Hemodialysis Fistula Thrombosis Treatment Using Mechanical Thrombectomy and Angioplasty

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ABSTRACT: **In the United States, end-stage renal disease affects nearly 1 million people, nearly half of whom depend on hemodialysis, which is best delivered via a native arteriovenous fistula (AVF), for life. The durability of AVF is limited by access failures and thromboses, most of which can be successfully treated percutaneously. This report briefly reviews the background, preoperative preparation, treatment, postoperative care, and outcomes for AVF thrombosis. (J Radiol Nurs 2014;33:14-17.)**

KEYWORDS: **Dialysis; Fistula; Dysfunction; Thrombectomy; Angioplasty.**

BACKGROUND

Over 40% of the nearly 1 million patients with end-stage renal disease (ESRD) depend on hemodialysis, which is best delivered via a native arteriovenous fistula (AVF) (Clearinghouse, 2012). The durability of AVF can be limited by stenosis and thrombosis, but most such episodes can be successfully treated percutaneously by catheter-based interventions (Bittl, 2010; Zaleski, 2004). Venous outflow and anastomotic stenoses from neointimal hyperplasia are the main causes of thrombosis in mature AVF (Lee, 2013; Mercado et al., 2008; Turmel-Rodrigues, 2003), although stenosis can occur anywhere in the vascular circuit between the anastomosis and the superior vena cava (Turmel-Rodrigues, 2003). The underlying mechanism of fibrotic venous lesion formation is focal fibromuscular hyperplasia induced by the high-pressure high-volume arterial blood flow's significant shear stresses on the outflow vein (Bittl, 2010).

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Every episode of access failure should prompt consideration for placing a new AVF (NKF-DOQI, 1997). This said, provided that the fistula was functioning well before failure, even if other access options exist, an attempt at percutaneous salvage is nearly always warranted.

PREOPERATIVE PREPARATION

Assuming that the existing access is considered salvageable, if the patient is a candidate for percutaneous intervention and does not require correction of coagulopathy or pretreatment for contrast allergy, thrombectomy should be performed before the patient's next hemodialysis session, preferably on the same day that the thrombosis is detected.

AVF thrombosis is diagnosed clinically from a careful physical examination, especially of the vein usually cannulated for dialysis (Mercado et al., 2008; Turmel-Rodrigues, 2003). Venous outflow occlusion presents with distension of the upstream venous segment and may be accompanied by localized pain and inflammation (Turmel-Rodrigues, 2003); this phlebitis is the norm and must not be mistaken for infection. Furthermore, transmission of pulse into the thrombus may cause a mistaken diagnosis of stenosis instead of thrombosis; attempts at puncturing this segment for dialysis should be avoided particularly if the use of thrombolytic agents is contemplated. When in doubt, limited ultrasound examination can readily distinguish between stenosis and thrombosis. Perianastomotic occlusion presents with a nonpalpable venous outflow that engorges on the placement of a tourniquet proximally

(Turmel-Rodrigues, 2003). In addition, pulse examination of bilateral radial and ulnar arteries is important because it provides a baseline of comparison to help detect possible arterial embolization of thrombus fragments during treatment.

Proper intervention planning also requires knowledge of the patients' international normalized ratio and platelet count, the AVF's age from surgical construction, and dates and natures of previous surgical revisions and percutaneous interventions. Our recommended thresholds for an AVF declot are as follows: international normalized ratio $\leq$ 2, platelet count $\geq$25,000/μL, and standing heparin orders should be discontinued during the procedure. Laboratory values obtained within 30 days of the procedure are acceptable, unless there is a reason to believe that the values may have changed, such as a recent disease, chemotherapy, anticoagulation, and so forth.

Given the small possibility of failure in every AVF thrombectomy, every patient consented for declot should also be consented at the same time for the placement of a tunneled or nontunneled dialysis catheter, so that hemodialysis may continue.

Immature, infected, or markedly aneurysmal AVF should not undergo thrombectomy (Turmel-Rodrigues, 2003), keeping in mind that infection is rare in AVF and it is normal to have inflammation in the arm around a clotted fistula. For patients at high risk of fluid overload or hyperkalemia, dialysis via an alternative access should be performed before declotting the AVF (Turmel-Rodrigues, 2003).

TREATMENT

Percutaneous mechanical thrombectomy, thromboaspiration, and thrombolysis are the main treatment options for AVF thrombosis (Mercado et al., 2008; Turmel-Rodrigues, 2003). Large series of studies favor the first two treatments over thrombolysis, which is relatively ineffective and tedious (Turmel-Rodrigues et al., 2000; Turmel-Rodrigues, 2003; Haage et al., 2000; Rocek, Peregrin, Lasovicková, Krajícková, & Slavíoková, 2000; Rousseau et al., 1997; Schmitz-Rode et al., 2000; Turmel-Rodrigues, Raynaud, Louail, Beyssen, & Sapoval, 2001). Based on physical examination and diagnostic fistulogram findings, access to the AVF is directed antegrade to treat lesions in the outflow and retrograde to treat lesions in the inflow. Separate antegrade and retrograde cannulations are needed if lesions are present in both the outflow and the inflow (Schon & Mishler, 2003; Turmel-Rodrigues et al., 2000). In forearm fistulas in particular, provided a downstream vein free of clot can be identified, the procedure may be able to be done with a single puncture. Appropriate doses of moderate sedation, local anesthesia, heparin, and antibiotics should be administrated (Turmel-Rodrigues, 2003). We start with 3000 U of heparin, given intravenously just before the procedure. Heparin is important for preventing both rethrombosis during the procedure and vasospasm and bronchospasm that can accompany small pulmonary emboli, which inevitably occur with any thrombectomy procedure. Antibiotic coverage is important as colonization of clotted access is common even when not infected; we use a single dose of cefazolin or equivalent given just before the procedure. We feel sedation (midazolam and fentanyl, titrated to effect) is an essential component of what can otherwise be a painful procedure, especially during venous angioplasty.

Access is performed using an Angiocath (Becton, Dickinson and Company, Franklin Lakes, NJ) or other access device according to personal preference, and high-flow sheaths are used to allow aspiration. The intended angioplasty balloon size will nearly always dictate sheath size; for the retrograde "arterial" sheath, this will usually be 6F and the antegrade "venous" sheath will be 7F. Passing a wire and catheter through the anastomosis of the fistula is an essential component of the procedure (Figure 1); if this is not possible, thrombectomy should not be initiated (rarely, an arterial puncture may be needed to facilitate this process). As a consequence, over-the-wire devices and approaches are preferable to non–over-the-wire ones in the AVF setting. Clot removal should be performed before percutaneous transluminal angioplasty (PTA) to keep central embolization to a minimum. After restoring flow in the AVF, a diagnostic fistulogram is performed. Next balloon angioplasty is performed (Figure 2A and B), and after any necessary additional thrombectomy, a completion fistulogram is performed from the perianastomotic arterial inflow to the right atrium (Figures 3–5). After removing the sheaths, hemostasis can be achieved with manual compression or a variety of purse-string techniques. The patient should not leave IR with sutures in place as this risks infection and skin erosion.

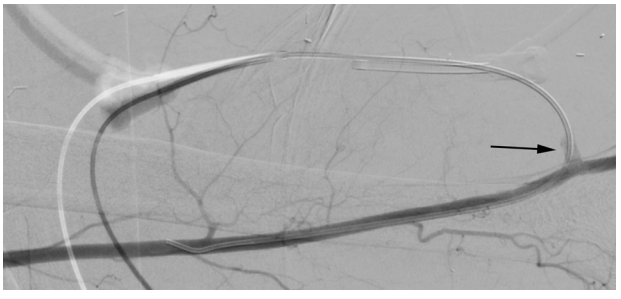

Figure 1. Clotted left upper arm brachiocephalic fistula. A catheter has been passed through the anastomosis into the brachial artery, and contrast injection shows occlusion of the fistula, with just a stump of cephalic vein filling (arrow).