

Complications of Percutaneous Nephrolithotomy and their Management: Experience from a Single Centre

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ABSTRACT:

Introduction: Increasing global prevalence of nephrolithiasis has resulted in the development of new minimally invasive techniques and has also led to the resurgence of established methods such as percutaneous nephrolithotomy (PCNL). This procedure is now recommended as the first option for the treatment of single large or multiple renal stones and those in the inferior calyx. This study was done to assess the complications of PCNL and their management, in our centre. **Methods:** Medical records of 144 patients who underwent PCNL at Lumbini Medical College Teaching Hospital, during the last one year were reviewed. The demographic data, size, tract number and location of the calculi, and intraoperative and postoperative complications were evaluated. The various parameters of the calculi were evaluated. Descriptive analysis with frequencies was done. **Results:** Complications occurred in 13 (9.02%) patients. Post operative bleeding occurred in seven (4.8%) patients, out of which one patient developed pseudoaneurysms and the other developed arteriovenous fistula. One patient developed hypovolemic shock immediately after surgery. Frequent blockage of urine, excessive drainage of urine from the drain site, hemothorax and colonic perforation was seen in one patient each. One patient had mortality due to post operative bleeding. Complications increased with the number and size of stones and number and site of the tracts. **Conclusion:** Percutaneous nephrolithotomy has low complication rate in experienced hands and complications depend upon stone size, history of open stone surgery, tract number, and tract location.

Keywords: complications • minimally invasive • nephrolithiasis • nephrostomy • percutaneous

INTRODUCTION:

Increasing global prevalence of nephrolithiasis continues to burden the healthcare delivery systems of industrialized nations and exact a disproportionate humanitarian toll on populations of the developing world.¹ In the United States alone, the prevalence of nephrolithiasis is nearly twice the rate reported in the 1960s.²⁻⁵ The subsequent

rise in surgical interventions for nephrolithiasis has resulted in the development of new minimally invasive technologies and techniques, but it has also led to the resurgence of established methods such as percutaneous nephrolithotomy (PCNL).

Percutaneous entry into the renal collecting system was first described in the 1950s, but it was not until later that percutaneous access to the renal collecting system was routinely utilized for the removal of nephrolithiasis.⁶⁻⁸ PCNL was established as a minimally invasive treatment option for removal of kidney stones in the 1970s and was further developed in the ensuing years.⁹⁻¹¹

Today, this procedure should be the first option for the treatment of single large or multiple renal stones and those in the inferior calyx.¹² Percutaneous stone removal was suggested as the first line treatment option for the management of staghorn calculi by the American Urological Association Nephrolithiasis Clinical Guidelines panel.¹³

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How to cite this article:

Thapa N. Complications of percutaneous nephrolithotomy and their management: experience from a single centre. Journal of Lumbini Medical College. 2015;3(2):30-3. doi: 10.22502/jlmc.v3i2.67.

Although PCNL initially proved to be an effective technique, the near-concurrent introduction of shockwave lithotripsy (SWL) resulted in a rapid and marked decrease in the utilization of PCNL.¹⁴ There has been, however, a recent increase in the utilization of PCNL, largely attributed to the limitations of newer SWL equipment, an increase in stone prevalence, and the refinement of PCNL indications, techniques, and instrumentation.¹⁵⁻¹⁹

Although percutaneous renal surgery is less invasive than an open procedure, complications may occur. "Percutaneous nephrolithotomy is a successful (> 90%), less invasive surgery at the cost of greater complications (> 10%)".^{20,21} There are some complications that may be predictable or unpredictable, such as hemorrhage, collecting system injuries, contiguous organ injuries, intra-operative technical complications, hypothermia, fluid overload, sepsis, stricture formation, nephrocutaneous fistula, renal loss, and death.^{20,22} In this study we evaluated the occurrence and types of complications and their associated factors with special attention to bleeding and adjacent organ injuries.

METHODS:

This retrospective descriptive study was done from 1st of June, 2015 to 30th of September, 2015 in Lumbini Medical College Teaching Hospital. Medical records of all the patients who underwent PCNL from June 2014 to May 2015 were reviewed. Ethical approval was granted by the Institutional Review Committee. Patients with comorbidities, like hypertension, diabetes mellitus, COPD, asthma, coronary artery disease, were excluded from the study.

All these parameters were noted from the patients' medical records along with the demographic data, size of renal calculi, number and location of renal calculi, location and number of tracts, duration of surgery, complications and duration of hospital stay. The collected data were analyzed with SPSS-13.

Technique of PCNL: All the patients presenting for PCNL were admitted a night before surgery and following tests were done: hemoglobin, ultrasonography of abdomen and pelvis, X-ray KUB and intravenous pyelography. Patients underwent standard PCNL. In lithotomy position, ureteric catheter was inserted in the kidney to be punctured. Foley catheter was inserted and patient was changed to prone position. In this position, kidney was punctured under C-arm guidance after the retrograde instillation of radiopaque dye through

ureteric catheter. Commonly, the posteroinferior or the posterosuperior calyx was punctured. Stones were fragmented using a pneumatic lithotripter and extracted out using forceps. DJ stenting was done in all cases and drain was kept as deemed necessary. Drain if kept, was removed on the second post operative day and the patients were usually discharged on the third post-operative day in uneventful cases. DJ stent was removed after six weeks.

RESULTS:

A total of 144 patients underwent PCNL, out of which there were 70 (48.6%) men and 74 (51.4%) women. The mean duration of the operation was 40 minutes ($SD=9.3$). The mean post operative stay was three days ($SD=3.7$). The affected kidney was right side in 78 (55%) and the left in 66 (45%) cases. No PCNL was done for chronic renal failure and no open conversion was done in any of the patients.

Complications occurred in 13 (9.02%) patients. Post operative bleeding occurred in seven (4.8%) patients and they underwent blood transfusion. One of them developed pseudoaneurysms and was referred to higher centre for angio-embolization. Another patient developed arteriovenous fistula and underwent the same. One patient developed hypovolemic shock immediately after surgery and was managed promptly with intravenous fluids and blood transfusion. Another patient had frequent blockage of urine and underwent bladder wash along with observation for four days which was sufficient for his recovery. One patient had excessive drainage of urine from the drain site and recovered after three days of observation. One patient developed hemothorax and was managed with the placement of chest tube. One patient had colonic perforation and underwent laparotomy on the sixth postoperative day and recovered completely. One patient had postoperative bleeding in the first day was managed with nephrectomy along with intensive care. On the 3rd postoperative day, the patient expired secondary to the development of disseminated intravascular coagulation and renal failure with metabolic acidosis. Other details about the type of cases and complications in each type is presented in Table 1.

DISCUSSION:

Significant complications in PCNL can be attributed to incorrect patient selection, the lack of adequate equipment and technical errors. The

Table 1: Disease variables and complications.

Disease variables	n	Complications
Upper Calyx	3	1
Middle calyx	12	0
Lower Calyx	21	3
Pelvic	78	2
Multiple calyx	30	7
stone size		
<2cm	96	4
>2cm	42	6
Staghorn	6	3
Hydronephrosis		
Absent	16	1
Mild	71	6
Moderate	41	5
Severe	16	1
History of open stone surgery		
Yes	1	1
No	143	12
Tract number		
One	141	10
Two	3	3
Tract location		
Supracostal	3	1
Infracostal	140	11
Both	1	1

percentage of complication in our series is less than the rate of complications found in literatures. Lesser number of extravasation could be due to correct dilatation with metallic dilators. The lower rate of haemorrhage could be attributed to ultrasound and radiology guided puncture.

Although open stone surgery is needed for some specific renal stones, no open conversion occurred in our patients. In a study by Lee and colleagues on 500 patients who underwent PCNL, the most common complication was bleeding, with a 12% transfusion rate.²³ Renal hemorrhage is the most worrisome and frequent complication of PCNL, which has been often addressed.²⁴ However, severe bleeding leading to complications, such as hypovolemic shock or renal failure, may occur in less than 3% of patients.²⁵⁻²⁷ In our study also the most common complication was bleeding which was about 4.8%.

The probability of vascular lesions increases when the nephrostomy tract passes close to the renal hilus or goes directly posteriorly to it. The high

pressure system of a lacerated artery will leak into the lower pressure system of a vein or parenchyma leading to arteriovenous fistula or pseudoaneurysm formation, respectively. In our study there were two patients with such vascular complications.

Excessive bleeding during PCNL can be managed by some maneuvers, like placement of a larger nephrostomy tube, nephrostomy tube clamping, hydration, and balloon tamponade. The bleeding is mainly venous in origin and can be controlled with the above maneuvers. Occurrence of vascular lesions depends mainly on the total number of punctures. It would be logical that decreasing the total number of punctures would reduce the risk of damage to the renal vasculature.^{28,29}

The risk of injury to the pleura and lung increases (10%) if the puncture is above the 12th rib.³⁰ If puncture is through the pleura, a chest tube has to be inserted for prevention of hydrothorax or hemothorax. Rate of pleural injury in our study was 0.69% i.e one patient, which only occurred with the supracostal access and was controlled with chest tube insertion.

Several risk factors contribute to the colonic injury during PCNL, such as left-sided procedure, an extremely lateral percutaneous nephrostomy tract, horseshoe kidney, advanced patient's age, distended colon, an associated colon obstruction, a hypermobile kidney, a retro-renal colon, and extremely thin patients.^{31,32} Perforation of the colon can be seen in less than 1% of subjects.³³ In our study colonic perforation was seen in one patient.

Complications were associated with multiple punctures and tract formation with larger or multiple stones. One patients who was previously operated on the same side, had two stones, each two cm in size. This patient underwent multiple tract formation i.e. both supracostal and infracostal, and had mortality.

Septicemia may be due to introduction of infection via the access tract to the kidney or due to working on the infected stones. Following PCNL, fever is significantly higher and more frequent in patients with infected urinary stones than in those with sterile stones.^{30,34} Therefore, prophylactic antibiotics and drainage of a pyonephrotic kidney is mandatory prior to PCNL.³⁰ Antibiotics can be applied as single-dose or short-course with no significant differences between these two regimes in the occurrence of postoperative infections.^{25,35} The total time of procedure and the amount of irrigation fluid are major risk factors for occurrence of postoperative fever.^{30,36} It is important to preserve

low pressure in the collecting system and keep the duration of surgery to minimum (< 90 minutes).³⁰

CONCLUSION:

Based on our findings, percutaneous

nephrolithotomy has a low complication rate in experienced hands and good equipments. PCNL complications are related to stone burden, stone location and the type of access.

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