

# Outcome of percutaneous nephrolithotomy in anomalous kidney: Is it different?

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## Abstract

**Introduction:** Various anomalous kidneys such as horseshoe kidney, crossed ectopic kidney, simple ectopic kidney, pelvic ectopic kidney, kidney with duplex system, and malrotated kidney are frequently associated with stone disease. Percutaneous nephrolithotomy (PCNL) is a challenging procedure in these patients because of abnormal orientation of kidney.

**Patients and Methods:** Since 2005–2015, 86 patients underwent PCNL for stone removal in anomalous kidneys. Stone characteristics, type of calyceal puncture, number of punctures, need of relook procedures, mean hemoglobin drop, blood transfusion, mean operative time complications, mean hospital stay, stone free rate, and auxiliary procedure were analyzed.

**Results:** Totally 91 sessions of PCNL was done in 86 patients including five of horseshoe kidney who had bilateral stone disease. Mean age, duration of symptoms, stone size, and hospital stay was  $29.6 \pm 12.6$  years,  $2.18 \pm 1.41$  years,  $4.40 \pm 1.16$ , and  $4.17 \pm 2.11$  days, respectively. Sixteen patients underwent relook procedure, out of which only 6 could have complete stone clearance.

**Conclusion:** PCNL in anomalous kidney is a safe and feasible procedure similar to normally located kidney, but requires careful preoperative planning and intra- and post-operative vigilance.

**Key Words:** Anomalous kidney, horseshoe kidney, percutaneous nephrolithotomy

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## INTRODUCTION

Various types of anomalous kidneys have been described with reported incidence of 3%–11%.<sup>[1]</sup> Horseshoe kidney, crossed ectopic kidney, simple ectopic kidney, pelvic ectopic kidney, kidney with duplex system, and malrotated kidney are associated with stone disease because of impaired urinary drainage due to abnormal anatomy such as narrowing of pelvic ureteric junction or high insertion of ureter.<sup>[2,3]</sup> Due to this

abnormal anatomy, there is an ongoing debate regarding the best technique for stone removal in anomalous kidneys.

Extracorporeal shock wave lithotripsy (ESWL) has been moderately successful and reported stone clearance in horseshoe kidney is 28%–78% while for ectopic kidney it is 66%–71%.<sup>[4]</sup> For larger stones and in cases with

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impaired urinary drainage, stone clearance by ESWL is unsatisfactory.<sup>[4]</sup> Various minimal invasive techniques have been used for stone removal including flexible ureteroscopy, percutaneous nephrolithotomy (PCNL), laparoscopy-assisted PCNL, and laparoscopic pyelolithotomy.

PCNL is a challenging procedure because of abnormal orientation of kidney, abnormally placed calyces and high incidence of abnormal renal vessels. During PCNL in normally located kidney, pelvis is found medially while calyces are found posteriorly. In horseshoe kidney and malrotated kidneys, pelvis rotates anteriorly, and calyces are found posterolaterally so puncture becomes difficult, while in ectopic pelvic kidney, as bowel is surrounding the kidney so laparoscopic assistance is required.<sup>[2]</sup> Similarly, in duplex system stones of superior calyx cannot be negotiated by inferior calyx and vice versa. All these factors make PCNL quite difficult in such cases.

The chance of stone clearance by PCNL in horseshoe kidney varies due to technical difficulty ranging from 75% to 100% with an average stone-free rate of 84%.<sup>[5]</sup> Similarly, stone clearance of PCNL in ectopic kidney is better than ESWL. Although there are individual studies on PCNL in horseshoe kidney and ectopic pelvic kidney but only few studies are available showing feasibility and success of PCNL in other malformed and malpositioned kidneys. We present our experience of PCNL in various types of anomalous kidneys over last one decade.

## PATIENTS AND METHODS

Since January 2005 to December 2015, a total of 86 patients were included who had PCNL for stone removal in anomalous kidneys. Among these patients, 40 patients had kidney with duplex system, 20 had horseshoe kidneys (15 were unilateral and 5 bilateral total 25 renal units), 10 patients had crossed ectopia, 8 patients had ectopic kidney, and rest 8 had malrotated system [Table 1].

All patients were evaluated preoperatively with clinical history, examination, hemogram, renal function test, liver function test, and urine analysis. Imagings were done by ultrasound and X-ray of kidney, ureter, and bladder (KUB). Intravenous urogram was done in 30 patients and Computed tomography (CT) urogram in 56 patients. Diethylenetriaminepentaacetic acid scan was done in 24 patients, who had thin renal parenchyma due to obstruction. Totally 1562 patients who had normal kidney with stones and underwent PCNL in this period were excluded from the study. All data were collected in retrospective manner. For statistical analysis, SPSS 16.0 (IBM, USA, 2009) software and unpaired *t*-test were used.

## Procedure

Contrast tomography (CT) urogram was discussed with radiologist preoperatively for the associated vascular anomalies with regard to pelvicalyceal system and a most suitable calyceal puncture was selected, but all punctures were done by urologists only. All procedures were done either in regional or general anesthesia. Initially, the patient placed in dorsal lithotomy position; ureteric catheter was placed on affected side, and retrograde pyelography was done. All patients of horseshoe kidneys, malrotated kidneys, kidneys with duplex systems, and crossed renal ectopia were placed in prone position while patients with pelvic kidney were kept in supine position.

## Horse shoe kidney

PCNL were done in standard fashion under fluoroscopic guidance using bull's eye technique with an end on view of posterior calyx. Site and number of punctures were decided by position of stones in different calyces or pelvis. In case of horseshoe kidney, infracostal calyceal puncture was performed in all cases due to downward displacement of the kidney without danger of pleural violation.

## Pelvic kidney

In ectopic pelvic kidney, the patient remained in supine position, and laparoscopic assistance was taken for puncture. Port placements were done following creation of pneumoperitoneum, camera port (10 mm) were placed 10 mm distal to umbilicus and two 5 mm working port were placed in iliac fossa. Peritoneum was reflected, and bowel retracted away from the kidney. With the help of C-arm guidance, desired calyx is punctured and intra-abdominal course was guided by laparoscopy. The tract dilatation was done under combined help of laparoscopy and fluoroscopy.

## In duplex system, malrotated kidney and crossed ectopia

Standard principle is applied and using C-arm and radiocontrast agent calyceal puncture was done.

After confirming the correct puncture, guide wire inserted and tract was dilated up to 24–28 Fr and amplatz sheath placed. In all cases, 22 Fr (20°, Richard Wolf) nephroscope was used. With the help of Swiss pneumatic lithoclast (Richard Wolf), stones were fragmented and removed. Postoperative

**Table 1: Percutaneous nephrolithotomy in various anomalous kidneys with stone disease**

Types	Number of patients (n=86)
Kidney with bifid system	40
Horseshoe kidneys	20 (bilateral in 5)
Malrotated	8
Simple renal ectopia/pelvic ectopia	8 (4+4)
Crossed ectopia (separate)	6
Crossed ectopia (fused)	4

stone clearance was detected by X-ray and renal ultrasound. In 15 cases, CT scan KUB was done. Stones <4 mm were considered clinically insignificant. In all patients, stone characteristics, type of calyceal puncture, number of punctures, need of relook procedures, mean hemoglobin drop, blood transfusion, mean operative time, mean hospital stay, stone free rate, auxiliary procedure, and complications were recorded.

## RESULTS [TABLES 1-3]

Totally 91 sessions of PCNL were done in 86 patients including five of horseshoe kidney who had bilateral stone disease. Mean age and mean duration of symptoms were  $29.6 \pm 12.6$  years and  $2.18 \pm 1.41$  years. Presenting complaints were flank pain (36%), hematuria (18%), and nonspecific abdominal pain (22%). Totally 74 patients required only single session of PCNL for complete stone clearance while 16 patients underwent relook procedure. However, only six could achieve complete stone clearance, while rest ten patient required ESWL

**Table 2: Demographic characteristics and stone configuration**

Characteristics	Mean±SD (n=86, units=91)
Age (years)	29.6±12.6
Duration of symptoms (years)	2.1±1.41
Right/left	56/35 (units=91)
Male/female	58/28
Site of stone (unilateral/bilateral)	86/5
Stone size (cm)	4.40±1.16
Number of stones (single/multiple)	71/20
Stone configuration	
Pure pelvic	50
Calyceal	26
Complex (pelvis with multiple calyces)	15

SD: Standard deviation

**Table 3: Perioperative results of percutaneous nephrolithotomy**

Characteristics	Mean±SD (n=86, units=91)
Mean operative time (min)	123.9±19.7
PCNL in one sitting/relook	75/16
Stone clearance with single session (%)	75/91 (82.4)
Stone clearance after the second session (%)	81/91 (89.0)
Mean hospital stay, days (%)	4.17±2.11
Calyceal puncture	
Superior only	29
Mid posterior only	40
Inferior only	14
Multiple calyceal	8
Mean drop of Hb (g/dl)	0.8
Blood transfusion (%)	15/91 (16.4)
Complications (Clavien)	
Grade 1	16
Grade 2	15
Grade 3	0
Grade 4	3
Minor complications	
Fever	10
Hematuria	3

PCNL: Percutaneous nephrolithotomy, SD: Standard deviation

for complete stone clearance. Out of 91 sessions, 83 patients had single puncture while nine patients had multiple calyceal puncture for stone removal. No major complications were found in intra- and post-operative period. Three patients required one session of hemodialysis in postoperative day 2, due to postprocedural raised serum creatinine. These three patients had raised serum creatinine preoperatively (mean 2.3 mg/dl) and had bilateral renal stones. Totally 13 patients had minor complications and were managed conservatively.

## DISCUSSION

The common congenital renal anomaly present with stone diseases is horseshoe kidney, ectopic pelvic kidney, crossed ectopic kidney (fused or separate), kidney with duplex system, and malrotated kidneys.<sup>[6]</sup> Stone removal in anomalous kidney by PCNL is difficult due to altered orientation of pelvis and calyces, altered renal vasculature as well as altered relations with intra-abdominal organs and relative immobility.<sup>[7]</sup> Minimal invasive techniques are advantageous in stone removal due to satisfactory stone clearance, reduced hospital stay, early recovery, and reduced analgesia requirement.<sup>[8]</sup> Although there are individual case reports and case series of minimal invasive techniques in horseshoe kidneys or pelvic ectopic kidney,<sup>[9]</sup> an overall data regarding PCNL in various anomalous kidneys are less reported.

ESWL remains one of the options for stone clearance, yet the anatomic abnormalities may prevent fragment passage in a substantial number of patients. The limitation of ESWL is that success rate of stone clearance decreases with increasing stone size.

Although literature suggested flexible ureteroscopy as a feasible option for stones in pelvic kidneys,<sup>[10]</sup> again it is indicated for small stones. The mean stone size in the present study was 4.4 cm for which PCNL should be the preferred treatment. In the present study, rigid nephroscope for PCNL was used in all cases.

Stone configuration has an impact in stone clearance rate. In our series, most of the patients who had pelvic stone required one session for complete clearance. In those 16 cases that underwent relook nephroscopy, stone were either larger in size or present in multiple calyces. In these cases, flexible nephroscopy could be one option.<sup>[11]</sup>

Patients of complex stones should be counselled preoperatively regarding the need for relook procedure as well as probability of residual stones and auxiliary procedures. In the present study, stone clearance rate was 82% in single session and 89% after relook and auxiliary procedure which are comparable to those

reported literature.<sup>[11]</sup> 16 (17.5%) patients needed relook procedure which is similar to the reported incidence of various literatures.

Although in our series mid posterior calyceal puncture was most commonly done, superior calyceal puncture can be done without injury of pleura particularly in horseshoe kidneys with negligible or no chance of pleural complications.<sup>[12]</sup>

In one series of horseshoe kidney with stones, major complications were in the range of 6.6%. In the present series, no major complications were found, although a large number of patients (20/86) were of horseshoe kidney.<sup>[13]</sup> Three patient of renal failure had to undergo dialysis in postoperative period due to an elevation of serum creatinine. These three patients had raised serum creatinine due to bilateral renal calculus since preoperative period, and for which bilateral double-J stenting was done. After stabilization of serum creatinine (mean nadir 2.3 mg/dl), these patients underwent surgery.

PCNL has its own complications and morbidities; intraoperative bleeding is not very rare with reported incidence of blood transfusion is 14%–24% in larger stones.<sup>[14]</sup> In the present case, total 15 (16.4%) patients underwent blood transfusion in postoperative period. The incidence of bowel injury in pelvic kidneys in various reported literature is 13%–27%,<sup>[8]</sup> four of our patients had stones in pelvic kidney that underwent PCNL with complete clearance. Although the number is small but no incidence of bowel injury was found. Similarly, other perioperative results such as mean operative time, mean hospital stay, other minor complications, and need for auxiliary procedure were similar to those reported in literature.<sup>[3,6]</sup> Although there are no individual series for duplex system with stones to the best of our knowledge, in our case, 40 patients successfully underwent PCNL procedure which was done as per standard protocol.

## CONCLUSION

PCNL in anomalous kidney is a safe and feasible procedure similar to normally located kidney but requires careful

preoperative planning and one has to be vigilant for all possible intra- and post-operative complications.

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## Conflicts of interest

There are no conflicts of interest.

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