

Comparison of retrograde intrarenal surgery and mini-percutaneous nephrolithotomy for lower calyx renal stones



Ershad Hussain Galeti¹, Saqib Shahab², Mriganka Deuri Bharali³, Rajaboina Yakaiah⁴

¹Senior Resident, Department of Urology, Narayana Medical College, Nellore, Andhra Pradesh, India, ²Senior Resident, ⁴Consultant Urologist, Department of Urology, Venkateshwara Kidney Centre, Karimnagar, Telangana, India, ³Senior Resident, Dr. Pinnamaneni Siddhartha Institute of Medical Sciences, Chinna Avutapalle, Andhra Pradesh, India

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ABSTRACT

Background: Due to the anatomic characteristics of the lower calyx, lower polar stones are difficult to be removed through the ureter, retrograde intrarenal surgery (RIRS) can be used to deal with lower polar stones, while mini-percutaneous nephrolithotomy (mini-PCNL) is mainly used to deal with RIRS failed to eliminate the stone. **Aims and Objectives:** Prospective comparison of mini-PCNL and retrograde intrarenal surgery outcomes in lower calyx management with respect to surgery duration, pain score (visual analog score), analgesic requirement, hemoglobin drop, and hospital stay. **Materials and Methods:** This is a prospective study in 50 patients (25 cases of RIRS and 25 cases of MINIPERC) over 2 years who came to the urology department with lower calyx stone of size up to 20mm. The selection of the management methods was primarily based on the patient's preferences. Preoperatively, all patients underwent routine workup and CT KUB plain. The primary and secondary objective was stone clearance rates, retreatment rate, complications, surgical duration, pain score (visual analog score [VAS]), analgesic requirement, hemoglobin drop, and hospital stay. **Results:** Miniperc and RIRS had stone clearance rates of 100% and 96%, respectively. In the RIRS group, one patient required retreatment for 1 month. Hospital stay, intraoperative and post-operative complications were non-significant between both groups. Operative duration ($P=0.003$) was lower in the Miniperc group. Hemoglobin drop ($P<0.0013$), patient pain, and visual analog scale score at 6, 24, and 48 h, as well as an analgesic requirement ($P<0.020$), were all lower in the RIRS group. **Conclusion:** The stone clearance rates in both modalities are high, and complications are low. RIRS requires a longer operative duration, and it is associated with favorable pain scores and a lower hemoglobin drop.

Key words: Miniperc; RIRS; Renal stones

INTRODUCTION

With the lifetime prevalence of stone disease estimated at up to 15% and on the rise, it has become even more important to formulate a clear and effective management strategy that offers high stone-free rates (SFRs) in a few sessions and with the least invasiveness as possible.¹ While this might be possible in some stone locations, lower pole stones management continues to be a subject of fierce debate; anatomical variations in the lower pole calyx pose challenges unique to this stone location.¹

The role of flexible ureteroscopy in the urologist's armamentarium has undergone a dramatic evolution.² This is generally attributed to improvements in fiber-optics designs, downsizing of instrumentations, better irrigation system, and the availability of small instruments, both powered and mechanical, to allow complex maneuvers within the confines of the upper urinary tract.

Parallel to these developments, there is an increasing interest in applying retrograde intrarenal surgery (RIRS) to treat renal calculi.

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Address for Correspondence:

Dr. Ershad Hussain Galeti, Senior Resident, Department of Urology, Narayana Medical College, Nellore 524003, Andhra Pradesh, India.

Mobile: +91-8074847997. E-mail: dr.ershadhussain@gmail.com

The last couple of years have seen some significant steps forward in providing a more substantial evidence base for lower pole calyceal management, extracorporeal shockwave lithotripsy (ESWL), RIRS, and percutaneous nephrolithotomy (PCNL). Since the end of the 1970s, PCNL has played a significant role in treating kidney stones. However, complications such as bleeding and transfusion prevent it from being the preferred choice of treatment. Furthermore, PCNL requires more analgesia and can result in prolonged hospitalization. To mitigate the disadvantages of conventional PNL, instruments with smaller diameters have been developed, and Helal et al. have described a technique for minimally invasive PCNL (mini-PCNL), which they first used in the pediatric population in 1997.³

Jackman et al. first performed mini-PCNL in adult patients using smaller sheaths and instruments, and later studies have shown mini-PNL to be a safe treatment choice. However, conventional PCNL is done through the tract size 24 Fr. Thus, mini-PCNL terminology is used for the procedures done through 22-14Fr-tract size.⁴

Flexible ureterorenoscopy was first described in 1990 and became the preferred treatment for kidney stones smaller than 2 cm. Improvements in laser and fiber technology improved the success rates of flexible ureterorenoscopy, and it then became an alternative to PCNL.⁵

This study aimed to compare our results using mini-PCNL and RIRS to treat lower calyceal stones smaller than 2 cm.

Aims and Objectives

The primary objective was to compare the outcomes of mini-PCNL and RIRS in the management of lower calyx stone concerning stone clearance rates, retreatment rate, and complications. Secondary objectives are to compare the surgical duration, pain score (VAS), analgesic requirement, hemoglobin drop, and hospital stay.

MATERIALS AND METHODS

This is a prospective study in 50 patients (25 cases of RIRS and 25 cases of mini-percutaneous [MINIPERC]) over 2 years who came to the urology department with lower calyx stone of size up to 20mm. The institutional ethics committee approved the present clinical study. Exclusion criteria are stone size >20mm, multiple stones, urinary sepsis, bleeding disorder, and pregnancy. The selection of the management methods was primarily based on the patient's preferences. Preoperatively, all patients underwent routine workup, including CBC, coagulation profile, renal

profile, ultrasound of plain abdominal radiograph of the kidneys, ureters, and bladder (KUB), and X-ray KUB. The urine culture was done in all cases to make sure urine is sterile before the procedure. If there was a positive culture, the patient was treated according to the culture-sensitive antibiotics and repeat culture after a couple of weeks to ensure the culture is sterile before the procedure. In addition, all patients had imaging study with CT KUB plain.

Miniperc technique

Nephroscopy was done with a 12Fr nephroscope (Karl Storz, Germany), and stone fragmentation was performed using a pneumatic lithotripter and stone extraction using a 5Fr stone extractor.

RIRS

Pre-procedure 5Fr DJ ureteric stent was left *in situ* for 2 weeks. Ureteric access sheath was placed in all the cases. 7.5Fr flexible ureterorenoscopy passed through ureteral access sheath and lithotripsy done with holmium laser (200micronfiber).

Postoperatively in all patients, Foleys were removed on the 1st POD and discharged with DJ stent *in situ* and oral antibiotics for a week. All patients were followed up at 4 weeks with an X-ray KUB, ultrasound abdomen. DJ stent was removed at 4 weeks if reports were normal.

RESULTS

Mean age of patients in the RIRS group was 44.48 ± 14.68 , and the Miniperc group was 42.96 ± 15.44 . $P=0.8$ was considered, not significant.

Male-to-female ratio in RIRS and Miniperc group 17:8 to 14:11, respectively, $P=0.26$ was considered, not significant.

Mean stone size (mm) in RIRS and Miniperc group was 14.88 ± 3.4 mm and 14.80 ± 2.9 mm, respectively, $P=0.7$ was considered, not significant.

Left-/right-sided ratio in RIRS and Miniperc group was 15/10 and 7/18, respectively.

Diabetes was noted in five RIRS patients and six Miniperc patients; hypertension was noted in 10 RIRS patients and 11 Miniperc patients. However, both comorbidities were not significant between the two groups.

Miniperc group

All patients had renal punctures under fluoroscopy guidance. All calculi were removed through a single track.

Track size was 15Fr in two patients, 16.5Fr in 10 patients, and 21Fr in 13 patients. 12Fr nephroscope and ballistic energy (Pneumatic lithoclast) was used in all patients. The intraoperative duration was 48 ± 4.78 (mean \pm SD), ranging from 40 to 60 min. One patient had significant intraoperative bleeding, so 14Fr nephrostomy was kept, which was removed on the 2nd post-operative day, and the patient was discharged on the 3rd post-operative day. None of the patients required blood transfusion.

RIRS group

Access to the pelvicalyceal system was successful in all 25 patients. A flexible ureteroscope of 7.5Fr was used in all patients and stone fragmentation done with laser. There was no intraoperative complication, and intraoperative duration was 73.2 ± 10.29 (Mean \pm SD) range from 50 to 90 min. Postoperatively, 5Fr D J stent was kept in all patients.

Post-operative parameter

Patients of RIRS group and Miniperc group had VAS at 6h, 24h, and 48 h 3.04 ± 1.20 , 1.92 ± 0.9 , 1.2 ± 0.40 and 4.64 ± 0.99 , 2.88 ± 0.88 , 1.88 ± 0.83 , respectively. Patients of the RIRS group had less pain postoperatively than the Miniperc group, which was statistically significant. Patients of the RIRS group had significantly less analgesia than the Miniperc group ($P=0.02$).

The hemoglobin drop was less profound in the RIRS group, 0.4 ± 0.27 compared to the Miniperc group 1.68 ± 0.33 , which statistically significant, although none of the patients of either group required blood transfusion.

Three patients of the RIRS group had a fever (Clavien Grade 1) postoperatively required antipyretics for 2 days, while one patient had stent-related hematuria (Clavien Grade 1); patients required stent removal at the 10th post-operative day.

One patient of Miniperc group had a fever (Clavien Grade 1) postoperatively required antipyretics for 2 days and one patient had intraoperatively significant bleeding, so nephrostomy was kept which was removed on the 2nd post-operative day followed by Foleys removal on the 3rd post-operative day otherwise Foleys catheter in either group removed on the 1st post-operative day. D J stent was kept in all RIRS and Miniperc group patients, which was removed at 1 month. The complication rates between both the groups were not significant.

The hospital stay in RIRS group was 2.16 ± 0.37 days as compared to Miniperc group which was 2.12 ± 0.33 with P value 0.99 was not statistically significant.

Stone clearance at 1 month in RIRS group was 96% versus 100% in Miniperc group with P value 0.99 which was not significant.

One patient of the RIRS group had residual calculus of size 6mm found during evaluation at 1 month, for that patient underwent Re RIRS with laser lithotripsy (Table 1).

DISCUSSION

Management of small bulk renal urolithiasis is still evolving, with no clear-cut advantage of either of the three modalities; ESWL, PCNL, and RIRS.² PCNL modification by miniaturization, specifically Miniperc, has established its role in managing small renal urolithiasis.⁶ In a comparative study between Miniperc and standard PCNL, Mishra et al.,⁷ showed that Miniperc had a better safety profile with similar efficacy.

Two retrospective studies are comparing RIRS and Miniperc. In the first study, Chung et al.⁸ reported a SFR of 67% in the RIRS group compared to 87% in the PCNL group. In the second study, Ferroudet al.,⁹ reported a SFR of 88% in the RIRS group compared to 93% in the Miniperc group.

In the study by Fatih Akbulut et al., the mean age in the RIRS group was 47.7 ± 15.3 years, and the Miniperc group was 42.96 ± 15.44 years, male-to-female ratio 33:19 to 30:12, respectively.¹⁰ The study by Sabnis et al., showed that a mean age of the RIRS group was 44.48 ± 12.36 years, and Miniperc group was 49.28 ± 12.19 years, male-to-female ratio 19:13 to 25:7, respectively, which are primarily similar to our study.¹¹ Our study means that the RIRS group's age was 44.48 ± 14.68 years and 42.96 ± 15.44 years and 17:8 to 14:11, male-to-female ratio, respectively, male patients were higher in both the groups.

In our study, hypertension was the most common in both groups followed by diabetes mellitus. Nearly similar findings were noted in the study by Sabnis et al.¹¹

Sabnis et al., showed the mean stone size of RIRS and Miniperc group 15.2 ± 0.33 and 15.2 ± 0.34 mm, respectively.¹¹ A study by Jung et al. showed a mean stone size of 23.7 ± 0.64 and 14.2 ± 0.34 mm, respectively.¹² Our study means stone size in RIRS and Miniperc group was 14.88 ± 0.34 mm and 14.80 ± 0.29 mm, respectively.

A various study comparing operative duration is noted in Table 2. The shortest duration for RIRS is noted by Sabnis et al., group; the average duration was between 40 and

Table 1: Intraoperative and post-operative parameters

Intraoperative observation	RIRS (Mean±SD)	Miniperc (Mean±SD)	P value
Duration	73.2±10.29(min) (Mean±SD)	48±4.7(min) (Mean±SD)	0.003(significant)
Complications	0	1(Bleeding)	--
Post-operative observation	RIRS (Mean±SD)	Miniperc (Mean±SD)	P value
Visual analog score			
Pain score			
At 6 h	3.04±1.20	4.64±0.99	0.0001(significant)
At 24 h	1.92±0.9	2.88±0.88	0.004(significant)
At 48 h	1.2±0.40	1.88±0.83	0.005(significant)
Analgesic requirement tramadol (mg)	40±34.10	92±65.67	0.020(significant)
Hemoglobin drop (g/dl)	0.4±0.27	1.68±0.33	0.0013(significant)
Post-operative complication	4	1	0.8(not significant)
Hospital stay (days)	2.04±0.37	2.12±0.33	0.99(not significant)
Complete stone clearance (at 1 month)	96%	100%	0.99(not significant)
Retreatment required	1/25	0/25	1(not significant)

RIRS: Retrograde intrarenal surgery, Miniperc: Mini-percutaneous

Table 2: Comparative studies on intraoperative duration between the two groups

Study	RIRS	Miniperc	P value
Akbulut et al.,2016 ¹⁰	44.4±18.3	91.9±37.36	0.001
Jung et al.,2015 ¹²	123.0±574	90.7±475	0.069
Karakoç et al.,2015 ¹⁴	75.55±21.5	100.26±33.26	0.001
Sabnis et al.,2012 ¹¹	50.63±19.21	40.81±13.79	0.003
Mishra et al.,2011 ⁷	45.2±12.6	31±166	0.0008
Ferroudet et al.,2011 ⁹	59±32.6	48±28.3	0.05
Kiracet et al.,2013 ¹⁶	66.4±15.8	55.7±14.5	0.01
Our study (2018–20)	73.2±10.29	48±4.78	0.003

RIRS: Retrograde intrarenal surgery, Miniperc: Mini-percutaneous

75 min.¹¹ Our study shows more intraoperative duration for RIRS as its new modality requires a longer learning curve. Compare to Miniperc, in all studies, RIRS required more operative time. In all studies, the intraoperative duration for both procedures were statistically significant. In our study, also the duration for RIRS was more than Miniperc, which was statistically significant.

Patients of RIRS group and Miniperc group had VAS at 6h, 24h, and 48h 3.04±1.20, 1.92±0.9, 1.2±0.40 and 4.64±0.99, 2.88±0.88, 1.88±0.83, respectively. Patients of the RIRS group had less pain postoperatively than the Miniperc group, which was statistically significant.

The analgesic requirement in the Miniperc group was higher than RIRS, which was statistically significant. A nearly similar finding was noted in the study by Sabnis et al.¹¹ In addition, Lee et al., noted that pain VAS postoperatively and analgesic requirement were higher in the Miniperc group than in the RIRS group.¹³

A study by Orhan Karakoç et al., showed that hemoglobin drop in Miniperc was 2.39±17 g/dl and in RIRS 0.48±05 g/dl.¹⁴ Sabnis et al., showed hemoglobin drop by

1.43±1.01 g/dl in Miniperc and 0.4±0.63 g/dl in RIRS group, respectively.¹¹ In all studies, hemoglobin drop was significantly noted in the Miniperc group. Our study's hemoglobin drop in the RIRS group was 0.4±0.27 g/dl and 1.68±0.33 g/dl in the Miniperc group, statistically significant; no patients in either group required blood transfusion.

Orhan Karakoç et al., noted fever in nine patients; blood transfusion was required in two patients of the Miniperc group where there were no complications in the RIRS group.¹⁴ Sabnis et al., noted one pelvis perforation intraoperatively and fever in one patient postoperatively in Miniperc, whereas no intraoperative complication and postoperatively three patients had a fever in the RIRS group.¹¹ Pelit et al., recorded no significant complications in both groups.¹⁵ Minor complication (Clavien Grade 1–3) rates were 15.5% and 12.5% for the Miniperc and RIRS groups, respectively, were noted by Kirac et al.¹⁶ In our study, one patient of the Miniperc group had the fever (Clavien Grade 1) postoperatively and one patient had intraoperatively significant bleedings, so nephrostomy was kept, which was removed on the 2nd post-operative day. In the RIRS group, three patients had a fever, and one patient had stent induced hematuria, so the stent removed on the 10th post-operative day. Complications in both groups were statistically not significant.

The hospital stays in the RIRS group was 2.04±0.37 days compared to the Miniperc group 2.12±0.33 days, statistically not significant.

Stone clearance at 1 month in RIRS group was 96% and in Miniperc group was 100%. One patient of the RIRS group had residual calculus of size 6mm found during evaluation

Table 3: Various studies show outcome of each procedure regarding stone clearance at 1 month

Study	RIRS	Miniperc	P value
Akbulut et al., 2016 ¹⁰	85.7%	90.3%	0.8
Jung et al., 2015 ¹²	93%	84.1%	0.9
Sabnis et al., 2012 ¹¹	96.88%	100%	0.09
Ferroud et al., 2011 ⁹	93%	88%	0.96
Mishra et al., 2011 ⁷	100%	96%	0.9
Ferroud et al., 2011 ⁹	88%	93%	0.17
Our study (2018–20)	96%	100%	0.09

RIRS: Retrograde intrarenal surgery, Miniperc: Mini-percutaneous

at 1 month, and the patient underwent Re RIRS with laser lithotripsy. Various studies are listed in Table 3 regarding the stone clearance at 1 month compared to our study. From the above studies, we noted that the stone clearance rate by Miniperc and RIRS was nearly similar.

CONCLUSION

Managing lower calyceal renal stones area challenge for the urologist to attain the best SFR among the available techniques. In conclusion, Miniperc and RIRS represent two equally safe and efficacious techniques for treating lower calyceal renal stones of size ≤ 2 cm, with similar hospital stays. Furthermore, RIRS is superior in terms of less post-operative pain and analgesic requirement, hemoglobin drop, although it is associated with a longer operating time.

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Author's contribution:

EHG – Concept and design of the study, prepared first draft of manuscript, interpreted the results, statistically analyzed and interpreted; **SS** – Reviewed the literature and manuscript preparation; **MDB** – Coordination, review of literature, and manuscript preparation; **RY** – Concept, preparation of manuscript, and revision of the manuscript.

Work Attributed to:

Venkateshwara Kidney Centre, Karimnagar, India.

Orcid ID:

Dr. Ershad Hussain Galeti - <https://orcid.org/0000-0003-3857-5400>

Dr. Saqib Shahab - <https://orcid.org/0000-0001-8260-7831>

Dr. Mriganka Deuri Bharali - <https://orcid.org/0000-0002-9257-1956>

Dr. RajaboinaYakaiah - <https://orcid.org/0000-0001-6099-3815>

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