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ORIGINAL ARTICLE

Comparison between the Outcomes of Standard Percutaneous Nephrolithotomy (S-PCNL) and Mini-Percutaneous Nephrolithotomy (M-PCNL) while Treating Renal Calculi

MUHAMMAD IQBAL NASIM[1], AYAZ AHMAD KHAN[2], RAJAB ALI[3], FARAZ KHALID[4], SAFIULLAH SOHU[5], ZULFIQAR AHMED[6], RASHID BIN HAMID[7]

[1]*Consultant Urologist, Karachi Institute of Kidney Diseases Karachi Pakistan*
[2]*Registrar Urology, University Hospital Limerick Ireland*
[3]*Assistant Professor Urology, Isra University Hospital Hyderabad Pakistan*
[4]*Senior Registrar Urology, Almana General hospital Alhasa KSA*
[5]*Assistant Professor Urology, Shaheed Mohtarma Benazir Bhutto Medical University Larkana Pakistan*
[6]*Assistant Professor Urology, Bilawal Medical College LUMHS Jamshoro Pakistan*
[7]*Assistant Professor Urology, Dow International Medical College Karachi Pakistan*
Corresponding author: Muhammad Iqbal Nasim, Email: iqbal.mallick@hotmail.com

ABSTRACT

Background: In urology, the most common disorder is represented as renal stones. Renal stones have 10% of humans reporting complaints. Their recurrence rate is very high, exhibiting approximately 70 percent recurrence rate. There have been significant advancements made in the treatment of renal stones. PCNL can be used in situations where renal stones are between 10-20 millimeters in the lower pole of a kidney and larger than 20 millimeters.

Objective: This study was performed to compare the outcomes of S-PCNL and M-PCNL while treating renal calculi.

Study design: A randomized control trial

Place and Duration This study was conducted in Karachi Institute of Kidney Diseases Karachi from February 2022 to February 2023

Methodology: There were a total of 50 people included in this research who were equally divided into 2 groups. All of the participants were having a single unilateral renal stone which was <3cm in size. All of the included people were aged 18 years or older. Each patient underwent a physical examination as well as laboratory investigations which included urine culture, CBC, liver function, urinalysis, coagulation profile, and kidney function. There were certain imaging studies that included pelvic and abdominal ultrasonography, kidney–urinary bladder X-ray (KUB), and either intravenous pyelography (IVP) or computed tomography urinary tract (CTUT).

Results: There were 25 patients in each group; Group A (M-PCNL) and Group B (S-PCNL). There were 14 women and 11 men in group A. The mean age of group A was 36.9 years. There were 8 women and 17 men in group B. The average age of group B was 45.06 years. It was observed that the operation time for Group A was more than Group B. It is because stone fragmentation took longer as there was a need to break the stones into smaller pieces in group A. We also identified several complications.

Conclusion: When compared to S-PCNL, M-PCNL offers longer operating times and achieves a greater stone-free rate, making it an excellent method for treating renal calculi.

Keywords: mini-percutaneous nephrolithotomy, standard percutaneous nephrolithotomy, renal calculi, adults

INTRODUCTION

In urology, the most common disorder is represented as renal stones [1]. Renal stones have 10% of humans reporting complaints. Their recurrence rate is very high, exhibiting approximately 70 percent recurrence rate [2]. Renal colic makes an appearance as the stone moves. This causes stone obstruction which compromises the function of the kidney [3, 4, 5].

There have been significant advancements made in the treatment of renal stones. Some minimally invasive methods that are introduced are retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL), and laparoscopy. Some minimally non-invasive methods are also introduced such as ESWL [6]. However, due to unstable conditions, ESWL has failed in a number of situations. Because of its failure, PCNL has been recommended as the treatment of choice for renal stones by the European Association of Urology [7]. PCNL can be used in situations where renal stones are between 10-20 millimeters in the lower pole of a kidney and larger than 20 millimeters.

In order to achieve a high rate of stone-freeness for stones that are larger than 2 cm, Standard-PCNL is used as a standard method to treat them [8]. However, there are certain complications related to this procedure such as excessive bleeding requiring blood transfusion. This leads to the emergence of the requirement of less invasive methods to lower the rate of deaths. Bleeding and parenchymal trauma can be reduced by implementing mini-percutaneous nephrolithotomy (M-PCNL) [9]. This method was introduced by Jackman et al. so that the complexity profile of the PCNL procedure can be improved [10]. In this method, narrower tracts are created (≤18 Fr) to allow smaller scopes access to the kidney. However, it was compulsory to compare the procedure of M-PCNL with the procedure of S-PCNL to find which method is more effective. A few studies have been conducted on the comparison of both of these methods but the people included in most of them were very less in number and controversies regarding their efficacy and safety also remain [11, 12]. Therefore, this study was performed to compare the outcomes of S-PCNL and M-PCNL while treating renal calculi.

METHODOLOGY

There were a total of 50 people included in this research who were equally divided into 2 groups; Group A used M-PCNL and Group B used S-PCNL. Overall 25 patients were in group A and 25 in group B. The people were divided randomly to eliminate biases. All of the people were having a single unilateral renal stone which was <3cm in size. All of the enrolled patients were aged 18 years or older. The Scientific Research Ethics Committee approved this research. The consent from all patients was taken in written form. We have followed the CONSORT guidelines for this research.

Exclusion criteria: Patients who had renal stones larger than 3 cm, multiple renal stones, complicated urinary tract infection, abnormal coagulation profile, congenital renal anatomy, and staghorn stones were not a part of this research.

MedCalc software with a power of 80% was used to calculate the sample size. The confidence level was 95% and the alpha was 0.05. Before the treatment was conducted, every patient's personal, surgical, and medical history was obtained. Each patient underwent a physical examination as well as laboratory investigations which included urine culture, CBC, liver

function, urinalysis, coagulation profile, and kidney function. There were certain imaging studies that included pelvic and abdominal ultrasonography, kidney–urinary bladder X-ray (KUB), and either intravenous pyelography (IVP) or computed tomography urinary tract (CTUT). Appropriate prophylactic antibiotics were given to patients who were having positive urine cultures. These antibiotics were given 48 hours before treatment and continuously after the treatment.

The day after the treatment, participants were discharged from the hospital. The double J (JJ) ureteral stent was removed at the follow-up after 2 weeks of treatment (in cases where it was inserted). Catheterization was continued in those situations where leakage was consistent for more than 3 days after the treatment. During the research, we examined the stone clearance, postoperative analgesic requirement, operating time, leakage, and postoperative hospitalization. Before discharge from the hospital (after the treatment), hemoglobin levels were measured, and an X-ray of the ureter, kidney, and bladder was conducted. Pelvic abdominal ultrasound was also performed. These were conducted to identify stone clearance. The kidney's clinically insignificant remaining stone fragments were determined to be less than 4 mm. One week after the operation, patients were checked on.

SPSS version 26 was used to examine the data. Mean and SD was used for quantitative variables while frequency was used for qualitative variables.

RESULTS

There were a total of 50 people included in this research where they were divided with 1:1 ratio into 2 groups. There were 25 patients in each group; Group A (M-PCNL) and Group B (S-PCNL). There were 14 women and 11 men in group A. The mean age of group A was 36.9 years. There were 8 women and 17 men in group B. The average age of group B was 45.06 years. Table number 1 shows the variables and their values according to the groups. (Note: All the values are expressed as mean in Table 1). It was observed that the operation time for Group A was more than that for Group B. It is because stone fragmentation took longer as there was a need to break the stones into smaller pieces in group A. Table number 2 and 3 show the data on auxiliary procedures and complications.

We encountered some difficulties because the M-PCNL procedure used a ureteroscope rather than a mini perc scope. These difficulties included the ureteroscope's restricted movement due to its length, the migration of stones, and adequate but less intensive irrigation compared to S-PCNL. The Modified Clavien Score was used to identify a few problems. In Table number 3, these complications are displayed.

Table 1: variables and their values according to the groups

Variables	Group A	Group B
Stone burden (cm)	1.6	1.77
Operation time (min)	133.3	48.6
Postoperative VAS pain score	1.4	3.5
Postoperative Hemoglobin g/mL	12.95	12.57
Preoperative Hemoglobin g/mL	13.09	13.38
DJ indwelling time (months)	0	1.5
Clearance (SFR) (%)	100	86.7
Catheter indwelling time (days)	1.4	3.23
Hospital stay (days)	1.4	3.33
Hemoglobin drop (g/dL)	0.14	0.82
Nephrostomy duration (days)	0	1
No. of NSAID ampoules	1.53	4.2
Fluoroscopy exposure time (min)	2.93	3.07

Table 2: data on auxiliary procedures and complications.

Auxiliary procedures (%)	Group A	Group B
Double J insertion	0	12
Catheterization for more than 3 days	0	4
Nephrostomy tube	0	4

Table 3: data on auxiliary procedures and complications.

Complications (%)	Group A	Group B
Grade I		
Bleeding	0	2
Leakage (follow-up)	4	22
Grade II		
Fever (SIRS)	2	7
Grade III		
ESWL postoperative	0	4
Pelvic injury	0	2

DISCUSSION

The major goal of kidney stone treatment is to use a technique that guarantees optimum safety, efficacy, and minimal side effects. In our study, we compared Mini-PCNL (M-PCNL) and Standard-PCNL (S-PCNL) in the treatment of people with a single kidney stone measuring less than 3 cm on one side and normal renal function tests to see how they performed.

Our study found a notable and significant increase in operation time when using M-PCNL as compared to S-PCNL, which is relevant to the length of the procedures. These findings are consistent with earlier works by some researchers [13]. The lengthier period of time required to break down the stones into smaller bits, which facilitated their removal through the narrower tract, can be linked to the reduced field of vision brought on by the employment of miniature endoscopes. However, several investigations found no appreciable difference in the length of the operation between the two approaches [14].

In our study, we found that M-PCNL had a 100% stone clearance rate while S-PCNL had an 86.7% clearance rate. These results are in line with a study done in 2010 by Cheng et al., which showed that utilizing a small-caliber ureteroscope enhances access to various calyces and increases clearance rates [15]. Elsheemy et al.'s study, which found that clearance rates are higher in PCNL, disagrees with these findings [16]. There is no difference between the M-PCNL and S-PCNL stone-free rates, according to certain other writers. In contrast, Abdelhafez et al. in 2016 found that when M-PCNL was employed, the stone-free rate (SFR) for larger stones (2 cm) was considerably lower than for smaller stones (76.3% vs. 90.8%) [17].

M-PCNL showed a significant advantage in terms of postoperative discomfort and length of hospital stay. According to our research, the M-PCNL group experienced significantly shorter hospital stays and less postoperative pain. However, Sakr et al., Cheng et al., and Li et al. reported that there was no appreciable distinction between M-PCNL and S-PCNL in terms of hospital stays [18,19]. The M-PCNL's tubeless technique, which increased patient comfort after the treatment, was blamed for the shorter hospital stays seen in the patients.

Patients undergoing M-PCNL required fewer NSAID vials than those in the S-PCNL group, indicating a substantial statistical difference in NSAID dosages between our study groups. This result is comparable with that of the study by Zeng et al., which showed that the S-PCNL group had higher VAS scores and a greater proportion of patients who required analgesics for pain alleviation [20].

The S-PCNL operation carries a considerable risk of hemorrhage, which could necessitate blood transfusions and raise the risk of kidney impairment. M-PCNL was created with the intention of lowering morbidity, especially bleeding, which can happen when using big nephroscopy and their access tracts. In our investigation, we found that hemoglobin levels dropped less after M-PCNL than after S-PCNL. This result is consistent with a number of other studies, such as those by ElSheemy et al. in 2019, Zeng et al. in 2021, and Cheng et al. in 2010, which all indicated decreased rates of bleeding and blood transfusions in the M-PCNL group.

CONCLUSION

In conclusion, when compared to S-PCNL, M-PCNL offers longer operating times and achieves a greater stone-free rate, making it an excellent method for treating renal calculi.

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