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Clinical Research

Management of Postbiopsy Arteriovenous Fistulas in Transplanted Kidneys and Effectiveness of Endovascular Treatment: A Single-center Experience

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Background: We sought to evaluate the best therapeutic management of postbiopsy arteriovenous fistulas (AVFs) in transplanted kidneys.

Methods: Between January 2005 and December 2011, we observed 17 cases of postbiopsy AVF in transplanted kidneys (9 asymptomatic; 8 symptomatic). Asymptomatic cases were managed conservatively, while patients with symptomatic AVF underwent endovascular treatment. We used a technique that consisted in a superselective transcatheter embolization of the afferent branch. We evaluated the technical success (postoperative closure of AVF), the immediate clinical efficacy (cessation of symptoms), and clinical efficacy at follow-up (measurement of serum creatinine at 7 days and 6 and 12 months compared with preoperative levels using *t*-tests).

Results: Asymptomatic AVFs resolved spontaneously, while the endovascular treatment in symptomatic AVFs showed a complete technical and clinical success with prompt remission of the presented symptoms. We observed a statistically significant reduction in serum creatinine at 7 days and 6 and 12 months postoperatively (mean creatinine—preoperative: 3.23 ± 1.4 mg/dL; 7 days: 2.25 ± 0.8 mg/dL; 6 months: 1.65 ± 0.28 mg/dL; 12 months: 1.4 ± 0.26 mg/dL; in all cases $P < 0.05$).

Conclusions: In our experience, asymptomatic AVFs could be managed conservatively with close follow-up while the endovascular treatment for symptomatic AVFs is both safe and effective in the short- and long-term.

Kidney transplantation is the treatment of choice for end-stage renal failure; however, it is burdened by a wide variety of complications, both vascular and nonvascular, that may compromise long-term function.[1] Vascular complications are represented by transplanted renal artery stenosis, arteriovenous fistulas (AVFs), pseudoaneurysms, and thrombosis; nonvascular complications include urologic complications (i.e., ureteral obstruction) and perirenal fluid collections (i.e., lymphocele, abscess, hematoma, and urinoma).[1]

Biopsy specimens of the transplanted kidney, although relatively easy to perform because of the superficial site of the transplanted kidney, is the

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main cause of iatrogenic vascular complications (AVF and pseudoaneurysms), with an incidence of 1−15%.[1] In most cases, AVFs are asymptomatic and undergo spontaneous resolution[2]; in some cases, however, they may present with massive hematuria, refractory hypertension, and decreased renal function, and may require treatment.[3] Endovascular treatment is a viable alternative to surgery because, with modern techniques of coaxial superselective catheterization of the afferent vessels, it is possible to completely embolize the AVF with minimal renal ischemic injury.[4]

There are few published studies regarding the endovascular treatment of postbiopsy AVFs,[4−12] most of which are represented by case reports or short follow-up studies; the largest published study to date by Lorenzen et al.[12] was comprised of 20 patients with 24 AVFs.

The aim of this work was to evaluate the best therapeutic management of AVFs and to test the clinical efficacy of endovascular treatment by carrying out a literature review.

METHODS

Between January 2005 and December 2011 at our hospital, 17 patients developed a postbiopsy AVF: 9 patients were asymptomatic and were managed conservatively; 8 patients were symptomatic (6 men and 2 women; mean age: 47.5 years [range: 32−65 years]), with a total of 8 AVFs and underwent endovascular treatment.

Indications for renal transplant in this group of 17 patients were as follows: glomerular disease (9 patients), diabetes type I (5 patients), polycystic kidney disease (1 patient), refractory hypertensive nephropathy (1 patient), and hemolytic-uremic syndrome (1 patient). All patients were undergoing triple immunosuppressive therapy and had no major contraindication for transplant (i.e., they were of the appropriate age, were HIV/hepatitis C and hepatitis B virus−negative, and had good cardiac and respiratory function).

Biopsy was performed at a mean interval from transplantation of 238 ± 65 days (range: 4 days−52 months); biopsy specimens were obtained in all cases under local anesthesia (10 mL of lidocaine 2%) under ultrasound guidance using a 14−18 gauge needle (CR Bard, Covington, UK); both the upper pole than the lower pole of the transplanted kidney were biopsied.

We cannot establish a certain relationship between the size of the needles used and the development of a fistula, because in our cases there was an almost equal distribution between biopsies obtained with 18-gauge needles (10 patients) and 14-gauge needles (7 patients).

In all 8 cases, the outcome of the biopsy did not reflect a change in the medication of the patient.

All patients treated underwent a color Doppler ultrasound diagnosis of AVF associated with worsening renal function; in 3 cases, hematuria was observed, and in the other 2 refractory hypertension. Patients with a color Doppler ultrasound diagnosis of AVF not associated with worsening of renal function or clinical manifestations were managed conservatively with close follow-up.

All fistulas that required treatment were of significant size and therefore symptomatic; asymptomatic fistulas were usually smaller.

In all cases, the transplanted kidney was from a cadaver donor; in 5 cases, it was housed in the left iliac pouch and in 3 cases in the right iliac pouch. The mean interval between biopsy and endovascular intervention was 92 days (range: 4−156 days). All patients signed valid informed consent before the procedure. For the retrospective nature of the study, the opinion of the ethics committee of our institution was not sought.

Procedures were all performed in the angiography suite (Angiograph Integris V5000; Philips Medical, Endhoven, the Netherlands) under local anesthesia (10 mL of lidocaine 2%), in 5 cases by means of retrograde ipsilateral common femoral artery puncture (5-French introducer; Terumo Corp., Tokyo, Japan) and in 3 cases using a contralateral approach. Using selective catheterization of the external iliac artery (catheter diagnostic 5-French Cordis; Johnson and Johnson, Roden, the Netherlands), a diagnostic angiography was performed. In coaxial technique, a superselective catheter was inserted into the afferent arterial branch of the fistula through a 0.025″ Progreat microcatheter (Terumo Corp.) on a 0.021″ microguidewire and then we proceeded to the embolization of the AVF using fibered platinum microcoils (Boston Scientific, Natick, MA).

The mean dose of contrast medium used (Visipaque 320 mgI/mL; GE Healthcare, Carrigtohill, Ireland) was 110 mL (range: 80−130 mL). In all cases, postprocedural control angiography was performed and hemostasis was obtained by manual compression.

The evaluated parameters included technical success, defined as complete cessation of flow in correspondence of the fistula; postprocedural complications, clinical efficacy, and immediate cessation of symptoms as assessed; and long-term clinical efficacy, which was assessed by measurement of serum creatinine at 7 days, 6 and 12 months, and then annually after the procedure.

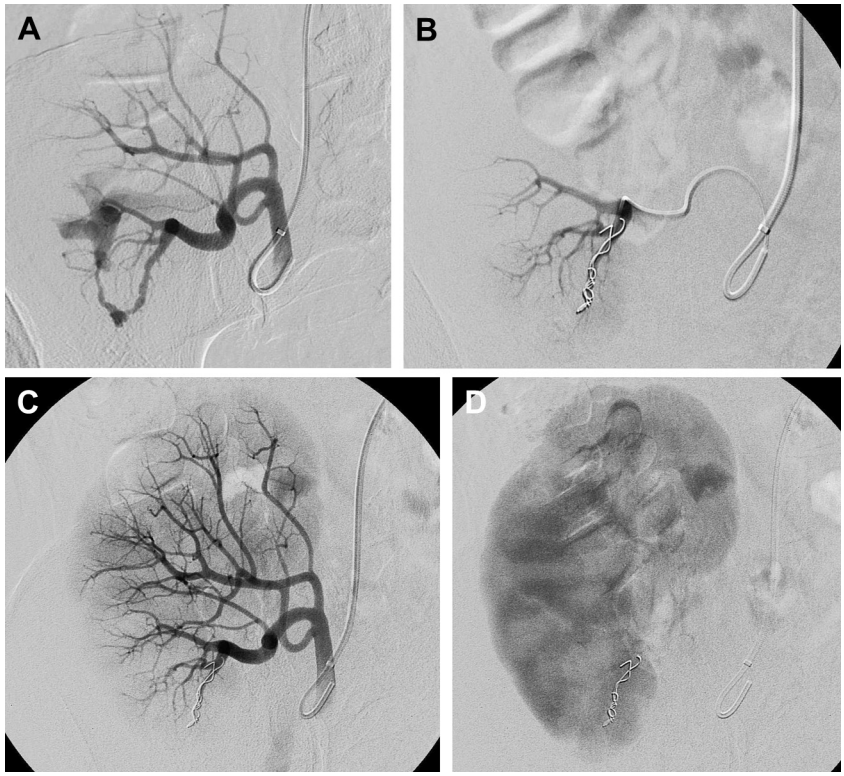

Fig. 1. Endovascular treatment of postbiopsy arteriovenous fistula (AVF). Using contralateral femoral access, selective catheterization of the transplanted renal artery is performed. (**A**) Angiography confirmed the presence of an AVF in the lower pole of the kidney. (**B**) Using selective catheterization, we proceeded to microembolize the AVF using a spiral VortX occlusion coil (Boston Scientific, Natick, MA; 4- × 3.7-mm; patient 1). (**C**) Final control angiography documented complete exclusion from the circulation of the AVF, with preserved renal perfusion (**D**).

Values of serum creatinine before and after the operation were compared using a *t*-test and the Wilcoxon rank-sum test; $P < 0.05$ was considered statistically significant.

RESULTS

Technical success was achieved in all cases: at the end of the treatment, AVFs were completely excluded from the circulation (Fig. 1). There was no need for additional embolization procedures. Postprocedural renal ischemia, assessed as loss of the parenchymal phase at the final angiography, was partial and not associated with impaired renal function postoperatively.

There were no postoperative complications.

Asymptomatic AVFs as of latest follow-up presented in stable condition, with normal renal function and spontaneous regression of the vascular lesions. Table I shows the clinical outcomes of the patients.

Embolization was associated in all cases with a rapid clinical success; in patients with massive hematuria, there was a rapid cessation of bleeding, while in those suffering from hypertension, there was a progressive normalization of blood pressure postoperatively.

All patients were subjected to recording of serum creatinine levels at 7 days, 6 and 12 months after treatment, and then annually thereafer. The mean preoperative creatinine level was 3.23 ± 1.4 mg/dL (range: 1.8−5.6 mg/dl). Seven days after surgery, the average creatinine level was 2.25 ± 0.8 mg/dL (range: 1.4−4.2 mg/dL); the comparison of preoperative creatinine values with those after 7 days showed a statistically significant reduction ($P < 0.005$; *W* value: 36). At 6 months, the average creatinine level was 1.65 ± 0.28 mg/dL (range: 1.2−2.0 mg/dL); at 12 months, this was 1.4 ± 0.26 mg/dL (range: 1.0−1.8 mg/dL). At both 6 and 12 months, the reduction of creatinine was statistically significant compared to baseline ($P < 0.005$; *W* value: 36).

Table I. Clinical outcome of treated patients[a]

Patient no.	Sex	Age (yr)	Technical success	Serum creatinine level (mg/dL)			
				Baseline	7-day	6 months	12 months
1	M	43.5	Yes	1.8	1.4	1.2	1.2
2	M	38.1	Yes	4.4	2.3	1.5	1.4
3	F	32.0	Yes	3.4	2.4	1.7	1.8
4	M	54.8	Yes	2.0	1.6	1.4	1.4
5	M	48.8	Yes	5.6	4.2	2.0	1.6
6	M	51.4	Yes	2.2	1.8	1.6	1.2
7	F	60.2	Yes	4.2	2.4	2.0	1.0
8	M	34.5	Yes	2.3	1.9	1.8	1.6
Mean		45.4	—	3.2	2.2	1.6	1.4
SD		—	—	1.38	0.87	0.28	0.26
P value		—	—	—	0.005	0.007	0.006

F, Female; M, male; SD, standard deviation.
[a]*t*-test comparing baseline serum creatinine values to those recorded at 7 days and 6 and 12 months showed statistically significant differences in all cases.

At a mean follow-up of 40 months (range: 12–64 months), we observed complete long-term clinical success at with normalization of renal function (mean creatinine: 1.5 ± 0.6 mg/dL; $P < 0.05$), and no patient required hemodialysis treatment.

DISCUSSION

Biopsy is an essential procedure for the evaluation of an eventual dysfunction of the transplanted kidney, allowing for the precise identification of the pathologic process in progress and adequate therapeutic classification.[1] AVFs and pseudoaneurysms represent the most frequent vascular complications associated with biopsy, with an incidence ranging of 1–15%.[1] In most cases, AVFs resolve spontaneously and do not require treatment but only a conservative management with close color Doppler ultrasound follow-up[2]; in a smaller percentage of cases, however, an AVF can manifest clinically with hypertension, hematuria, and reduction of renal function, and in such cases, treatment is mandatory.[3]

The management of asymptomatic AVFs is a matter of debate: Loffroy et al.[7] recommend the treatment of AVFs even if they are asymptomatic, because they may cause renal ischemia, heart failure, or undergo gradual growth with massive bleeding and possible renal failure; other authors,[12,13] however, recommend treatment of AVFs only if they are symptomatic or associated with worsening of renal function. We agree with the latter therapeutic management, because there are no strong data in the literature in favor of a preventive treatment in asymptomatic AVF, while there is a strong finding that about 70% of the AVFs in native and transplanted kidneys undergo spontaneous resolution.[1,5] This therapeutic approach we have adopted has proven effective; the 9 asymptomatic AVFs managed conservatively, with close follow-up, regressed spontaneously while the 8 symptomatic and treated AVFs showed a benefit from the operation.

Currently, endovascular treatment is considered the first therapeutic choice for postbiopsy AVFs because it allows for complete exclusion from the circulation, with minimum risk of renal ischemic injury.[13]

The effectiveness of the treatment depends on the embolization technique and the material used. In our experience, we have implemented all treatments in coaxial superselective transcatheter embolisation technique[10–12]: this method allows to obtain the selective exclusion from the circle of the vascular lesion, saving the remaining renal parenchyma and thereby minimizing the risks and complications associated with it.

In all cases we used as the embolic agent fibered platinum microcoils, in line with the literature data.[4–12] Other techniques described in the literature include the following: in cases of high-output AVFs, the use of an arterial occlusion balloon and subsequent release of coils[14] or an occlusion balloon positioned on the arterial and venous side[15]; in cases of high-flow AVFs, the use of an Amplatzer vascular occluder (AGA Medical Corp., Plymouth, MN) with dual access from the arterial and venous side[16] or the use of interlocking detachable coils.[12,17] The literature also describes the ability to embolize AVFs by injection of cyanoacrylate[12] or ethylene vinyl alcohol copolymer.[18]

In our experience, we preferred the exclusive use of microcoils according to our greater experience with these agents and the good results obtained in all cases. In fact, we have had 100% technical success with adequate exclusion from the circle of the vascular lesions, in the absence of complications and minimal postoperative renal ischemic injury.

Few studies have made a correlation between endovascular treatment and improvement of renal function. The results we observed in terms of improvement of kidney function are in line with those recently published by Lorenzen et al.[12] that, with the higher statistics as of now, observed a good result in 19 of 20 patients with a mean follow-up of 31 months. Other studies have documented less important results in terms of improvement in renal function: Maleux et al.[6] observed an improvement in 9 of 13 patients, deSouza et al.[8] in 4 of 7 patients, and Loffroy et al.[7] in 4 of 12 patients. Lorenzen et al.[12] suggested as a possible factor affecting the renal function the amount of contrast medium administered, which in its series was 80 mL while in that of Loffroy et al.[7] was 111 mL. This hypothesis is not reflected in our study, where the average dose of contrast medium administered was 110 mL.

The major limitation of this study is the low number of patients enrolled, which does not allow us to make a final judgment on the correct therapeutic management; postbiopsy AVFs are, however, infrequent complications and are therefore difficult to capture in a larger, single-center series of patients.

In conclusion, our study shows that asymptomatic AVFs should be managed conservatively with close color Doppler ultrasound every 3 months until regression of the fistula occurs; in symptomatic AVFs, endovascular treatment is a safe and effective option that is able to ensure the restoration of renal function in both the short- and long-term. Angiographic treatment has low risks and is able to minimize ischemic damage to the kidney.

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