Renal Access by Sonographer versus Urologist during Percutaneous Nephrolithotomy

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Purpose: To evaluate the percutaneous access outcomes and complications following percutaneous nephrolithotomy (PCNL) that was obtained by sonographer or urologist at a single academic institution.

Material and Methods: A retrospective chart review of 259 patients who underwent PCNL was performed. Patients were stratified according to percutaneous access by sonographer (group 1) or urologist (group 2) in 174 and 85 patients, respectively. Demographic, stone characteristics, operative variables, percutaneous access complications and stone-free rates were compared between groups.

Results: The major complication rate and minor complication rate, mean blood loss and rates of blood transfusion were comparable between groups. Compared with urologist, sonographer preferred to choose subcostal rib puncture instead of intercostal rib puncture. The lower calyx was the most frequent site of target calyx puncture in group 1 (165 cases, 94.8%), while the percentage of lower calyx in group 2 was 82.3% (72 cases) (P = .001). The overall stone-free rates were significantly higher in group 2 than that in group 1 (90.6% vs. 79.9%, P = .03). In group 1, 23 cases (13.2%) needed post-operative extracorporeal shock wave lithotripsy (SWL), while, the percentage of post-operative SWL in group 2 was only 4.7% (4 cases) (P = .035).

Conclusions: Renal access in PCNL can be safely and successfully obtained by both sonographer and urologist. Infracostal and lower calyx access in our study has poor stone-free rates and sonographer prefers infracostal and lower access. We encourage urologists establish renal access by themselves during PCNL.

Keywords: nephrostomy; percutaneous; retrospective studies; ultrasonography; treatment outcome; physician's role.

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INTRODUCTION

Percutaneous nephrolithotomy (PCNL) has become a mainstay for the treatment of renal stones since the first successful removal of a renal calculus via a nephrostomy tract in 1976[1] Implications of PCNL include stones > 2.0 cm in diameter, complex and special renal stones. In China, historically, access to the kidney for stone has been performed by radiologists or sonographers. Recent studies compare the outcomes of renal access for PCNL that is obtained by radiologists or urologists.[2-5] However, to our knowledge, no study has yet been discussed about the difference between sonographers and urologists. We evaluated percutaneous access for PCNL that was obtained by sonographer or urologist and compared access outcomes and complications.

MATERIAL AND METHODS

Clinical data

A total of 259 patients (148 men and 111 women, mean age 42.1 years, range from 20 to 67 years) were prospectively enrolled in this study from January 2009 to May 2012 in the First Hospital of Jilin University. Patients were stratified according to percutaneous access by sonographer (group 1) or urologist (group 2) in 174 and 85 patients, respectively. Patients in group 1 were consecutively performed by sonographer from January 2009 to May 2011. Patients in group 2 were consecutively performed by urologist from May 2011 to May 2012. Preoperative factors that were analyzed included gender, age, body mass index (BMI), stone position, mean maximum stone diameter, presence of hydronephrosis, stone type (complete staghorn, partial staghorn or pelvic), associated comorbidities (hypertension, diabetes mellitus, pulmonary disease or coronary artery disease) and previous medical or surgical history. Kidney patients were excluded from the study if they had 1 phase nephrostomy. All surgeries were finished by the same surgeon. Furthermore, the sonographer was the same person in this study.

Procedure of PCNL

The entire procedure was performed under general anesthesia. Ureteral catheter was inserted retrograde into the pelvicaliceal system with the patient in lithotomic position. The patient was repositioned to the prone position and a specially designed cushion was placed on the table to enable a deflected position.

An 18-gauge coaxial needle (Cook Inc., Bloomington, Indiana, USA) was introduced into the targeted calyx under the guide of Doppler ultrasound (Aloka 5) by the sonographer or surgeon. Selection of the targeted calyx and number of access tracts were dependent on stone location, pelvicaliceal anatomy and the preference of sonographer or surgeon. The working channel was then dilated by using the plastic dilator system (Cook Inc., Bloomington, Indiana, USA) or X-Force Nephrostomy Balloon Dilation Catheter (BCR Inc., Tainan, Taiwan), followed by placement of either 18F or 26F working sheath.

The Lumenis 60 w lithotripter (Lumenis, Santa Clara, CA, USA) or Cybersonics Double-catheter system (Gyrus/ACMI, Southborough, Mass., USA) was used to fragment the renal stone. At the end of the procedure, an X-ray check for residual stone fragments was performed. A 20 Fr Foley catheter was placed as a nephrostomy tube and it was removed if there was no extravasation at approximately 3 days post-operation. Patients were considered stone-free when no stone > 4 mm was visualized. Residual fragments > 5 mm in diameter were treated with extracorporeal shock wave lithotripsy (SWL) or the second phase PCNL.

Major complications were considered as septicemia, hemorrhage requiring angiographic renal embolization or nephrectomy, thoracic or abdominal organ injury, acute pancreatitis. Transient fever, clinically insignificant bleeding, urinary tract infection without signs of urosepsis, renal colic, and prolonged urinary leakage from the percutaneous access were considered minor complications.

Statistical analysis

The statistical package for the social science (SPSS Inc, Chicago, Illinois, USA) version 15.0 was used for all statistical analyses. Comparisons were made using Student's t tests and Pearson's chi-square tests, where P value < .05 was considered statistically significant.

RESULTS

Of the 259 patients reviewed, 67.2% and 32.8% underwent percutaneous access by sonographer or urologist, respectively. The patients and stone characteristics of the study groups are summarized in Table 1. There was no statistically significant difference between the groups with regard to sex, age,

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Table 1. Patients and stones characteristics in the two study groups.

	Sonographer-made access (Group 1)	Urologist-made access (Group 2)	P
Patients, no.	174	85	-----
Male to female ratio	96/78	52/33	.359
Mean age, year (range)	41.6 (21-65)	42.5 (20-67)	.745
Mean BMI, kg/m^2	25.3 (20-28)	24.6 (21-28)	.426
Renal/Ureter stone, no.	139/35	63/22	.293
Stone side, right/left	88/86	45/40	
Mean maximum stone diameter, cm (range)	3.2 (1.6-7.2)	3.1 (1.8-6.8)	.395
Hydronephrosis, yes/no	151/23	69/16	.236
Stone type, n (%)			
Complete staghorn	31 (17.8)	16 (18.8)	.843
Partial staghorn	45 (25.9)	23 (20.1)	.837
Pelvic	62 (35.6)	34 (40)	.494
Multiple stones, no.	102 (58.6)	58 (68.2)	.135
Associated comorbidities n (%)			
Hypertension	23 (13.2)	10 (11.8)	.742
Diabetes mellitus	12 (6.9)	7 (8.2)	.698
Pulmonary disease	9 (5.2)	5 (5.9)	.812
Coronary artery disease	8 (4.6)	5 (5.9)	.657
Previous medical and surgical history (%)	8 (4.6)	5 (5.9)	.657

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mean BMI, stone position, stone diameter, presence of hydronephrosis, stone type (complete staghorn, partial staghorn or pelvic), associated comorbidities (hypertension, diabetes mellitus, pulmonary disease or coronary artery disease) and previous medical or surgical history.

Double accesses were required in 8 cases (4.6%) in group 1 and in 6 cases (7.1%) in group 2 ($P < .05$) (Table 2). Sonographer preferred to choose subcostal rib puncture (166 cases, 95.4%) instead of intercostal rib puncture (8 cases, 4.6%), however, in urologist group, 74 cases (84.7%) were subcostal rib puncture and 13 cases (15.3%) were intercostal rib puncture ($P = .003$). The lower calyx was the most frequent site of target calyx puncture in group 1 (165 cases, 94.8%), while the percentage of lower calyx in group 2 was 82.3% (72 cases) ($P = .001$).

The major complication rate (1.7% vs. 1.2%; $P = .737$) and minor complication rate (7.5% vs. 8.2%; $P = .829$) were comparable between groups. Mean blood loss and rates of blood transfusion were also similar between groups. The overall stone-free rates were significantly greater in the urology access group than that in the sonographer access group (90.6% vs. 79.9%, $P = .03$). There was no statistically significant difference between the groups with regard to mean operation time (defined as the time from ureteral catheterization to the placement of the nephrostomy tube), mean hospital stay and stage 2 PCNL. However, 23 cases (13.2%) needed postoperative SWL in group 1 and the percentage was only 4.7% (4 cases) in group 2 ($P = .035$).

DISCUSSION

Improvement of technology and increasing experience has led to enhancement of safety and efficacy of PCNL. However, reported complication rates still reach 3% to 18% according to different scholars.[6-8] Proper selection of the targeted calyx and successful puncture could raise the stone-free rate and avoid injuring important blood vessels. Dependent on the ultrasonography or fluoroscopy guided PCNL, historically, access to the kidney for stone treatment has been performed by sonographers or radiologists. However, recently, in the past several years, urologists attempted to puncture by themselves.[9,10] Recent studies discussed the outcomes of percutaneous access for PCNL that was obtained by ra-

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Table 2. Operative details and outcomes in the two study groups.

	Sonographer-made access (Group 1)	Urologist-made access (Group 2)	*P*
No. of sites required (%)			
Single	166 (95.4)	79 (92.9)	.411
Multiple	8 (4.6)	6 (7.1)	
No. of rib puncture (%)			
Subcostal	166 (95.4)	72 (84.7)	.003
Intercostal	8 (4.6)	13 (15.3)	
Calyx puncture (%)			
Lower	165 (94.8)	70 (82.3)	.001
Middle	9 (5.2)	15 (17.7)	
Upper	0	0	
Mean operative time, min (range)	74.5 (43-145)	75.6 (38-163)	.853
Stone free rate, n (%)	139 (79.9)	77 (90.6)	.03
Mean hospital stay, day, (range)	8.2 (6-16)	7.9 (6-15)	.385
Stage 2 PCNL, n (%)	8 (4.6)	1 (1.2)	.158
Stage 2 ESWL, n (%)	23 (13.2)	4 (4.7)	.035
Mean blood loss(ΔHb), g/dL	-2.2 (3.5-0.4)	-2.3 (3.6-0.4)	.355
Need of blood transfusion, n (%)	4 (2.3)	3 (3.5)	.566
Major complications, n (%)	3 (1.7)	1 (1.2)	.737
Minor complications, n (%)	13 (7.5)	7 (8.2)	.829

diologists or urologists. To our knowledge, no study has yet been discussed about the difference between sonographers and urologists.

Jeffrey and colleagues[11] retrospectively evaluated PCNL performed by interventional radiologists or urologists with regard to use of multiple access tracts, percentage of supracostal tracts, mean access difficulty parameters, access-related complications, overall stone-free rate and additional access tract placement at the time of surgery. Access-related complications were the same in the two groups. However, overall stone-free rate was higher in the urologists' access group, and 36.8% of access obtained by radiologists could not be used, which need additional access at the time of surgery. Conversely, El-Assmy and colleagues[2] found that access related complications and stone-free rates were comparable in urologist group and radiologist group.

In this study, there was no statistically significant difference between the groups with regard to major and minor complications. Three cases (1.7%) in group 1 and 1 case (1.2%) in group 2 encountered septic shock which was considered major complications. Minor complications were comparable in both groups (7.5% vs. 8.2%, $P = .829$). Mean blood loss and rates of blood transfusion were also similar between groups. The reasons of high stone-free rates in the urologist-made access group, in our opinion, were that sonographer was not familiar with and not care about the subsequent steps of PCNL. Furthermore, compared to urologist, sonographer preferred to subcostal rib puncture (95.4%) and lower calyx puncture (94.8%). Lack of suitable intercostal rib puncture and middle calyx puncture might result in the difficult fragment during PCNL. The lower stone-free rate in sonographer-made access group resulted in higher stage 2 SWL.

Our study has several limitations. Main limitation of study was that it was not randomized and prospective. A selection bias is inherent for its retrospective nature. Furthermore, the number of cases in the study was comparatively smaller, which result in lack of enough confidence on statistical analysis of the data.

CONCLUSION

Renal access in PCNL can be safely and successfully obtained by both sonographer and urologist. Infracostal and

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lower calyx access in our study has poor stone-free rates and sonographer prefers infracostal and lower access. We encourage urologists establish access by themselves during PCNL.

CONFLICT OF INTEREST

None declared.

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