Successful use of partial aneurysmectomy and repair approach for managing complications of arteriovenous fistulas and grafts

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ABSTRACT

Objective: Arteriovenous fistulas and grafts may often be associated with localized complications related to aneurysms/pseudoaneurysms, buttonholes, or structural defects that require proper management to ensure continued access functionality for hemodialysis. Partial aneurysmectomy and repair (PAR) is a targeted surgical approach specifically designed for managing these complications. The basic concepts of PAR include resecting unhealthy or excessive tissue over an access, reconstructing the vascular access lumen using in situ vascular wall or tissue when possible, and closing overlying skin with healthy margins to promote reliable healing. This report analyzes the clinical outcomes of PAR in a large clinical series.

Methods: The demographic and outcome data of patients who underwent PARs at an ambulatory surgery center from 2009 to 2016 were collected and analyzed.

Results: A total of 220 PAR operations were performed in 209 patients, of which 185 had fistulas and 24 had grafts. In the fistula group, 11 patients underwent subsequent staged aneurysm repairs. Comparing the fistula group (n = 185) vs the graft group (n = 24): men were 63% vs 29%, the mean age was 60.1 ± 14.8 vs 63.9 ± 16.0 years, diabetic patients were 54% vs 75%, the mean age of the accesses at the time of repair was 5.3 ± 3.2 vs 5.0 ± 4.0 years, the upper arm accesses were 69% vs 88%, the forearm accesses were 31% vs 12%, and the mean follow-up was 27.9 ± 21.9 vs 14.0 ± 11.6 months. A pneumatic tourniquet was used during 81% of the fistula and 42% of the graft operations. Dialysis catheters were required in 2% of the patients in the fistula group and 4% in the graft group to continue hemodialysis. After repair operations, the primary patency, assisted primary patency, and secondary patency rates of the whole access conduit for the fistula group were 45%, 96%, and 98% at 1 year; 28%, 91%, and 96% at 2 years; and 19%, 87%, and 95% at 3 years, respectively. The same patency rates of the graft group were 31%, 70%, and 96% at 6 months and 10%, 57%, and 96% at 1 year, respectively. Two fistulas and one graft were lost ≤30 days postoperatively.

Conclusions: PAR is a reliable approach for managing localized arteriovenous access complications related to aneurysms/pseudoaneurysms, buttonholes, or structural defects. Given its simplicity and reliability, we recommend PAR as a first-line choice for managing these complications of arteriovenous fistulas and a choice in selected arteriovenous graft patients. (J Vasc Surg 2017;■:1-9.)

Arteriovenous fistulas and grafts are preferred vascular access options over catheters for hemodialysis therapy according to National Kidney Foundation Kidney Disease Outcomes Quality Initiative and Society for Vascular Surgery guidelines.[1,2] However, fistulas and grafts may often be associated with various complications that require proper management to ensure continued access functionality for hemodialysis.[3] A subset of arteriovenous access complications is related to localized structural changes or integrity compromises: aneurysms, pseudoaneurysms, buttonholes,[4,5] or structural defects. These changes may result in bleeding or pose danger for bleeding, infection, or other complications that may contribute to access dysfunction, access loss, and even patient death.[3,6-8] These complications usually require surgical or endovascular interventions to achieve reliable clinical outcomes. Although various approaches have been used for managing these complications,[6,7] accesses are often ligated, especially when the integrity of their structures is compromised.[7,8] It is important to realize that these accesses can usually be saved when proper management is applied.

A key feature of this subset of complications is the localized nature of their pathology, making targeted surgical therapy possible and desirable. Partial aneurysmectomy and repair (PAR) is a targeted surgical approach specifically designed for managing these complications. The basic concepts of PAR include resecting unhealthy or excessive tissue over an access, reconstructing the vascular access lumen using in situ vascular wall or tissue when possible, and closing overlying skin with healthy margins to promote reliable healing. Many clinical

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reports have demonstrated the concept of using native tissues for managing fistula aneurysms and related complications.[6,9-14]

Since the initial report of the outcomes of 36 fistula aneurysm repairs using the PAR approach several years ago,[6] we have accumulated more extensive clinical experience using PAR for managing the complications of both arteriovenous fistulas and grafts. This report analyzes the long-term outcomes of our large series and discusses some clinical considerations of using PAR.

METHODS

Setting and patients. This series included 220 PAR operations performed in 209 patients, 185 with arteriovenous fistulas and 24 with grafts, from September 2009 to December 2016 in an ambulatory surgery center specialized in dialysis access care. Also included were 36 previously reported patients for whom longer follow-up was available.[6] All operations in this series were performed by one of the authors (S.W.). Informed consent was obtained from patients before surgery. The Western Institutional Review Board (Puyallup, Wash) approved the study protocol.

Preoperative assessments. Besides assessments of patients' general conditions, focused assessments of the dialysis accesses were performed on the day of surgery for urgent cases or as a separate encounter for elective cases, which included a combination of history, physical examination, duplex Doppler ultrasound evaluation, and review of prior interventions. The duplex Doppler ultrasound evaluation included arterial inflow and venous outflow anatomies as well as the volume flow and hemodynamics of the access conduit.

A management plan was chosen after these assessments: surgical repair only if there was no concern of the access circulation, or endovascular intervention before or at the time of repair surgery if there were concerns of an access circulation or clinical indications of access dysfunction for hemodialysis. Flow reduction was indicated when a fistula was still pressurized after proper intervention for the outflow stenosis and the access flow was >2000 mL/min.

Surgical procedures. All PAR operations were performed under conscious sedation (midazolam and fentanyl) and local anesthesia (1% lidocaine). Operations were rarely canceled unless a patient had systemic infections or was in an unstable state (low blood pressure, significant arrhythmia, respiratory distress, chest pain, altered mental status). Prophylactic intravenous antibiotics (2 g cephazolin or 1 g vancomycin) were given preoperatively.

For most patients, a pneumatic tourniquet was applied on the upper arm to achieve hemostasis that facilitated the operation (Table I). For upper arm accesses, a narrower tourniquet cuff (3 or 3.5 inches wide) was applied over the proximal half of the upper arm, leaving the distal half exposed. Most lesions of the upper arm accesses were located in the distal half of the upper arm where the accesses were typically cannulated for hemodialysis. The tourniquet was well tolerated under conscious sedation when the continuous inflation time was limited to <30 minutes, which was sufficient time for repairing of the vascular lumen.[15] When applying a pneumatic tourniquet was not feasible, other methods used for controlling the access circulation included endovascular balloon occlusion, Esmarch elastic bandage occlusion of the arterial circulation at the elbow, or occasionally, direct manual compression of an arteriovenous access or cutdown occlusion using vascular clamps or loops.

The arteriovenous fistula aneurysm repairs included resecting unhealthy and excessive tissues of the fistula aneurysms, reconstructing the vascular access lumen using in situ vascular wall with nonabsorbable sutures, and closing overlying skin with healthy margins to promote reliable healing (Fig 1). The removal of diseased tissues to produce healthy margins was crucial for promoting primary tissue healing after repair. There were almost always adequate adjacent tissues for primary closure after resection of diseased tissues.

For repairs of buttonholes or other tissue defects over a minimally dilated fistula, PAR included resection of diseased (scarred, necrotic) skin, suture repair of the vascular wall, and closure of overlying skin with healthy margins. For arteriovenous graft repairs, PAR included resection of diseased (scarred, necrotic) skin, reconstruction of the graft lumen with existing graft wall (adjacent fibrous tissue could be included between sutures to enhance hemostasis) or autogenous/prosthetic patch, and closure of overlying skin with healthy margins (Fig 2).

Occasionally, a patient presented with multiple fistula aneurysms that required surgical repairs. PAR in these patients was performed in stages in order to leave enough fistula areas for dialysis cannulations. The

ARTICLE HIGHLIGHTS

- **Type of Research:** Single-center retrospective cohort study
- **Take Home Message:** Partial aneurysmectomy and repair of vascular access aneurysms, buttonholes, or structural defects resulted in 3-year secondary patency of 95% in 185 patients with arteriovenous fistulas and in 1-year secondary patency of 96% in 24 patients with arteriovenous grafts.
- **Recommendation:** The authors suggest that treatment of aneurysms, pseudoaneurysms, and defects involving arteriovenous fistulas and grafts using partial aneurysmectomy and repair yields excellent results and is the preferred method of treatment.