Original Article

# Prospective study on Comparison of outcomes of mini percutaneous nephrolithotomy versus retrograde intrarenal surgery for renal stones of 1–2 cm size

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## Abstract

**Aim and Objectives:** The aim of this study is to demonstrate the outcomes of retrograde intrarenal surgery (RIRS) and Mini percutaneous nephrolithotomy (M-PCNL) in the management of 1–2 cm renal stones, with factors considered being operative time, duration of hospital stay, complication rate, and auxiliary procedure rate.

**Materials and Methods:** This is a single-center, prospective study on patients diagnosed with 1–2 cm renal calculi between April 2018 and March 2020. Informed written consent was obtained from all the patients. A total of 60 patients were included in the study. Patients were divided into two groups – Group I and Group II; Group I: 30 patients who underwent RIRS and Group II: 30 patients who underwent Mini-PCNL-Mini percutaneous nephrolithotomy. Data were collected to compare the operative data, postoperative complications, duration of hospital stay, stone-free rate, and auxiliary procedure rate associated with RIRS and Mini pcnl for the treatment of 1–2 cm renal calculi.

**Inclusion criteria:**

- All patients who presented with 1–2 cm renal calculi between April 2018 and March 2020
- Age >15 years.

**Exclusion criteria:**

- Stones larger than 2 cm and smaller than 1 cm. More than 3 stones in the pelvicalyceal system
- Pregnant women.

**Results:** The mean age in the Mini Perc and RIRS groups was 30.40 ± 14.36 years and 39.20 ± 12.45 years, respectively, with no statistical significance. Of the 60 renal units, 66.7% were male and 33.3% were female in the Mini Perc group. In the RIRS group, 73.3% were male and 26.7% were female. There was no statistical significance. In the Mini Perc group, 53.3% were operated on the right side and 46.7% were operated on the left side, and in the RIRS group, 33.3% were operated on the right side and 66.7% were operated on the left side, with no statistical significance. The mean stone size in the Mini Perc group was 1.4 ± 0.37 cm and the mean stone size in the RIRS group was 1.3 ± 0.27 cm, with no statistical significance. Of the 60 renal units,

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3.3% and 6.7% in Mini Perc and RIRS groups had diabetes alone, and 3.3% and 16.7% in Mini Perc and RIRS groups had hypertension alone. 3.3% in RIRS group had tuberculosis, 6.7% and 13.3% in Mini Perc and RIRS groups had both hypertension and diabetes, and 6.7% in Mini Perc group had diabetes with hypertension with coronary artery disease. The mean operating time in the Mini Perc group was 44.07 ± 9.05 min. The mean operating time in the RIRS group was 72.23 ± 11.01 min. There is statistical significance noted in terms of operating time. There were complications noted in both the groups, of which 6.7% and 16.7% in Mini Perc and RIRS groups had postoperative fever, and 3.3% and 6.7% in Mini Perc and RIRS groups had postoperative hematuria with no statistical significance noted. The mean postoperative pain in the first 24 h was 3.63 ± 1.35 in Mini Perc group, whereas it was 1.43 ± 0.72 in RIRS group; the mean postoperative pain at 48 h was 1.80 ± 0.96 in Mini Perc group, whereas it was 1.03 ± 0.18 in RIRS group, with significance between both the groups. The mean hemoglobin drop in Mini Perc group was 0.88 ± 0.44 g in Mini Perc group, whereas it was 0.99 ± 0.65 in RIRS group, with no statistical significance between both the groups. The mean stone clearance rate for Mini Perc group is 99% ± 5.47%, whereas it was 96.33% ± 10.98% in RIRS group, with no statistical significance. In comparison with both the groups, the retreatment rate was 3.3% in Mini Perc group and 13.3% in RIRS group, with no statistical significance.

**Conclusion:** The result of this study revealed that between both the techniques, patients undergoing RIRS procedure had significantly less pain than Mini Perc, though RIRS procedure took longer operating times. We found that both the techniques were safe, in regard to complications (both intraoperative and postoperative), and there was no significant difference in hospital stay between the groups.

**Keywords:** Extracorporeal shockwave lithotripsy, mini percutaneous nephrolithotomy, mini-percutaneous nephrolithotomy, mini-percutaneous nephrolithotomy, noncontrast computed tomography, percutaneous nephrolithotomy, percutaneous nephrostomy, shock wave lithotripsy, ureterorenoscope

## INTRODUCTION

Nephrolithiasis is a common medical problem in the world. Percutaneous nephrolithotomy (PCNL) was introduced in 1976 to tackle the problem of treating recurrent stone disease and the associated technical difficulties with reoperation.[1] Since then, it has played an important role in the urologist's armamentarium in the management of calculus disease. With the invention of extracorporeal shock wave lithotripsy (ESWL) in the late 1980s, it seemed that PCNL would make an early exit, but it soon became clear that ESWL could not be considered for all stones. For renal calculi sized 1–2 cm, there has been a steady decline in the use of ESWL with a concomitant increase in the use of PCNL and retrograde intrarenal surgery (RIRS), as they are associated with better clearance rates.[2-4]

PCNL is regarded as a second-line therapy for several reasons, including procedure-related bleeding requiring a blood transfusion or intervention,[5-8] greater demand for postoperative parenteral analgesics, and a longer hospital stay.[9] To decrease the disadvantages of PCNL, a "Mini Perc" technique was first developed for children and reported by Helal *et al*.[10] Jackman *et al*. defined "Mini Perc" as a PCNL achieved through a sheath too small to accommodate a standard rigid nephroscope.[11,12]

Marshall performed the first ureteroscopy using a 9 Fr fiberoptic scope in 1964 to visualize an impacted ureteral stone.[13] Flexible and deflectable ureteroscopy was introduced by Takagi *et al*. from Japan at the 15th SIU Congress in 1970. He passed a similar scope through an open ureterotomy into the upper collecting system in a retrograde fashion.[14]

Initial scopes were diagnostic scopes, with no channel for irrigation or working instruments and no active deflecting mechanisms. Major advances in the evolution of the flexible ureteroscope spanning over decades have included reliable active deflection, miniaturization of endoscopes, improvement in intracorporeal lithotripsy, and the development of 2–3 Fr accessory instrumentation.[15,16] The usage of RIRS is limited to patients who are contraindicated for PCNL/shockwave lithotripsy (ESWL) such as bleeding diathesis, morbid obesity, malrotated/malpositioned kidney, horseshoe kidney, and calculus (<1.5 cm) in unfavorable lower calyx.[17]

As our center caters to a large population in the stone belt region, with urolithiasis forming 50% of our overall patient subset, it was considered appropriate to conduct this study.

### Aim and objectives

The aim of this study is to demonstrate the outcomes of RIRS and Mini Perc PCNL in the management of 1–2 cm

renal stones, with factors considered being operative time, duration of hospital stay, complication rate, and auxiliary procedure rate.

## MATERIALS AND METHODS

This is a single-center, prospective study on patients diagnosed with 1–2 cm renal calculi between April 2018 and March 2020. Informed written consent was obtained from all the patients. Patients were divided into two groups – Group I and Group II; Group I: 30 patients who will undergo RIRS and Group II: 30 patients who will undergo MINI PNL. Data were collected to compare operative data, postoperative complications, duration of hospital stay, stone free rate, and auxiliary procedure rate associated with RIRS and Mini pcnl for treatment of 1–2 cm renal calculi.

### Inclusion criteria

- All patients who presented with 1–2 cm renal calculi between April 2018 and March 2020
- Age >15 years.

### Exclusion criteria

- Stones larger than 2 cm and smaller than 1 cm
- More than 3 stones in the pelvicalyceal system
- Pregnant women.

### Retrograde intrarenal surgery technique

Patients were placed in dorsal lithotomy position. Cystoscopy was performed with a 17 Fr/30° cystoscope; a 0.032" zebra guidewire was passed through the ureter into the PCS. A ureteric access sheath (9/11-F) (Cook Medical) was passed over the zebra guidewire. A 7.5-Fr Flex X-2 S (Karl Storz) flexible ureteroscope was used along with a 200- or 365-μm laser fiber for treatment. The lower calyceal calculus was relocated to the upper or middle calyx before fragmentation. Holmium laser power was set in the range 15–20 W. Basketing of the fragments was carried out if necessary, with a nitinol stone basket (Cook Medical).

After lithotripsy, a 5 Fr/26 cm DJ stent was placed in all the cases. The Foley catheter was removed on postoperative day 1 or 2.

### Mini percutaneous nephrolithotomy technique

Patients were placed in lithotomy position. Cystoscopy was performed with a 17 Fr/30° cystoscope; a 0.032" guidewire was passed through the ureter into the desired PCS. Over guidewire, 5 Fr/70 cm ureteric catheter was passed into the renal pelvis. Foley catheterization was done.

In prone position, puncture usually at the posterior lower pole calyx was carried out with an 18-gauge PCN needle (Cook Medical). A flexible 0.035-inch glidewire was then passed into the renal collecting system, preferably in the ureter. The access needle was removed and the skin and fascia were incised. Nephroscopy was performed with a miniature nephroscope. The sheath sizes used were reusable in respective sizes of 15 Fr, 16.5 Fr, and 20 Fr. The renal stone was fragmented by a holmium: YAG laser using 200- or 365-μm fiber (Sphinx 30 laser). Stone fragments were evacuated using grasping forceps. Planning of a tubeless mini-PCNL (mPCNL) was performed at the discretion of the operating surgeon. All cases 5 Fr/26 cm DJ stent was placed. Foley catheter and PCN were removed on postoperative day 1 or 2.

## RESULTS

The mean age in the Mini Perc and RIRS groups was 30.40 ± 14.36 years and 39.20 ± 12.45 years, respectively [Table 1]. There was no statistical significance noted in regard to age with a $P = 0.014$ [Table 1].

Of the 60 renal units, 66.7% were male and 33.3% were female in the Mini Perc group. In the RIRS group, 73.3% were male and 26.7% were female. There was no statistical significance noted, with a $P = 0.573$ [Table 2].

In the Mini Perc group, 53.3% were operated on the right side and 46.7% were operated on the left side [Table 3]. In the RIRS group, 33.3% were operated on the right side and 66.7% were operated on the left side [Table 3]. There was no statistical significance noted, with a $P = 0.118$ [Table 3].

The mean stone size in the Mini Perc group was 1.4 ± 0.37 cm and mean stone size in RIRS group was

**Table 1: Age distribution between Mini Perc and retrograde intrarenal surgery groups**

| Group Age | *n* | Mean±SD | SEM | *P* |
|---|---|---|---|---|
| Mini perc | 30 | 30.40±14.366 | 2.623 | 0.014 |
| RIRS | 30 | 39.20±12.455 | 2.274 | |

RIRS: Retrograde intrarenal surgery, SD: Standard deviation, SEM: Standard error mean

**Table 2: Sex distribution between Mini Perc and retrograde intrarenal surgery groups**

| Sex | Group | | Total | *P* |
|---|---|---|---|---|
| | Mini perc | RIRS | | |
| Male | | | | 0.573 |
| Count | 20 | 22 | 42 | |
| Percent within group | 66.7 | 73.3 | 70.0 | |
| Female | | | | |
| Count | 10 | 8 | 18 | |
| Percent within group | 33.3 | 26.7 | 30.0 | |
| Total | | | | |
| Count | 30 | 30 | 60 | |
| Percent within group | 100.0 | 100.0 | 100.0 | |

RIRS: Retrograde intrarenal surgery

1.3 ± 0.27 cm [Table 4]. There was no statistical significance noted with $P = 0.211$ [Table 4].

All the patients were screened for comorbid conditions, of which the noted complications in the 60 renal units were diabetes, hypertension, tuberculosis, diabetes with hypertension, and diabetes with hypertension with coronary artery disease [Table 5]. Of the 60 renal units, 3.3% and 6.7% in Mini Perc and RIRS groups had diabetes alone [Table 5]. 3.3% and 16.7% in Mini Perc and RIRS groups had hypertension alone. 3.3% in RIRS group had tuberculosis [Table 5]. 6.7% and 13.3% in Mini Perc and RIRS groups had both hypertension and diabetes [Table 5]. 6.7% in the Mini Perc group had diabetes with hypertension with coronary artery disease [Table 5].

The mean operating time in the Mini Perc group was 44.07 ± 9.05 min. The mean operating time in the RIRS group was 72.23 ± 11.01 min [Table 6]. There is statistical significance noted in terms of operating time, with a $P = 0.000$ [Table 6].

There were complications noted in both the groups, of which 6.7% and 16.7% in Mini Perc and RIRS groups had postoperative fever [Table 7]. 3.3% and 6.7% in Mini Perc and RIRS groups had postoperative hematuria. There was no statistical significance noted with $P = 0.379$ [Table 7].

The mean postoperative pain in the first 24 h was 3.63 ± 1.35 in Mini Perc group, whereas it was 1.43 ± 0.72 in RIRS group [Table 8]. The mean postoperative pain at 48 h was 1.80 ± 0.96 in Mini Perc group, whereas it was 1.03 ± 0.18 in RIRS group [Table 8].

There was statistical significance between both the groups in respect to postoperative pain, with a $P = 0.000$ [Table 8].

The mean hemoglobin drop was 0.88 ± 0.44 g in Mini Perc group, whereas it was 0.99 ± 0.65 in RIRS group [Table 9]. There was no statistical significance between both the groups, with a $P = 0.422$. A nonparametric analysis with Mann–Whitney test showed a $P = 0.656$, which was not significant [Table 9].

The mean hospital stay in the Mini Perc group was 3.30 ± 0.95 days, whereas it was 3.07 ± 1.91 days in RIRS group [Table 10]. There was no statistical significance noted between both the groups in regard to hospital stay, with $P = 0.552$ [Table 10].

**Table 3: Laterality of stones**

| Laterality | Group | | Total | *P* |
|---|---|---|---|---|
| | Mini perc | RIRS | | |
| Right | | | | 0.118 |
| Count | 16 | 10 | 26 | |
| Percent within group | 53.3 | 33.3 | 43.3 | |
| Left | | | | |
| Count | 14 | 20 | 34 | |
| Percent within group | 46.7 | 66.7 | 56.7 | |
| Total | | | | |
| Count | 30 | 30 | 60 | |
| Percent within group | 100.0 | 100.0 | 100.0 | |

RIRS: Retrograde intrarenal surgery

**Table 4: Stone size noted in both Mini Perc and retrograde intrarenal surgery groups**

| Group | *n* | Mean±SD | SEM | *P* |
|---|---|---|---|---|
| Stone size (cm) | | | | |
| Mini Perc | 30 | 1.407±0.3732 | 0.0681 | 0.211 |
| RIRS | 30 | 1.300±0.2716 | 0.0496 | |

SD: Standard deviation, SEM: Standard error mean, RIRS: Retrograde intrarenal surgery

**Table 5: Comorbidities between both Mini Perc and retrograde intrarenal surgery groups**

| Co-morbidities | Group | | Total | *P* |
|---|---|---|---|---|
| | Mini Perc | RIRS | | |
| DM | | | | 0.185 |
| Count | 1 | 2 | 3 | |
| Percent within group | 3.3 | 6.7 | 5.0 | |
| HTN | | | | |
| Count | 1 | 5 | 6 | |
| Percent within group | 3.3 | 16.7 | 10.0 | |
| TB | | | | |
| Count | 0 | 1 | 1 | |
| Percent within group | 0 | 3.3 | 1.7 | |
| DM + HTN | | | | |
| Count | 2 | 4 | 6 | |
| Percent within group | 6.7 | 13.3 | 10.0 | |
| DM + HTN + CAD | | | | |
| Count | 2 | 0 | 2 | |
| Percent within group | 6.7 | 0 | 3.3 | |
| Nil | | | | |
| Count | 24 | 18 | 42 | |
| Percent within group | 80.0 | 60.0 | 70.0 | |
| Total | | | | |
| Count | 30 | 30 | 60 | |
| Percent within group | 100.0 | 100.0 | 100.0 | |

RIRS: Retrograde intrarenal surgery, DM: Diabetes mellitus, HTN: Hypertension, TB: Tuberculosis, CAD: Coronary artery disease

**Table 6: Operating time between both Mini Perc and retrograde intrarenal surgery groups**

| Group | *n* | Mean±SD | SEM | *P* |
|---|---|---|---|---|
| Operating time (min) | | | | |
| Mini Perc | 30 | 44.07±9.059 | 1.654 | 0.000 |
| RIRS | 30 | 72.23±11.019 | 2.012 | |

SD: Standard deviation, SEM: Standard error mean, RIRS: Retrograde intrarenal surgery

The mean stone clearance rate for Mini Perc group is 99% ± 5.47%, whereas it was 96.33% ± 10.98% in RIRS group [Table 11]. There was no statistical significance in

stone clearance when comparing both the groups, with $P = 0.239$ [Table 11].

In comparison with both the groups, the retreatment rate was 3.3% in Mini Perc group and 13.3% in RIRS group [Table 12]. There was no statistical significance noted between both groups, with a $P = 0.161$ [Table 12].

**Table 7: Complications between Mini Perc and Rirs groups**

| Complications | Group | | Total | *P* |
|---|---|---|---|---|
| | Mini Perc | RIRS | | |
| Fever | | | | 0.379 |
| Count | 2 | 5 | 7 | |
| Percent within group | 6.7 | 16.7 | 11.7 | |
| Hematuria | | | | |
| Count | 1 | 2 | 3 | |
| Percent within group | 3.3 | 6.7 | 5.0 | |
| Nil | | | | |
| Count | 27 | 23 | 50 | |
| Percent within group | 90.0 | 76.7 | 83.3 | |
| Total | | | | |
| Count | 30 | 30 | 60 | |
| Percent within group | 100.0 | 100.0 | 100.0 | |

RIRS: Retrograde intrarenal surgery

**Table 8: Postoperative pain both 24 and 48 h postoperatively**

| Group | *n* | Mean±SD | SEM | *P* |
|---|---|---|---|---|
| Postoperative pain 24 h | | | | |
| Mini Perc | 30 | 3.63±1.351 | 0.247 | 0.000 |
| RIRS | 30 | 1.43±0.728 | 0.133 | |
| Postoperative pain 48 h | | | | |
| Mini Perc | 30 | 1.80±0.961 | 0.176 | 0.000 |
| RIRS | 30 | 1.03±0.183 | 0.033 | |

SD: Standard deviation, SEM: Standard error mean, RIRS: Retrograde intrarenal surgery

**Table 9: Hemoglobin drop**

| Group | *n* | Mean±SD | SEM | *P* |
|---|---|---|---|---|
| Hb drop (g) | | | | |
| Mini Perc | 30 | 0.880±0.4468 | 0.0816 | 0.422 |
| RIRS | 30 | 0.997±0.6526 | 0.1191 | |

SD: Standard deviation, SEM: Standard error mean, RIRS: Retrograde intrarenal surgery, Hb: Hemoglobin

**Table 10: Hospital stay**

| Group | *n* | Mean±SD | SEM | *P* |
|---|---|---|---|---|
| Hospital stay (days) | | | | |
| Mini Perc | 30 | 3.30±0.952 | 0.174 | 0.552 |
| RIRS | 30 | 3.07±1.911 | 0.349 | |

SD: Standard deviation, SEM: Standard error mean, RIRS: Retrograde intrarenal surgery

**Table 11: Stone clearance**

| Group | *n* | Mean±SD | SEM | *P* |
|---|---|---|---|---|
| Stone clearance | | | | |
| Mini Perc | 30 | 99.00±5.477 | 1.000 | 0.239 |
| RIRS | 30 | 96.33±10.981 | 2.005 | |

SD: Standard deviation, SEM: Standard error mean, RIRS: Retrograde intrarenal surgery

## DISCUSSION

The management of small renal calculi has evolved in the last decade with the advent of newer procedures, such as Mini Perc and RIRS. The past few years has seen significant advancement in endoscopic instrumentation and laser technology and faster and minimally invasive treatment for stone disease. On the other hand, because of patients growing reluctance for repeated hospitalization and treatment with ESWL, where stone clearance rates are as low as 29%, Physicians are questioning the use of conservative noninvasive treatments.[18,19] Physicians are questioning the use of conservative noninvasive treatments.

A renewed interest for definitive treatment for nonbulky urolithiasis, such as PCNL, and an improvement in minimally invasive approaches, such as flexible ureteroscopes, have spawned interest in techniques such as Mini Perc and RIRS.

In 1983, Huffman *et al*.[20] first reported the use of ureteroscopy to treat renal pelvic calculus. Grasso *et al*.[21] have shown the use of RIRS for large renal stones in patients who were unfit to undergo PCNL.

The role of ESWL for the treatment of small renal calculi has faded. The modifications of PCNL by miniaturization, especially Mini Perc, has established its place in the treatment of small renal calculi.[4,5]

The advantage of our study is that both the groups were comparable as far as the energy used for fragmentation was holmium laser lithotripter, which was the predominant method utilized in both the groups.

The mean age of the patient's in Mini Perc group was 30.40 ± 14.36 years, whereas it was 39.20 ± 12.45 years in RIRS group, with $P = 0.14$, which is statistically not significant.

The mean stone size in Mini Perc group was 1.40 ± 0.37 cm, whereas it was 1.30 ± 0.27 cm in RIRS group. The $P = 0.211$, which was not statistically significant. Both groups were comparable in regard to stone size.

The presence of comorbidities, in general, was 6/30 in Mini Perc group and 12/30 in RIRS group. $P = 0.185$, which is not significant.

The primary objective of this study is to evaluate the safety and efficacy of both the procedures. There was no significant difference in both the intraoperative and postoperative complication rates and both techniques were equally safe. There were no major complications in previous

**Table 12: Retreatment rate between Mini Perc and Rirs groups**

| Retreatment | Group | | Total | *P* |
|---|---|---|---|---|
| | Mini perc | RIRS | | |
| Yes | | | | 0.161 |
| Count | 1 | 4 | 5 | |
| Percent within group | 3.3 | 13.3 | 8.3 | |
| No | | | | |
| Count | 29 | 26 | 55 | |
| Percent within group | 96.7 | 86.7 | 91.7 | |
| Total | | | | |
| Count | 30 | 30 | 60 | |
| Percent within group | 100.0 | 100.0 | 100.0 | |

RIRS: Retrograde intrarenal surgery

studies on Mini Perc, but the studies had comparatively fewer cases.[10,12,22,23] Monga *et al*. in their study of 21 patients undergoing mPCNL did not have major complications, but there was one episode of prolonged fever.[22] Mishra *et al*. in their comparative study between Mini Perc and standard PCNL had only one intraoperative complication in the form of pelvic perforation and two patients had postoperative fever.[24]

RIRS is a safe procedure and major complications are extremely rare. Perforation was reported in 1% of cases.[25] Postoperative stricture rate is <1%, since the miniaturization of instruments and improvement in stone fragmentation devices.[26] Urinomas, urosepsis, or ureteric avulsions have not been reported in large series including almost 1500 procedures.[25,27,28] Reported complications are minor. The colic rates postoperatively reported were 3.5%–9%.[29,30] Gross hematuria and postoperative pyelonephritis occur in 3% of cases.[31]

We also have found that RIRS is a more time-consuming procedure when compared to Mini Perc. This could be attributed to the time-consuming maneuvers, which are required for acquiring access, stone repositioning, and stone fragmentation. A method to reduce the operating time in RIRS is by fragmenting the stone by popcorn technique, which breaks the stones into <4 mm which is sufficient for the stones to pass out. The bulk of residual fragments is less when the fragmentation is done by laser, as the laser vaporizes the stone and the dust is easily washed out in the irrigation during the procedure.[32,33] The mean operating time was 44.07 ± 9.05 min for Mini Perc group and 72.23 ± 11.01 min in RIRS group. There was statistical significance in regards to operating time between both the procedures, with a $P = 0.000$.

A meta analysis performed by Srisubat *et al*. which compared three modalities ESWL, PCNL, and RIRS for renal stones.[34] There were three studies and the results could not be pooled. Two randomized control trials comparing ESWL with PCNL established that the efficacy quotient was higher with PCNL when compared to ESWL. A single randomized control trial comparing RIRS with ESWL showed no significant success rate at 3 months. Finally, it was concluded that ESWL was less efficacious for lower pole stones than PCNL but not significantly different from RIRS.

The primary aim of devising the Mini Perc technique was to reduce the pain related to standard PCNL. Our results demonstrated that there was significantly less pain in the RIRS group as compared to the Mini Perc group. The general understanding is that postoperative pain depends more on the presence of nephrostomy tube rather than the tract's bore, as initially thought.[35-37] However, in a study conducted by Mishra *et al*., it was reported that there is no significant difference in pain between the Mini Perc and standard PCNL group, though most of the Mini Perc procedures were tubeless.[24] This supports our findings of our study that merely performing a tubeless procedure does not lead to reduced postoperative pain.

One of the main risks of percutaneous access for stone treatment is hemorrhage, which sometimes requires blood transfusion and also an increased risk of renal loss.[38-42] In our study, the mean hemoglobin drop was 0.88 ± 0.44 g in Mini Perc group whereas in Rirs group it was 0.99 ± 0.65 g which was not statistically significant with a $P = 0.422$. Even a nonparametric statistical analysis showed no significance with a $P = 0.656$. Due to reduced tract dilatation in Mini Perc, the potential for damage to the renal vasculature reduces, but sometimes complications occur even in experienced hands, by the failure to recognize improper puncture of collecting system.[17]

In regard to length of hospital stay, the Mini Perc group had a mean hospital stay of 3.30 ± 0.95 days, whereas the RIRS group had a mean hospital stay of 3.07 ± 1.91 days. There was no statistical difference between both the groups in comparison to hospital stay. Prabhakar *et al*. discharged all their patients after 24 h of performing RIRS.[17] In a study done by Breda *et al*., 97.6% of their cases undergoing RIRS were performed as outpatient procedures.[43] RIRS was done as an outpatient procedure and PCNL had average of 2 days of hospital stay in a study by Chung *et al*.[4] Monga *et al*. estimated 1.1 days of mean hospital stay in their series of patients undergoing Mini Perc.

A stone-free rate of 100% would outweigh the drawbacks of the surgical procedure. In our study, stone-free rates at

1 month were 99% and 96.03% for Mini Perc and RIRS, showing no statistical significance. The primary aim of this study is to evaluate the efficacy of both the procedures and Mini Perc and RIRS are equal in terms of efficacy and safety.

The complication rates were higher in the RIRS group when compared to Mini Perc group. The complications encountered include fever and hematuria. Two patients in Mini Perc and 5 patients in RIRS groups had postoperative fever, which is a Clavien Dindo grade I complication. One patient in Mini Perc and 2 patients in RIRS group had hematuria, which was also a grade I Clavien Dindo complication. Though the complication of bleeding is noted with conventional PCNL, the miniaturization of the tract diameter in Mini Perc reduces the risk of damage to the renal vasculature, calyceal tear, and damage. The complication of fever seen more in the RIRS group may be attributed to the high intrarenal pressures during the procedure.

In regard to postoperative pain, the Mini Perc group had less pain when compared to a standard PCNL. However, between both the groups, RIRS group showed significantly less pain when compared to Mini Perc group. In our study, we found that there was statistical significance in regards to postoperative pain, with $p = 0.000$.

The pain in the Mini Perc arm can be attributed to the presence of nephrostomy tube. In a study conducted by Mishra et al. it was reported that there is no significant difference in pain between the Mini Perc and standard PCNL group, despite the fact that most of the Mini Perc procedures were tubeless.[24] Hence, this suggests that performing a tubeless PCNL will not reduce post op pain.

Many series on Mini Perc have reported stone free rates in a range of 70%–90%.[11,12,44,45] Previous reported that the Mini Perc stone-free rates have been 85% in pediatric and 89% in adults by Jackman *et al*.,[11,12] 90% by Monga *et al*., and 100% by Lahme *et al*., while Gusti *et al*. reported lower stone-free rates for Mini Perc compared to standard PCNL (77.5% vs. 94%), and they also highlighted about diminished visibility, migration of small fragments into inaccessible calices, and decreased maneuverability as responsible factors.

Previous studies on primary RIRS for renal stones of size 1–2 cm have addressed on some issues.[4] A retrospective analysis which compared RIRS with PCNL reported stone-free rates of 67% and 87%. In patients who cannot undergo PCNL, Grasso *et al*. treated renal stones of size 2 cm or greater with RIRS. In a retrospective study by Ferroud *et al*., the 1-month stone clearance rate was 88% and 93% in RIRS and Mini Perc groups.[46] In our study, the retreatment rate between both the groups was 3.3% in Mini Perc group and 13.3% in RIRS group, which is a grade III Clavien Dindo complication.[47] There was no statistical significance noted between both groups, with a $P = 0.161$.

In our study, there are few limitations; first, it is not a randomized study. The number of patients taken into study was less. There may be unavoidable internal validity bias. The postoperative follow-up was done by ultrasound abdomen and X-ray KUB; a noncontrast computerized tomography (NCCT) would have been more accurate.

A prospective study with randomization and larger sample size comparing Mini Perc and RIRS with follow-up postoperatively with NCCT would yield a better and more accurate data about the superiority of technique.

## CONCLUSION

We conclude that in the treatment of renal calculi of size 1–2 cm, both techniques of RIRS and Mini Perc are equal in terms of safety and efficacy with similar hospital stay. We feel that RIRS is superior to Mini Perc in terms of postoperative pain, although it is associated with longer operating times.

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### Conflicts of interest

There are no conflicts of interest.

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