



# Percutaneous Nephrolithotomy in Pelvic Kidneys: Is the Ultrasound-guided Puncture Safe?

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<b>OBJECTIVE</b>	To demonstrate our experience with the use of ultrasound (USG) for puncture guidance while performing percutaneous nephrolithotomy in ectopic pelvic kidneys.
<b>METHODS</b>	From January 1990 to December 2013, we have performed percutaneous nephrolithotomy in 26 patients with USG-guided punctures. The stones were solitary in 15 patients (58%) and multiple in 11 patients (42%). The mean stone size was 22 mm (range, 10-50 mm), including 3 staghorn calculi. All procedures were performed in an oblique-supine position, and the intraoperative complications as the postoperative outcome were reviewed.
<b>RESULTS</b>	The mean operative time was 93 minutes, achieving complete stone clearance in 22 (88%) of the patients. One of the patients had urine leakage after removing nephrostomy, needing postoperative double J stenting. One patient had significant intraoperative bleeding requiring staging of the procedure and blood transfusion. No bowel injuries were identified. Mean hospitalization time was 5.6 days.
<b>CONCLUSION</b>	USG-guided puncture is a safe and effective approach to the collecting system even in renal anomalies like in pelvic ectopic kidneys when performed in experienced hands. UROLOGY 85: 55–58, 2015. © 2015 Elsevier Inc.

The pelvic kidney has an incidence of 1 in 2200 to 1 in 3000, and it occurs owing to a failure of its ascent during development that makes it to stay below the pelvic brim,<sup>1</sup> laying over the sacrum and caudal to the aortic bifurcation.<sup>2</sup> Generally, they have a high insertion of the ureter and are malrotated, predisposing to urinary stasis and nephrolithiasis.<sup>1-3</sup> This abnormal situation creates altered spatial relations with the adjacent organs (lies anterior to sacrum, caudal to aortic bifurcation, and posterior to peritoneum), abnormal calyceal orientation, and anomalous vascular patterns (deriving blood supply from iliac vessels or distal aorta), making the approach to the pelvic kidney a big challenge.<sup>3</sup> Understanding this anatomic and spatial orientation would help the urologist to create a road map for percutaneous access.

Extracorporeal shockwave lithotripsy (ESWL) has variable results in different series, reporting stone-free outcomes from 25% to 82%.<sup>4</sup> The main factors that reduce its efficacy are the surrounding bony pelvis and the loops of bowel, both interfering with the transmission of the shock waves; additionally, in many cases, drainage of the kidney is impaired, reducing the clearance of the

fragments.<sup>5,6</sup> The retrograde intrarenal surgery (RIRS) approach counts only a small case series<sup>7</sup> with stone-free rates of around 75%, always related to the accessibility of the pelvicalyceal system through the tortuous ureter, its insertion, and the stone burden.

The percutaneous nephrolithotomy (PCNL) has become the most common approach for the management of large stone burden, and in pelvic kidneys, it has proved to be as effective as in normal kidneys.<sup>3</sup> As many authors support the need for laparoscopic guidance<sup>8,9</sup> to guarantee the safety of the procedure, it becomes more challenging and time and resource consuming. Here, we present the single-center largest series of PCNL in pelvic kidneys, demonstrating that the ultrasound (USG)-guided puncture performed by experienced hands is a safe and effective technique.

## METHODS

### Patients

Twenty-six patients presented to our hospital from January 1990 to December 2013 and were diagnosed to have stones in ectopic pelvic kidney. Of those, 22 were men and 4 women, with mean age of 46 years (range, 24-70 years), and in 73% of the cases, the ectopic kidney was located on the left side. The most common symptom was pain (69%), followed by fever (12%), hematuria (4%), and abdominal mass (4%), whereas 4 patients (15%) were asymptomatic. Stones were multiple in 42% and single in 58%

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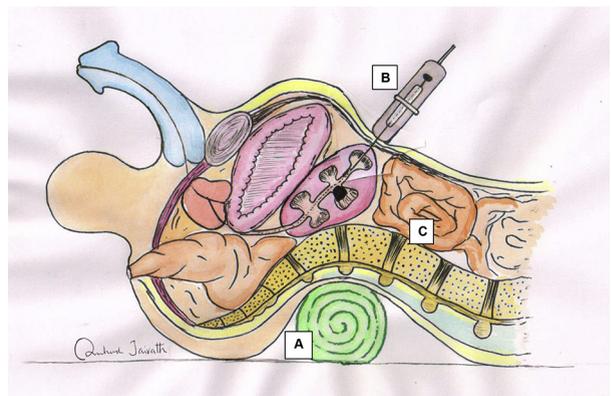
**Table 1.** Stone characteristics

	N	%
Number		
Solitary	15	58
Multiple	11	42
Size (mm)		
<15	5	19
15-30	19	74
>30	2	7
Location		
Pelvis	13	50
Calyx	7	27
Pelvis and calyx	3	11.5
Staghorn	3	11.5

of the patients. The most common location was the pelvis, and the mean size of the calculi was 22 mm (range, 10-50 mm; Table 1). Mean body mass index of patients was 21.43 kg/m<sup>2</sup> (range, 16.5-26 kg/m<sup>2</sup>), and mean preoperative creatinine was 1.09 mg/dL. Two patients had a solitary kidney and 3 had previous treatment attempts with other modalities as ESWL or RIRS.

### Technique

All the surgeries were performed under general anesthesia. Ureteric catheterization was done in every case under fluoroscopic guidance using cystoscope and the patient being in a lithotomic position. To achieve the adequate placement of the patient, a roller pack was placed under the ipsilateral hemi pelvis to attain a supine-oblique position, displacing the kidney closer to the abdominal wall. USG was done to select the desired calyx and to guide the needle with the help of puncture attachment, pressing the probe against the anterior abdominal wall to displace the bowel away from the puncture line. The target calyx chosen was the one that had the stone in it or had a direct access to the pelvis through the infundibulum in case of pelvic stone. The concept of anterior or posterior calyx, therefore, was not taken into account. As such in ectopic kidneys, the posterior calyx becomes anterior because of malrotation, and when accessing the target calyx, most of the posterior calyces were targeted when the access was done percutaneously in a supine position. The position of the needle was confirmed with the instillation of contrast under fluoroscopy. Tract dilatation was performed using serial metal Alken dilators in 72% of cases, whereas in the remaining 28% of patients, single-step dilatation was done based on the surgeon's preference. Fragmentation of the stones was achieved using a pneumatic lithotripter in 54%, USG in 15%, and Holmium laser in 12% of patients, whereas in 19% of the patients, the stones were retrieved intact. If needed, the procedure was staged. In all cases, a nephrostomy tube was placed at the end of the procedure, and ureteric stenting was done either with a 6-Fr double J (DJ) stent (65%) or by keeping the ureteric catheter (35%). In the first 6 hours after the operation, a note was made of the urine output through the per-urethral catheter and the nephrostomy tube. A note was also made of any signs suggestive of peritonitis, specifically the pulse rate, abdominal symptoms, and signs. The perinephrostomy site was dressed, and any fluid egressing by the side was also checked with respect to its color and odor. Patients were encouraged to be nil orally till the first postoperative day passed or until the time the patient cleared abdominal ileus. On the second postoperative day, postoperative workup with the x-ray and USG



**Figure 1.** Schematic representation of the puncturing technique. A roller pack (A) is placed under the ipsilateral hemipelvis to displace the kidney toward the abdominal wall. The ultrasound probe (B) is used to compress the abdominal wall over the kidney, moving the loops of the bowel cranially, away from the puncture line (C). (Color version available online.)

**Table 2.** Results

	N (%)
Complete clearance	
Yes	23 (88)
No	3 (12)
Operative time (min)	
Mean	93
Range	60-180
Tracts	
One	23 (88)
Two	3 (12)
Stage	
One	19 (73)
Two	7 (27)
Hemoglobin drop (g/dL)	
Mean	1.09
Range	0.1-2.6
Complications	
Clavien grade I	4 (2 Ileus, 2 fever)
Clavien grade II	1 (Bleeding)
Clavien grade III	1 (Wound leak)
Clavien grade IV	0
Need for auxiliary procedure	
Yes	2 (8; RIRS)
No	24 (92)
Hospital stay (d)	
Mean	5.6
Range	3-15

RIRS, retrograde intrarenal surgery.

was done to assess the stone-free status. Those patients planned for the second-stage PCNL were then subjected to the next PCNL stage through the previous tract on the third or the fourth postoperative day. In case complete clearance was achieved, patients in whom only the ureteric catheter was placed, it was removed on the second postoperative day and nephrostomy tube on the second or the third postoperative day. The per-urethral catheter was removed after 24 hours since the last documented urine leak through the nephrostomy site. Patients were discharged once all the tubes were removed. On 1-month follow-up, DJ stent was also removed under local anesthesia.

**Table 3.** Ultrasound-guided percutaneous nephrolithotomy (our experience) vs laparoscopic pyelolithotomy vs shock wave lithotripsy vs flexible ureteroscopy for ectopic pelvic kidney calculi (average stone burden ~2 cm)

	USG-guided PCNL (Our Experience)	Laparoscopic Pyelolithotomy <sup>1,2,14</sup>	SWL <sup>5,6,15</sup>	Flexible Ureteroscopy <sup>7</sup>
Number of patients	26	18	18	8
Number of access ports	1-2	3-4	0	0
Approach	Retroperitoneal	Transperitoneal or retroperitoneal	Extracorporeal	Extraperitoneal
Operative time, min	93 (60-180)	58 (40-113)	90 (60-120)	Not available
Hospital stay, d	3-16	4-11	1-2	1-3
Blood transfusions	1 patient	0	0	0
Stone-free rates, %	88	90-100	25-57	75
Need for auxiliary procedure	8	0	50-60	0
Complications			Not available	Not available
Clavien grade I	4	2		
Clavien grade II	1	0		
Clavien grade III	1	1		

PCNL, percutaneous nephrolithotomy; SWL, shock wave lithotripsy; USG, ultrasound.

In every patient, USG and kidney, ureter, and bladder (KUB) x-rays were performed the day after the surgery to exclude abdominal collections and residual stone fragments. On follow-up, patients were assessed by renal function test, urine culture, KUB x-ray, USG, and further investigations, if needed.

## RESULTS

Complete clearance was achieved in 23 patients (88%), and our mean operative time was 93 minutes. As listed in Table 2, the procedure was staged in 7 (27%) patients owing to intraoperative bleeding, active infection, or prolonged surgery time. In 2 of the 3 patients with residual stones, RIRS was done and complete clearance was attained, whereas the third patient was conservatively managed.

Of 26 patients, none had any bowel injury. One patient had urine leakage after nephrostomy removal that needed intervention in the form of DJ stenting. One patient had significant intraoperative bleeding, so the procedure was staged, and intraoperative blood transfusion was given. Two patients had ileus and 2 had fever, which were managed conservatively.

The mean hospital stay was 5.6 days (3-15 days). The follow-up period ranged from 3 months to 11.5 years. One patient had stone recurrence, which was successfully managed by RIRS during follow-up. All patients had maintained stable renal function (with mean post-operative serum creatinine being 1.07 mg/dL) and sterile urine cultures.

## COMMENT

PCNL in ectopic kidneys are infrequent and a challenging procedure. As showed by the Clinical Research Office of the Endourological Society PCNL Study Group,<sup>3</sup> in this large study of 5803 patients from 96 institutions of the 5 continents, the incidence of ectopic kidneys was 0.5%, which makes ours the largest single-center experience published until the date.

As described in previous series, the major proportion of our patients was men (85%), and the ectopic kidney was

located more frequently on the left side (73%). The most common form of presentation was flank pain in 69% of patients, which can be explained because the innervation pathways remain the same as that in the normal positioned kidneys, and pain commonly behaves in a similar manner.<sup>1</sup>

Until now, the largest series were on ESWL, showing heterogeneous results<sup>5,6</sup> with variable stone clearance rates and a substantial proportion of patients requiring repeated ESWL sessions or additional treatments as ureteroscopy.<sup>8</sup> RIRS has been described only in small series, and its use is limited by the aberrant pelvicalyceal anatomy.<sup>7,8</sup>

As an infrequent anomaly, it is difficult to establish the protocols of management, but until now even in small series, it has been demonstrated that ESWL and RIRS have high rates of failure<sup>5-7</sup> and PCNL remains as the most effective treatment modality.<sup>9-11</sup> The stone clearance rate in this study was 88%, even when a high proportion of patients had stones >2 cm and 3 of them presented with a staghorn calculus. A comparison of different parameters has been demonstrated in Table 3, which clearly shows that USG-guided PCNL is much superior compared with ESWL and flexible ureteroscopic and is comparable with laparoscopic pyelolithotomy in terms of stone clearance.<sup>5-7,12-15</sup>

Mean operative time in renal anomalies is usually longer and particularly true for pelvic ectopic kidneys. In our series, it was 93 minutes, similar to the procedures performed in normal renal units.<sup>3</sup> It is not surprising that operative times will be longer when additional procedures are associated as showed by Matlaga et al<sup>9</sup> who presented 6 cases of laparoscopic-assisted PCNL with mean operative times of 154 minutes.

The intraoperative bleeding is one of the major risks in anomalous kidneys because of the aberrant vascular patterns.<sup>2</sup> We observed intraoperative bleeding in 1 patient who needed staging of the procedure and subsequent blood transfusion. To prevent this particular complication, we are now using color Doppler during the USG

assessment to rule out any important vessel in the puncture line.<sup>16</sup> The mean hemoglobin drop was 1.09 g/dL similar to the one that has been reported in normally situated kidneys.<sup>3</sup>

In 2 patients, there was a postoperative ileus, which was managed conservatively. It is due to the extravasation of fluid into the abdominal cavity, little but enough to irritate the peritoneal surface to cause ileus. Staging of operation is done in cases in which the surgeon feels there is excessive bleeding or in case there is clinically significant abdominal distention or signs of septicemia.

Urine leakage from the tract after nephrostomy removal was observed in 1 patient that resolved after DJ stenting. In every subsequent case, we placed intraoperative DJ catheters, and we did not experience any leakage afterward.

At present, there is no consensus about the ideal method to puncture ectopic pelvic kidneys but is well known that the key point in PCNL is to achieve an adequate access to the collecting system.<sup>17,18</sup> In our center, the USG guidance is the preferred method, and we have developed a systematic puncture technique with the use of a needle guide and applied it in uncommon situations in the pediatric population and anatomic anomalies, including horseshoe kidney, crossed ectopia, and ectopic pelvic kidneys.<sup>18</sup> In this study, all the punctures were performed under USG guidance, and the target calyx was reached in every case; the complications we experienced are not related to the puncture itself but to the condition treated and thus reaffirming the safety of the USG-guided puncture in pelvic kidneys when performed in experienced hands.

An element that contributes to reduce the complications in any PCNL is the use of smaller tracts, and this is no less true in pelvic kidneys. This is taken to its maximal expression with micropercutaneous nephrolithotomy in which the size of the tract is negligible and the puncture can be done under direct vision.<sup>18</sup>

The USG helps to recognize the anatomy of the pelvicalyceal system and the ideal calyx, as well as the localization of stones and the relationship with the contiguous structures.<sup>17</sup> The benefits of selecting the USG for puncture guidance are multiple and include the possibility to discriminate between posterior and anterior calices, 3-dimensional spatial orientation, identification of the shortest access to the collecting system, precision in the plane and depth of the puncture, identification of radiolucent calculi, and localization of vascular structures. The main limitation of the USG is its learning curve, and that is why, in our opinion, the training should be systematic. Other limitation of the study is the fact that computed tomography was not done in the postoperative

period in all patients such that the stone clearance rates were mainly based on the basis of USG and x-ray KUB.

## CONCLUSION

USG-guided puncture is a safe and effective approach to the collecting system even in renal anomalies like in pelvic ectopic kidneys, when performed in experienced hands.

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