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Miniaturized Percutaneous Nephrolithotomy versus Retrograde Intrarenal Surgery (RIRS) in the Treatment of Renal Stones of Size between 1-1.5 cm

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Abstract: ***Introduction: Minimally invasive procedures have almost completely replaced open surgery in patients with kidney stones over the past two decades1. Percutaneous nephrolithotomy (PCNL) is now the standard of care for the treatment of renal stones2. Miniaturized percutaneous Nephrolithotomy (PCNL) & Retrograde Intrarenal Surgery (RIRS) has become important alternative to standard PCNL for treatment of renal stones. Purpose of this study is to compare stone free rate, overall operative time, hospital stay and complication rate. Methods: Patients with single stone of size between 1-1.5 cm on non contrast CT-KUB were enrolled in this prospective randomised clinical study which was conducted from April 2021 to March 2022. Patients were randomised into two groups. Group 1: Mini PCNL – 30 patients Group 2: RIRS-30 patients. Results: In Mini PCNL group stone free rate was 86.7% (26/30). In RIRS group stone free rate was 76.7% (23/30). Haemorrhage in PCNL in 2 cases needing Blood transfusion. The overall stone free rate and complication rate for PCNL was higher. The operative time was more for RIRS than for Mini PCNL. Post operative hospital stay was longer in PCNL (4 days) than RIRS (2 days). Conclusion: Both mini-PCNL and RIRS have excellent outcomes for renal stones 1–1.5 cm in size. RIRS is close to mini-PCNL in terms of surgical duration, SFR, and repeated session and is an applicable alternative method due to advantages in terms of complications, duration of hospital stay, radiation exposure and blood loss.***

Keywords: Percutaneous Nephrolithotomy, Retrograde Intrarenal Surgery, RIRS, Renal Stone

1. Introduction

Minimally invasive procedures have almost completely replaced open surgery in patients with kidney stones over the past two decades. Percutaneous nephrolithotomy (PCNL) is now the standard of care for the treatment of renal stones. Its higher stone-free rates are counterbalanced by the risk of complications. Recent advances have led to a reduction in nephroscope diameter with the goal of minimising the surgical morbidity of PCNL.

An alternative to the percutaneous approaches is provided by flexible ureteroscopy, RIRS. With the advent of newer-generation flexible ureterorenoscopes, Holmium: YAG laser lithotripsy, RIRS has been gaining popularity among urologists and is widely accepted as an alternative to SWL for the management of renal stones. Drawbacks of retrograde access include limited visualization, restrictions on the size of fragments that can be removed.

2. Materials Methods

Patients with single stone of size between 1-1.5 cm on non contrast CT-KUB were enrolled in this prospective randomised clinical study which was conducted from April 2021 to March 2022. Patients were randomised into two groups.

Group 1: Mini PCNL – 30 patients Group 2: RIRS-30 patients.

Preoperatively, all patients had

- Serum biochemistry
- Renal function tests
- Urine routine and culture
- X-Ray KUB
- Ultrasonogram (USG)
- Contrast Enhanced Computed Tomography (CECT)

Outcome Measures

- Overall operative time
- Stone clearance rate
- Duration of hospital stay
- Complications
- Need for ancillary procedures

Inclusion criteria

- Patients with single renal calculus of size 1-1.5cm in lower pole

Exclusion Criteria

- More than 1 stone
- Uncontrolled coagulopathy

Mini PCNL technique: After general anaesthesia, 5 Fr ureteric catheter placed, Patient then turned prone. Puncture done using 18G needle under fluoroscopy, using triangulation technique. Tract dilated and 16F mini-Perc Amplatz sheath placed, 12 Fr (Karl Storz) nephroscope was used**,** Stone fragmented using pneumatic lithotripsy. Per op Stone clearance was assessed by fluoroscopy and endoscopy.5F J-J stent was placed.

RIRS technique: Prior stenting was done (2-3 weeks before). Flexible Urterorenoscope (URF P-7r, Olympus) & Holmium laser. (200 µ fiber) used.9.5/11 Fr ureteric access sheath placed and Laser fragmentation of stone done. Per op Stone clearance assessed by fluoroscopy and endoscopy.5 Fr DJ stenting done.

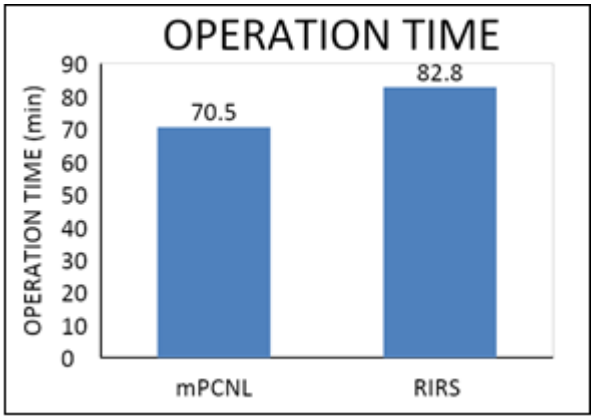
Statistical Analyses

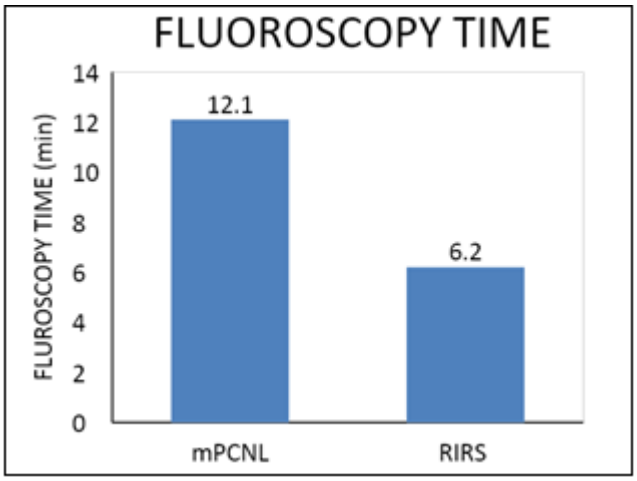
Categorical variables were expressed as frequncy and percentage, continuous variables were expressed as mean and standard deviation. Comparison of continuous variable between two group were analysed by independent sample t test. Association between categorical variables were analysed by Chi square test. A p value <0.05 was considered as statistically significant. Data analysis was performed using spss ver 24

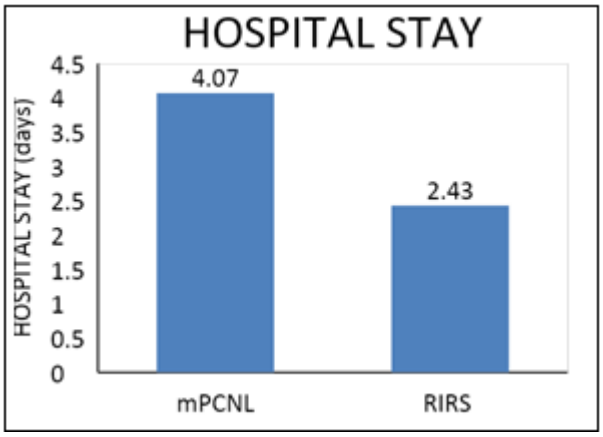
Results: This study included 30 patients in each group of Mini PCNL and RIRS. The demographic characteristics of age, sex were similar in both groups (p>0.05).

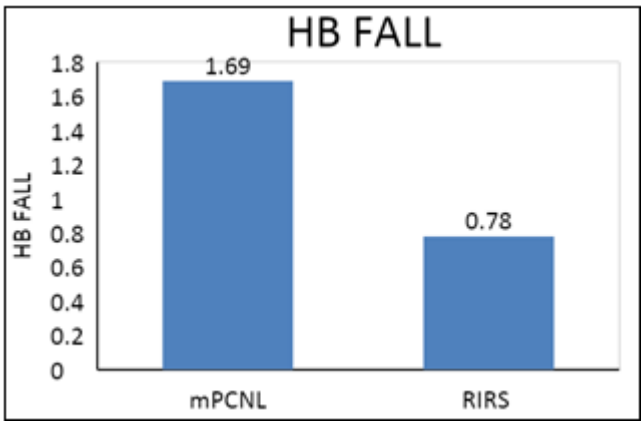
		mPCN	NL %	RN	IRS %	p
Sex T2DM HTN Side SFR Auxillary Procedures Blood Transfusion Fever	Male	22	73.3	20	66.7	0.573
	Female	8	26.7	10	33.3	
	Yes	6	20	6	20	1.000
	No	24	80	24	80	
	Yes	6	20	8	26.7	0.542
	No	24	80	22	73.3	
	Right	17	56.7	18	60	0.793
	Left	13	43.3	12	40	
	Yes	26	86.7	23	76.7	0.317
	No	4	13.3	7	23.3	
	Yes	3	10	7	23.3	0.166
	No	27	90	23	76.7	
	Yes	2	6.7	0	0	0.150
	No	28	93.3	30	100	
	Yes	4	13.3	9	30	0.117
	No	26	86.7	21	70	

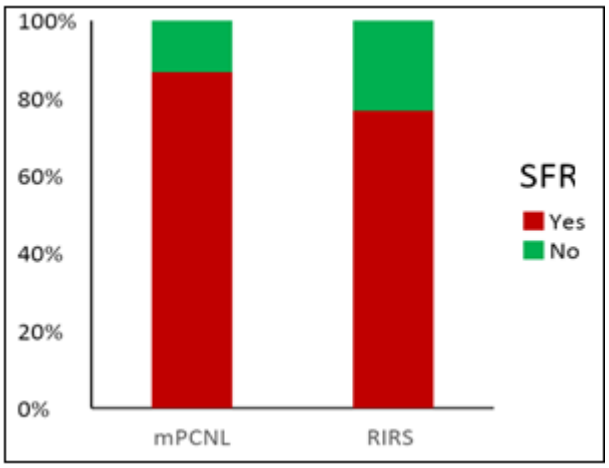
Category	mPCNL (n=30)		RIRS (n=30)		p
	Mean	sd	Mea n	sd	
Age	44.6	11.2	43.4	10.6	0.654
Stone Size (cm)	1.33	0.14	1.33	0.14	1.000
Operation Time (min)	70.5	9.5	82.8	6.5	<0.001
Fluroscopy Time (min)	12.1	1.9	6.2	1.8	<0.001
Hospital Stay (days)	4.07	0.83	2.43	0.57	<0.001
HB Fall	1.69	0.52	0.78	0.22	<0.001

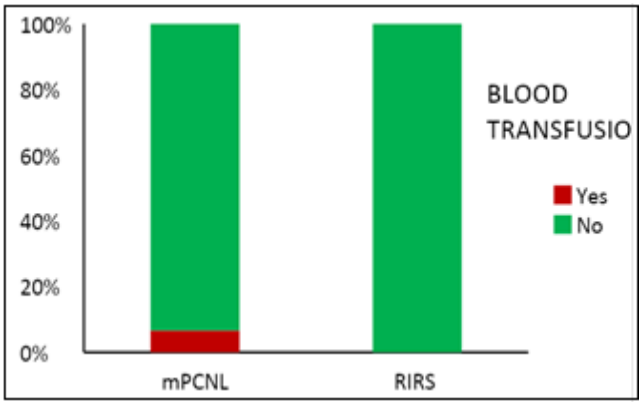


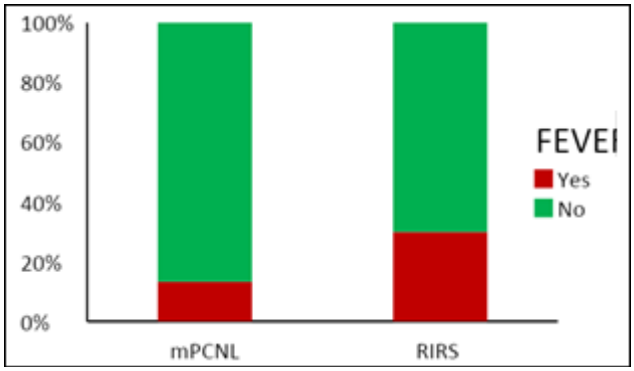












In terms of co-morbid both groups were similar. Stone size was approximately 1.33cm in both groups.

Surgery durations were 82.8 ±9.5 minutes and 70.5±9.5 minutes for RIRS and mini – PCNL and this difference was accepted as statistically significant in favor of mini-PCNL (P<0.001).

The fluoroscopy duration was more advantageous for RIRS (RIRS and mini-PCNL; 6.2±1.8 minutes, 12.1±1.9 minutes; P<0.001). RIRS was more advantageous for hemoglobin fall (0.78±0.22mg/dl, 1.69±0.52 mg/dl; p<0.001).

Duration of stay in hospital was 2.43±0.5 days versus 4.07±0.83 (P<0.001), with RIRS again more advantageous compared to PCNL.

Post operative fever was more in RIRS (9 patients) as against Mini PCNL (4 patients). The stone-free rate after RIRS and Mini PCNL was 76.7% versus 86.7%.

Blood transfusion was needed in 2 patients in Mini PCNL group vs none in RIRS group.

3. Discussion

The size, site, and number (single or multiple) of stone (s), comorbidities, age, are important for the treatment plan. The aim of surgery is achieving the highest stone-free rate with the lowest morbidity. Currently, less invasive endourological methods are used in urinary stone treatment.

Standard and/or miniaturized PCNL methods are currently the best treatment methods known for kidney stones. But the procedure may cause blood loss, neighboring organ injury and parenchyma injury in the kidney. Mini-PCNL has begun to be used to reduce the complications of standard PCNL. The low success rate of ESWL and the high morbidity of PCNL in lower calyx stones directed investigators to other alternatives. RIRS is a reasonable alternative to PCNL and ESWL in low-volume lower calyx stones, because it has a lower complication rate compared with PCNL and a stone-free rate similar to that of ESWL.

A retrospective study by Li, et al. compared mini-PCNL (16 F surgical sheath, 10 F nephroscope) with RIRS for 1.5-2.5 cm lower calyx stones and revealed the advantage of RIRS for duration of hospital stay. They reported the outcomes for mean surgical duration and total stone-free rates were similar for both methods. They emphasized that RIRS may be a good alternative treatment choice to mini-PCNL for lower pole stones.

The meta analysis study by Gao, et al. reported that mini-PCNL was more successful that RIRS for lower calyx stones in terms of SFR [15]; however, RIRS involved shorter hospital stay and less hemoglobin fall.

Fayad, et al. compared mini-PCNL with RIRS for lower calyx stones smaller than 2 cm in a prospective randomized study [16]. They found mini-PCNL disadvantageous in terms of length of hospital stay, while it was more advantageous than RIRS in terms of surgical duration. In terms of SFR, mini-PCNL was more successful (92.72%, 84.31% for mini-PCNL and RIRS, respectively). They found the increased fever rate was higher after RIRS.

Lee, et al. in a prospective and randomized controlled study of RIRS and mini-PCNL for kidney stones larger than 1 cm found they were equivalent in terms of SFR [18], surgery duration, amount of hemoglobin fall and duration of hospital stay. However, postoperative VAS and analgesic requirements were worse in the RIRS group.

De, et al. in a meta analysis study reported RIRS was ahead of minimally invasive PCNL for stones smaller than 2 cm in terms of SFR [22]. They stated that RIRS also had advantages in terms of short hospital stay, while complication rates and amount of hemoglobin fall were worse than PCNL methods. Our results were similar as compared in above studies.

Ramon, et al. compared miniperc with RIRS. Miniperc had disadvantages in terms of hemoglobin fall values [25],

analgesic agent requirements and hospital stay, while RIRS had disadvantages of requiring more sessions for large volume stones, long surgical duration and higher costs of hospital stay.

Our duration of hospital stay was significantly high for mPCNL. As RIRS access is through the natural route, each stage of the surgery is performed visually and there is low complication risk, the duration of hospital stay being superior to PCNL is an expected result.

Fluoroscopy is used in every stage of PCNL to enter the kidney with the nephroscope and visualize the stone and comprises a health risk for the doctor, patient and health workers in the surgery. In the literature, as in our study, studies comparing mini-PCNL and RIRS showed m-PCNL was disadvantageous in this regard [23]. Currently there are authors achieving the same surgical success without any fluoroscopy with RIRS. Perhaps the use of ultrasonography for initial entry to the kidney with mPCNL may reduce the fluoroscopy exposure slightly.

4. Conclusion

1) Both mini-PCNL and RIRS have excellent outcomes for renal stones 1–1.5 cm in size.
2) RIRS is close to mini-PCNL in terms of surgical duration, SFR, and repeated session and is an applicable alternative method due to advantages in terms of complications, duration of hospital stay, radiation exposure and blood loss.