Postintervention Patency Rates and Predictors of Patency after Percutaneous Interventions on Intragraft Stenoses within Failing Prosthetic Arteriovenous Grafts

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ABSTRACT

Purpose: To determine postintervention patency rates after endovascular interventions on intragraft stenosis within failing prosthetic arteriovenous (AV) grafts, as well as predictors of patency.

Materials and Methods: Retrospective review of percutaneous interventions on prosthetic AV grafts presenting with first-time intragraft stenoses over a 7-year period revealed 183 patients (81 male; mean age, 59.7 y). "Intragraft" was defined as 2 cm or more from the arterial or venous anastomosis. Procedural imaging was retrospectively reviewed. Patency rates were estimated by Kaplan–Meier test. Predictors of patency were calculated by Cox proportional-hazards model.

Results: Two-hundred twenty-nine intragraft stenoses were identified in 183 grafts. Intragraft stenoses were treated at a median of 20.7 months (interquartile range, 12.0–33.9 mo) after graft creation. Graft thrombosis was present in 62%. The anatomic success rate of angioplasty was 85%. Fifteen percent required stent or stent-graft deployment because of inadequate response to angioplasty. A concurrent nonintragraft stenosis within the access circuit was identified in 76% of grafts. At 3, 6, and 12 months, postintervention primary patency rates were 56%, 40%, and 23%, respectively. Secondary patency rates were 84%, 77%, and 67%, respectively. The lesion-specific patency rates were 89, 75%, and 63%, respectively. Graft thrombosis (hazard ratio [HR], 1.43; $P = .048$) and concurrent nonintragraft lesion (HR, 1.51; $P = .047$) were independent negative predictors of primary patency. Graft thrombosis (HR, 1.81; $P = .029$) was a negative predictor of lesion patency, and stent or stent-graft deployment (HR, 0.42; $P = .045$) was a positive predictor of lesion patency.

Conclusions: Endovascular interventions on intragraft stenoses resulted in primary, secondary, and lesion-specific patency rates of 40%, 77%, and 75%, respectively, at 6 months. Stent or stent-graft deployment may prolong lesion patency.

ABBREVIATIONS

AV = arteriovenous, CI = confidence interval, HR = hazard ratio, IQR = interquartile range

Dysfunction of prosthetic arteriovenous (AV) grafts for hemodialysis is most commonly caused by a hemodynamically significant stenosis at the venous anastomosis (1). The underlying pathogenesis of stenoses at the venous anastomosis, arterial anastomosis, or outflow veins has been shown to be formation of neointimal hyperplasia that results in progressive luminal narrowing (2–5). In contrast, stenoses that occur within the prosthetic graft remote from the vascular anastomoses may instead be related to the development of perigraft scar formation and fibroplastic ingrowth through needle puncture tracts in the setting of direct needle trauma at the access sites (4–6). Although numerous studies have reported pooled postinterventional access patency outcomes for lesions at any location or lesions specifically at the venous anastomosis and outflow veins, there is a paucity of studies analyzing outcomes of interventions specifically on intragraft stenosis. Primary access patency rates have been reported to be in the range of

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56%–75% after angioplasty of intragraft lesions, but secondary and lesion patency rates were not reported (7–9). Therefore, the purpose of the present study was to determine the postintervention access and lesion patency rates after endovascular interventions on intragraft stenosis within failing prosthetic AV grafts and to determine predictors of patency.

MATERIALS AND METHODS

Study Design

This retrospective study was approved by the institutional review board, and a waiver of informed consent was obtained. Procedural database review of all percutaneous interventions on AV accesses occurring between January 2005 and December 2011 revealed 2,577 procedures. Procedures on autogenous AV fistulae were excluded. All procedures were reviewed for performance of an endovascular intervention (angioplasty or stent/stent-graft deployment) specifically for treatment of an intragraft stenosis. Only the initial intragraft intervention for a given graft was analyzed to avoid clustering of results as a result of multiple treatments of the same graft. Grafts with less than 1 month of follow-up data after the initial intervention were excluded.

The initial intragraft intervention was analyzed in 183 patients (81 male and 102 female; mean age, 59.7 y; range, 31–94 y), which included 229 treatment-naive intragraft stenoses in 183 grafts (6-mm-diameter polytetrafluoroethylene straight grafts). Electronic medical records were retrospectively reviewed to determine patient and graft characteristics.

AV Graft Interventions

Patients undergoing hemodialysis were referred by the hemodialysis unit, nephrologist, or vascular surgeon whenever there was concern for access dysfunction. All procedures were performed under moderate sedation by an attending interventional radiologist or a fellow under the direct supervision of the attending physician. The decision to perform a percutaneous intervention, the type of intervention, and techniques used were at the discretion of the attending interventional radiologist. If access thrombosis was present, mechanical thrombectomy was performed with a Fogarty balloon or percutaneous rotational thrombectomy device (Arrow PTD; Teleflex, Morrisville, North Carolina) with or without tissue plasminogen activator (10). Any intragraft stenosis with 50% or greater luminal narrowing (based on visual inspection) in the setting of any additional indicator of graft dysfunction (thrombosis, low access flow, abnormal findings on physical examination of the graft, or prolonged bleeding) was treated. All intragraft stenoses were initially treated with angioplasty with the use of a 6-, 7-, or 8-mm-diameter high-pressure noncompliant balloon (n = 45, n = 119, and n = 18, respectively; Conquest; Bard Peripheral Vascular, Tempe, Arizona). Stents or stent grafts were used at the operator's discretion for significant elastic recoil after angioplasty in the setting of persistently abnormal graft examination findings. Prostheses used included the SMART stent (n = 8; Cordis, Bridgewater, New Jersey), VIABAHN stent graft (n = 12; W.L. Gore & Associates, Flagstaff, Arizona), Fluency stent graft (n = 12; Bard Peripheral Vascular), or Wallgraft (n = 2; Boston Scientific, Natick, Massachusetts). Prophylactic antibiotic agents were not administered in any case.

Image Review

Angiograms derived from procedures involving intragraft interventions were retrospectively reviewed jointly by an interventional radiology fellow (A.B.B.) and attending physician (C.Y.K.). An intragraft stenosis was defined as luminal narrowing occurring at least 2 cm from the arterial or venous anastomosis (**Fig 1**). Venous anastomosis lesions extending into the graft were not included. Treated lesion characteristics were categorized based on estimated lesion length (focal, < 1 cm; short-segment, 1–3 cm; or long-segment, > 3 cm) and multiplicity (one, two, or three or more). Electronic calipers were calibrated to the angioplasty balloon length markers to assist measurements. For purposes of length and multiplicity characterization, a discrete lesion was defined as a segment of luminal narrowing on angiography with normal graft diameter at both margins of the stenosis. The location of the stenosis was also categorized. Straight grafts were divided in half from the arterial to venous anastomosis; intragraft stenoses occurring closer to the arterial or venous anastomosis were localized to the arterial limb or venous limb, respectively. Loop grafts were divided into thirds, with stenoses localized to the arterial limb, apex, or venous limb. Interventions on concurrent nonintragraft stenoses anywhere within the access circuit (from the arterial anastomosis to the cavoatrial junction) were noted.

Graft Patency Data Collection

Postintervention patency was determined based on retrospective review of medical records. Procedural and clinic notes were reviewed for dates of all graft angiograms, thrombectomies, hemodialysis catheter insertions, or graft surgeries subsequent to the index intervention on an intragraft stenosis. Patients were routinely assessed at each hemodialysis session by the hemodialysis staff for graft flow rates, pressures, and physical examination status. Patients found to have high intragraft pressures, inadequate flow rate, or prolonged postcannulation bleeding were referred for nonurgent outpatient angiographic assessment. Patients with suspected graft thrombosis were referred for urgent graft thrombectomy or hemodialysis catheter insertion. Clinical and operative reports were