longevity of each site.

Many factors influence the primary patency of an arteriovenous fistula (AVF), including vessel size, fistula flow rates, cannulation practice, and thrombotic tendencies.² One institutional study showed the 1-year functional patency of distal, midarm, and proximal AVF to be 80.5%, 75.8%, and 61.5%, respectively.³ It is important to create vascular access with as few complications as possible and to develop techniques that prolong the functional patency of AVFs. With many patients waiting for kidney transplantation, an important area of research

is the identification and use of techniques that extend the functional patency of each AVF.⁴

An autogenous AVF is the preferred access for long-term hemodialysis, which is a first-line recommendation by the National Kidney Foundation Kidney Disease Outcomes Quality Initiative because fistulas provide the lowest rate of thrombosis, the longest access survival, the lowest rate of infection, and the most efficient cost of access maintenance.⁵ However, the creation and use of an AVF can lead to complications that include hematoma formation, development of stenosis, thrombosis, nerve injury, steal syndrome, focal aneurysm formation, and development of a megafistula, which is defined as a fistula that is generally tortuous, is dilated, and has flow rates of >2 L/min.^{6,7} The development of a megafistula can lead to high-output heart failure, venous hypertension, pain, and thinning of the overlying skin, which can lead to fistula rupture and life-threatening hemorrhage.^{8,9}

Traditional management options for the repair of a megafistula include ligation and excision with creation of a new fistula and excision of aneurysmal segments and placement of prosthetic interposition grafts, both of which usually require the placement of a tunneled dialysis catheter for interval access until the revised access can be used. This new technique eliminates both the need for prosthetic graft material and temporary dialysis catheter placement. The purpose of this study was to describe our experience with a technique of AVF revision to manage the megafistula that uses the existing autogenous conduit and allows immediate access of the fistula for hemodialysis.

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METHODS

The charts of patients who underwent autogenous AVF revision with aneurysmectomy and vein transposition by a single surgeon (N.N.) during a 7-year period from January 1, 2009, through December 31, 2016, were reviewed. Data collection included demographic information, operative and procedural records, and follow-up documentation. Outcomes of interest included functional patency duration, indications for aneurysmectomy, complications, and length of stay. Functional patency was defined as the presence of a palpable pulse, an audible bruit, and the ability to perform successful cannulation and completion of dialysis in fistulas that underwent revision for development of a megafistula. Primary patency, on the other hand, was the duration of time from the creation of the AVF to the point at which our technique was applied to repair the megafistula. If a patient's fistula was no longer able to undergo successful cannulation or there was no pulse or bruit on physical examination, the patient no longer had functional patency. The primary end points of salvaged megafistulas were the ability to use the revised segment of AVF immediately, the time to repeated revision of the AVF, and the loss of functional patency. Patients with salvaged fistulas who died or underwent transplantation and became dialysis independent were censored from functional patency duration data calculations. Indications for surgery included patients with usable but dilated and tortuous fistulas, with either pain or skin compromise.

Extreme dilation was defined as dilation so much that skin compromise or pain occurred. Focal stenosis was that which was significant enough to prevent successful cannulation. Hemorrhage was defined as acute bleeding, whereas ulceration did not have bleeding present.

The University of Tennessee Institutional Review Board reviewed this study and exempted it from requiring informed consent of the patient because information was gathered retrospectively in a blinded fashion and with no disclosures of patient identifiers.

Operative technique. We did not routinely perform preoperative fistulography. Proximal occlusive disease and thrombosis can be due to central venous stenosis, but these megafistulas are so large in diameter that stenosis was not evaluated with routine fistulography. We found that central venous obstruction in the presence of high-flow fistula was manifested as arm swelling. This was evaluated on physical examination.

Anesthesia technique was determined on an individualized basis according to the patient's comorbidities. Local anesthetic was often employed around incision lines. Multimodal postoperative pain medications have been successful for controlling the patient's discomfort.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective cohort study
- **Take Home Message:** Analysis of results of 102 megafistula repairs using aneurysmorrhaphy and 90-degree rotation of the vein in a new tunnel revealed excellent patency, with only 10 failures at a mean of 29 months; 7 patients required repeated aneurysmorrhaphy.
- **Recommendation:** The authors suggest aneurysmorrhaphy with 90-degree rotation of the vein in a new tunnel for repair of dilated megafistulas because this technique allowed immediate postoperative dialysis access.

The operation starts with obtaining control of the AVF within 2 cm of the arterial anastomosis and the venous end proximal to the venous dilation. Control was acquired as far proximally as the deltopectoral groove, depending on the extent of aneurysmal degeneration of the AVF. Heparin was administered intravenously. The fistula was clamped near the arterial anastomosis and as far proximally along the venous end as possible. The fistula was then transected 2 cm away from the arterial clamp, leaving a stump of vein with the arterial anastomosis. A longitudinal, elliptical skin incision was made over the aneurysmal portion of the AVF, excising any thinned or ulcerated skin. The entire length of the vein was dissected circumferentially. Once fully mobilized, the aneurysmal portion was opened longitudinally, and excess aneurysmal fistula tissue was excised. An appropriately sized thoracostomy tube (24F-36F) was placed within the vein, and the vein was then sutured longitudinally over the tube with a running, monofilament, nonabsorbable suture (Figs 1 and 2). The suture line was tested for integrity with heparinized saline before tunneling.

The vein was sutured to the tapered portion of the thoracostomy tube, which was attached to a tunneling device (Fig 3). We have been unable to suture the vein directly to the tunneling device and to pull it through successfully without causing damage to the vein. Circumferential suturing of the vein to the thoracostomy tube distributes the pressure evenly while pulling the vein through the tunnel, resulting in less trauma. The repaired vein was then pulled through a new anteromedial subcutaneous tunnel and out through the original incision (Fig 4). The chest tube mandrel was then removed and the end of the vein trimmed. The suture line of the repaired aneurysmal megafistula was positioned posteriorly, which buries the suture line in the central aspect of the tunnel. This rotation is critical because it protects the suture line from new dialysis punctures and allows a vein surface that has not been used for access or involved in repair to be the most

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