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Study of Percutaneous Nephrolithotomy, Outcome and Analysis

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ABSTRACT

Background- Percutaneous nephrolithotomy is the mainstay for treating staghorn calculi. History of ipsilateral renal stone surgery and stone burden are prognostic factors determining stone clearance after PCNL on staghorn stones.

Methods and materials- In the present series, 60 patients were included in the study. Procedure was done by single surgeon. The patients with simple renal calculi were preferred. In all cases spinal anesthesia was used. The site of puncture it was subcostal. No procedure was converted in to the open nephrolithotomy. Cooks' nephrostomy set and Metallic renal dilator sets were found to be safe, easy to use and reusable. The irritant fluid used was isotonic saline which was cheap, easily available and safe. All cases were done as single staged procedures and found to be safe.

Results- During the course of study, we failed to extract all calculi in 9 cases. Hence, they will require second sitting PCNL for complete stone clearance. The average number of days of stay in the hospital were 4 days and average days for full recovery after surgery was nearly 5 days.

Conclusion- PCNL is a safe and reliable procedure for treating kidney stones if done by an expert hand with adequate instrumentation. It can achieve a stone clearance of almost 85% and with acceptable morbidity. However, this study is limited as the number of patients is small and it is done by a single surgeon without any randomization. But as this procedure was recently started in our department there was a need to evaluate this procedure in our setup.

Keywords: *PCNL, renal stone, nephrolithotomy, complications.*

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1. INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is supported by the American Urological Association (AUA) and European Association of Urology (EAU) as first line treatment for large and complex upper urinary tract stones.[1,2] It has been estimated that complications after PCNL can be as high as 25%, nearly 5% of which are Clavien grade 3 or higher.[3] Despite such challenges, PCNL remains a commonly performed procedure accounting for approximately 5% of all stone-related surgeries.[4, 5] Since its introduction in 1976,[2] the operative technique and the endoscopic equipment's have had constant evolution, increasing the success rates and decreasing complications and morbidity.

It has gradually, evolved to be one of the main endourologic treatment options. With the introduction of other treatment modalities such as extracorporeal shock wave lithotripsy (ESWL) [2] and ureterorenoscopy [3], the indications for percutaneous stone surgery have changed. Initially, patients unfit for open surgery were referred for the percutaneous approach. Later, the indications were broadened to include particular situations such ureteral [4] and calyceal diverticular [5] stones as a result of improvements in energy delivery and intraoperative visualisation. Miniaturized tools were created in an effort to lower morbidity without reducing the procedure's effectiveness or percentage of patients without stones. [6] The improvements to PCNL techniques included not just a reduction in the diameter of the working instruments but also better patient placement, safer and more precise tract formation techniques, new imaging modalities, advancements in intracorporeal lithotripters, and the use of flexible devices for effective collecting system screening. Urinary stone disease management constitutes today more than a third of the surgical volume of a contemporary urological department.[7]

As this modality was recently introduced in our department, thus study was planned to evaluate the outcomes of renal stone disease treatment with PCNL.

2. AIMS

"STUDY OF PERCUTANEOUS NEPHROLITHOTOMY, OUTCOME AND ANALYSIS.

Materials and method- Study will be conducted in those patients who will be admitted in hospital for renal calculi undergoing percutaneous nephrolithotomy in OPD Index Medical College, Hospital and Research Center, Indore (M.P.) & those who will fulfill the inclusion criteria.
Study design: Prospective Observational study.
Inclusion Criteria:
Males and females above 18 years are included in study.
Exclusion Criteria:

- All males and females below 18 years.

- Patient unfit for either general or spinal anaesthesia.
- Patient with history of previous renal surgeries.
- Patients with severe anemia, haematological disorder, hepatic or renal condition and immunocompromised status.
- Pregnant females.

3. DATA COLLECTION & METHODS

Registration details of all the patients including their name, age, sex was noted. Consent of each patient was taken. A thorough history of each patient was taken regarding family history, history of previous surgery or any treatment, history of drug allergy, history of any co-morbidity. The present study has been done in the department of general surgery, Index medical college, hospital & Research Centre, Indore from 1st March 2021 to 30th September 2022.

It included all cases who presented with renal calculus in emergency department of IMCHRC. An elaborate clinical history and clinical examination was been conducted. The data was noted on proforma which included all the risk factors like age, gender, clinical features, type of management undertaken, complications and patient satisfaction rates with post op investigations & follow up.

Sample size:
Based on number of patients admitted during the course of the study & minimum of 60 patients to be studied.

Statistical analysis plan
For our study Fishers exact test was used.

Surgical technique:
- Following anesthesia, patients were placed in lithotomy position and a 22.5F rigid cystoscope (OLYMPUS) was used to pass a 5F open-end ureteral catheter under fluoroscopic guidance, into the renal pelvis, to allow injection of contrast material to delineate the intrarenal collecting system.
- A 16F Foley catheter was inserted into the bladder to provide drainage during the procedure and the ureteral catheter was fixed to the Foley catheter.
- Then the patient was moved to prone position and the side of kidneys to be operated was positioned higher 30°. Percutaneous puncture to gain access to the kidney was done with the help of C-arm control fluoroscopy.
- Calyx puncture was performed through a superior, media, or inferior, using 18-gauge, diamond-tip needle. The needle was positioned so that the target puncture, the needle tip, and the base of the needle was in a position in line.
- The depth of puncture was controlled using fluoroscopy in the anteroposterior position. After the needle of puncture had been confirmed in the pelvicalyceal system, then a 0.038 guidewire was inserted. After that, the tract was then dilated to 30F using metal dilators (Telescope Bougie Set), fascial dilator and malleable dilators (Amplatz Renal Dilator Set).
- After inspection by 24-F rigid nephroscope, mechanical lithotripsy could be done by breaking the stone. Stone forceps were used to retrieve a hard rock fragment.

Figure 1. PCNL trolley Post-operative Evaluation for stone free rate:

Postoperative imaging was performed 1 or 2 days after PCNL with either Kidney Ureter Bladder (KUB) photos, computed tomography (CT) scan, or antegrade pyelography (APG). Stone free is defined as the absence of residual stones after undergoing PCNL for the first time. Patients who required additional treatment after their first PCNL, such as secondary PCNL and or ESWL, were automatically excluded from the stone-free group.

Observations and results

The highest number of patients was seen in the age group above 31-40 years, irrespective of the pathological conditions followed by 21-30 years age group. In this study youngest patient was 18 years and the oldest was 74 years.

Overall male preponderance was observed in our study, ratio of male: female being 3:2 for our study. Although, females were comparatively more affected in younger age group as compared to males.

Flank pain was the presenting symptom in maximum number of cases (80%) and onset was gradual in most of them. In most cases pain started from the affected flank and in severe case radiated to back presenting as renal angle tenderness. Burning micturition was present in nearly half of the patients and around 23% had microscopic hematuria.

Table 1: Presenting symptoms in study subjects (n=60)

Presenting symptoms	No.	%
Burning micturition	29	48.3
Flank pain	48	80.0
Hematuria	14	23.3

Around 71.7% had multiple renal calculus on investigations. 10% of patients had delayed functioning of kidney in IVP in our study.

Table 2: Grade of hydronephrosis in study subjects (n=60)

Grade of hydronephrosis	No.	%
Grade I	29	48.3
Grade II	16	26.7
Grade III	10	16.7
Grade IV	5	8.3

In our study, drain was placed in 13 study subjects' post-surgery. In our study, the average duration of study was observed to be 69.0±9.76, minimum being 55 minutes while 95 minutes was the maximum.

Table 3: Duration of surgery in study subjects (n=60)

Duration of surgery (min)	No. of patients	Percentage (%)
</= 55	02	3.33%
56-65	30	50%
66-75	16	26.67%
76-85	8	13.33%
86-95	4	6.67%

Intra-op complications were noted in 16.67% (10 patients) of the population studied. Among the complications, the most commonly noted one was hemorrhage (13.33%) followed tear in PCS & extravasation of irrigant was noted in 1.67% of the patients.

Table 4: Post-op complications in study subjects (n=60)

Postop complications	No.	%
No	52	86.66
SSI	3	5.00
UTI	1	1.67
Delayed hemorrhage	1	1.67
Nephro-cutaneous fistula	2	3.33
Sepsis	1	1.67

Post-op complications were present in 13.34% of study population, surgical site infection being the most common in it. But there was no mortality intra-op or post-op in our study.

Patient satisfaction rate was observed to be 81.7% in our study population after proper intervention.

Stone free rate (SFR) was 85% for patients in our study. 15% patients usually with multiple renal pelvic calculi or large staghorn calculus still had residual stones in the operated kidney.

4. DISCUSSION

Since the introduction of PCNL to treat kidney stones, there has been a rapid development in techniques and instruments that can be used to treat staghorn calculi and complex stone. In 1983, Clayman et al. reported the capability and safety of PCNL in treating staghorn calculi. Currently, PCNL is the preferred treatment option for patients with staghorn calculi, complex stone, and big stone.12 The goal treatment of staghorn calculi is stone-free thoroughly with minimal morbidity.13 PCNL in patients with staghorn calculi still represents a procedural challenge, thus requiring the surgeon to perform complete removal of the stone while keeping morbidity to a minimum.16

In spite of the high success rates, serious complications such as blood loss adjacent organ injuries and life-threatening infections can occur during percutaneous renal surgery. In a large study 39 retrospective analysis of complications reported minor complications like fluid extravasation 7.2 % transfusion 11.2 – 17.5 % and fever 21.0 – 32.1 %, whereas major complications were septicemia 0.3-4.7 % and colonic or pleural injury 0.03-3.1 % .8

The overall complications rate of ~14% cases was seen in our patients. Lower to that reported in larger studies. That is 20.5 % (Rosette J et al).8

However, in comparison to a similar prospective study by (Mandal S et al),9 they had an overall complication rate of 41.7% which is not comparable to our study. One can hypothesize this for our study that all the surgeries were performed by an experienced urosurgeon in comparison to other studies where procedures were performed during the learning curve of surgeons. 10

Post-op most common complication was surgical site infection with fever in nearly 5% patients of the study. SSI & fever usually subsided with oral medication. Factors predisposing to fever after PCNL, include preexisting untreated urinary tract infection, infected urinary stones, duration of surgery.11

One patient had severe sepsis which recovered after intensive care. There was no mortality in our study. Septicemia can occur as a result of infection introduced via the access to the kidney or if the stones are infected.8,9

The duration of the operation is an important factor in determining and comparing various procedural techniques17, as the duration of anesthesia and the risk of pulmonary complications after surgery can indirectly affect the operation outputs (amount of blood loss, decrease of hemoglobin, and blood transfusion requirements)18,19 and complications20, associated with PCNL. The mean length of surgery in this study was 69.0±9.76 minutes with a median value of 65 (range 55– 95) minutes. The mean operating time on research conducted by Huang et al.

was 63.5±11.8 minutes with a range of 29–103 minutes. The duration of operation on that research was shorter because Huang et al. did not use a ureteral catheter or balloon catheter before PCNL. According to Huang et al., direct puncture to the stone without previous insertion of ureteral catheter can be done so as to save operating time and reduce complications.23

Stone-free rate after PCNL monotherapy for staghorn calculi is reported to range between 49% to 78%. In this study, the stone-free rate after PCNL monotherapy was 85%. This is higher than the stone-free rate reported by Al - Kohlany et al. (49%)22 because they only considered and treated complete staghorn calculi, whereas in this study we included both patients with partial staghorn calculi and complete staghorn calculi and we made no distinction between partial and complete staghorn calculi. Stone-free rate in our study was not very different from the research conducted by El-Nahas et al.23 (56.6%) and Desai et al.24 (56.9%). They included subject criteria similar to our study, namely the complete and partial staghorn calculi23. also, the stone-free rate of our study was higher than that reported by Soucy et al.21 who reported stone-free rate (78%).

The mean hospital stay was also significantly low 2.57±0.99 days. The median of duration of hospital stays 2 days, where 2 days being the minimum and maximum days being 7 days.

In our study, time taken for full recovery after surgery was observed to be in nearly 83% of patients within 5 days, mean being 5.19±1.35 and median of 5 days with a range of 4 to 10 days overall.

The main strength of the study is the prospective nature of the study. The limitations of the present study are, the small sample size.

5. CONCLUSION

PCNL is a safe and reliable procedure for treating kidney stones if done by an expert hand with adequate instrumentation. It can achieve a stone clearance of almost 85% and with acceptable morbidity. However, this study is limited as the number of patients is small and it is done by a single surgeon without any randomization. But as this procedure was recently started in our department there was a need to evaluate this procedure in our setup.

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