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Urology

A COMPARATIVE STUDY OF PCNL VS RIRS IN THE TREATMENT OF SOLITARY RENAL CALCULI MEASURING 1 TO 2 CM

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ABSTRACT **Objective:** To assess the efficacy and safety of percutaneous nephrolithotomy (PCNL) and Retrograde intrarenal surgery (RIRS) for managing solitary renal calculi of size 1 to 2 cm. **Methods:** This study reviewed medical records of 81 patients who underwent PCNL and 69 patients who underwent RIRS in Institute of Urology, RGGGH between February 2021 and January 2024. Demographic data, operation time, duration of hospital stay, stone free rate, and complication rate were collected and analysed. **Results:** Demographic characteristics (age, sex, serum creatinine, stone hardness, stone diameter, stone impaction, and preoperative hydronephrosis) of the both PCNL & RIRS group have no statistically significant difference. PCNL group of patients had a considerably reduced operation time (48.5 vs. 70.9 min; P<0.001), but increased hospital stay (9.6 vs. 4.1 days; P<0.001) compared to RIRS group. The stone-free rate/stone clearance (SFR) in the PCNL group was superior compared to RIRS group (88.9% vs 68.1%; P<0.001). The complication rate between these PCNL & RIRS groups have no statistically significant difference (12.3% vs. 14.4%; P > 0.05). **Conclusion:** PCNL and RIRS, both procedures are viable and secure surgical choices for individuals with solitary renal calculi of size 1 to 2 cm. RIRS has reduced hospital stay compared to PCNL, but it had a comparatively lower stone free rate and required a longer duration for the operation. Complication rate has no disparity between these two groups.

KEYWORDS : PCNL, RIRS, Complication, Hospital stay, Operation time, Stone free rate

INTRODUCTION

The lifetime prevalence of kidney stone disease is estimated at 1% to 15%, varying according to age, gender, race, and geographic location which lead to disruption of renal function, renal failure and potentially life-threatening urosepsis[1, 2]. Treatment modalities used to manage renal stones are Extracorporeal shock wave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS), percutaneous nephrolithotomy (PCNL), and open/lap ureterolithotomy. But the stone free rate and complication rate associated with these procedures are variable[3, 4]. So deciding the best treatment for solitary renal calculi has long been controversial, but the aim is to achieve complete stone free rate with minimal complications [5].

ESWL was the chosen treatment of choice for patients with renal calculi less than 1 cm. In patients with failed ESWL or stone size larger than 1 cm, RIRS or PCNL were utilized as alternate management [6]. Ureterolithotomy (lap/open) is considered as the final option when alternative treatments were ineffective or unsuccessful [5].

The objective of this retrospective study was to assess the effectiveness and safety of PCNL vs RIRS in managing solitary calculi of size 1 to 2 cm.

Methods

Study Design :

This study combines a review of medical records and outcomes management database. Data for this study collected between February 2021 and January 2024 in Institute of Urology, RGGGH.

Patients :

Inclusion Criteria: stone of size 1-2 cm ,solitary calculi ,underwent PCNL or RIRS, age ≥ 18 years.

Exclusion Criteria: patients with a past history of renal surgery; multiple calculus, patients with severe underlying diseases, coagulation abnormalities or; patients with a solitary kidney, ureteropelvic junction obstruction, pelvic kidney abnormalities & anatomic variations, untreated UTI.

81 patients who were treated with PCNL and 69 patients with RIRS were discovered from February 2021 and January 2024 using our hospital's nominal database.

Procedure of PCNL and RIRS :

Preoperative urine routine, urine culture, blood routine, coagulation function, creatinine level ,USG KUB & CT KUB was done for all patients. All patients received preoperative prophylactic antibiotics. Patients with positive urine culture & sensitivity were administered with appropriate culture sensitive antibiotics, and the surgical procedure was conducted once the infection was well managed.

PCNL - Patient positioned in lithotomy after being given general anesthesia. A 5 Fr ureteral catheter was then introduced into the urethra and guided by fluoroscopy into the renal pelvis. The patient's collecting system became enlarged and filled with a contrast agent to simulate artificial hydronephrosis after the patient was repositioned to a prone position. A puncture is performed at the middle calyx with 18G needle by fluoroscopic guidance. A 0.035-inch Radifocus guide wire (Terumo, Tokyo, Japan) was advanced through the nephrostomy tract as a safety guide wire. Nephrostomy tract dilation was then performed with serial dilators over the working guide wire. The stone was fragmented using a Swiss Lithoclast Master and fragment removal was achieved through forceps extraction. At the conclusion of the procedures, only 5Fr DJ stent placed & no nephrostomy tube was inserted. DJ stent removal after 2 weeks with cystoscopy.

RIRS - 5 Fr DJ stent is inserted two weeks before the procedure to passively dilate the ureter. Under general anesthesia, the patient positioned in dorsal lithotomy and a mild Trendelenburg position. The 20Fr cystoscope was used to see the bladder clearly, and then the DJ stents were removed. A hydrophilic guide wire is used to install a 10 - 12 Fr ureteral access sheath which facilitates convenient and repeated access to the upper urinary tract. A flexible ureteroscope was inserted, and the ureter was meticulously examined to determine the precise position of the stones. The stone was thoroughly disintegrated using a holmium laser. A 5Fr DJ stent is inserted and subsequently removed after 2weeks post-surgery by the utilization of cystoscopy.

Data Collected

Demographic data were obtained from the nominal database of our hospital. The study involved examining the medical records of hospitalized patients, specifically their admission notes, progress notes, operative procedures, and discharge summaries to gather information on the date of admission, date and time of surgery, date of discharge, duration of stone presence, type of surgery performed, and any complications that occurred. The preoperative CT KUB was used to assess the stone hardness, stone diameter, and preoperative hydronephrosis. The surgery was deemed effective if there were no remaining stones in follow up CT KUB after 3months. The complications were categorized according to the Clavien-Dindo grading system [10].

Statistical Analysis

The data was analysed statistically with Statistical Package for the Social Science (SPSS,version 24.0). Numerical variables are

expressed as mean ± standard deviation. The significance of differences between the two groups was tested with the Mann-Whitney U test. Nominal variables were tested with Pearson's c2 test. Differences were considered significant at $P < 0.05$.

RESULTS

Characteristics of the two groups at baseline are given in Table 1. In the two groups, the comparative differences in preoperative general data of sex, age, serum creatinine, time of stone existence, stone hardness, stone diameter and preoperative hydronephrosis were not statistically significant ($P > 0.05$) .

Table 1 : Characteristics of Patients at Baseline

Parameters	PCNL (n = 81)	RIRS (n = 69)	P-value
Age (mean ± SD, year)	53.9 ± 14.3	51.4 ±12.4	P > 0.05
Sex (M/F)	49/32	40/29	P > 0.05
Side(right/left)	38/43	39/30	P > 0.05
Serum creatinine (mean ± SD, mg/dl)	1.0 ± 0.2	0.9 ± 0.3	P > 0.05
Stone hardness (mean ± SD, HU)	901.8 ± 213.3	918.1 ± 187.3	P > 0.05
Stone diameter (mean ± SD, mm)	13.18 ± 1.77	12.8 ± 1.88	P > 0.05
Stone impaction	26	17	P > 0.05
Preoperative hydronephrosis	62	51	P > 0.05

Surgeries in both these two groups were completed successfully. The data in Table 2 shows the differences with respect to outcomes between the two groups. Patients treated by PCNL had significantly less operation time (48.5 vs. 70.9 min; P<0.001) but longer hospital stay (9.6 vs. 4.1 days; P<0.001) than those treated by RIRS. Stone free rate in the PCNL group was better than that of the RIRS group (88.9% vs. 68.1%; P<0.001). There was no statistically significant difference in complication rate between these PCNL vs RIRS groups(12.3% vs. 14.4%;$P < 0.05$). Based on the Clavien-Dindo grading system, no complication over grade IV was noted in the present study. A total of 10 complications were observed in the PCNL group, which includes 3 cases of renal colic(grade I), 5 cases of fever over 38.5 ℃(grade II), 2 cases of hemorrhage(grade II) who was controlled with blood transfusion. A total of 10 complications were observed in the RIRS group, including 3 cases of renal colic(grade I), 7 cases of fever over 38.5 ℃(grade II).

Table 2 : Outcomes in the PCNL and RIRS

Parameters	PCNL (n = 81)	RIRS (n = 69)	P-value
Operation time(mean ± SD, min)	48.5 ± 9.4	70.9 ± 14.2	P < 0.001
Hospitalization time (mean ± SD, day)	9.6 ± 2.4	4.1 ± 1.3	P < 0.001
Stone free rate	88.9(72/81)	68.1(47/69)	P < 0.001
Complication rate	12.3(10/81)	14.4(10/69)	P > 0.05

DISCUSSION

In our study, the PCNL group demonstrated considerably decreased operation time, increased hospital stay, and a high rate of stone clearance compared to the RIRS group. No substantial disparities in the complication rate between these two groups.

The treatment of choice for solitary renal calculi been a subject of ongoing debate, the ultimate aim is to achieve a complete stone free rate with minimal morbidity. Minimally invasive therapies like ESWL, RIRS, PCNL, and laparoscopic ureterolithotomy are gradually replacing traditional open surgery as a result of advancements in surgical techniques and equipment.

According to AUA & EAU guidelines, ESWL is the first line approach for treating renal stones of size less than 1.5/1cm, due to its noninvasiveness, outpatient procedure, and lack of requirement for anesthesia or surgical intervention [5]. However, factors negatively affecting the success rate are stone composition, stone attenuation ≥1000 HU, skin-to-stone distance >10 cm (morbid obesity), renal anatomic anomalies (horseshoe kidney, calyceal diverticulum), unfavorable lower pole anatomy (narrow infundibulopelvic angle, narrow infundibulum, long lower pole calyx), relative or complete patient immobility[1]. ESWL has a potential danger of producing injury to the renal parenchyma [8]. Therefore, alternative therapies such as minimally invasive techniques ,PCNL and RIRS are replacing ESWL in certain individuals.

PCNL is a minimally invasive procedure that avoids the human cavity and causes less harm to tissues and organs, is commonly employed for managing renal stones [6,11]. PCNL has significantly higher stone clearance rates with reduced morbidity while comparing to open stone surgery and it is the recommended procedure for high stone burden and complicated renal calculi[15]. Nevertheless, patients undergoing PCNL treatment experienced complications of bleeding, fever, and bowel injury .

Currently, there is a growing preference for using holmium-YAG laser lithotripsy with FURS (flexible ureteroscopy) for the endoscopic treatment of renal stones [5]. RIRS, or Flexible Ureteroscopy, is a surgical procedure that utilizes the natural cavities of the human body. This method has the benefit of decreased morbidity and increased safety when treating stones near the ureter, and patients experience a swift recovery following the surgery [12]. The duration of hospital stay in the RIRS group was significantly shorter compared to the PCNL group in our study but RIRS group had a prolonged operation time compared to the PCNL group which may be due to intricate manipulation of RIRS, the need for more precise fragmentation, the assistance of a colleague, and appropriate watering [17]. Common complications of RIRS were fever and hematuria, with the majority of complications within categories I and II [14]. In our study, the predominant problem seen was fever, which matches the findings of previous literature. While RIRS showed a safety advantage over PCNL, it had a lesser stone-free rate than PCNL. The stone-free rate of flexible ureteroscopy (RIRS) in the current study was 68.1%, which was significantly lower compared to that of percutaneous nephrolithotomy (PCNL) at 88.9%.

Both PCNL and RIRS are viable and effective surgical therapies for patients with solitary renal calculi of size 1 to 2 cm, and the merits and drawbacks of these two surgical treatments have been previously deliberated[17]. Based on our study, we suggest that RIRS is a more preferable option for treating uncomplicated renal calculi of size 1-2cm due to its benefits of shorter hospital stay and faster recovery and PCNL is the preferred procedure for complex renal calculi(which includes impacted stones, big stones, severe hydronephrosis or urinary tract infections), where stone removal is anticipated to be challenging.

Limitations of Our Study

it is a retrospective study that depends on data available from medical record reviews, medical record review was unblinded, which could have led to bias in determining complications and, this study was a single-center study with a relatively small number of patients.

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