Original Article

DECREASING THE COMPLICATIONS OF PCNL WITH ALTERNATIVE TECHNIQUES INCLUDING COMPLETE SUPINE PCNL AND SUBCOSTAL APPROACH

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ABSTRACT

Objectives: To assess the incidence of complications during percutaneous nephrolithotomy.

Methodology: We studied the files of patients at our urology research center in Rasht, Iran from 2007-2008. One hundred and seventy four patients with symptomatic renal and upper ureteric calculi were selected with the technique of non-probability convenient sampling. Complications of surgery were evaluated and divided into 3 categories: peri-operative, early, and late complications of surgery. Perioperative complications included bleeding, transfusion, extravasation, and injury to adjacent organs. Early complications following surgery included post operative bleeding, post operative transfusion, extravasation, infection, and residual stones. Late complications included injury to adjacent organs. All patients were subjected to PCNL. The data was analyzed on SPSS version 10.

Results: Regardless of position, the pelvicaliceal system could be successfully approached in all patients. The mean age of patients was 44.71± 13.16 years. The mean stone size in was 26.64 ± 14.39 mm. The mean operation time was 95.14± 26.57 minutes. The stone free rate was 85.7%. Peri operative complications included transfusion due to bleeding 5.7%, and extravasation 3.4%. Early complications included transfusion due to bleeding 5.1%, extravasation 2.3%, infection 2.9% and residual calculi 14.3%. Late complications were not seen. No mortality was recorded. The most common stone site was pelvic stone (34.4%). Stone sites in 45.9% of our patients was in the right kidney while 54.1% was left-sided.

Conclusions: PCNL is a valuable treatment option for kidney stones. Potential advantages include less hospital stay with lower cost, lower discomfort and pain, and a lower complication rate. Also PCNL can be applied to many patients with kidney stones. We recommend a subcostal approach and also the use of complete supine PCNL (csPCNL) in decreasing the complications of PCNL.

KEY WORDS: Lithotripsy, Urinary calculi, Postoperative complications, Complete supine PCNL (csPCNL), Subcostal approach.

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INTRODUCTION

The formation of stones in the urinary tract is an ancient disease known to mankind for ages.[1] Hippocrates was the first urologist who removed an infected stone from a perinephric abscess.[2] Roman, Egyptain and Muslim physicians further advanced the treatment of

urinary tract stone disease.[3] Surgical management of urinary calculus disease has evolved considerably over the past two decades.[1] Specifically, the introduction and refinement of percutaneous and ureteroscopic access to the upper tracts, along with the nearly simultaneous development of both extracorporeal and intracorporeal lithotripsy, have relegated the role of open surgery to less than 1% of patients undergoing intervention for their stone disease.[4]

Percutaneous Nephrolithotomy (PCNL) is currently the procedure of choice for removing large and complex renal calculi.[5-7] Urinary stone is the third common disease of urinary tract. Recent improvements in instrumentation and techniques have furthered PCNL in kidney stone treatment. The most important indications of PCNL are stone size >2.5cm, resistance to ESWL, lower pole calyx stones with long and thin infundibulum and oblique infundibulo-pelvic angle. Complications of PCNL are bleeding, transfusion, renal vein rupture, ureteral or pelvic perforation, deoudenal perforation, splenic injury, liver injury, gram (-) sepsis and retained stones.[1] Even though percutaneous renal surgery is less invasive than an open procedure, complications may occur. Renal hemorrhage is the most worrisome complication of PNL.[6,8,9]

The advantages of the percutaneous method include lower morbidity and mortality faster convalescence, greater ease of repeat procedures, greater cost effectiveness, small incision, and minimum operative and postoperative complications.[2,3,8,10] In this study, we assessed the complications in a group of percutaneous nephrolithotomy cases (174 patients) and offer several recommendations for minimizing these problems.

METHODOLOGY

The study was conducted in our Urology Research Center from March 2007 to March 2008. A total of 174 patients were selected for the study with the technique of non-probability convenient sampling. All patients were from the age of 9-75 years (average 43.00 ± 12.78). All patients had normal preoperative coagulation profiles and a hemoglobin level greater than 10 g/dl before the procedure. One well-experienced urologist conducted all the operations. For both groups a 5F or 6F occluding ureteral catheter was inserted in a retrograde fashion cystoscopically to the ureteropelvic junction or just beneath the obstructive stone allowing the injection of air, saline or contrast media. Then, PCNL was performed under general or regional anesthesia and under a complete supine or prone position. The renal access tract was obtained subcostally in all patients in both groups by puncture of an 18-guage needle under fluoroscopic guidance. The return of urine on removal of the stylet of the needle confirmed entrance into the collecting system. Then, a 0.038-inch J-tip wire was inserted. Tract dilation was established by acute dilation from skin to fornix, papilla, or infundibulum. The stone fragments were subsequently retrieved with grasping forceps and irrigation. Nephrostography through an Amplatz sheath was performed at the end of the operation for all patients. No hemostatic agent was used during surgery. Within 24 hour after stone removal, a plain abdominal radiograph and sonography was obtained in order to verify that the stones had been completely removed, and that the collecting system had remained intact. The nephrostomy tube was clamped overnight and subsequently removed in patients with nephrostomy tube. A follow up KUB and sonography was obtained 2 weeks post-procedure and an IV urogram and CT scan were obtained after 3-6 months if deemed necessary.

RESULTS

The mean age of the patient population was 44.71± 13.16 years (range: 9-75 years). Among the 174 total patients, 90 were male (51.8%) and 84 were female (48.2%). Eighty patients (45.9%) had right sided stones and 94 (54.1%) had left sided stones. The most common site of stone was in the renal pelvis (34.4%) while the most uncommon was in the upper pole (3%). The mean stone size was 26.64± 14.39 mm

(range: 18-80cm) (Table-I). Access rate was 100% and the mean operation time was 95.14 ± 26.57 minutes (range: 30-160min). A single stone was seen in 42 patients (24.1%) and multiple stones (>1stone) were seen in 132 patients (75.9%). Stone free rate post surgery was 85.7% (149 patients), while 25 patients (14.3%) including 12 females and 13 males had residual stone (Table-II). Significant intraoperative complications were observed in 16 patients (9.1%) including extravasation, and need for transfusion. Ten patients (5.7%) required blood transfusion due to hemorrhage and six patients (3.4%) developed extravasation. Early complications included postoperative hemorrhage, postoperative transfusion, extravasation, infection, and stone residue. Nine patients (5.1%) required transfusion, and four patients (2.3%) had extravasation. Infection and stone residue were seen in five (2.9%) and 25 (14.3%) patients, respectively. Extravasation was defined as urine existence from the nephrostomy tract after five days. Injury to near organs as a late complication was not seen. In our study, hyponatremia and mortality were not seen (Table-II). Hypothermia also was not seen in our patients and may be due to Amplatz sheath dependent drainage in the complete supine position (Fig-1).

Fig-1: Complete supine position.

DISCUSSION

Surgical management of renal tract stone disease has been revolutionized during the last two decades after the introduction of minimal invasive techniques, like ESWL and PCNL.[1] PCNL has become a common procedure performed in patients with renal calculi.[11] Percutaneous nephrolithotomy (PCNL) was first described by Rupel and Brown in 1941.[12] Removal of a renal calculus via the percutaneous tract, was not performed until Fernstorm and Johnson used such a technique successfully in three patients 30 years later.[13] Percutaneous

Table-I: Patient demographics

Mean age± SD (yr)	44.71± 13.16
M: F	90:84 (51.8%:48.2%)
Site of stones	R= 80 (45.9%) L=94 (54.1%)
Most common site of stones	pelvic (34.4%)
Most uncommon site of stones	upper pole (3%)
Mean size of stones (mm)	26.64± 14.39
Mean operation time (minutes)	95.14 ± 26.57
Single stone	24.1%
Multiple stones (>1 stone)	75.9%

Table-II: Results of percutaneous nephrolithotomy

Access rate	100%
Stone free rate	5.7%
Intraoperative complications:	9.1%
Blood transfusion	5.7%
Extravasation	3.4%
Hypothermia	0
Early complications:	
Postoperative transfusion	5.1%
Extravasation	2.3%
Infection	2.9%
Stone residue	4.3%
Hyponatremia	0
Late complications:	
Injury to near organs	0
Mortality	0

nephrolithotomy is safe and effective.[1] In a community setting, approximately 90% of targeted stones can be removed successfully, and at experienced subspecialty care centers, this rate can approach 100%.[4] Improvements in the technique of percutaneous renal surgery have decreased the morbidity associated with these procedures.[14]

Our mean operation time was 95.14 ± 26.57 minutes (range: 30-160min), which is considerably less than Neto's results of 162.1 minutes.[15] In the Yeon Chin study, the mean operation time in PCNL on staghorn stones was 94.9 minutes[16] which is similar to our findings. An access rate of 98.3% had been reported from the Mayo clinic in a series of 1000 patients for small symptomatic calculi of the upper ureter and renal pelvis.[9] Access rate was 100% in our study. We believe that in today's world, because of an increase in experience of the urologist, access rate is high in all studies. We defined stone free rate as complete clearance and stone fragments<5mm. In the present study, stone free rate was 85.7%. These results were similar to different studies conducted by Wickham, Whitfield and Clayman. Their results of successful stone free rate varied from 80 to 92% according to the size, nature and chemical composition of the stones.[17,18] Also in Peyene et al study, which reviewed 450 patients of PCNL and reported successful removal of stones in 93% of cases.[19] Denby steele in his study, reported complete clearance of significant stone fragments in 91% of patients who underwent PCNL.[20] Rana et al reported their PCNL results in 110 patients with renal stone. A stone free rate of 80% was achieved using PCNL as monotherapy.[21] Also complete clearance with PCNL was 89% in Aron M study which was performed on preschool children with complete staghorn calculi[22] and in another study, an 82.8% stone free rate was reported.[16] All of these are similar to our results. A PCNL puncture and stone removal may reactivate infection as in two of the patients of the Won et al study.[8] In Sarhad Khan et al study, febrile UTIs were observed in 8 patients (4%) which were subsequently treated conservatively with parenteral antibiotics.[1] Li MK and Lames S reported symptomatic urinary tract infection in 5.5-9.2%.[23,24] In our study infection requiring antibiotics were seen in five patients (2.9%), which was similar to other studies. We did not have any reports of septicemia or mortality secondary to infection.

The organs most often injured during PCNL and stone removal are the lungs and pleura, with possible pneumothorax or hydrothorax.[25,26] Neither complication was seen in our study because of the subcostal approach we used for renal access.[7]

Bowel perforation can be a serious complication of PCNL puncture.[8] In a series of 250 patients reported from France, perforation of the left side of the colon led to rectal hemorrhage and shock in one patient and passage of gas through the PCN tract in another.[27] In the Juan et al study, only a few cases of colon perforation during percutaneous nephrolithotomy (PCNL) were reported but in our study there was not any injury to near organs as a late complication[28] and may be due to the complete supine position in our patients.[29]

Percutaneous nephrolithotomy is generally accepted as a safe procedure. Hemorrhage is the most frequent complication of this procedure. Excessive bleeding can occur during needle passage, tract dilation, or nephrostomy.[6,8,9] Acute bleeding requiring transfusion has been reported in 3% to 12% of cases.[9,10,30] Shoma and colleagues reported a bleeding rate of 9% in their patients.[31] In our study, postoperative complications included transfusion due to hemorrhage, extravasation, infection and stone residue. Nine patients (5.1%) developed postoperative transfusion due to hemorrhage, four patients (2.3%) had extravasation. Infection and stone residue were seen in five (2.9%) and 25 (14.3%) patients, respectively. In the Sarhad Khan et al study, postoperative complications were observed in 24 patients (12%), which was similar to our study. In their study, 8 patients (4%) required blood transfusion due to primary hemorrhage.[1] Blood transfusion requirement ranged from 2-18% according to the literature and the need

for selective embolization or open intervention was performed in 1-1.5%.[32] Fortunately, in our study and the Sarhad Khan et al. study no patient required selective embolization or nephrectomy.[1]

Overall morbidity ranges from 7.5% to 18% depending on the sample size and the presence of complicated renal stone.[33,34] Overall mortality of PCNL ranges from 0.5% to 1.1% and is generally attributed to severe hemorrhage, urosepsis or pulmonary embolism.[23,33,35] No mortality was recorded in the present study, thus highlighting the fact that PCNL is a safe and effective treatment modality in experienced hands.

Generally, compared to other studies, incidence of complications such as injury to near organs, hypothermia, hyponatremia, colon injury and pleura injury were not seen in our study, and intraoperative and early postoperative complications were similar to other studies. The colon floats away from the kidney when the patient is in the supine position decreasing the risk of colon injury, and Amplatz sheath drainage is better. The risk of hypothermia is also lower.[29]

Advantages of PCNL in comparison with open surgery include cost effectiveness, less complications, less discomfort and an increased stone free rate. PCNL is also suitable for stones greater than 2.5cm, for those with resistance to ESWL, and a closed infundibulic angle. Prevention of complications during endourologic procedures such as PCNL, and for optimal outcomes, proper education and experience of the urologist along with the use of modern equipment is necessary. To decrease lung and pleural injury, we recommend a subcostal approach if possible. To decrease colon injury and hypothermia, we recommend using complete supine PCNL (csPCNL).

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