Risk Factors for Postoperative Complications of Percutaneous Nephrolithotomy at a Tertiary Referral Center

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Abbreviations and Acronyms

CT = computerized tomography
ICU = intensive care unit
OT = operative time
PCNL = percutaneous nephrolithotomy
SFS = stone-free status
UTI = urinary tract infection

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Purpose: We sought to describe and evaluate the complications related to percutaneous nephrolithotomy and identify risk factors of morbidity according to the modified Clavien scoring system. We also sought to specify which perioperative factors are associated with minor and major complications.

Materials and Methods: We retrospectively analyzed data on patients who underwent percutaneous nephrolithotomy from 1990 to 2013. Descriptive statistics were used to analyze patient characteristics, medical comorbidities and perioperative features. Complications were categorized according to the Clavien score for percutaneous nephrolithotomy. The Mann-Whitney and Fisher exact tests were used as appropriate. Logistic regression analysis was performed to look for prognostic factors associated with major complications.

Results: A total of 2,318 surgeries were evaluated. Mean age of the population was 53.7 years. The stone-free rate at hospital discharge was 81.6%. The overall complication rate was 18.3%. Two deaths occurred. Patients with any postoperative complications were older, had more comorbidities, were more likely to have staghorn calculi and had longer operative time and hospital stay on univariate analysis ($p < 0.05$). Age 55 years or older and upper pole access were independent predictors of major complications on multivariate analysis. Other factors such as a history of urinary tract infections, body mass index, stone composition, previous percutaneous nephrolithotomy and multiple tracts were not associated with a major complication.

Conclusions: At our center percutaneous nephrolithotomy is an excellent option for complex kidney stone management with a low overall complication rate. Older patient age and upper pole access are significantly associated with an increased risk of a major complication.

Key Words: kidney; nephrolithiasis; nephrostomy, percutaneous; risk; postoperative complications

European Association of Urology urolithiasis guidelines recommend PCNL as the first choice treatment for renal stones larger than 2 cm and as a consideration for stones located in the lower pole that are larger than 1.5 cm.[1] Various groups have assessed several clinical, radiological and perioperative variables for a potential influence on postoperative complications.[2–6] Unfortunately a specific complication score was used for urological surgery in only a few published reports.[7–9] Moreover until

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recently there was a lack of standardization of PCNL reported outcomes.[10]

For the last decade the modified Clavien classification has been widely used to categorize and report complications of surgical procedures.[11] In 2004 the classification was improved to facilitate the evaluation of surgical outcomes and enhance the grading of life threatening complications.[12] It continues to be used to report outcomes after urological procedures. Major complications after PCNL that were identified in retrospective series include hemorrhage requiring transfusion, sepsis, adjacent organ injury, admission to the ICU and death.[13]

In 2012 de la Rosette et al categorized and validated associated complications of PCNL using data from the CROES (Clinical Research Office of the Endourological Society) study.[14,15] They developed a set of 70 complication management combinations that were evaluated by 74 urologists participating in the CROES PCNL Global Study. Results were used to categorize PCNL specific complications with the Clavien score as a basis. Best agreement among urologists was identified to define major complications (Clavien greater than 3a).

Previous analyses of prognostic factors have determined that patient age,[3] horseshoe kidney,[3] medial and multiple punctures,[16] supracostal access,[17] multiple tracts, staghorn calculi, diabetes,[18] type of intracorporeal lithotripter[15] and prolonged OT[19,20] are independent risk factors for postoperative complications.

We have previously reported our overall experience with PCNL[21] but had not evaluated potential risk factors for postoperative complications. The purpose of this study was to determine which factors were related to PCNL complications in our practice. The primary objective was to identify and analyze the rate of postoperative complications after PCNL according to the modified Clavien score. We examined perioperative factors that were associated with any type of complication, particularly major postoperative complications.

MATERIALS AND METHODS

We performed a retrospective review approved by the ethics review board of Western University of PCNL cases done at a single tertiary referral center from July 1990 to December 2013 by 1 of 2 fellowship trained endourologists (JDD or HR).

During the first years of the study patients underwent excretory urogram preoperatively and after 1999 CT was routinely performed. PCNL was done with the patient prone using a 3 to 5-day course of preoperative broad-spectrum antibiotics. The surgical technique was previously described.[21,22] We used upper pole access selectively for patients with staghorn stones, upper pole calyceal diverticular stones or a large upper pole stone burden. SFS was determined before hospital discharge by postoperative imaging chosen by the treating urologist based on intraoperative findings, location of the tract and complexity of the stone burden. Imaging included noncontrast CT, nephrotomography, nephrostography, plain x-ray of the kidneys, ureters and bladder, and renal ultrasound.

The information collected included demographics, clinical symptoms (history of recurrent UTIs, hematuria and pain), presence of complete staghorn calculi (stone in more than 2 calyces and 2 or more kidney regions) or partial staghorn calculi (stone in the pelvis, branching into 1 or 2 calyces in 1 region of the kidney). Medical comorbidities included hypertension, diabetes, cardiac and pulmonary diseases, and chronic renal failure. Patients were binary categorized depending on comorbidity and grouped depending on the number of any of the 5 analyzed comorbidities. Perioperative characteristics included OT, tract number and location (upper, mid and/or lower pole), dilation device, use of a nephrostomy tube/Double-J® stent at the end of the procedure, length of hospital stay and presence of urinary tract abnormalities as previously defined by Violette et al.[23]

Postoperative information such as stone composition, need for a second look procedure and SFS at discharge home (stones less than 5 mm) was included. Postoperative complications were collected during followup and classified by the modified Clavien score for PCNL.[14] Complications classified as Clavien 3a, 3b, 4a, 4b and 5 were categorized as major complications. When patients had more than 1 complication, only the highest Clavien score was included in final analysis. Patients with incomplete perioperative information were excluded from analysis.

We compared perioperative characteristics between patients with uneventful surgery and those with postoperative complications. Perioperative, clinical and radiological data were analyzed using the Fisher exact test for categorical variables and the Mann-Whitney test for continuous variables. Univariate and multivariate logistic regression testing was used to evaluate the influence of study variables on minor and major postoperative complications. ROC curve analysis was done to find the best cutoff point to analyze the impact of age on major complications. All p values were derived from the 2-tailed test with $p < 0.05$ considered statistically significant. Statistical analysis was performed using IBM® SPSS® Statistics for Windows®, version 20.0.

RESULTS

During the 24-year period 2,380 PCNLs were performed by a total of 2 endourologists. After excluding cases with incomplete information 2,318 surgeries were included in the final analysis. Mean ± SD patient age was 53.7 ± 15.15 years and 56.4% of the patients were male. The most common comorbidities were hypertension and diabetes in 20.4% and 13.3% of patients, respectively. Only 2.9% of patients had chronic renal disease. During the preoperative evaluation 64.6% of patients presented with flank pain, 19.8% had a history of UTI and 18.1% had had