Endovascular treatment of arteriovenous fistulas complicating percutaneous renal biopsy in three paediatric cases

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Abstract

Design. We evaluated the incidence and history of arteriovenous fistula (AVF) after kidney biopsy and assessed the use of superselective embolization for treatment.

Observations. During the last 10 years, 896 kidney biopsies (age range of the patients: 1 month–18.6 years) have been performed in our institution under real-time ultrasonographic guidance with a 14 gauge cutting biopsy needle, and 32 of the patients had renal allografts (3.4%). We observed three cases of AVF (two in allograft kidneys, one in a native kidney) among all biopsies (0.34%), and the incidence of developing AVF after renal allograft biopsy was 6.3%. All three patients with AVF were symptomatic, and intravascular therapy was indicated.

Interventions. An angiographic study combined with endovascular treatment of the intrarenal AVF and pseudoaneurysm was performed in all three patients. Embolization was performed with bucrylate and lipiodol in two patients and with micro-coils in one. After successful embolization, all three patients became asymptomatic (in two renal bleeding stopped, in one patient with severe uncontrollable hypertension blood pressure returned to normal limits). No complications were observed secondary to the embolization procedure.

Conclusion. The technique of superselective embolization using a coaxial catheter is an effective and safe method in the treatment of post-biopsy AVFs and pseudoaneurysm.

Key words: arteriovenous fistula; children; embolization; kidney biopsy

Introduction

Since the introduction of percutaneous renal biopsy, the procedure has provided important information for the diagnosis, management and prognosis of many patients with renal diseases [1,2]. However, this procedure is not free from complications. Although >90% of patients after renal biopsy have CT-detectable haematomas, bleeding requiring transfusion or other clinical intervention occurs in only 1–6% of patients [3–6]. Renal bleeding has been associated with intrarenal arterio-venous fistulas (AVFs), which are known to be a major complication of renal biopsy. AVFs can be demonstrated by arteriography in up to 15% of patients, and the frequency is high in renal allografts [7,8]. This complication may remain asymptomatic and resolve spontaneously, or lead to renal bleeding, uncontrollable hypertension and/or deterioration of renal function [9]. These are features that may require correction, and selective embolization with coaxial catheterization is known to be the most effective and non-invasive method of AVF treatment with minimal renal parenchymal damage [9–11]. We reported here three paediatric post-biopsy AVF patients who were treated successfully with this technique.

Patients and methods

During the last 10 years, 896 sonographically guided kidney biopsies (age range of the patients: 1 month–18.6 years) have been performed in our paediatric nephrology department. Thirty-two of the patients had renal allografts (3.4%). According to our routine protocol, before the biopsy procedure, all patients were evaluated for conditions that may increase the risk or consequences of complications. Coagulation tests and the assessment of renal anatomy by ultrasonography (US) were performed before biopsy in all patients. The biopsies were performed under real-time US with a 14 gauge cutting biopsy needle. The patients were placed under absolute bed-rest and monitored for at least the next 24 h. Control US was performed 24 h after the biopsy for assessment of complications.

Case 1

A 15-year-old girl with end-stage renal failure (ESRD) due to haemolytic uraemic syndrome underwent living...
related kidney transplantation in April 1994. The graft was implanted in the right iliac fossa, and she did not have any problem in the early post-operative period. The immunosuppressive therapy consisted of cyclosporin A (Cyca), azathioprine (AZA) and corticosteroid (CS). Proteinuria emerged in the seventh month post-transplantation, and percutaneous allograft biopsy was performed. She had no hypertension, and biochemical and coagulation parameters were within normal levels before the biopsy. Histological examination of the specimen was unremarkable except for a slight increase in the mesangial matrix. Thus, no further treatment was given. Two days after the biopsy, the gross haematuria which was seen following the biopsy disappeared, vital signs and laboratory findings were satisfactory, and the US evaluation of the allograft was normal. However, a systolo-diastolic bruit in the right iliac fossa and severe systolic hypertension were detected at the control examination, 1 week later. Colour-coded Doppler sonography (CCDS) revealed a pulsatile, hypoechoic mass (20 × 9 mm) in the allograft parenchyma. The diagnosis was an ‘AVF and pseudoaneurysm’ developing secondary to the percutaneous kidney biopsy, and the patient was followed for a further 2 months with antihypertensive medication for spontaneous disappearance of the AVF. No deterioration was observed in the allograft function, but the AVF and uncontrolled hypertension persisted during follow-up. An angiographic study and a trial for endovascular treatment of the intrarenal AVF and pseudoaneurysm was decided upon.

In February 1995 (2.5 months after biopsy), following abdominal aortography with a pig-tail catheter, selective transplant renal arteriography was performed with a Cobra-C2 catheter (Cordis, Miami, FL). A 1 cm diameter pseudoaneurysm with an AVF supplied by an enlarged branch of the lobular artery was detected on the corticomedullary junction of the upper pole (Fig. 1A). There was a wedge-shaped perfusion defect around the lesion (Fig. 1B). The pseudoaneurysm was catheterized superselectively using the side-winder catheter as a guide, with a microcatheter (Tracker-18, Target Therapeutics, Fremont, USA) system (Fig. 1C). An injection of 0.2 ml bucrylate (Histoacryl, Braun, Melsungen, Germany) and 0.2 ml lipiodol (Lipiodol ultra-fuide, Guerbet, Cedes, France) was given for embolization (Fig. 1D). The glue cast the pseudoaneurysm completely and sealed the perfusing artery close to the pseudoaneurysm. The control angiogram demonstrated that the early venous drainage stopped. There was excellent conservation of functional renal parenchyma, and no change in the configuration of the wedge-shaped perfusion defect was observed (Fig. 1E). After the embolization, while renal functions remained within normal levels, the blood pressure of the patient returned to normal, and the systolo-diastolic bruit disappeared totally. During the 3 years of follow-up, she had neither hypertension nor haematuria and retained her normal renal functions.

Case 2
A 13-year-old boy had ESRD secondary to vesicoureteral reflux nephropathy and, after 12 months of maintenance dialysis, he received a cadaver kidney transplant in April 1994. The first allograft biopsy was performed in the second month post-transplantation, and he was treated for the diagnosis of acute cellular rejection. A second rejection episode occurred in the thirteenth month, clinically manifesting with weight gain and an increase in serum creatinine (Cr) levels (2.0–3.5 mg/dl). The histological appearance was again consistent with an acute cellular rejection, and he was treated with steroid pulses with satisfactory return of graft function. Serum Cr decreased to 1.5 mg/dl. Following biopsy, no gross haematuria or other complication of allograft biopsy was observed, and CCDS revealed no pathological findings in either the early or late follow-up period. The immunosuppressive therapy consisted of Cyca, AZA and CS. Because of doubling of the serum Cr (from 4 to 5.5 mg/dl), a third-needle puncture of the renal allograft was performed in March 1997. Before biopsy, the patient had no hypertension, and all haematological and coagulation parameters were normal. Histopathological finding were consistent with chronic allograft nephropathy. Gross renal bleeding started immediately after the biopsy. The patient was followed with continuous bladder catheterization and intravenous hydration during bleeding, and blood transfusion was needed twice within the 72 h of follow-up. CCDS revealed an AVF with a pseudoaneurysm on the lower pole of the renal allograft. Because of persistent bleeding, we decided to perform an angiography and embolization. Four days after the biopsy, a pseudoaneurysm 1 × 2 cm in diameter with a large AVF at the lower pole of the allograft was catheterized selectively with a Cobra-4F catheter (Fig. 2A). Three Gianturco spring coils were used to occlude the feeding artery and the pseudoaneurysm. The control examination revealed an excellent result with no aneurysm or fistula, with excellent conservation of the functional renal parenchyma (Fig. 2B). Although renal functions remained within stable limits, the urine output of the patient diminished after the embolization. US evaluation of the bladder and renal pelvis showed an echogenicity suggesting a large blood clot in the bladder. The blood clot was removed by cystoscopy, urine output returned to normal and there was no further haematuria. We did not observe any evidence of haematuria or hypertension during the 18 months of follow-up. Renal function remained satisfactory.

Case 3
A 16-year-old boy with chronic renal failure secondary to an unknown origin was admitted to our department, and a kidney biopsy was performed in April 1998, with two separate punctures to define the primary renal disease. Histopathology revealed fibrous
Fig. 1. (A) Pseudoaneurysm and AVF supplied by an enlarged branch of the lobular artery in case 1. (B) A wedge-shaped perfusion defect around the lesion. (C) The superselective catheterization using the side-winder catheter as a guide with a Tracker-18 microcatheter. (D) The occlusion of the pseudoaneurysm and AVF after the embolization. (E) The excellent conservation of the allograft parenchyma with no additional perfusion defect after the procedure.
Endovascular treatment of post-biopsy renal arteriovenous fistula

Two large AVFs without pseudoaneurysms between two branches of the inferior lobar arteries and the lower lobe vein (Fig. 3A). The sites of the fistulas were catheterized selectively with a 4F renal double curve catheter (Cordis, Miami, FL) and embolized using two Gianturco spring coils. The fistulas were completely occluded. A control angiogram demonstrated that there was a very small perfusion defect, ~1–2% of the functional renal parenchyma (Fig. 3B). After the embolization procedure, the patient stabilized, haematuria disappeared and renal function remained stable.

Fig. 2. (A) Selective catheterization of the pseudoaneurysm with a large AVF at the lower pole of the allograft in case 2. (B) The excellent result with no aneurysm or fistula, with excellent conservation of the functional renal parenchyma.

crescentic glomerular lesions. Gross haematuria and hypovolaemic shock were observed immediately following biopsy. CCDS revealed a perirenal haematoma around the biopsied left kidney. The patient was followed with control of haemodynamics and urine output. Three blood transfusions were needed within 2 days. Although a fistula or pseudoaneurysm was not detected at CCDS, due to continuing renal bleeding and transfusion requirements, renal arteriography was performed. Two large AVFs without pseudoaneurysms

Fig. 3. (A) Two large AVFs without pseudoaneurysms between two branches of the inferior lobar arteries and the lower lobe vein in case 3. (B) The complete occlusion of the fistulas, and a very small perfusion defect, comprising 1–2% of functional parenchyma.
References


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Discussion

The incidence of AVFs after percutaneous renal biopsy is reported to range from 1 to 18% [7–10]. It has also been reported that 80% of post-biopsy AVFs disappear spontaneously within 3.5–20 months, therefore no therapeutic approach may be necessary [3,9,11]. Persisting or symptomatic (haematuria, hypertension, renal failure, high output cardiac failure, local and peripheral thromboembolization) fistulas can be a threat to the patient’s survival, and treatment may become essential [3,9,10]. The consequences of these complications are more important for patients with only one functioning kidney, especially for renal allografts [7,9,11].

In our series, there were three AVF cases (0.3%) among all biopsies, and the incidence of developing AVF after renal allograft biopsy was 6.3% over the 10 year period. It is known that all biopsy complications occur with a higher incidence in allografts, and the incidence of serious complications (haematoma, haemoperitoneum and AVF) was 16.5%, being more frequent in transplants than in native kidneys [7,9,11]. Similar to the results of reported series, we observed AVFs with a higher incidence in renal allografts.

Post-biopsy intra-renal AVFs and pseudoaneurysms are known to be identified accurately by colour-coded Doppler imaging [12,13]. However, we were able to demonstrate AVF and pseudoaneurysm in two of three cases by this method. Therefore, it must be emphasized that renal arteriography must be performed for patients with persistent or recurrent renal bleeding after biopsy for definitive diagnosis in unresolved patients.

Although it is reported that >80% of post-biopsy fistulas resolve spontaneously, none of the fistulas in our patients resolved, causing life-threatening renal bleeding in two patients and severe uncontrollable hypertension in one. Thus the treatment of the AVF and pseudoaneurysm was necessary in all patients.

Surgical treatment for AVF is either partial or total nephrectomy or arterial ligation, resulting in graft or gross renal parenchymal loss. Endovascular therapy is the procedure of choice [9–11,14]. There are different technical methods of embolization with the risk of varying degrees of parenchymal damage. Transcatheter embolization can be used to control bleeding, but unless it is sufficiently selective, it may result in the loss of significant amounts of renal parenchyma [10]. It has been reported that the superselective embolization of AVF is an effective and safe method [10–12]. However, there are some reports which suggest that angiographically successful embolization is not necessarily associated with clinical success, and there is a high rate of complications [15]. We did not observe any important complications due to the embolization procedure, and clinical success was associated with successful embolization in our patients.

In conclusion, we consider the technique of superselective embolization as the most effective and safe method, with minimal parenchymal and renal functional damage potential in the diagnosis and treatment of post-biopsy AVFs and pseudoaneurysms. This technique should be tried when intervention is indicated in post-biopsy complications in centres where expertise in intravascular procedures is available.