Massive Intracranial Hemorrhage as a Result of Renal Artery Thrombolysis

This fatal cerebral hemorrhage was a result of catheter-directed thrombolytic therapy during renal artery revascularization.

BY FILIP BANOVAC, MD, AND MICHAEL D. DAKE, MD

In July 2002, a 68-year-old woman with cerebral palsy and long-standing hypertension controlled with antihypertensive medications for many years presented to our facility. She also had a history of arterial occlusive disease with aortic reconstruction that included aortobifemoral graft placement with bilateral aortorenal bypass grafts in 1973. Subsequently, the right renal graft occluded, and she underwent right nephrectomy in 1974. Years later, and several days prior to transfer, she presented to another facility in acute, anuric renal failure. She was placed on hemodialysis and evaluated by means of arteriography. Aortography showed the absence of a right renal artery and complete occlusion of the left renal artery. Attempts to reestablish flow to the left kidney by endovascular methods at the outside facility failed.

After approximately 1 week of management at the other facility, the patient was transferred to our facility, a university-based, tertiary referral center. At the time of transfer, her serum creatinine was 4.8 mg/dL, and she had minimal urine output. Her prothrombin time was 11.3 seconds, and her partial thromboplastin time was 30 seconds—both of which were considered normal. Her physical examination was otherwise remarkable for 2+ left and 1+ right femoral artery pulses. Her distal pulses were palpable, and her extremities were warm without evidence of skin breakdown or gangrene. Her blood pressure was 166/89, her heart rate was 84 beats per minute, and her respiratory rate was 20 breaths per minute. She had a distant history of smoking but denied any history of claudication or diabetes. She likewise denied any history of stroke, recent surgeries, or gastrointestinal bleeding.

OVERVIEW OF UNDERLYING DISEASE

Initial angiographic evaluation at another facility demonstrated patent mesenteric vessels and an

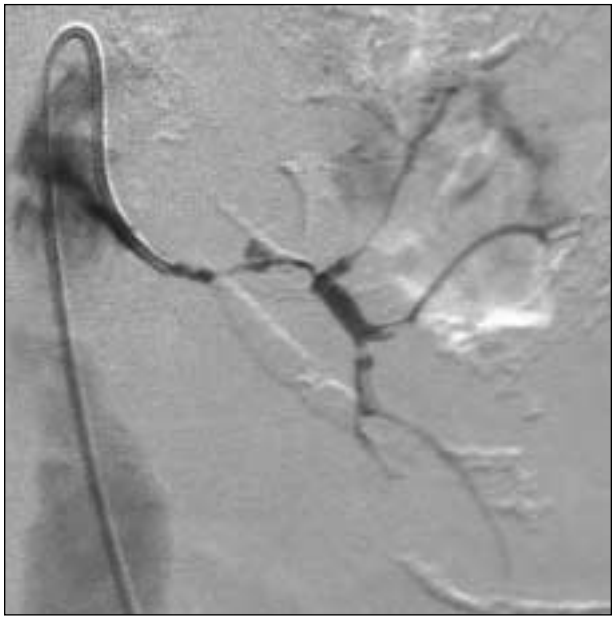

Figure 1. A selective angiogram from another facility showed partial thrombosis of the left renal artery with additional filling defects in branch arteries. Incomplete nephrogram of the left kidney is seen with contrast opacification of only the superior pole of the left kidney.

absence of flow to the kidneys (the patient had undergone previous right nephrectomy). The angiographer at that time was able to catheterize the native left renal artery, but not the occluded bypass graft to the left kidney. The arteriogram showed partial filling of only the main renal artery trunk and some of the branch vessels of the left renal artery (Figure 1). The patient's distal aortic graft was patent, and flow to both lower extremities was observed. Based on this arteriogram and her clinical presentation, it was believed that the acute renal failure was most likely due to acute occlusion of the renal artery. Although no intervention was performed at the other facility, catheterization of the renal artery likely re-established some flow to the kidney and resulted in minimal improvement in renal function and some urine output.

Complete occlusion of the renal artery is not a common complication of renal artery stenosis. In one study, complete renal artery occlusion of the stenosed renal arteries occurred in only nine of 295 prospectively followed vessels, all of which showed greater than 60% stenosis at the beginning of the follow-up period.[1] However, revascularization of the completely occluded renal artery in this patient with a solitary kidney was imperative because her renal function deteriorated acutely and she was severely oliguric. Treatment considerations at this time included repeat arteriography with percutaneous angioplasty and stenting. This approach has been well described, and outcomes have been well established.[2,3] Primary patency of renal artery stents was reported to be 82%, with 30% showing restenosis at 5 years.[4] Other possible treatments would include surgical bypass graft placement;[5] however, this patient was not considered a good surgical candidate. Thus, surgical options were less desirable and would be attempted only if an endovascular approach failed.

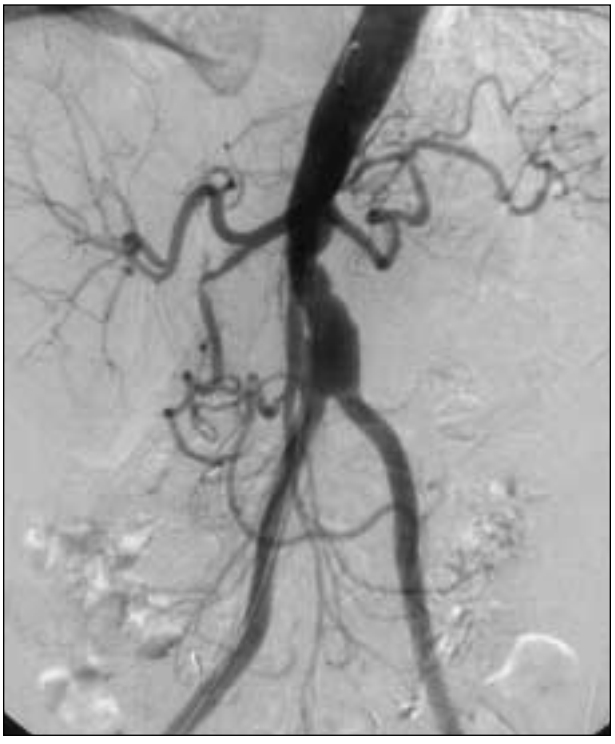

Figure 2. An initial aortogram performed at our institution demonstrates patent celiac artery and its branches and patent superior mesenteric artery. The suprarenal and infrarenal abdominal aorta demonstrates moderate atherosclerotic changes. The aortobifemoral graft is patent, and the right kidney is surgically absent. The left renal artery is not visualized.

ANGIOGRAPHY

The patient was transferred to our facility, and preprocedural evaluation was performed and informed consent obtained. Abdominal aortography was performed using right common femoral artery access. Aortograms showed patent celiac and mesenteric vessels and lack of perfusion to the solitary left kidney. Atherosclerotic changes were present in the suprarenal and infrarenal abdominal aorta extending to the level of the aortobifemoral graft. The graft itself had a normal appearance, and both distal limbs were patent (Figure 2).

ENDOVASCULAR INTERVENTION

After consideration of the revascularization options, a decision was made to attempt to recanalize the left renal artery. Using a 5-F, Sos-Omni catheter (Angio-Dynamics, Inc., Queensbury, NY) and a straight .035-inch Glidewire (Terumo Medical Corporation, distributed by Boston Scientific Corporation, Natick, MA), the ostium of the occluded left native renal artery was engaged, and selective arteriography was performed. Filling defects in the main left renal artery and several segmental branches were present. The flow was decreased, and some of the segmental branches were occluded (Figure 3A). Catheter-directed thrombolysis with tenecteplase (TNK; Genentech Inc., South San Francisco, CA) was initiated. A bolus dose of 5 mg was administered slowly via the arterial catheter, followed by an additional 2.5 mg several minutes later.

The patient was given eptifibatide bolus dose of 9 mg and a continuous intravenous drip of 1.1 µg/kg per minute. Repeat angiography showed marked improvement of the thrombus load, as well as the presence of an ostial renal artery stenosis. Angioplasty was attempted, but substantial recoil of the lesion was present and the decision was made to proceed with stenting. Sheath

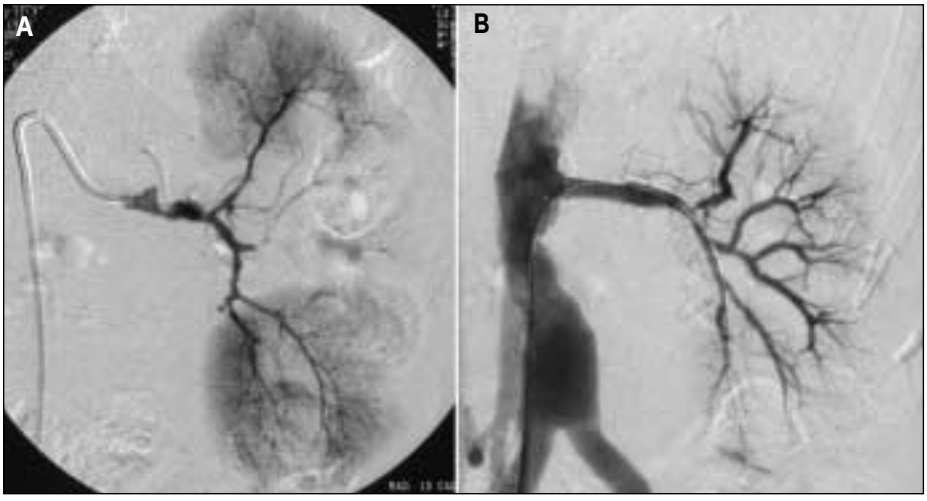

Figure 3. An initial renal angiogram demonstrates moderate thrombus in the main left renal artery with occlusion of branch arteries supplying the mid-pole of the left kidney (A). After stenting and thrombolysis, perfusion in the main left renal artery and all segmental branches is restored, constituting a good technical result (B).

access in the right common femoral artery was upsized to an 8-F, RDC-1 (Guidant Corporation, Indianapolis, IN), and two stents were placed to cover the ostial stenosis. First, a 6-mm X 28-mm Dynalink stent (Guidant Corporation) was deployed. Persistence of ostial narrowing prompted the placement of an overlapping 5-mm X 18-mm Omnilink stent (Guidant Corporation), which was extended proximally toward the abdominal aorta. The proximal stent was then expanded to 5.5 mm. An additional 5 mg of TNK was infused slowly via an arterial catheter for some residual thrombus in the segmental renal artery branches. Final angiograms demonstrated a patent left renal artery with newly deployed stents and patent segmental arteries (Figure 3B). Peripheral infusion of eptifibatide (1.1 µg/kg/min) was continued postprocedurally. The patient was also given an oral loading dose of clopidogrel (300 mg) prior to the procedure. No immediate complications were noted, and the patient returned to the recovery area in stable condition.

COMPLICATION AND MANAGEMENT

Two hours after the termination of her procedure, the patient was taken to the inpatient dialysis unit, where she became unresponsive. She was evaluated by a neurosurgical consultant. She was unresponsive to verbal or painful stimuli, she had no spontaneous movement, and her pupils were 5 mm and fixed. The infusion of eptifibatide was immediately stopped. A noncontrast CT scan of the head was performed, which showed massive intraparenchymal hemorrhage in the right frontoparietal region. Additionally, both subdural and subarachnoid hemorrhage were present and accompanied by midline herniation and uncal herniation (Figure 4). The patient remained unresponsive and was transferred to the intensive care unit. Her heart rate had decreased to 41 beats per minute, and her oxygen saturation had decreased to 85%. Emergent endotracheal intubation was performed. Shortly thereafter, she developed pulseless cardiac electrical activity, and cardiopulmonary resuscitation was initiated. Resuscitative measures failed, and the patient died.

TEACHING POINTS AND DISCUSSION

This case illustrates a fatal complication of catheter-directed thrombolysis. Use of peripherally administered TNK, or a combination of TNK with other agents, has

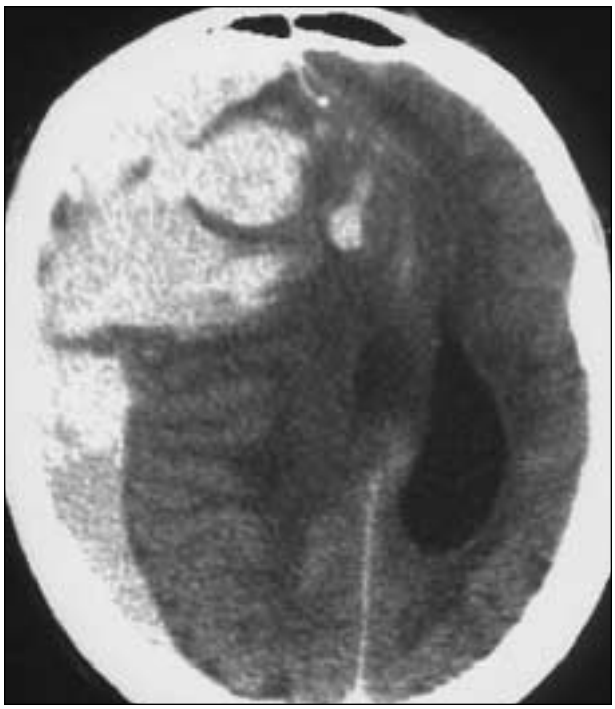

Figure 4. A CT scan of the head demonstrates massive intraparenchymal hemorrhage in the right frontoparietal region. Subdural hemorrhage is also present and is accompanied by midline herniation.

been previously described.[6,7] One large study demonstrated the incidence of intracranial hemorrhage to be 0.93% when a weight-adjusted dose of TNK was injected peripherally.[8] Use of TNK combined with eptifibatide also has been described in other studies, and the incidence of intracranial hemorrhage was less than 2%.[7] Therefore, fatal hemorrhage is an uncommon complication of catheter-directed thrombolysis. Patient selection remains important; pertinent medical history of stroke, recent surgical procedures, and gastrointestinal bleeding should be carefully obtained prior to any lytic therapy.

Several large studies examined factors related to cerebral hemorrhagic complications as a result of thrombolytic therapy. In the setting of thrombolysis for acute ischemic stroke, univariate analysis showed that among other factors, atrial fibrillation, history of cardiac disease, admission diastolic blood pressure >100 mm Hg, and admission glucose of >300 mg/L were associated with increased intracranial hemorrhage in tissue plasminogen activator (tPA)-treated patients.[9,10] In the setting of thrombolytic therapy after acute myocardial infarction, age was suggested as a strong predictor of risk for intracranial hemorrhage. Namely, the incidence of hemorrhagic stroke was 2.7% with tPA and 1.6% with urokinase administration for the patient population older than 70 years of age. For those younger than 70, the incidence of stroke was less than 1% in both groups.[11] One possible explanation is that, with advancing age, amyloid angiopathy has been implicated in intracerebral hemorrhage in the setting of thrombolytic therapy.[12-14]

Catheter-directed thrombolysis of acutely occluded renal arteries has been well described. Initial reports described catheter-directed delivery of streptokinase into occluded renal arteries.[15,16] Later, other lytic agents became available, and successful lysis of iatrogenically induced renal artery thrombosis with urokinase and tPA was reported.[17]

Prompt revascularization of the acutely thrombosed renal arteries is important because restoration of renal function has been shown in patients with solitary kidneys.[18,19] In our patient, we had a choice of thrombolytic agents. We choose TNK because of its favorable profile with respect to bleeding complications. One large study comparing TNK and tPA administered in the setting of acute myocardial infarction showed similar rates of intracranial hemorrhage. However, TNK administration resulted in lower rates of noncerebral bleeding and need for fewer blood transfusions.[8] Despite this lower rate, our patient had fatal intracranial hemorrhage. Although complication rates for peripherally administered tPA and TNK are now established, to the best of our knowledge, no large, prospective trials ever compared complications of catheter-directed lytic therapy between these agents. Such studies could be helpful in defining the complication rates and optimizing the dosing to deliver the best safety profile when using these agents in catheter-directed thrombolysis. ■

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