

Mechanical Thrombectomy in Acute Thrombosis of Dialysis Arteriovenous Fistulae and Grafts Using a Vacuum-Assisted Thrombectomy Catheter: A Multicenter Study

Clément Marcelin, MD, Stephen D'Souza, MD, Yann Le Bras, MD, Francois Petitpierre, MD, Nicolas Grenier, MD, PhD, Jos C. van den Berg, MD, PhD, and Bella Huasen, MD

ABSTRACT

Purpose: To prospectively analyze technical and clinical outcome of percutaneous thrombectomy aspiration using a vacuum-assisted thrombectomy catheter in acutely thrombosed dialysis arteriovenous fistula (AVF) and/or arteriovenous graft (AVG).

Materials and Methods: From June 2016 to April 2017, 35 patients (average age, 61.8 y; range, 33–81 y) presenting with acute thrombosis of dialysis AVF and/or AVG were prospectively evaluated for mechanical thrombectomy using the Indigo System. Adjunctive therapies and procedure-related complications were noted. Technical success, clinical success, primary patency, primary assisted patency, and secondary patency of the dialysis fistula were assessed.

Results: Mean follow-up time was 8.5 months (range, 3–12 months). Technical success was 97.1% (34/35 patients). Clinical success was 91.4% (32/35 patients). Complications included hematoma (n = 1), thrombosis < 24 hours (n = 1), and perforation (n = 1). Other mechanical/aspiration thrombectomy devices were used in 1 site to clear the thrombus burden (Arrow-Trerotola [2.8%; 1/35 patients] and Fogarty [5.7%; 2/35 patients]). Average procedure time was 38.1 minutes (range, 15–140 min). Average blood loss during the procedure was 122.5 mL (range, 50–300 mL). The 6-month primary patency, primary assisted patency, and secondary patency were 71%, 80%, and 88.5%. No risk factors for early dialysis fistula occlusion were identified. There was no 30-day mortality.

Conclusions: Percutaneous mechanical thrombectomy aspiration of thrombosed dialysis AVF and/or AVG with a vacuum-assisted thrombectomy catheter is a safe procedure with a low complication rate and effective method for restoring patency before hemodialysis.

ABBREVIATIONS

AVF = arteriovenous fistula, AVG = arteriovenous graft

Thrombosis is a cause of failure of autologous arteriovenous fistula (AVF) and/or arteriovenous graft (AVG) owing to an underlying stenosis in the venous anastomosis segment or along the venous limb (1,2). Delaying treatment can lead to the loss of AVF access and unnecessary temporary catheter placement (3). Percutaneous intervention

has become widespread and is now universally included in the management of thrombosed AVF/AVG with good efficacy (76%–100%) (4–8). Different kinds of devices have been described in a limited number of cases (4–8). Fistula salvage (native or graft) is a long procedure (5,8), as it involves a number of intraoperative management steps

From Interventional Radiology (C.M., Y.L.B., F.P., N.G.), Service d'Imagerie Diagnostique et Thérapeutique de l'Adulte, Hôpital Pellegrin, Place Amélie-Raba-Léon, Bordeaux 33076, France; Endovascular Unit (S.D., B.H.), Royal Preston Hospital, Lancashire University Teaching Health Trust, Preston, United Kingdom; and Interventional Radiology (J.C.v.d.B.), Centro Vascolare Ticino, Lugano, Inselspital, Universitätsspital Bern Universitätsinstitut für Diagnostische, Interventionelle und Pädiatrische Radiologie, Bern, Switzerland. Received October 31, 2017; final revision received and accepted

February 26, 2018. Address correspondence to C.M.; E-mail: clement.marcelin@gmail.com

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(gaining access, removal of clot, management of the underlying cause with balloon angioplasty and/or stent placement, and restoring flow). Despite the excellent published results, this treatment has important disadvantages, including bleeding complications with systemic therapy (9,10), hemolytic complications secondary to the AngioJet device (Boston Scientific, Marlborough, Massachusetts) (5), and long procedure time (5,8). The original Penumbra System (Penumbra, Inc, Alameda, California) was developed for thrombectomy in patients with stroke, demonstrated efficacy and safety (11–12), and was further developed with the Indigo Mechanical Thrombectomy System (Penumbra, Inc) for peripheral vascular indications, such as acute limb ischemia (13,14). The Indigo System consists of vacuum-assisted thrombectomy, which enables continuous thrombus aspiration. The catheter is available in 4 different sizes (3, 5, 6 and 8 F), which allows it to be used in fistulae of various sizes (immature to large aneurysmal). This article reports use of the Indigo System for management of dialysis fistula thrombosis and salvage. This study evaluated the technical and the clinical efficacy of thrombosed dialysis AVF and/or AVG with the use of the Penumbra Indigo device.

MATERIALS AND METHODS

Study Design

All patients who presented with acute thrombosis of dialysis AVF and/or AVG were prospectively followed over a 6-month period. Exclusion criteria were AVF and/or AVG infection or sepsis. No patients were excluded during the study period. The institutional review board approved the waiver of obtaining informed consent. All patients provided signed informed consent. Data were updated and analyzed in a prospective manner acquired through review of medical records and imaging reports.

Patients

Between June 2016 and April 2017, 35 patients with acutely thrombosed dialysis fistulae were treated. Patient and fistula characteristics are summarized in the **Table**. Clinical examination by the attending nephrologist or dialysis physician or failed dialysis demonstrated by the absence of thrill and Duplex ultrasound confirmed the presence of thrombosis and stenosis of the vein or anastomosis. All procedures were performed within 48 hours of the occurrence of thrombosis. Patients (N = 35; average age, 61.8 y; age range, 33–81 y; 19 men and 16 women) were treated with the Indigo System. The mean age of the dialysis fistula was 4.1 years (range, 1–7 y).

Three patency outcomes were used in accordance with the Society of Interventional Radiology (SIR) reporting standards (15). Primary patency after intervention was defined as the interval after percutaneous transluminal angioplasty (PTA) until repeated percutaneous intervention or fistula thrombosis. Assisted primary patency after

Table. Patient and Fistula Characteristics

Characteristics	Mean (range) or Number (%)
Average age, y	61.8 (33–81)
Sex	
Male	19
Female	16
Graft fistula	19
Autologous fistula	16
Fistula location	
Forearm	22
Upper arm	13
Cause of renal failure	
Diabetes	16
Sarcoidosis	1
Reflux	1
Vascular	2
Genetics	5
PCKD	5
Cryoglobulinemia	1
FSG	1
Undetermined	3
History of renal graft	3 (8%)
Age of fistula at intervention, y	4.1 (1–7)
History of AVF/AVG thrombosis	15 (42%)
Previous angioplasty for AVF/AVG stenosis	26 (74%)
Previous AVG stent placement	6 (20%)
Concomitant diseases	
Arterial hypertension	18 (51%)
Diabetes	19 (54%)
Insulin-dependent	2
Non-insulin-dependent	17
Coagulopathy	4* (11%)
Smoking	12 (34%)
Long-term antithrombotic therapy with ASA	19 (54.3%)
Anticoagulation therapy with warfarin for atrial fibrillation and lupus	8 (26.6%)

ASA = acetylsalicylic acid; AVF = arteriovenous fistula; AVG = arteriovenous graft; FSG = focal segmental glomerulosclerosis; PCKD = polycystic kidney disease.

*One patient had lupus treated with anti-DNA antibodies, 1 patient had a lupus anticoagulant, and 2 patients had myelodysplasia. No other patient had acquired or hereditary thrombophilia (protein C, protein S, antithrombin, factor VII, factor V mutation, factor II mutation, plasminogen activator inhibitor, lipoprotein (a), lupus anticoagulant, IgG or IgM anticardiolipin antibodies).

intervention was defined as the interval after PTA until fistula thrombosis or surgical intervention that excluded the treated lesion from the access circuit. Secondary patency after intervention was defined as the interval after PTA until the fistula was surgically declotted, revised, or abandoned. Clinical success, defined as successful dialysis session after procedure; safety, defined as the absence of complications classified according to the Clavien-Dindo grading system (16) and the SIR classification

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