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Clinical effectiveness of open thrombectomy for thrombosed autogenous arteriovenous fistulas and grafts

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ABSTRACT

Objective: Arteriovenous (AV) fistulas are the preferred hemodialysis access for patients with end-stage renal disease, although multiple interventions are typically needed to maintain patency. When AV fistulas thrombose, however, there is debate as to whether open thrombectomy should be attempted, particularly for salvage of upper arm fistulas. This study was designed to evaluate outcomes after open thrombectomy of upper arm and forearm AV fistulas compared with AV grafts.

Methods: We identified all patients who underwent an open thrombectomy procedure for a thrombosed AV fistula or graft at a single academic medical center between January 2006 and March 2017. The specific type of AV fistula or graft was evaluated, as were the patients' demographics, comorbidities, medications, adjunctive procedures during thrombectomy, and secondary interventions. The primary outcome measures, postintervention primary patency and postintervention secondary patency, were analyzed using Kaplan-Meier curves and Cox regression models for risk adjustment.

Results: During the study period, 209 open thrombectomy procedures were performed in 139 patients; 73 (35%) were undertaken in AV fistulas and 136 (65%) in grafts. Patients with upper arm fistulas (n = 52; 54% brachiocephalic, 46% brachiobasilic) and forearm fistulas (n = 16) were more likely to be male but less likely to have cerebrovascular disease or ischemic heart disease and to be receiving anticoagulation therapy compared with graft patients. After thrombectomy, the majority of patients underwent dialysis successfully (70% upper arm fistulas, 56% forearm fistulas, 63% grafts; $P > .05$), and 1-year survival rates were similar in all three cohorts. Postintervention primary patency at 1 year was significantly higher for AV fistulas vs grafts (33% for upper arm fistulas and 25% for forearm fistulas vs 9% for grafts; $P < .05$), which was confirmed in multivariate analysis, where upper arm AV fistulas had a 46% lower risk of recurrent thrombosis or secondary intervention (hazard ratio, 0.56; 95% confidence interval, 0.35-0.85; $P < .05$). Postintervention secondary patency at 1 year was similar between AV fistulas and grafts (44% for upper arm fistulas vs 43% for forearm fistulas vs 31% for grafts; $P = .16$), but in multivariate analysis, upper arm fistulas were significantly less likely to fail (hazard ratio, 0.63; 95% confidence interval, 0.40-1.00; $P = .05$).

Conclusions: Our data suggest that AV fistula thrombectomy is successful in up to 70% of cases, with significantly improved risk-adjusted 1-year primary and secondary patency rates for upper arm fistulas compared with grafts. Whereas the risk of access failure is high after thrombectomy, efforts to salvage upper arm AV fistulas are effective in most patients and should be undertaken when feasible. (J Vasc Surg 2018;68:189-96.)

Arteriovenous (AV) fistulas are the preferred type of hemodialysis access for patients with end-stage renal disease (ESRD) based on superior durability and outcomes compared with AV grafts and tunneled dialysis catheters.[1-4] This is underscored in current practice guidelines for hemodialysis access published by the Fistula First Initiative, the Society for Vascular Surgery, and the Kidney Disease Outcomes Quality Initiative (KDOQI).[1,5] It is well recognized, however, that multiple percutaneous interventions are typically needed during the life span of an AV fistula to maintain functional patency.[1,2] This is commonly due to the development of stenosis near

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the anastomosis and the venous outflow tract that requires secondary interventions, such as angioplasty and stent placement, to maintain adequate flow volumes and to prevent fistula thrombosis.[4-6]

When AV fistulas thrombose, however, there is debate about how they should be managed.[4,5,7-9] First, open and percutaneous thrombectomy techniques can be used to try to salvage thrombosed fistulas, but algorithms for choosing when to undertake a thrombectomy and what specific technique to employ are not well defined and are largely based on institutional preference.[4,5,7-10] It is recognized that thrombectomy of AV fistula is more challenging to perform than of AV grafts because of the interaction and attachment of inflammatory thrombus with the vessel wall, making it difficult to remove with a Fogarty balloon.[4,8,11,12] A meta-analysis, however, reported satisfactory short- and long-term outcomes with open thrombectomy of forearm AV fistulas that were significantly improved compared with endovascular methods alone.[8] Second, there is also debate about what specific types of AV fistulas should undergo thrombectomy.[9] Whereas KDOQI guidelines suggest attempting open thrombectomy of forearm fistulas in combination with anastomotic revision when there is evidence of juxta-anastomotic stenosis, they do not recommend open thrombectomy of upper arm fistulas, given the lack of evidence.[4] For both upper arm fistulas and forearm fistulas, there is a paucity of evidence to support open thrombectomy procedures without adjunctive anastomotic revision.

The clinical effectiveness of undertaking open thrombectomy of thrombosed forearm and upper arm AV fistula remains unclear. We sought to compare the effectiveness of open thrombectomy procedures in risk-adjusted patients with different types of AV fistulas and AV grafts at a single high-volume institution. Whereas AV fistula thrombectomy is technically more challenging to perform compared with AV graft thrombectomy, we hypothesized that open thrombectomy of native upper arm and forearm AV fistulas would result in improved patency rates compared with prosthetic AV grafts.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective, single-center, cohort study
- **Take Home Message:** Surgical thrombectomy of thrombosed upper extremity hemodialysis fistulas and grafts was successful in up to 70% of procedures, with 1-year primary patency being higher in upper arm fistulas (33%) than in forearm fistulas (25%) and grafts (9%). There is a not inconsequential chance of rethrombosis.
- **Recommendation:** This study suggests that the risk of access failure after thrombectomy is high, but efforts to salvage upper arm arteriovenous fistulas should still be undertaken when feasible.

METHODS

Study cohort. We retrospectively reviewed the medical records for all patients with ESRD at the University of Utah Medical Center who had undergone an open thrombectomy procedure of an AV fistula or AV graft between January 2006 and March 2017. Patients were identified from an institutional electronic data warehouse using *Current Procedural Terminology* codes for open thrombectomy (36831 and 36833) and *International Classification of Diseases, Ninth Revision* or *International Classification of Diseases, Tenth Revision* codes for ESRD. We then manually reviewed the operative notes for all identified patients to confirm that an open thrombectomy procedure was performed and to determine the exact type of fistula that underwent thrombectomy. Cases were included for analysis only if they represented the first time the access had thrombosed. No percutaneous thrombectomy procedures were included in this study, given that fewer than 10 procedures were performed during the study period. Patients were included in the analysis only if they had a functionally mature AV fistula or graft that had been successfully used for hemodialysis access before thrombosis. We excluded patients with lower limb fistulas and patients for whom the specific type of AV fistula was not able to be determined from the clinical notes.

Open thrombectomy procedures. Patients were referred to the vascular surgery service from the dialysis center because of complications experienced with access during hemodialysis. Thrombosis was confirmed with preoperative duplex ultrasound, and the decision to perform open thrombectomy was individualized by patient and based on the discretion of the attending surgeon. If patients were eligible for an open thrombectomy procedure, this was performed within 24 hours of presentation and involved the use of a Fogarty balloon catheter to express thrombotic material in antegrade and retrograde fashion through a selected fistulotomy site to restore inflow and outflow. Extensive clot burden in aneurysmal fistulas was managed by manual "milking" or compression of the vein using Esmarch bandages. Although valves were rarely encountered within mature fistulas, they were disrupted with valvulotomes when needed. Intraoperative angiography was performed in all cases to confirm the complete extraction of thrombus, and any venous or arterial stenosis was treated with balloon angioplasty or stenting, depending on anatomic location and indications for treatment. The decision to perform any other adjunctive procedures at the time thrombectomy (ie, patch angioplasty, interposition or bypass jump grafts) was at the discretion of the operator and dependent on the patient's specific