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Original article

# Comparative Study between Retrograde Intrarenal Surgery and Miniaturized PCNL in Treatment of Lower Calyceal Stones 1-2cm

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## Abstract:

**Background:** Treatment of lower- calyceal stones is more complicated due to the challenging anatomical structure. The optimal modality for treating lower- calyceal stones remains controversial. **Objective:** Comparison between the outcomes of retrograde intrarenal surgery (RIRS) and miniaturized percutaneous nephrolithotomy (mini-PCNL) in treating lower-calyceal stones with a diameter of 1-2cm. **Methods:** During this study, 100 patients with lower calyceal stones were enrolled and divided into 2 equal groups; 1st group underwent RIRS and 2nd group underwent mini PCNL for stones with a diameter of 1-2cm. comparing both group regarding operative time, stone-free rate, complications and hospital stay. **Results:** No significant differences were observed regarding age, gender, body mass index, diabetes mellitus, hypertension, smoking, urinary tract infection, pain, stone side, hydronephrosis, stone density, and stone size. The mini PCNL groups demonstrated significantly lower operative time but higher hemoglobin reduction than the RIRS group. Additionally, JJ stent insertion was significantly higher in the RIRS group than in the mini PCNL group. **Conclusion:** our study concludes that, both MPCNL and RIRS both are effective procedures to treat lower calyxes stones 1-2 cm in diameter with less operative time and less need for jj stents in MPCL but with higher HB drop inspite of no need blood transfusion, also MPCNL characterized by high stone free rate than RIRS but the difference was not statistically significant.

**Keywords:** Retrograde Intrarenal Surgery; Miniaturized Percutaneous Nephrolithotomy; Calyceal Introduction.

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## Introduction

The lower pole (LP) renal stones is the most debatable site of management, EAU guidelines recommend PCNL for stones larger than 2 cm and RIRS or ESWL for stones less than 1 cm. There is debate about the best method of management of LP stones from 1 to 2 cm either ESWL, PCNL, or RIRS.(1)

ESWL is non-invasive with very low complication rate but it's efficacy depends on multiple factors like stone characters (size , number, and density) and patient factors ( BMI, and ifundibulopelvic angle). (2,3) PCNL is effective method for stone retrieval but with peri operative morbidity like bleeding with blood transfusion (4). To decrease these periooerative complications, miniaturized PCNL was developed (5,6) , the smaller the diameter, the less renal parenchymal injury and bleeding. (7,8) RIRS is less invasive method for stone fragmentation or dusting by using laser technology and removal of large fragments by tippless dormie (9).

The aim of the present study is to compare betweenMPCNL and RIRS in management of LP renal stone(1-2cm) particularly operative and postoperative findings and stone free rate.

## Patients and methods:

This study was conducted from February 2022 until September 2023

This is a prospective randomized study conducted on 100 patients with lower calyceal stone 1-2 cm at Urology department, Benha university hospital, Benha, Egypt. These patients were randomly divided into 2 groups using closed envelops, group (A) MPCNL and group (B) RIRS

Every patient involved in the study had all explanations about the aim of this work. A specific freely given informed consent regarding involvement in this study and explanation of the procedures was gained and signed before enrolling in this study protocol .

All patients were evaluated by complete history taking, physical examination , routine pre operative laboratory investigations, and radiological investigations in the form of PUT and non contrast CTUT.

**Statistical analysis**

All data were collected, tabulated and statistically analyzed using SPSS 22.0 for windows (SPSS Inc., Chicago, IL, USA).

***MINI-PCNL Technique:***

All procedures were performed with the patient under general anesthesia. At the beginning of the procedure, placement of a 6 Fr ureteral catheter up to the renal pelvis was performed by means of rigid cystoscopy over a sensor guide wire 0.035 inch in lithotomy position . Subsequently, patients were placed in supine position, and percutaneous access was achieved under fluoroscopic guidance and retrograde urography using an 18-gauge needle through the target lower calyx, after assuring of being in the collecting system, a J-tipped (0.038 inch) super stiff guidewire was inserted through the puncture needle to pass to the renal pelvis downwards to the ureter. The Teflon dilators 10, 12, and 14 fr were used to dilate the tract, then 16 fr dilator with its sheath was used then removal of the dilator leaving the sheath in the calyceal system then a rigid 12-F Nephroscope (Karl Storz) was used .The stone fragmentation was performed using a Ho:YAG laser (365-µm fibre; energy 2.5 Jd; frequency 20 Hz). Before finishing the procedure, antegrade urography was done. A Closed 16-F nephrostomy tube was inserted into the calyceal system at the end of the procedure then opened in next day then we removed the ureteric catheter and close the nephrostomy tube for another 2 hours. If no fever, pain or soaking, we opened

the nephrostomy tube for 1/2 hour then we removed it.

***RIRS Technique***

The RIRS surgery was performed under general anesthesia and patients were located in lithotomy position. First, we use cystoscopy to insert a sensor guide (0.038 inch) through the ureteric orifice, retrograde urography was done, then dilatation of the ureter by Teflon dilators up to 16 French under fluoroscopic guidance. For nondilatable ureter we insert jj stent for passive dilatation for 2 weeks. After ureteral dilatation, a ureteral access sheath (UAS) (12/14 F) was inserted over the guide wire traversing the pelviureteric junction. A safety guide wire was inserted and then using flixible ureterorenoscopy (LithoVue$^{TM}$ single-use Flexible ureteroscope-Boston scientific) through the UAS, deflection of the FURS to inspect the All data were collected, tabulated and statistically analyzed using SPSS 22.0 for windows (SPSS Inc., Chicago, IL, USA). All statistical comparisons were two tailed with significance Level of P-value ≤0.05 indicates significant, p<0.001 indicates highly significant difference while, P> 0.05 indicates non-significant difference.

No significant differences were observed regarding age (P = 0.681), gender (P = 0.109), body mass index (P = 0.841), diabetes mellitus (P = 0.834), hypertension (P = 0.061), smoking (P = 1.0), urinary tract infection (P = 0.839), pain (P = 0.680), stone side (P = 0.317), hydronephrosis (P = 0.229), stone density (P = 0.340), and stone size (P = 0.272) (table 1).

The mini PCNL groups demonstrated significantly lower operative time (table 2, fig 1) (58 ±6 vs. 74 ±8, P < 0.001) stone in the lower calyx, then dusting was performed using a Ho YAG laser (200-µm fiber; energy 0.2-0.5 Jd; frequency 50-80 Hz). Larger fragments were removed by tipless dormia. Before finishing the procedure, retrograde study was performed and the jj stent was inserted.

**Postoperative follow up:**

Postoperative follow up of patients included in the study was in the form of regular visits of patients in the outpatient clinic with postoperative evaluation through the routine investigations like ultrasonography, plain x-ray films; CT scans on urinary tract, urine analysis, CBC and KFT. Patients were followed up after 1 week, 1 month and 2 months.

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## Results

but higher hemoglobin reduction (median = 0.82 vs. 0.44 g/dl, P < 0.001) than the RIRS group (fig 2). Additionally, JJ stent insertion was significantly higher in the RIRS group (28% vs. 8%, P = 0.009) than in the mini PCNL group.

No significant differences were observed regarding hospital stay (P = 0.525), creatinine (P = 0.118), one-month stone free (P = 0.249), two-month stone free (P = 0.1), Clavien classification (P = 0.664), fever (P = 0.218), bleeding (P = 0.617), Post urinary tract infection (P = 0.338), Post operative sepsis (P = 1.0), Post narcotic analgesic (P = 0.338), and urine leakage (P = 0.117)

**Table (1)** Demographic, clinical, and stone characteristics of the studied groups

| | | Mini PCNL(n = 50) | RIRS (n = 50) | P-value |
|---|---|---|---|---|
| **Age (years)** | | | | |
| **Gender** | Mean ±SD | 41 ±12 | 42 ±11 | 0.681 |
| Males | n (%) | 28 (56) | 20 (40) | |
| Females | n (%) | 22 (44) | 30 (60) | 0.109 |
| **Body mass index** | Mean ±SD | 27.02 ±2.41 | 27.11 ±2.22 | 0.841 |
| **Diabetes mellitus** | n (%) | 17 (34) | 18 (36) | 0.834 |
| **Hypertension** | n (%) | 16 (32) | 8 (16) | 0.061 |
| **Smoking** | n (%) | 10 (20) | 10 (20) | 1.0 |
| **Hematuria** | n (%) | 9 (18) | 10 (20) | 0.799 |
| **Urinary tract infection** | n (%) | 21 (42) | 20 (40) | 0.839 |
| **Pain** | n (%) | 30 (60) | 32 (64) | 0.680 |
| **Stone side** | | | | |
| Right | n (%) | 23 (46) | 28 (56) | 0.317 |
| Left | n (%) | 27 (54) | 22 (44) | |
| **Hydronephrosis** | | | | |
| Minimal | n (%) | 26 (52) | 20 (40) | 0.229 |
| Mild | n (%) | 24 (48) | 30 (60) | |
| **Stone density (HU)** | Mean ±SD | 1011 ±204 | 966 ±259 | 0.340 |
| **Stone size (mm)** | Mean ±SD | 17 ±3 | 17 ±2 | 0.272 |

MPCNL: mini-percutaneous nephrolithotomy; RIRS retrograde intrarenal surgery

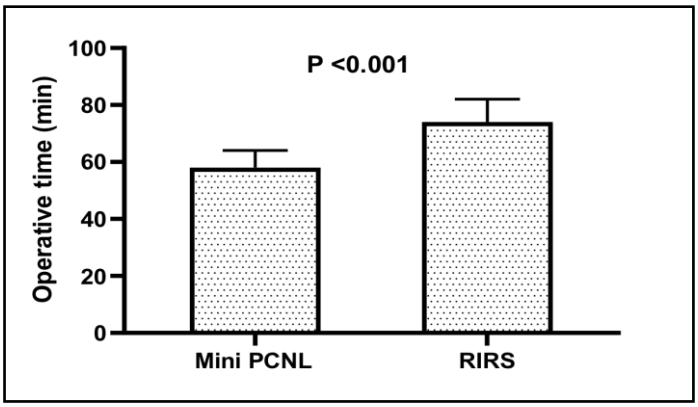


**Figure (1)** Operative time in the studied groups

**Table (2)** Operative and postoperative findings of the studied groups

| | | Mini PCNL (n = 50) | RIRS (n = 50) | P-value |
|---|---|---|---|---|
| **Operative time (min)** | Mean ±SD | 58 ±6 | 74 ±8 | **<0.001*** |
| **Hospital stay (day)** | | | | |
| One day | n (%) | 43 (86) | 45 (90) | 0.525 |
| Two days | n (%) | 7 (14) | 4 (8) | |
| Three days | n (%) | 0 (0) | 1 (2) | |
| **Creatinine (mg/dl)** | Mean ±SD | 1 ±0.16 | 0.95 ±0.1 | 0.118 |
| **Hemoglobin reduction (g/dl)** | Median (range) | 0.82 (0.32 - 1.39) | 0.44 (0.24 - 0.59) | **<0.001*** |
| **One-month stone free** | n (%) | 45 (90) | 41 (82) | 0.249 |
| **Two-months stone free** | n (%) | 48 (96) | 47 (94) | 1.0 |
| **Clavien classification** | | | | |
| Grade 0 | n (%) | 42 (84) | 41 (82) | 0.664 |
| Grade 1 | n (%) | 3 (6) | 5 (10) | |
| Grade 2 | n (%) | 5 (10) | 3 (6) | |
| Grade 4 | n (%) | 0 (0) | 1 (2) | |
| **Fever** | n (%) | 4 (8) | 8 (16) | 0.218 |
| **Bleeding** | n (%) | 3 (6) | 1 (2) | 0.617 |
| **Urinary tract infection** | n (%) | 4 (8) | 7 (14) | 0.338 |
| **JJ-stent** | n (%) | 4 (8) | 14 (28) | **0.009*** |
| **Sepsis** | n (%) | 0 (0) | 1 (2) | 1.0 |
| **Post narcotic analgesic** | n (%) | 7 (14) | 4 (8) | 0.338 |
| **Urine leakage** | n (%) | 4 (8) | 0 (0) | 0.117 |

* Significant P-value; MPCNL: mini-percutaneous nephrolithotomy; RIRS retrograde intrarenal surgery

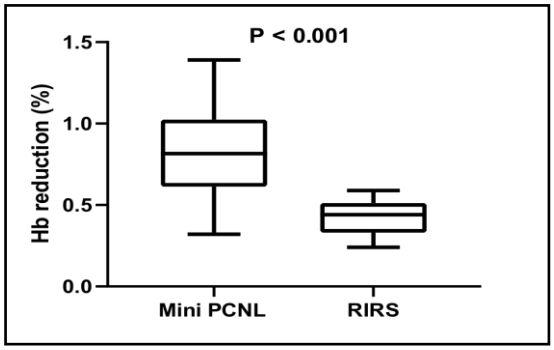


**Figure (2)** Hemoglobin reduction in the studied groups

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## Discussion

The renal stone disease is one of the most common disease in Urology, PCNL and RIRS are the most common surgical methods to gain the highest SFR. And because of the complications associated with standard PCNL like bleeding and extravasatiin, miniaturized PCNL was developed . So MPCNL and RIRS are the least invasive effective procedures for treatment of LP renal stones [(10)].

In the present study we compared between both minimally invasive techniques MPCNL and RIRS for treatment of medium sized (1-2cm) lower calyceal stones. The pre operative criteria are comparable between both groups as regard age, gender, BMI, urinary symptoms like haematuria, UTI, and pain , stone size, density and degree of hydronephrosis. All patients of both groups have single lower calyceal stone 1-2 cm in diameter. We found that the mean operative time in group A (MPCNL) was 58$\pm$6 min while in group B RIRS was 74$\pm$8 min which is highly statistically significant different and this attributed to short wide tract of MPCNL with easy removal of the lower calyceal stone fragments but the RIRS had a long tract and time consuming for trial of deflection of the flexible URS and small caliber of laser fiber. The median post operative hemoglobin reduction was 0.82 g/dl in group A while it was 0.44 gm/dl in group B which is highly significant statistically different inspite of no cases required blood transfusion, and this attributed to kidney parenchymal puncture and dilatation. As regard jj stenting, there was high significant difference between both groups, the group B (RIRS) required pre operative jj stent in 14(28%) cases due to tight ureter, while group A ( MPCNL) required jj stent in 4 (8%) cases post operative due to minor extravasation. There was no any statistically significant differences between both groups as regard hospital stay, stone free rate, Intra operative and post operative complications by Clavien classification, postoperative narcotic analgesic, and urine leakage. The stone free rate was higher in MPCNL than RIRS but not statistically significant different that due to short tract and easy removal of stone fragments in MPCNL.

Akbulut et al [(11)] reported that the operative time in MPCNL is 91.9 min vs 44.4 min in RIRS and this is contrary to our results.While Fayad et al [(12)] reported operative time in tubeless MPCNL is 71.6 min Vs 109.6 min in RIRS for lower calyceal stones $\leq$ 2cm and this agree with our results . These variations may be due to differences in definition of operative time and different surgical protocols

Mahmood et al [(13)] evaluated retrograde intrarenal surgery and mini-percutaneous nephrolithotomy in an economically challenged setting. Two-hundred-seventy-one patients who underwent mPCNL (120) or RIRS (151) for renal calculi 1–2 cm were recruited in the study. Given the fact that all preoperative parameters were very similar or not statistically significant, Both mPCNL and RIRS, are viable, safe, and efficient options for the treatment of renal stones 1–2 cm in size. mPCNL is the more cost-effective option and therefore should be considered if minimally invasive treatment is considered in economically challenged countries. However our study didn't evaluate the economic issue. Stone free rate was slightly higher for mPCNL, and significantly higher in the lower pole. But in our study the difference was not . signficant , hospitalization was shorter for RIRS, in our study there was no signficant statistical difference, but operative time did not differ significantly while in the present study, the MPCNL has a significant statistically shorter operative time than FURS. There was no statistically significant difference in postoperative complications of both groups like our study . There was a significantly higher Hb drop for MPCNL, but that did not translate in a significantly higher transfusion rate which is the same in the present study

Elmansy et al [(14)] compared the safety and efficacy of RIRS and ambulatory tubeless

(mini-PCNL) in the treatment of 1-2 cm lower calyceal renal stones in sixty-four participants. They concluded that ambulatory mini-PCNL and RIRS are effective treatment options for 1-2 cm lower calyceal renal stones. However they reported that both techniques have a comparable hospital stay and complication rates, with a significantly better stone-free rate with mini-PCNL. Also Gao et al [(15)] reported that the stone free rate in MPCNL is higher than FURS in treatment of lower pole renal stone without categorization of stone diameter which is comparable with our results but the difference was not significant.

In contrast to our study, some studies as Akar and Knudsen [(16)] and Mhaske et al [(17)], SFR were found similar or even better for RIRS as reported by Davis et al [(18)].

Regarding procedures' safety profiles in our study, both methods are considered safe which is similar to other studies like Haghighi et al [(19)] , Li et al [(20)], Mhaske et al [(17)] and Davis et al [(18)], and rates of complications were generally low in our study as well.

In our study, there was a significant Hb drop after mPCNL which has been documented in the literature reported by Mhaske et al [(17)] and Li et al [(20)].

The strength points of this study are that it was prospective comparative cohort randomized study design and had no patients who were lost during the study period.

The limitations of the study are worthy of mention, this study was a hospital-based study, hence there was a limited number of cases with relatively smaller sample size relative to study outcomes, and not being a multicentric.

## Conclusion

From our study we can conclude that, both MPCNL and RIRS both are effective less invasive procedures to treat lower calyxes stones 1-2 cm in diameter with less operative time and less need for jj stents in MPCL but with higher HB drop inspite of no cases reported to need blood transfusion, also MPCNL characterized by high stone free rate than RIRS but the difference was not statistically significant.

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