Renal Artery Embolization for Renal Biopsy Bleed

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Percutaneous renal biopsies (PRBs) provide useful information in determining diagnosis, prognosis, and treatment plans for patients with renal disease. The procedure is considered relatively safe with low rates of complications, which include bleeding (rarely leading to death), extended duration of pain, arteriovenous fistula formation, and others. When patients experience postprocedural bleeding, renal arteriography and renal artery embolization (RAE) may be performed. Embolic agents used may include sterile compressed sponge (Gelfoam; Surgifoam, Ethicon, Somerville, NJ), polyvinyl alcohol (PVA) particles, microcoils, or n-butyl cyanoacrylate (nBCA). Success rates are high, and with careful selection of small vessels, kidney function can often be preserved.

Clinical Case

A 22-year-old woman, with a history of systemic lupus erythematosus (SLE), suspected antiphospholipid antibody syndrome (APLAS), and currently at 12 weeks' gestation, presented to the emergency department with 1 week of lower extremity edema and facial rash. She was initially diagnosed with SLE 7 years ago and had a miscarriage 5 months prior to presentation that was attributed to APLAS. Initial laboratory exams showed hypoalbuminemia and nephrotic range proteinuria. These findings were deemed due to lupus nephritis, as her blood pressure remained normal. A PRB was ordered. Owing to her suspected APLAS and current pregnancy, the patient was placed on a heparin drip until 8 hours prior to the procedure. A biopsy of the inferior pole of the left kidney was performed at bedside 7 days later without immediate complication.

Two days after the biopsy, however, the patient was noted to be tachycardic. She was otherwise hemodynamically stable with normal hemoglobin and hematocrit (Hgb and Hct). On physical exam, she appeared in mild distress and had notable tenderness and tightness of the left flank. Very mild distension of the area was also appreciated. Due to the patient's pregnancy, the team was hesitant to expose the patient to large doses of radiation. Though after some discussion, the patient and her

fiancé decided that termination of the pregnancy would be their best course of action. As the patient was stable at this time, no imaging or intervention was planned. Later that evening, the patient began to experience increased pain and tightness of her left flank. Her Hgb also dropped from 8.7 to 6.7. The decision to image the patient was made. The subsequent CTA of the abdomen showed a significant perinephric/retroperitoneal hematoma. CTA also showed a focus of extravasation at what was most likely an inferior arcuate artery, consistent with the location of the recent renal biopsy (►Fig. 1a). Interventional radiology was notified and preparation was begun for an emergent arterial embolization.

Soon thereafter, the risks and benefits of the procedure were discussed with the patient and both written and oral consent was obtained. General anesthesia was administered. A time out was performed and the patient was prepped and draped for right groin access. Using continuous ultrasound guidance, the right common femoral artery was accessed using micropuncture technique. A 035 wire was then placed along with a 5F sheath. The left renal artery was accessed using a 4F SOS Omni selective catheter (AngioDynamics, Queensbury, NY) catheter and a Glidewire. A subsequent left renal arteriography showed extravasation from the inferior pole supplied by segmental/arcuate branches of the inferior left renal artery (►Fig. 1b, c). A microcatheter system was then used to access these individual branches.

An anterior segmental branch was first accessed and embolized using 500 to 700 μ m PVA particles. The branch was then further embolized using 2 and 3 mm detachable coils. Though the individual branch had been embolized to near stasis, renal arteriography showed persistent extravasation likely from a superimposed branch posterior to the treated segment (►Fig. 1d). Using the same technique, the posterior branch was then selected and embolized. Renal arteriography following the second embolization showed cessation of bleeding (►Fig. 1e). The estimated effected renal parenchyma was less than 20%. Follow-up Hgb/Hct levels were stable for over 24 hours at Hgb greater than 10. The patient remained hospitalized for her pregnancy termination

Fig. 1 (a) CT abdomen with contrast (arterial phase) showing active extravasation (A) at inferior-posterior left kidney and hyperdense fluid collection consistent with acute hematoma (B). (b) Arteriography of left kidney with placement of catheter in left renal artery showing abnormal branch vessel (arrow) (c) Continuation of arteriography from b showing active extravasation (A) from inferior pole of left kidney. (d) Arteriography of left kidney following particle and coil embolization of an anterior-inferior branch (A) demonstrating continued extravasation from previous location (B). (e) Arteriography of left kidney following particle and coil embolization of an inferior-posterior branch (A) and particle and coil embolization of an anterior-posterior branch (B) of the renal artery demonstrating no abnormal vessel or extravasation. There is an expected wedge defect from embolization (C).

and SLE-related treatment. She was discharged from the hospital 12 days following the procedure and follow-up with multiple clinics. She has been stable with the most recent laboratory test results showing an Hgb of 12.3. Though her hematoma will likely take months to resolve, her life-threatening condition was effectively treated.

Discussion

PRBs are a useful tool in establishing diagnoses of renal disease, identifying prognostic factors, and in determining treatment plans. Indications for biopsies include glomerular hematuria, nonnephrotic proteinuria, nephrotic syndrome, acute nephritic syndrome, unexplained acute renal failure, and patients with SLE. Whether or not a biopsy is actually performed under these circumstances varies among nephrologists, as a clinical diagnosis is often sufficient. Studies have shown that biopsy results affect patient care in 40 to 60% of cases.¹ Thus, biopsies are often not performed when patient is only mildly symptomatic. Relative contraindications to PRB include small, hyperechoic kidney; solitary native kidney; multiple bilateral masses; refractory bleeding disorder; severe hypertension; and others. Although anticoagulation is not considered an absolute contraindication, physicians must consider risk of bleeding alongside the urgency of the biopsy. Current recommendations state that heparin should be stopped at least 6 hours prior to procedure, although 1 week is preferred.^{2,3} These patients must be observed closely, as bleeding may occur up to days after the procedure.⁴

In most cases, vascular injuries heal spontaneously and thus require only conservative management. RAE is currently the mainstay of treatment for hemodynamically unstable patients suffering from traumatic renal hemorrhage, or for bleeding that lasts for more than 72 hours.⁵ The alternative to embolization is nephrectomy or renal artery clamping, both of which lead to loss of the kidney. Other indications for RAE include malignant renal tumors, renal angiomyolipomas, arteriovenous fistulas/malformations, arterial aneurysms/pseudoaneurysms, and chronic parenchymal disease.⁶ A thorough understanding of the anatomy of the renal arterial system is vital in preparation for the embolization procedure. Typically, the renal arteries arise from the abdominal aorta between levels L1 and L2. Near the renal hilum, each of the two primary arteries divides into anterior and posterior branches. These then separate into the superior, middle, and inferior pole segments. Each artery then branches further until they give rise to the arcuate arteries running parallel to the kidney surface and then diving deep once again to form the interlobar arteries that eventually feed into the glomeruli as the afferent arterioles. Due to the fact that variations in renal anatomy occur often, visualizing via CT, MRI, or ultrasound prior to embolization can be helpful. Though the aforementioned modalities can be useful, arteriography remains the diagnostic standard in embolization.⁷ Not only does it allow for better visualization of vasculature and sites of extravasation, it also allows for super selective embolization of smaller vessels, leading to reduced kidney damage.⁵

Another important factor to consider in RAE is the choice of embolization material. Factors that contribute to the choice in material include the size and flow pattern of the vessels, the organ being embolized, the availability of the material, and the preference and knowledge of the radiologist performing the procedure.⁵ Available agents for RAE include Gelfoam, coils, PVA, and nBCA. Coils are the most commonly used agent as they allow for precise placement, which reduces affected normal parenchyma. But multiple coils are often needed, which increases cost and procedure time.⁵ PVA occludes vessels quickly and is biologically inert. But control of flow patterns can be difficult and inadvertent embolization occurs more frequently. Studies have shown that PVA particles do not fully occlude large vessels and instead become embedded in the vessel wall.⁸ This can lead to increased postembolization syndrome via occlusion of smaller vessels. The use of nBCA in renal arteries has also been reported and has been shown to be efficacious and cost-effective.⁵ The fact that it is a liquid, however, predisposes it to potential nontargeted embolization due to reflux, or accidental delivery of the agent during catheter removal. The addition of iodized oils slows down polymerization and gives the mixture radiopacity, which allows more precise placement of the nBCA and decreases risk of inadvertent embolization.⁹

The most common complication in RAE is postembolization syndrome and can affect up to 90% of patients.¹⁰ Symptoms include flank pain, fever, nausea/vomiting, ileus, and leukocytosis persisting for up to 3 days. Because of this, all RAE patients should be hospitalized overnight to monitor for these events. Treatment is primarily supportive.¹¹ Another potential complication includes coil migration, which occurs in less than 2% of cases.¹¹ Typically this is corrected at the end of the procedure using an endovascular grasping device. Inadvertent embolization of nontarget structures is yet another potential complication which can result in ischemia and infarction of bowel, lower spine, and the lower extremities. Furthermore, passage of embolic agents through an arteriovenous fistula (AVF) can lead to pulmonary emboli. Other potential complications include hematoma at the access site and contract nephropathy.

Conclusion

RAE is safe and effective and is the treatment of choice in patients with renal artery hemorrhage who are either hemodynamically unstable or have prolonged periods of bleed. When performing an RAE, it is important to visualize the anatomy of the vasculature, and to thoroughly consider the embolic agents used to best treat the patient and to minimize the embolic effect to the surrounding parenchyma. With advances to technology and improvements to the techniques available to interventional radiologists, RAE has become, and will continue to be, a vital tool in the treatment of renal artery hemorrhage.

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