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Ultrasound-Guided Renal Access and Tract Dilation

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Abstract

Introduction: Ultrasound guidance is a unique alternative to fluoroscopy for percutaneous renal access. Besides being free of ionizing radiation exposure to the patient and intraoperative personnel, it offers several advantages including easier identification of the posterior renal calix and surrounding visceral structures. In this video, we demonstrate how ultrasound can be used to guide percutaneous nephrolithotomy (PCNL) in a step-by-step manner.

Materials and Methods: From March to June 2016, 16 consecutive patients of age 18 and more with kidney or proximal ureteral stones underwent completely X-ray-free ultrasound-guided PCNL. No patients were excluded during the study period. Under general anesthesia, we place an externalized ureteral catheter through a flexible cystoscope with the patient in a frog-leg position. Retrograde saline injection is used to distend the collecting system only when needed. Then the patient is placed in a prone position. An ultrasound machine with a 3.5-MHz convex abdominal probe (Hitachi Aloka Medical America) is used to guide all steps of PCNL. For renal access, a longitudinal approach for needle insertion is usually chosen.[1] An 18-gauge Echotip needle (Cook Medical) is slowly advanced through the skin either in front of or behind the probe. On the ultrasound screen, the entire needle should be fully seen from skin to kidney and into the targeted calix. Entry into the collecting system is confirmed with either aspiration of urine or efflux of urine through the puncture needle. Then, the needle stylet is removed and a

J-tip coaxial guidewire (Bard Medical) is inserted into the renal pelvis or down the proximal ureter under ultrasound monitoring. Gently moving the wire back and forth will help identify the location of the wire tip relative to the collecting system. Subsequently, the needle is withdrawn, a 1-cm skin incision is made surrounding the wire, and a 10F fascial dilator and a safety wire introducer are then passed over the wire. Although the wire appears with a bright echogenic signal, the dilator and the safety wire introducer are not echogenic. Their advancement over the wire can be observed ultrasonographically as they obscure the echogenic appearance of the wire. A second wire is subsequently advanced into the collecting system through the safety wire introducer. A high-pressure balloon dilator (BARD X-Force, Bard Medical) is then advanced into the collecting system over one of the wires. Because the deflated balloon tip can be difficult to identify on the ultrasound screen, the wire should be moved back and forth while passing the balloon and the operative surgeon should look for a change in the wire contour to judge where the balloon tip is relative to the wire. The placement of the tip of this balloon dilator is crucial, as ideally, it should be just within the collecting system of the target calix.[2] A working tract is then dilated and the access sheath is carefully advanced until the back end of the balloon is seen. Then the balloon is withdrawn, an offset rigid nephroscope is inserted, and the stone is treated.

Results: The mean age of patients was 48.8 ± 19.9 years. Forty-four percent of patients were male with a mean body mass index of 29.9 ± 7.9 kg/m^2 and a mean stone size of 33.7 ± 15.0 mm. All procedures were effectively performed with ultrasound guidance with a mean operative time of 101.3 ± 32.2 minutes. Patients and intraoperative personnel were not exposed to any ionizing radiation during the surgery. No patients experienced any significant immediate postoperative complication. All patients were stone free (no visible stone fragments) based on intraoperative visual inspection using a flexible nephroscope and a renal ultrasound and KUB at 30 days after surgery, and no secondary procedures were required.

Conclusions: Ultrasound guidance for renal access and tract dilation in prone PCNL is feasible and efficient. Although some situations such as obese patients or nondilated collecting system may present a challenge, the benefits of adopting this technique—namely eliminating ionizing radiation exposure and live imaging of anatomy surrounding the collecting system—provide value during PCNL.

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Runtime of video: 5 mins 12 secs

Keywords: ultrasound guidance, percutaneous nephrolithotomy, renal stone

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