

Outcome of Percutaneous Nephrolithotomy in Patients with Spinal Cord Neuropathy

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Purpose: To investigate technical problems, complications and stone clearance rate in patients with spinal neuropathy who had undergone percutaneous nephrolithotomy.

Materials and Methods: This cross-sectional study was done between 2004 and 2013 on 29 patients with both spinal cord neuropathy and kidney stones who were chosen for percutaneous nephrolithotomy in Sanandaj city, Iran. The data were obtained from patients' medical records and were documented in a researcher-made checklist. Absolute and relative frequency, mean and standard deviation were calculated.

Results: A total of 43 percutaneous nephrolithotomies were performed on 32 kidneys. In 51.7% the right kidney, in 37.9% the left kidney and in three patients (10.3%) both kidneys were involved. There were 24 patients (82.8%) with spinal cord injury. Five patients (17.2%) had spina bifida. The mean of operation time was 129.7 minutes and the mean of hospital stay was 8.3 ± 3.1 days. The mean of kidney stone size was 35.7 ± 6.1 mm (25 to 45 mm). In 58.5% of the patients, surgery lasted more than two hours. Stone clearance rates were 53.1% and 78.1% after the first and second percutaneous nephrolithotomy.

Conclusion: Although patients with spinal cord injury have problems in terms of surgery and complications, percutaneous nephrolithotomy is an appropriate and safe treatment method for their kidney stones. Pre-operative counseling with a radiologist and an anesthesiologist is recommended.

Keywords: kidney calculi/surgery; nephrostomy, percutaneous/adverse effects; postoperative complications/etiology; spinal cord injuries; spinal dysraphism; treatment outcome.

INTRODUCTION

Patients with spinal cord injury are at higher risk of obtaining kidney stones. Studies have shown that the prevalence of urinary stones in this group of patients is about 7% and recurrence rate after treatment is about 77%. Spinal cord injuries (traumatic or non-traumatic) because of urinary tract nervous system dysfunction result in numerous problems in this system. Urinary stasis, infection, immobility, chronic catheterization, and vesicoureteral reflux are associated with stone formation. Despite major improvements in stone treatment, urinary stones treatment in this group of patients has remained a challenge.⁽¹⁻³⁾ Effective stone treatment is very important, because the presence of stones is associated with decreasing kidney function.⁽⁴⁾

In the past decades extracorporeal shock wave lithotripsy (SWL), with its low morbidity and improved stone clearance rates, has been a valid option for treating stones in patients with spinal cord injury.⁽³⁾ However, the required positioning for SWL and its initial insufficiency as a treatment means that there are a number of patients who need percutaneous nephrolithotomy

(PCNL). Furthermore, previous studies have shown that PCNL can be safely done in high risk patients.⁽⁵⁾ PCNL was first done in 1973 in Sweden as a less invasive alternative to open surgery on the kidneys.⁽⁶⁾ Then it replaced open surgery for the treatment of patients with large and complex kidney stones. Because of the complexity of patients with spinal neuropathy, PCNL has more complications in these patients compared to the general population.⁽¹⁾

Although there are limited reliable data on PCNL mortality and morbidity in patients with spinal neuropathy, it still has a higher risk in these patients. In a study by Culkun and colleagues, 8.5% major complications were recorded after surgery for 23 men with spinal cord injury who had underwent PCNL.⁽⁷⁾

PCNL is generally a safe treatment method and is associated with a low but specific complication rate.⁽⁸⁾ Many complications develop from the initial puncture including injury of the surrounding organs such as colon, spleen, liver, pleura, and lung. Other specific complications include postoperative bleeding and fever.⁽⁹⁾ Fever is a common postoperative complication of PCNL

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with 10.8% overall incidence. Bleeding during PCNL is generally common but is rarely substantial to require transfusion.⁽¹⁰⁾

Given the importance of treatment and management of urolithiasis in patients with spinal neuropathy, the aim of this study was to investigate technical problems, complications and stone clearance rate in patients with spinal neuropathy who had underwent PCNL in a hospital in Sanandaj city, Iran, from 2004 until 2013.

MATERIALS AND METHODS

This cross-sectional study was done on 29 patients with spinal cord neuropathy and kidney stones who were chosen for PCNL from 2004 until 2013 in Tohid Hospital of Sanandaj city. Patients with spinal cord neuropathy and kidney stone larger than 2 cm who had shown stone resistance to SWL were included in this study. Data including laboratory test results, counseling, treatment progress, physician's order, imaging data relating to kidney lithiasis and surgery sheets were obtained from patients' medical records and documented in a researcher-made checklist.

Preoperative Considerations

Urine cultures were obtained from patients before surgery. All of them had bacteriuria and were admitted one day before the surgery. An appropriate antibiotic was used before the procedure. Voiding dysfunction due to neurogenic bladder in our patients was managed by clean intermittent catheterization for 16 patients, indwelling catheterization for six patients and diversion with conduit for seven patients.

Twelve patients had severe scoliosis. This anatomical deformity caused several problems in positioning. All patients underwent preoperative upper tract imaging (kidney ultrasound, intravenous urography, and non-contrast computed tomography). Stone size was determined by measuring the greatest length of the stone on kidneys, ureters, and bladder (KUB) and computed tomography. In case of multiple stones, stone burden was determined by adding the sizes of all the stones.

Surgical Technique

All PCNL procedures were done by a single surgeon in our department. Under general anesthesia in lithotomy position, a rigid ureteroscope was inserted and a 5 French (F) ureteric catheter was advanced up to the renal pelvic. The ureteric catheter was fixed to a 16F Foley catheter. The patient was then turned to the prone position.

The choice of tract site was determined by biplanar fluoroscopic guidance at 0 and 30 degrees primarily by stone location, stone burden, and the presence of spi-

nal deformity. Percutaneous puncture and dilation of the tract was done by a urologist surgeon. Contrast material was given through the ureter catheter and an 18-gauge needle was used to puncture the collecting system. A super stiff guide wire 0.038 inch was placed down the needle and the tract was dilated up to 30F by one shout Amplatz dilators. The access sheet was then placed.

A LithoClast[®] lithotripter was used to fragment the stones. At the end of the procedure, a 20F Foley catheter was used as nephrostomy tube. All patients were evaluated on the first day after surgery with a KUB and kidney ultrasound. We had defined success by complete absence of stones or presence of insignificant fragments less than 4 mm. If patients were stone free, the nephrostomy tube was taken out. If there were significant residual stones, nephrostomy tube was kept in place for the second PCNL. The second PCNL procedure was scheduled within two weeks after the first PCNL. All patients were evaluated in terms of stone clearance and intra-operative and post-operative complications. Final treatment success was defined as being stone free on non-contrast computed tomography at the six months follow-up.

Nephrostomy tube was used for all patients and was only removed when a nephrostogram showed clear and free drainage of the operated system three days after surgery. Urinary leakage was seen in five patients after removing the nephrostomy tube. This was stopped with conservative therapy after 7-10 days. In 11 patients nephrostomy tube was kept for two weeks due to residual stones and they were prepared for the second PCNL.

Statistical Analysis

Data were analyzed by statistical package for social sciences (SPSS) software version 18 (Chicago, IL, USA) and described by descriptive statistics including absolute and relative frequency, mean and standard deviation.

RESULTS

Among 29 patients with spinal cord injury who had underwent PCNL in this study, 12 (41.4%) were men and 17 (58.6%) were women. The mean age was 45.45 ± 13.7 years old (age range of 32 to 68 years old). The mean of operation time was 129.7 minutes (range of 45 to 190 minutes). In 51.7% the right kidney, in 37.9% the left kidney and in three patients (10.3%) both kidneys were involved. There were 24 patients (82.8%) with spinal cord injury, two of whom were paraplegic. In 58.5% of the patients, surgery lasted more than two hours.

Table. The frequency of complications in our studied patients.

Variables	Number	%
Blood transfusion	7	21.8
Visceral injury	2	6.25
ICU stay	7	21.8
Urosepsis	6	18.75
Fever	11	34.37

Abbreviation: ICU, intensive care unit.

The mean of hospital stay was 8.3 ± 3.1 days (range of 3 to 14 days). From 32 kidneys which underwent PCNL, the hospital stay of eight cases was more than 10 days because of respiratory complications and severe infection. The mean of kidney stone size was 35.7 ± 6.1 mm (range of 25 to 45 mm). Of the 32 kidneys, seven had only one stone, 17 had multiple stones, and eight had complete staghorn. The stone clearance rates were 53.1% after the first PCNL and 78.1% after the second PCNL.

Complications were urosepsis, significant hemorrhage that required blood transfusion, visceral injury (pneumothorax), intensive care unit stay, and fever. Nephrostomy drainage lasted 7 to 10 days in five cases. Mortality rate was zero. 34.37% of cases had post-operative fever with temperature higher than 38.5 degrees centigrade (**Table**).

DISCUSSION

Risk factors for urolithiasis in patients with spinal cord dysfunction are recurrent urinary tract infections secondary to urinary stasis or catheterization and hypercalciuria associated with prolonged immobility. In a study by Hall and colleagues the association between the presence of chronic indwelling Foley catheter and the development of bladder and kidney stones has been confirmed.⁽¹¹⁾ Because of the mentioned problems, many patients with spinal cord dysfunction are at risk of stone formation. Urinary stone occurs more often during the first two years after spinal cord injury, especially during the first six months.⁽¹²⁾ In a cohort study there was a significantly greater risk of kidney stones in people older than 45 years old within the first year after spinal cord injury.⁽¹³⁾

After the diagnosis of urinary stones, choosing an appropriate treatment method in patients with spinal cord dysfunction is challenging. Kidney's anatomic abnormalities, chronic urinary tract infections, decreased pulmonary capacity, and morbidity due to movement restrictions should be considered for selecting a treatment method. Urinary tract infections in patients with spinal

cord injury develop as a result of neurogenic bladder and the need for catheterization. Pathogenetic factors include bladder over-distention, vesicoureteral reflux, high-pressure voiding, large post-voiding residual volume, stones in the urinary tract, and outlet obstruction.⁽¹⁴⁾

Open surgery was the only method for treating kidney stones in patients with spinal cord injury for a long time. When SWL was introduced, it seemed that an effective and safe method for the treatment of these patients has become available. But the success of SWL in patients with spinal cord dysfunction and multiple stones was not acceptable. Difficulty in positioning, movement restrictions, as well as anatomical disorders in these patients affected the success rate of SWL. Although SWL is well tolerated in these patients, the clearance of stones is poor and delayed.⁽¹⁵⁾

With the development of PCNL a new hope flourished to cure these patients. PCNL is still the standard treatment for stones larger than 2 cm.⁽¹⁶⁾ It can also be used in patients with body and musculoskeletal abnormalities. Urolithiasis management is challenging in spinal cord injury patients due to anatomic variations and cardio-respiratory dysfunction.⁽¹⁷⁾ We evaluated the effect of 32 PCNL procedures on 29 patients in our study.

In our study mean of operation time was 129.7 minutes while in a study by Hubsher and Costa it was 150 minutes.⁽¹⁸⁾ Reasons such as the condition of patients with spinal cord injury and urologist's skill during surgery can reduce the surgery length. Additionally, because of anatomical disorders, positioning limitations, severe lower limbs spasm, presence of screws and plates of previous surgeries and severe scoliosis, the access time is long in these patients. In our study, duration of the first puncture with needle until onset of nephroscopy was almost 13 minutes. Considering multiple and sporadic stones, accessing calyces with rigid nephroscope is difficult and time-consuming, prolonging the operation time. We used rigid nephroscope for our patients. Stone clearance rates were 53.1% and 78.1% after the first and second PCNL. In case of bleeding and pulmonary problems, the operation was ended based on an anesthesiologist's advice. In a study by Nabbout and colleagues after the first PCNL, stone clearance rate was 53.8%. Also kidney stone removal success rate for the treatment of upper urinary tract stones in patients with spinal cord injuries was 88.5% with an average two procedures per stone.⁽¹⁾ In Symons and colleagues' study this was 62%.⁽²⁾ In a study by Culkin and colleagues stone removal rate was 53.6% with one procedure and 90.4% with an average of 1.67 procedures per stone.⁽¹⁹⁾

These authors in their next study have reported the low rate of stone removal for patients with spinal cord injuries.⁽⁷⁾ Donnellan and Bolton have reported 84% stone removal rate with an average of 1.3 procedures for each stone.⁽²⁰⁾ Stone removal success rate with PCNL was 81% in a study by Lawrentschuk and colleagues⁽³⁾ and 96% in a study by Rubenstein and colleagues.⁽⁵⁾ Major complications in patients with spinal cord dysfunction are bleeding, urosepsis, urine leakage, pulmonary problems, and post-operative fever. In our study, six cases (18.75%) had urosepsis. They were hospitalized in the intensive care unit and broad spectrum antibiotics were administered for them. They also received pulmonary support and sufficient hydration. All patients had positive urine culture before the operation. They were hospitalized 1-3 days before the operation and broad spectrum antibiotics were administered for them. The operation was done under antibiotic therapy; hence their urine culture was positive after the operation too. Then they stayed in the hospital for 5-14 days to remove infectious symptoms. Perhaps this was the reason for the increase in hospital stay in our study (8.3 ± 3.1 days). In a study by Nabbout and colleagues the rate of adverse events was 14.3% and three patients had urinary tract infection.⁽¹⁾ Lawrentschuk and colleagues had reported 12% adverse effects in their study.⁽³⁾ This has been 17% and 20% in other studies.^(7,19) In a study by Symons and colleagues, nine patients had experienced minor complications such as fever, hypotension and leakage from the nephrostomy site.⁽²⁾ In our study, 21.8% of the patients needed blood transfusion. The frequency of blood transfusion in previous studies was 28.6%⁽¹⁾ and 21%^(3,21) which are similar to our study. Inflammation can lead to activation of the coagulation system. As a response to severe infection or trauma, acute inflammation results in a systemic activation of the coagulation system.⁽⁵⁾ Bleeding in these patients may be due to chronic infection of the urinary tract which causes chronic inflammation and eventually blood coagulation disorders.

CONCLUSIONS

Kidney stone surgery in patients with spinal cord injury is quite challenging. Although PCNL has technical difficulties and major complications in these patients, it is an appropriate and safe method for their kidney stone treatment. Pre-operative counseling with an anesthesiologist, a radiologist, and even an infectious disease specialist is recommended.

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CONFLICT OF INTEREST

None declared.

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