Salvage Percutaneous Nephrolithotomy: Analysis of Outcomes following Initial Treatment Failure

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Purpose: Percutaneous nephrolithotomy has high potential for morbidity or failure. There are limited data regarding risk factors for failure and to our knowledge no published reports of surgical outcomes in patients with prior failed attempts at percutaneous stone removal.

Materials and Methods: We identified patients referred to 3 medical centers after prior failed attempts at percutaneous nephrolithotomy. A retrospective chart review was performed to analyze reasons for initial failure and outcomes of salvage percutaneous nephrolithotomy. Outcomes were compared to those in a prospectively maintained database of more than 1,200 patients treated with a primary procedure.

Results: Salvage percutaneous nephrolithotomy was performed in 31 patients. Unsuitable access to the stone was the reason for failure in 80% of cases. Other reasons included infection, bleeding and inadequate instrument availability in 6.5% of cases each. Compared to patients who underwent primary percutaneous nephrolithotomy those treated with salvage were more likely to have staghorn calculi (61.3% vs 31.4%, $p < 0.01$) and a larger maximum stone diameter (3.7 vs 2.5 cm, $p < 0.01$), and require a secondary procedure (65.5% vs 42.1%, $p < 0.01$). There was no significant difference between the cohorts in the remaining demographics or perioperative outcomes. All patients were deemed completely stone free except one who elected observation for a 3 mm nonobstructing fragment.

Conclusions: Despite the more challenging nature and prior unsuccessful attempts at treatment, the outcomes of salvage percutaneous nephrolithotomy were no different from those of primary percutaneous nephrolithotomy when performed by experienced surgeons.

Key Words: kidney; nephrolithiasis; nephrostomy, percutaneous; treatment failure; complications

Abbreviations and Acronyms

CT = computerized tomography

PCNL = percutaneous nephrolithotomy

SWL = shock wave lithotripsy

Accepted for publication October 30, 2015.

The corresponding author certifies that, when applicable, a statement(s) has been included in the manuscript documenting institutional review board, ethics committee or ethical review board study approval; principles of Helsinki Declaration were followed in lieu of formal ethics committee approval; institutional animal care and use committee approval; all human subjects provided written informed consent with guarantees of confidentiality; IRB approved protocol number; animal approved project number.

* No direct or indirect commercial incentive associated with publishing this article.

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‡ Financial interest and/or other relationship with Boston Scientific.

PERCUTANEOUS nephrolithotomy is supported by the AUA (American Urological Association) and EAU (European Association of Urology) as first line treatment for large and complex upper urinary tract stones.[1,2] This procedure can be quite challenging and it carries a significant potential for morbidity. It has been estimated that the rate of complications after PCNL can be as high as 25%, of which almost 5% are Clavien grade 3 or higher.[3] Despite such challenges, PCNL remains a commonly performed procedure, accounting for approximately 5% of all

0022-5347/16/1954-0977/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2015.10.176
Vol. 195, 977-981, April 2016
Printed in U.S.A.

stone related surgeries with increasing use with time.[4,5]

The most complex step in performing PCNL is obtaining proper access. Inability to appropriately perform this critical maneuver can lead to patient morbidity and sometimes treatment failure. Prior studies estimate that it takes a minimum of 60 cases to achieve competence in obtaining access and 115 procedures before achieving excellence.[6,7] Subsequently the number of urologists who obtain their own access is low, estimated at 11% in 2003, with the majority favoring that access be obtained by radiologists.[8] While this collaboration is most often successful, it can pose unique challenges, particularly in the event that initial access is unsuitable and the radiologist is not present to perform additional access to allow for safe and effective treatment of the stone burden. In such cases the safest option is to abort the procedure.

Given the inherent complexity of PCNL, its frequency of use and logistic challenges in coordinating access, treatment failures would be expected from time to time. However, surprisingly studies focusing on PCNL treatment failures are universally absent from the published medical literature to our knowledge.

Conversely, treatment failures after other minimally invasive alternative treatments, such as SWL and ureteroscopy, are well characterized.[9–13] One potential reason for this discrepancy in publication is the fact that these alternative procedures have secondary treatment options such as PCNL to achieve more definitive outcomes. In contrast, failed PCNL represents a much greater clinical challenge, given the more invasive nature of the procedure and the lack of suitable secondary treatment options. Less invasive salvage procedures after PCNL failure, including SWL and ureteroscopy, would be expected to achieve suboptimal stone-free rates while more invasive approaches such as open and laparoscopic renal surgery carry even greater potential for morbidity.

In such situations a repeat attempt at PCNL is potentially the best choice. However, to our knowledge there are no data to date on the outcomes of PCNL performed in the salvage setting. In fact there are no data showing that PCNL failures can be successfully treated with a repeat attempt at all. Such information is necessary not only to help guide clinical care, but also to the patient, who may have experienced a failed initial attempt at PCNL and otherwise may be skeptical of repeating a complex and invasive procedure that has already proved unsuccessful on 1 occasion.

We sought to assess treatment outcomes of PCNL performed in the salvage setting as well as better characterize risk factors for primary PCNL failure.

METHODS

PCNL cases accrued from internal review board approved databases of 3 high volume endourologists experienced with PCNL were reviewed to identify patients referred to them from other urologists for attempts at salvage PCNL. Salvage was defined as a patient referred from another provider after an initial unsuccessful attempt was made to treat an upper tract stone using a percutaneous approach. A retrospective chart review was performed to analyze the transferred records brought with the patient at the time of initial consultation as well as the hospital chart pertaining to the ultimate salvage procedure. Patient demographic, perioperative and operative data were collected on the initial attempt at treatment and on the salvage procedure.

The salvage PCNL technique was chosen at the discretion of the treating surgeon. In all cases preoperative CT was available to facilitate surgical planning. New access was obtained by the referral endourologist using standard biplanar fluoroscopy and a bull's-eye or triangulation technique. The decision to perform multiple accesses was at the discretion of the surgeon to facilitate efficient and complete stone removal.

All patients underwent cross-sectional imaging on postoperative day 1 to identify residual fragments and/or other post-procedural complications. Patients were offered a secondary procedure for definitive stone removal in the event that any residual fragments were seen on imaging. Patients were ultimately deemed stone free by the absence of residual fragments on postoperative CT or by direct second look inspection of the kidney.

Patient demographic and operative variables in the salvage cohort were then compared to the same variables in a prospectively maintained database of more than 1,200 patients who underwent primary percutaneous nephrolithotomy.

Statistical analysis was performed using IBM® SPSS® Statistics, version 22. Continuous measures were compared between groups using the Student t-test and categorical measures were compared between groups using the Fisher exact test with $p < 0.05$ considered statistically significant.

RESULTS

A total of 31 patients underwent salvage PCNL. Unsuitable access to the stone was the most common reason for prior failed attempt with 80% of salvage procedures associated with prior difficulty with accessing and treating the stone. Other reasons for failed PCNL included infection (hemodynamic instability in the presence of purulent urine), excess bleeding and inadequate instrument availability in 6.5% of cases each. Percutaneous access during the initial PCNL failure was obtained exclusively by interventional radiologists in 73.3% of cases, by urologists in 20% and by members of both specialties in 6.5%.

When comparing the salvage cohort to a group of more than 1,200 patients treated with primary PCNL (see table), there were no demonstrable