CLINICAL STUDY

Transjugular Access for Endovascular Treatment of Immature Autogenous Arteriovenous Fistulae

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ABSTRACT

Purpose: To assess the feasibility and outcome of transjugular access for endovascular treatment of immature arteriovenous fistulae (AVFs).

Materials and Methods: Between August 2013 and January 2016, 90 patients (mean age, 64.5 y ± 12.8) underwent endovascular treatment of immature AVFs via transjugular access. The mean age of fistulae was 3.3 months ± 1.8. Total procedure time and technical and clinical success rates of endovascular procedures were assessed. Primary and secondary patency rates were calculated according to the Kaplan–Meier method, and complications were assessed.

Results: All patients had inflow lesions, among which 19 (21.1%) had occlusions. The juxtaanastomotic segment was the most common site (44.3%). Transjugular access was successful in 83 patients (92.2%), and 7 required additional standard or transarterial access. The mean procedure time was 36.5 minutes. Technical and clinical success rates were 98.9% and 90.5%, respectively. Mean primary and secondary patency durations were 14.3 months ± 1.7 and 31.0 months ± 0.7, respectively. Primary patency rates at 3, 6, and 12 months were 84.4%, 67.3%, and 48.8%, respectively. Secondary patency rates at 6 and 18 months were 98.6% and 95.5%, respectively. Venous rupture occurred as a result of balloon inflation in 9 patients (10%), and was managed by balloon tamponade. There were no complications related to transjugular access during a mean follow-up period of 12.6 months.

Conclusions: Transjugular access for angioplasty of immature AVFs is feasible and safe. Potential problems associated with access in the outflow vein could be avoided by transjugular access.

ABBREVIATIONS

AVF = arteriovenous fistula, IJV = internal jugular vein

An autogenous arteriovenous fistula (AVF) is widely recognized as the ideal access for providing hemodialysis in patients with end-stage renal disease because of its longer duration of patency, fewer infections, lower mortality, and higher quality of life (1). For this reason, the National Kidney Foundation Kidney Disease Outcomes Quality Initiative vascular access guidelines (2) recommend AVF creation whenever possible.

Despite the advantages of AVFs, reported rates of maturation failure are between 28% and 53% (3–7). As a result, several reports in the literature have investigated the efficacy of endovascular treatment for their management (8–16). However, there is difficulty in accessing immature veins because they are thin and fragile (10). In addition, hematoma formation has been reported to occur in as many as 15% of procedures in which immature veins have been accessed (13). Transarterial access, which has been described as an alternative access, may also be associated with hematoma formation at the access site (10,17). To avoid these difficulties, we performed angioplasty via the internal jugular vein (IJV) in the present study, which was performed to evaluate the feasibility and safety of transjugular access for the management of immature AVFs.

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MATERIALS AND METHODS

Subjects

This retrospective study was approved by our institutional review board, and requirement for informed consent was waived. Between August 2013 and January 2016, a total of 94 patients were referred for endovascular treatment of immature AVFs. Immature AVF was defined as (*i*) an AVF that was at least 8 weeks old since creation but that had not matured enough to allow cannulation for hemodialysis or (*ii*) an AVF with absence of blood flow at any time before its use for hemodialysis (18). Palpation and Doppler ultrasound (US) were routinely performed by the physician before referral. In patients with immature AVFs, there was a general consensus between two interventional radiologists specializing in endovascular procedures to perform angioplasty via the ipsilateral IJV. In four patients, standard access had been used because of the presence of a tunneled hemodialysis catheter in the ipsilateral IJV or obliteration of the IJV secondary to long-term catheterization. A final total of 90 patients (45 men and 45 women; mean age, 64.5 y ± 12.8) underwent angioplasty via transjugular access (Table 1). Sixty-six patients (73.3%) had a left-sided AVF, and radiocephalic AVF was the most common type (n = 57; 63.3%). The mean age of fistulae was 3.3 months (range, 1.2–11.5 mo).

Endovascular Technique

Under conscious sedation, the ipsilateral IJV was punctured by using a 21-gauge needle under ultrasound (US) guidance, and a 6- or 7-F sheath was placed. A 10-cm vascular sheath (Terumo, Tokyo, Japan) was used during the early stages of practice, which was later replaced by a 24-cm-long braided sheath (Super Arrow-Flex; Arrow, Reading, Pennsylvania; Fig 1a) that could be advanced into the cephalic arch for better catheter support. A 90-cm Bernstein angiographic catheter (Terumo/Cordis, Miami Lakes, Florida) was routinely used to direct the guide wire toward the brachiocephalic anastomosis. For radiocephalic AVFs, a 125-cm Davis angiographic catheter (Cook, Bloomington, Indiana) was used because of the long work length. Occasionally, when there was acute angulation at the confluence of the IJV and subclavian vein, a Sos Omni angiographic catheter (Angiodynamics, Latham, New York) was used to direct the guide wire into the outflow vein. When necessary, the juxtaanastomotic vein was cannulated with a 23-gauge scalp needle (Fig 2b), and nonionic contrast medium (Visipaque 320; GE Healthcare, Princeton, New Jersey) was subsequently injected to provide a roadmap during retrograde catheterization. When the catheter had reached the anastomosis, fistulography was performed (Fig 1b). Significant stenosis was defined as a 50% or greater decrease in the luminal diameter compared with that of the adjacent normal segment. Lesions were treated by standard techniques of angioplasty by using semicompliant balloon catheters (Boston Scientific, Marlborough, Massachusetts; Abbott Vascular, Santa Clara, California; and ev3, Plymouth, Minnesota; Fig 1c). When there was residual stenosis of more than 30%, additional treatment was performed by using a cutting balloon (Boston Scientific) or bare metallic stent (Smart Flex; Cordis; or Zilver Flex; Cook). In the presence of inflow stenosis, collateral veins were not treated. After the procedure, the sheath was removed and hemostasis was achieved by manual compression.

Table 1. Characteristics of Patients and AVFs

Characteristic	Value
Age (y)	64.5 ± 12.8
Sex	
Male	45 (50.0)
Female	45 (50.0)
Side of AVF	
Right	24 (26.7)
Left	66 (73.3)
AVF age (mo)	
Mean ± SD	3.3 ± 1.8
Range	1.2–11.5
AVF type	
Radiocephalic	57 (63.3)
Brachiocephalic	29 (32.2)
Radiobasilic	3 (3.3)
Brachiobasilic	1 (1.1)

Note–Values presented as mean ± SD where applicable. Values in parentheses are percentages.
AVF = arteriovenous fistula; SD = standard deviation.

Outcome and Statistical Analyses

The outcome of angioplasty was determined by reviewing our electronic database of medical records. For patients receiving hemodialysis in other hospitals, a telephone survey was performed to determine if the patients were undergoing hemodialysis via the fistula and if they had received additional endovascular procedures or surgery. According to the guidelines and reporting standards of the Society of Interventional Radiology Technology Assessment Committee (18), we assessed the technical and clinical success rates, primary and secondary patency rates, and major or minor complications.

Total procedure time was defined as the time interval from the start of percutaneous access to the completion of the procedure. Technical success was defined as improved venographic patency with residual stenosis of less than 30% following treatment, and clinical success was defined as resumption of normal dialysis for at least one session with the use of the AVF after treatment. Primary patency was defined as the interval following intervention until the next access thrombosis or repeated intervention. Secondary patency was defined as the interval after intervention until the access was surgically