Ultrasound-Guided Therapeutic Urological Interventions

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KEYWORDS

• Ultrasound • Renal • Cyst • Aspiration • Sclerosis
• Nephrostomy • Suprapubic cystostomy

Interventional uroradiology is a well-established discipline that offers minimally invasive treatment options for a wide spectrum of urinary system conditions.[1,2] Many interventional uroradiology procedures are amenable to ultrasound guidance, either alone or in combination with other modalities, such as fluoroscopy and computed tomography (CT). The use of ultrasound guidance is particularly desirable because of its low cost, accurate real-time target visualization, and lack of ionizing radiation. Furthermore, many procedures are more safely and rapidly performed with ultrasound guidance.[3] In this article, indications, techniques, and outcomes of ultrasound-guided nephrostomy, cyst aspiration, sclerotherapy, and suprapubic catheterization are reviewed and illustrated.

NEPHROSTOMY

Ultrasound-guided percutaneous nephrostomy (PCN) is a minimally invasive procedure in which the pelvicalyceal system is accessed to provide external urinary drainage or a route for minimally invasive procedures. Indications for PCN include urinary diversion for urinary tract obstruction, nephrolithiasis, urinary tract infections, urinary fistulas, hemorrhagic cystitis, and ureteral injuries, as well as to provide a percutaneous portal for more advanced interventions, including stone extraction, lithotripsy, and ureteroscopy.[3–6] Infected urinary tract obstruction is an urgent indication for PCN. The main contraindication to PCN is severe coagulopathy.[7]

Preparation for PCN includes reviewing available imaging studies to evaluate the location, anatomy, and orientation of the target kidney. In the presence of renal dysfunction, a noncontrast CT scan is still valuable. This type of study can identify and delineate the extent of subcapsular hematoma, uncontained retroperitoneal hemorrhage, and gross hematuria in the collecting system, as manifested by high-attenuation material. Ideally, patients should be made to fast for 6 to 8 hours before the procedure and intravenous access should be obtained. Most patients tolerate PCN with moderate conscious sedation and local anesthesia; general anesthesia is usually not required. Patients are typically positioned prone or oblique prone, and the target kidney is imaged using ultrasound to assess its location and anatomy again. Ultrasound-guided PCN can be successfully performed in patients with nondilated pelvicalyceal systems after diuretic administration, which provides transient distension.[8] The skin at the access site is prepared and draped following

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surgical standards. After infiltrating the region of interest with local anesthetic, a small skin incision is made using a scalpel.

Needle access for PCN can be achieved entirely by ultrasound guidance (**Fig. 1**), which is of comparable efficacy to fluoroscopic guidance and may be associated with fewer complications.[9,10] Attempting to perform PCN solely by ultrasound guidance with minimal fluoroscopy is especially desirable in pregnant patients. However, fluoroscopy is the guidance modality of choice for percutaneous nephrolithotripsy.

A posterior calyx located below the level of the 11th rib should be selected for access to the collecting system.[11] An 18- to 22-gauge access needle is oriented in a 20° to 30° posterolateral oblique approach along the avascular plane of Brödel and passed directly into the target calyx under real-time ultrasound guidance, using a single-stick technique.[11] Large-caliber needles are recommended for definitive access because they are more likely to maintain a straight path toward the target calyx during ultrasound-guided insertion.[12] Furthermore, 18- to 19-gauge needles accept the 0.035-in wires that are used for dilators and nephrostomy tubes. Alternatively, direct access to the collecting system can be obtained using a trocar system technique under ultrasound

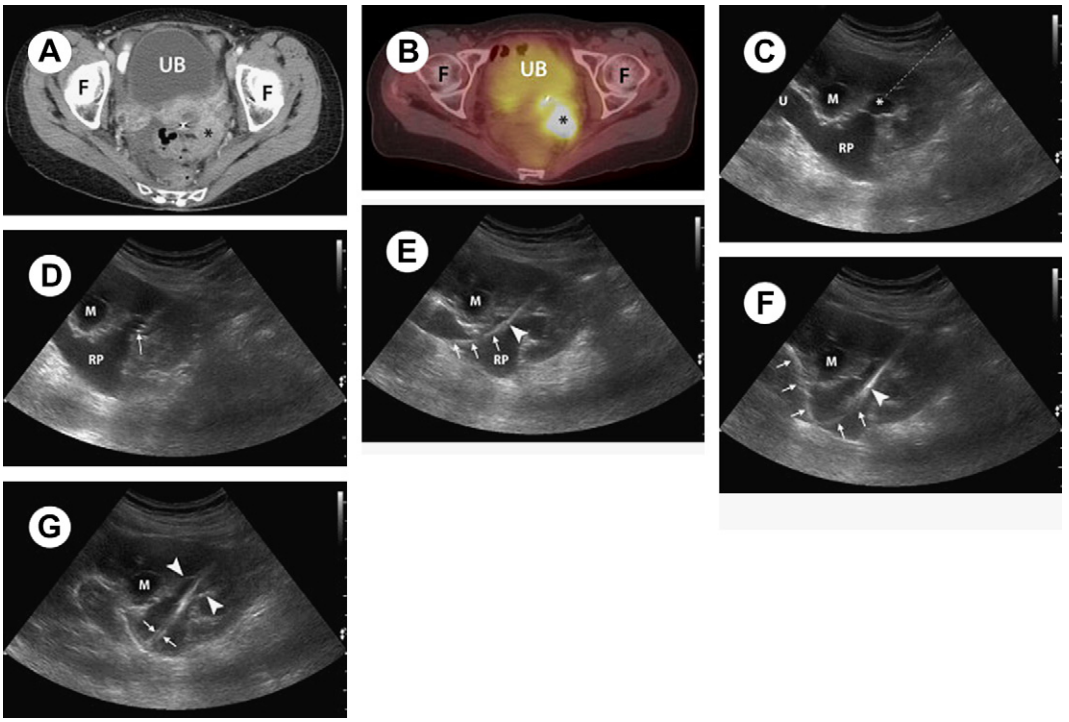

Fig. 1. Ultrasound-guided definitive needle access for PCN. (*A, B*) Axial contrast-enhanced CT image (*A*) and a positron emission tomography-CT image (*B*) at the level of the femoral heads (F) of a patient with left pelvic mass (*asterisk*) obstructing the left ureter in its distal course as it approaches the urinary bladder (UB). The malignant mass takes up radiotracer (*asterisk*). (*C*) Gray-scale ultrasound image of the left kidney with the operator centered at the lower pole calyx (*asterisk*). A dashed line is drawn to show the needle trajectory that is planned. Above the target calyx (*asterisk*) lies the mid to lower pole calyx (M). The upper pole calyx (U) is observed continuous with the renal pelvis (RP) that lies deep to the mid and lower calyces. (*D*) Gray-scale ultrasound image of the left kidney of the same patient. The operator has passed an 18-gauge needle (*arrow* at needle tip) directly into the lower pole calyx. (M indicates mid to lower pole calyx, RP indicates renal pelvis). (*E, F*) Gray-scale ultrasound image of the left kidney of the same patient. The operator has passed a 0.035-in guidewire (*arrows*) through the 18-gauge needle (*arrowhead* at needle tip) that is in the lower pole calyx. At this point of the procedure, fluoroscopy is used as the image-guidance modality. (*G*) Gray-scale ultrasound image of the left kidney of the same patient. This is an image obtained after the 8F nephrostomy drain (between *arrows*) has been placed through the lower pole calyx (between *arrowheads*) and into the RP.