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A PROSPECTIVE COMPARATIVE STUDY OF STANDARD PCNL VERSUS MINI PCNL FOR THE TREATMENT OF RENAL STONE OF SIZE 10-30 MM.

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Abstract

Background

About 2-3 percent of the general population suffers from urolithiasis. When percutaneous nephrolithotomy (PCNL) was introduced, open surgery was no longer the primary surgical treatment for renal stone disorders. There are currently few studies comparing Mini PCNL to regular PCNL. Furthermore, their relative safety and effectiveness are still up for discussion.

Objectives

The goal of the study was to compare the effectiveness of Mini PCNL with regular PCNL in treating kidney stones that were between 10 and 30 mm in size.

Materials and methods

It was a prospective-interventional study. The study took place at the Department of Urology, Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, Bihar, India. The study was conducted for one year, i.e., from November 2021 to December 2022.

Results

With a p-value of 0.0001, the average decline of hemoglobin in mini PCNL was 0.79 ± 0.37, and in Standard PCNL, it was 1.34 ± 0.84. Both were deemed significant. The average number of days spent in the hospital after surgery was 4.38 ± 1.079 in Mini PCNL and 5.30 ± 1.47 in Standard PCNL, with a p-value of 0.18. The characteristics that were determined after the treatment were stone-free status, the need for ICU, the need for blood transfusion (BT), and fever post-operatively.

Conclusion

The study concluded that mini PCNL can be considered a safe, acceptable, and effective modality and alternative to Standard PCNL for the treatment of renal calculi of sizes 10-30 mm, resulting in fewer post-op complications, lesser post-op hospital stays, lesser bleeding, and lesser chances of post-op fever and post-op ICU admission.

Recommendations

A stone-free status should be disclosed to the patient only after post-operative imaging, not based solely on intraoperative results.

Keywords: *Renal Stones, Percutaneous Nephrolithotomy, Ureteroscopy, Mini PCNL, Standard PCNL*
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Introduction

Approximately 2-3% of the general population suffers from urolithiasis. The primary surgical treatment for kidney stone disorders was replaced by open surgery with the introduction of percutaneous nephrolithotomy (PCNL). Compared to SWL or flexible ureteroscopy (URS), PCNL achieves greater stone-free rates and necessitates fewer auxiliary operations for renal stones. PCNL is only widely used to treat renal stones larger than 1 cm due to its more invasiveness and higher risk of serious consequences. Numerous series have been developed that compare the results of shock wave lithotripsy (SWL), URS, and PCNL for kidney stones that range in size from 1 to 3 cm. PCNL had the highest success rates (91% to 98%), followed by flexible ureteroscopy (f-URS) with reasonable rates (87% to 91%) and SWL with somewhat lower rates (66% to 86%) [1, 2].

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Although the PCNL groups had the greatest total and severe problems, they also required the fewest extra procedures. Smaller PCNL access sheaths have been employed in recent years to try to lower morbidity associated with PCNL. Mini PCNL is the term that emerged from this experience. In general, PCNL done through sheaths from 12 Fr to 20 Fr is called mini PCNL. Compared to traditional PCNL, mini-PCNL has shown comparable stone clearance (96% vs. 100%), with a smaller hemoglobin drop, shorter hospital stays, and lower analgesic need. Although the urologic community has not widely adopted the approaches at large, these procedures are of great interest [3, 4]. Therefore, more research is required to assess these methods more thoroughly. There are currently few studies that compare Mini PCNL to regular PCNL. Furthermore, their relative safety and effectiveness are still up for discussion.

The purpose of this study was to compare the effectiveness of Mini PCNL with regular PCNL in treating kidney stones that are between 10 and 30 mm in size.

Methodology

Study Design

It was a prospective-interventional study. It was performed at the Department of Urology, Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, Bihar, India. The study was conducted for one year, i.e., from November 2021 to December 2022.

Study Population

A total of eighty patients were enrolled in the study. All patients having Renal stones were admitted for planned PCNL at IGIMS, Patna, Bihar. The inclusion criteria for enrolment of participants were age more than 18 years, participants having stone size between 10 to 30 mm and solitary stone. The exclusion criteria of patients involved participants who previously underwent stone surgery or extracorporeal shock wave lithotripsy (ESWL), patients who underwent conversion to open surgery, and patients with multiple renal stones.

Study Procedure

Patients were categorized into two groups equally-

Group 1- Standard PCNL (n=40)

Group 2- Mini PCNL (n=40)

Medical history, physical examination, complete blood count, kidney and liver function tests, prothrombin time, blood sugar, blood grouping, viral markers, urinalysis, urine culture, renal ultrasonography, and IVP KUB and NCCT KUB region were all used to evaluate each patient before surgery. Stone size was estimated using NCCT Abdomen. Tract for standard PCNL was taken at 26 Fr, and for Mini, PCNL will be 16 - 20 Fr. Three months following PCNL, the stone-free status was evaluated using an NCCT KUB. If the stone was entirely removed or if there were clinically negligible remnants (less than 4 mm) three months after the treatment, the patient was considered stone-free. Blood loss was assessed by Hb measurement 12-24 hr after surgery. Upon obtaining a sterile urine culture, each patient received 1 gram of ceftriaxone on the morning of surgery.

Under general anesthesia, PCNL was performed on each subject. After putting the patients in the lithotomy position, a 5FR Ureteric catheter was inserted. To locate the collecting system and choose the calyx for puncture, the patient was placed in a prone posture and given a contrast injection. To ensure full clearance, the level of puncture was determined based on the stone's placement. An 18G two-part needle was used for the puncture, and a guide wire was inserted into the system. After inserting a guide rod and using Am Platz dilators or single-step dilators to serially dilate the tract, an Am Platz sheath was inserted. Using a lithotripter and nephroscope, the stone was broken up. After fragments were retrieved, an antegrade 5FR double J stent with a 20-22 FR nephrostomy tube was placed as needed. Post-op parameters were recorded in the ward.

Statistical Analysis

For statistical analysis, version 15 SPSS was utilized. Data were presented as either mean±SD or n (%). Independent t-tests and chi-square tests were used to obtain the p-value. P values less than 0.05 were considered statistically significant.

Ethical Clearance

Ethical approval was provided by the Institutional Ethics Committee (IEC), IGIMS, Patna, Bihar, India, under letter 280/IEC/IGIMS/2021 dated 05 October 2021.

Results

Among all 80 patients, 62 patients are male, and 18 patients are female. The average drop in hemoglobin in Mini PCNL was 0.79 ± 0.37, and in the Standard PCNL group was 1.34 ± 0.84 with a p-value of 0.0001, which was considered significant. The mean post-op hospital stay (days) in Mini PCNL was 4.38 ± 1.079, and in standard PCNL was 5.30 ± 1.47 with a p-value of 0.18. Table 1 represents patients' demographics.

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Table 1. Patients Demographics

Parameter	Standard PCNL (n=40)	Mini PCNL (n=40)	P-value
Age (in years)	36.95±12.03	35.53±12.95	0.61
Male Participants	27 (67.5%)	35 (87.5%)	**0.03**
Female Participants	13 (32.5%)	05 (12.5%)	
Hb drop (g/dl)	1.34± 0.84	0.79±0.37	**0.0001**
Operative time (in minutes)	70±24.4	78.50±3	0.16
Post-op hospital stays (in days)	5.30±1.47	4.38±1.07	**0.002**

Data were presented as either mean±SD or n (%)
Independent t-tests and chi-square tests were used to obtain the p-value
p-value was considered significant at <0.05

Table 2 depicts the post-operative status after the treatment of renal stones. The characteristics that were determined after the treatment were stone-free status, the need for ICU, the need for blood transfusion (BT), and fever post-operatively.

Table 2. Post-operative status after the treatment of renal stone

Parameters		Standard PCNL (n=40)	Mini PCNL (n=40)	P-value
Stone free status	Yes	38 (92.6%)	37 (95%)	0.64
	No	02 (5%)	03 (7.4%)	
Need of ICU	Yes	02 (5%)	00 (00%)	0.47
	No	38 (92.6%)	40 (100%)	
Need of blood transfusion (BT)	Yes	06 (15%)	05 (12.5%)	0.74
	No	34 (85%)	35 (87.5%)	
Post-op Fever	Yes	09 (22.5%)	05 (12.5%)	0.23
	No	31 (77.5%)	35 (87.5%)	

Data was presented as n (%)
Chi-square tests were used to obtain the p-value
p-value was considered significant at <0.05

Table 3 represents the need for pressure irrigation. It was further divided into three grades, including grade 1 for no bleeding, grade 2 for bleeding, no need for pressure irrigation, and grade 3 for bleeding and need for pressure irrigation.

Table 3. Need for Pressure Irrigation

Need for Pressure Irrigation	Standard PCNL (n=40)	Mini PCNL (n=40)	P-value
Grade 1 (No Bleeding)	16 (40%)	29 (72.5%)	
Grade 2 (Bleeding, No need for pressure irrigation)	08 (20%)	09 (22.5%)	
Grade 3 (Bleeding and need for pressure irrigation)	16 (40%)	02 (5%)	**0.0001**

Data was presented as n (%)
Chi-square tests were used to obtain the p-value
p-value was considered significant at <0.05

Discussion

Our study was a prospective-interventional study that included only a single stone in any calyces and a wide range of stone sizes of 10-30 mm. This is the largest study that compares Mini PCNL and Standard PCNL for a single kidney stone that is between 10 and 30 mm in size, as far as we are aware.

In our study, it has been observed that blood transfusion tends to be higher in the standard PCNL group due to more chances of bleeding compared to mini PCNL. A meta-analysis inclusive of eight trials comparing Mini PCNL and

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Standard PCNL revealed that the former had a considerably higher blood transfusion rate of 5.8% than the latter, with a 0.84% rate, respectively [5]. Numerous comparative studies indicate that the Mini PCNL had a blood transfusion rate of 1.07–3.4%, whereas the Standard PCNL had a rate of 3–12% [6]. Similarly, Abdelhafez MF et al. found that the standard PCNL group experienced a higher rate of complications, particularly major complications; they also found a p-value of 0.02 for leakage, bleeding-related complications, and abortion of the procedure, which only happened in the standard PCNL group. To address problems in 6.45% of patients in the conventional PCNL group, additional procedures were also necessary [7].

Operative time and post-op hospital stay are more in the standard PCNL group in this study compared to the mini PCNL group. A similar study conducted by ElSheemy MS et al. reported longer operative time with Mini PCNL. Mini PCNL group had a significantly lower hospital stay and a significantly higher rate of tubeless PCNL comparatively. The typical PCNL group saw considerably more difficulties overall. The SFR in Mini PCNL was much lower [8].

The conventional PCNL group had considerably greater rates of fever and UTI. This was unexpected because a smaller tract in mini PCNL may be linked to a larger RPP. Pyelovenous-lymphatic backflow from elevated RPP, particularly if >30 mm Hg, increases the risk of bacteremia and fever [7, 9, 10, 11].

It has been considered in our study that Mini PCNL is a better alternative as far as bleeding is concerned. Also, pressure irrigation requirement is less in mini PCNL due to less bleeding and also less tract size augmenting the pressure inside the Pelvicalyceal system. Less pressure leads to less myelogenous outflow, which leads to less post-op fever and infection. Compared to standard PCNL, most of the Mini PCNL were tubeless. Pressure irrigation was required more in the case of the Standard PCNL group, so Mini PCNL is more visually comfortable.

Conclusion

The study concluded that mini PCNL was a more acceptable, acceptable and effective modality and alternative to Standard PCNL for the treatment of renal calculi of sizes 10-30 mm, resulting in fewer post-op complications, lesser post-op hospital stay, lesser bleeding, and lesser chances of post-op fever and post-op ICU admission. According to our Visual comfort scale, the need for pressure irrigation required during intra-op is lesser compared to standard PCNL, so mini is more visually comfortable during the procedure. Standard PCNL was considered the choice for renal stones >2cm, but Mini PCNL can also be a good alternative for larger stones. So, we suggest that mini PCNL is a good candidate to treat a wide size range of renal stones safely.

Limitations

Our study has its limitations. One of them was that different surgeons operated different cases. Another limitation was that the laser and pneumatic lithotripter both were used during procedure with surgeon preferences. Additionally, the brief follow-up period prevented a sufficient assessment for stone disease recurrence. Lastly, the limitation was that it was a single-centric study.

Recommendation

A stone-free status should be disclosed to the patient only after post-operative imaging, not based solely on intraoperative results.

Acknowledgment

We are thankful to the patients; without them, the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in the patient care of the study group.

Data Availability

Data is available upon request.

Author contributions

All authors contributed to the design of the research. GB collected and analyzed the data. RK, RU, and KD wrote the manuscript. GB and RK edited the paper. All authors read and approved the paper.

List of abbreviations

PCNL- percutaneous nephrolithotomy
BT- blood transfusion
URS- ureteroscopy
SWL- shock wave lithotripsy
ESWL- extracorporeal shock wave lithotripsy
UTI- Urinary Tract Infection
RPP- rate pressure product

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No funding was received.

Conflict of interest

The authors have no conflicting interests to declare.

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