ORIGINAL PAPER

UROLITHIASIS

A prospective comparative study between retrograde intrarenal surgery vs supine mini percutaneous nephrolithotomy for single upper ureteric stones >10 mm

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Introduction To compare retrograde intrarenal surgery (RIRS) and supine mini percutaneous nephrolithotomy (smPCNL) in the management of upper ureteric stones larger than 10 mm.

Material and methods Patients with upper ureteric stones (above L4 vertebra transverse process) larger than 10 mm at Ford Hospital and Research Centre between January 2023 and June 2024 were included in the study and were operated with either RIRS (group A) or smPCNL (group B) based on the informed consent and patients' decision. Patient demographics, stone parameters, intraoperative variables, postoperative outcomes, stone-free rates (SFR) and complications were recorded, and the two groups were compared.

Results Over 18 months, 140 patients (70 in each group) were available for comparison. Both the groups were comparable in terms of patient's demographics and the stone parameters. For RIRS and smPCNL, the mean stone size was 13.87 ±3.69 and 14.21 ±3.47 mm (p = 0.329), mean operative duration was 42.52 ±28.37 and 30.69 ±18.55 minutes (p = 0.0001), mean drop in haemoglobin at 24 hours was 0.44 ±0.96 and 0.69 ±0.92 g/dl (p = 0.364) and postoperative hospital stay was 0.92 ±0.68 and 1.13 ±0.76 days, respectively.

The SFR (at 3 months post-surgery) were 94.2% for RIRS and 98.57% for smPCNL (p = 0.084) and complications rate (Clavien-Dindo ≥II) was 2.88% for both groups. Primary access was not possible in 30% of patients in RIRS leading to staged intervention.

Conclusions RIRS and smPCNL are safe and effective surgical alternatives for managing upper ureteric stones larger than 10 mm. smPCNL offers a single stage solution and equivalent results with RIRS for the large upper ureteric stones.

Key Words: supine PCNL ‹› ureteroscopy ‹› retrograde intrarenal surgery ‹› ureter ‹› kidney calculi

INTRODUCTION

Urinary tract stones have become a common cause of morbidity worldwide, with a lifetime risk for stone development estimated to be around 5.0–10.0% and recurrences in up to 50.0% of patients [1]. Impacted upper ureteric stone is a urological emergency and it poses a serious risk for kidney damage if left untreated [2]. There are various management options for treating the upper ureteric stones, such as extracorporeal shockwave lithotripsy (ESWL), retrograde rigid ureteroscopy (RURS), retrograde intrarenal surgery (RIRS), antegrade percutaneous lithotomy (PCNL), laparoscopy, open surgery and pushback PCNL (pbPCNL) which is a combination of RURS followed by antegrade PCNL [2, 3]. RIRS and PCNL form the mainstay of treatment of upper ureteric stones in the current era, still there

is dilemma regarding the best approach to manage this set of patients [3, 4].

While both techniques aim to provide effective stone removal, their comparative efficacy, safety profiles, and patient-related outcomes necessitate thorough investigation to determine optimal treatment strategies for patients presenting with single upper ureteric stones larger than 10 mm [5]. Recent studies have indicated that both procedures yield favourable outcomes, but there remains a lack of comprehensive data directly comparing the two techniques in a prospective manner. There is need for specialized research in this domain to better guide clinical decision-making and optimize patient care.

In the current study, we aim to compare the clinical outcomes, safety profiles, and patient-reported satisfaction between RIRS and supine mini PCNL (smPCNL). As per our knowledge, there is no study at present which compares smPCNL with RIRS for management of upper ureteric stones larges than 10 mm.

MATERIAL AND METHODS

A prospective comparative study consisting of patients who underwent surgical treatment for upper ureteric stones larger than 10 mm was conducted at Ford Hospital and Research Centre from January 2023 and April 2024. All patients aged over 14 years old, presenting with upper ureteric stones [above the L4 vertebra transverse process and below the ureteropelvic (UPJ)], measuring more than 10 mm, were included in the study. Patients with associated renal stones, obstruction distal to stone, pregnancy, renal anomalies, non-functioning renal units, associated pyelonephritis/urosepsis, uncorrected coagulopathy and with incomplete data or follow-up were excluded.

Patients were informed about both procedures and their associated cost, complications, advantages and disadvantages. After thorough understanding of the procedure and its related issues, patients were asked to select between RIRS or smPCNL for removal of their stone. We could not randomise the participants because of the cost difference between both the procedures. Baseline demographic data and following parameters were recorded: age, sex, body mass index (BMI), comorbidities, side, size, stone location, impaction, Hounsfield unit (HU), renal anomalies, previous surgery and type of anaesthesia.

RIRS group (A)

Spinal anaesthesia (SA) was administered to all the patients except for a few who demanded general anaesthesia (GA), and they were placed in the lithotomy position. Rigid ureteroscopy was performed with a 6 Fr ureteroscope and ureteral compliance was noted. A 10/12 Fr ureteral access sheath (UAS) was placed over a Terumo 0.035 in guidewire under fluoroscopic guidance. If the ureter was too narrow and it was difficult to pass the UAS or the ureteroscope, a double J (DJ) stent was placed, and the procedure was staged. A 7.5 Fr flexible ureterorenoscope (Seeshen Medicals, China) was used to access the stone and Holmium 60 W laser (Cyber Ho Quanta) was used for lithotripsy of the stone.

A setting of 0.6 J and 10 Hz (6 W) fragmentation mode was used initially to break and dislodge the stone proximally (either in the more proximal ureter or in the kidney) from its impacted position. The scope and UAS was then advanced and the stone was dusted using 0.8 J and 12 Hz (9.6 W, vapour tunnel mode) or further fragmentation into small pieces using 1 J and 10 Hz (10 W, fragmentation mode). For the latter, a flexible navigable access sheath (FANS) was used to remove the fragments. If the stone was densely impacted and could not be pushed up, a channel was created, a wire was passed across and a stent was placed for a staged procedure. At end of the surgery a 5 Fr 26 cm DJ stent was placed in all cases and 14 Fr urethral catheter was placed (Figure 1).

smPCNL group (B)

Spinal anaesthesia (SA) was administered to all patients except for a few who demanded general anaesthesia. A 25 gauge spinal needle was used and 3 ml of bupivacaine was instilled, 1 ml (50 μg) of fentanyl was used as an adjuvant in cases with larger stone burden.

After achieving the necessary anaesthesia effect, patients were positioned in modified supine position. The contralateral leg was kept in lithotomy position and ipsilateral leg was kept either straight or flexed at the knee. The contralateral arm was kept on an arm rest, abducted less than 90 degrees, and the patient was asked to hold the contralateral shoulder with the ipsilateral arm. The patient was brought to the edge of the table and two small bolsters were placed, one below the scapula and the other below the buttocks (Figure 2). Tilt of the trunk was kept to a minimum to avoid overlap between the pelvicalyceal system (PCS), stones and bony spinal structures.

The operation theatre and instruments were set up in a very particular way to help the surgeon perform the procedure with minimal assistance. The camera trolley was placed near the patient's head, the c-arm

machine in the center, and the screen of the c-arm near the patient's feet (all three on the contralateral side of the stone). The c-arm foot switch was kept on the floor (head end), the lithotripsy/laser foot pedal was kept near the feet of the patient and the laser was also located near the feet (Figure 2). Assistance from operating theatre (OT) floor staff was limited to changing saline and water pressure regulation.

A 5 Fr ureteric catheter was placed, and retrograde pyelogram (RGP) was performed. Middle calyx was preferably punctured, then the tract was dilated to 16.5 Fr (Storz mini dilator) and a sheath was placed under c-arm guidance. Supine monoplanar technique (c-arm in 0 degrees) was used in all cases and biplanar technique was used only after 3 failed initial attempts (Figure 2).

Holmium 60 W laser (Cyber Ho Quanta) was used for lithotripsy of the stone with settings of 1 J and 10 Hz and a combination of vapour tunnel dusting and fragmentation modes. The fragments were removed mostly by gravity and with forceps when required. After clearing the stone, a 5 Fr 26 cm DJ stent was placed and cystoscopy was performed to confirm the bladder end coil of the DJ stent. Tubeless exit was done in all cases and a single staple applied to the puncture site.

In the RIRS group, primary/secondary, ureteric access sheath (UAS) placement, use of suction, were recorded. In the smPCNL group, number, size, location of tracts and exit strategy were recorded.

The lithotripsy modality, duration of surgery, stone clearance, haemoglobin (Hb) drop, transfusion rate, hospital stay, and complications were recorded for both the groups. Primary outcomes were stone-free rates (SFR) and incidence of postoperative complications (graded by the Clavien-Dindo classification), while secondary outcomes included duration of surgery, postoperative pain scores, hospital stay, and time to resume normal activities. Patient satisfaction scores were noted using the Freiburg Index of Patient Satisfaction (FIPS) questionnaire.

Imaging was performed on the morning of the next day to check for any residual stones. Patients were discharged on the first or second postoperative day

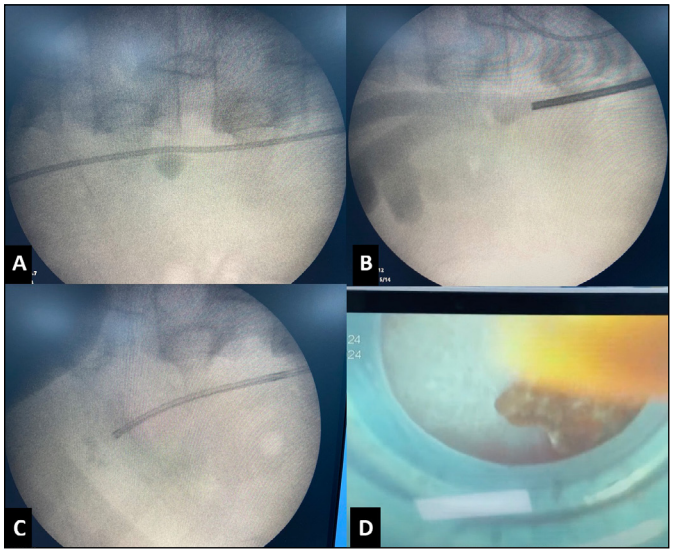

Figure 1. A) *Upper ureteric calculus in pre-stented patient.* **B)** *Initial assessment with semirigid ureteroscope.* **C)** *RIRS in progress, stone pushed in upper calyx.* **D)** *FNAS sheath.*

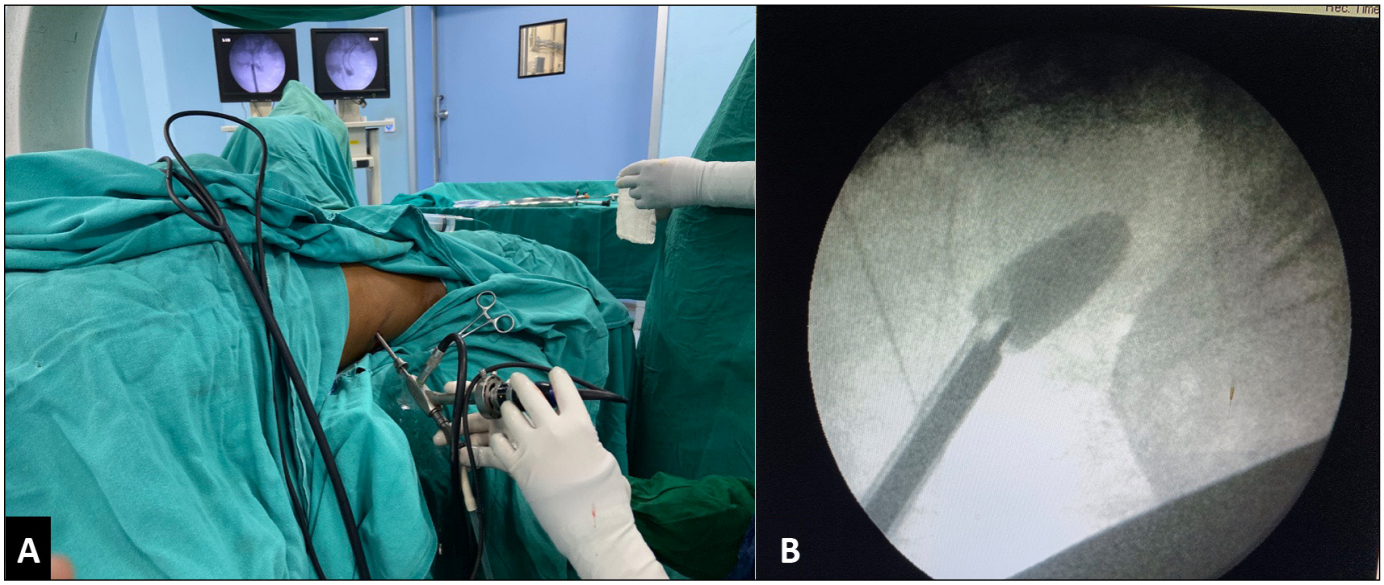

Figure 2. A) *Position and smPCNL for a 12 mm upper ureteric stone, middle calyx access.* **B)** *smPCNL for a large 4 cm upper ureteric stone.*

after removing the Foley catheter, depending on the clinical condition. All patients were reviewed after a month with non-contrast CT scan (NCCT) bone window, to document and assess stone clearance and the DJ stent was removed. Relook RIRS was done at the time of stent removal in cases with residual stones based on patient counselling and shared decision making. A repeat follow-up was performed at 3 months with abdominal ultrasound (US) and patient satisfaction scores were recorded. SFR was defined as complete clearance of stone endoscopically or presence of fragments <2 mm on the follow-up imaging. Complications were graded according to the Clavien-Dindo classification system.

Statistical analysis

Data analysis was done with XlStat2021 software. Continuous variables were expressed as mean ±standard deviation and compared using the Student's t-test. Categorical variables were analysed using the χ^2 test. A p-value of <0.05 was considered statistically significant.

Bioethical standards

Ethical approval was obtained by Ford Hospital Research Centre Institutional Ethics Committee in January 2023 (FHRC/IEC/JAN-2023/002).

RESULTS

One hundred forty-eight patients were ultimately enrolled in the study, out of which 140 were available for final analysis (70 patients in the RIRS group and 70 patients in the smPCNL group). Eight patients were excluded (4 from each group) due to incomplete follow-up not meeting our protocol.

Patient demographics and stone characteristics are shown in Table 1. Mean age was 41.64 ±13.87 and 42.42 ±13.43 years, male to female ratio was 1.26 : 1.33, stone laterality (right : left) ratio was 1.33 and 1.25, one or more comorbidities were present in 45.8% and 47.2% patients in the RIRS and smPCNL groups, respectively.

Mean stone size was 13.87 ±3.69 and 14.21 ±3.47 mm, mean HU of stone was 1068 ±218.63 and 1052 ±227.73 in the RIRS and smPCNL groups, respectively. Stone impaction was noted in 35.71% and 37.14%, with a prior history of upper ureteric or renal stone surgery in 14.3% and 11.5% in the RIRS and smPCNL groups, respectively.

The procedure details, outcome and complications of both the groups are recorded in Table 2. A total of 94.2% of RIRS and 97.1% of PCNL cases were performed under spinal anaesthesia. The smPCNL access was mid-pole in 50 (70.1%), lower pole in 11 (15.7%) and upper pole in 9 (12.8%) patients. A 16.5 Fr Storz mini tract was used in 57 (81.4%) and a 22 Fr tract was used in 13 (18.5%) cases in the smPCNL group. Primary RIRS was possible in 50 (71.4%) cases, where a 10/12 Fr UAS was used in 53 (75.7%) cases and 9/11 Fr was used in 17 (24.2%) cases. Of these, a flexible navigable access sheath (FNAS) was used in 40 (57.1%) cases. DJ stent was placed in all the cases in both the groups as the exit strategy, and no percutaneous nephrostomy (PCN tube) was placed in any case in the smPCNL group.

The duration of surgery was 42.52 ±28.37 and 30.69 ±18.55 minutes, respectively in groups A and B (p = 0.001). Haemoglobin drop at 24 hours was 0.44 ±0.96 and 0.69 ±0.92 g/dl, and it was slightly higher in smPCNL patients but this was statistically insignificant (p = 0.364). None of the patients in either group required blood transfusion. The SFR was 98.57% and 94.2% (p = 0.137), with a mean duration of hospital stay of 1.13 ±0.76 and 0.92 ±0.68 (p = 0.084) for smPCNL and RIRS, respectively.

High-grade (Clavien-Dindo ≥II) complications were noted in 2 patients each group (2.8%). In the RIRS group this included a case of sepsis and ureteric colic each, while in the smPCNL group it was prolonged haematuria needing hospitalisation. Postoperative

Table 1. *Patient demographics and stone characteristics*

Variables	Group A: RIRS (n = 70)	Group B: smPCNL (n = 70)	p-value
Mean age ±SD (range)	41.64 ±13.87	42.42 ±13.43	
Sex (male : female)	1.26	1.33	
BMI	24.5 ±3.56	24.3 ±3.81	0.451
Comorbidities (0 : 1 : 2 : >2) [%]	54.2 : 22.8 : 15.7 : 7.1	52.8 : 24.2 : 14.2 : 8.5	
Stone side (right : left)	1.33	1.25	
Mean stone size ±SD (range) [mm]	13.87 ±3.69	14.21 ±3.47	0.329
Mean HU ±SD (range)	1,068 ±218.63 (315–1,478)	1,052 ±227.73 (321–1,503)	0.274
Impacted stone [%]	35.71	37.14	
Previous surgery [n (%)]			
Nil	60 (85.7)	62 (88.5)	
PCNL	6 (8.5)	5 (7.1)	
RIRS	3 (4.3)	1 (1.4)	
Open surgery	1 (1.4)	2 (2.8)	

BMI – body mass index; HU – Hounsfield Unit; PCNL – percutaneous nephrolithotomy; RIRS – retrograde intrarenal surgery

haematuria was noted in 4.3% and 7.1% with fever noted in 7.1% and 1.6% for RIRS and smPCNL groups, respectively.

The patient reported outcomes are summarised in Table 3. Postoperative pain was comparatively less in the RIRS group both at 1 and 24 hours after the surgery, being 2.59 ±0.87 and 0.43 ±0.54 vs 3.72 ±1.15 and 1.24 ±0.89 and the difference was significant (p = 0.013 and 0.017, respectively). Time to resume normal activities (in days) was significantly shorter (p = 0.002) in the RIRS group 3.58 ±3.63 when compared to the smPCNL group 6.16 ±4.24. Patient satisfaction at the end of surgery was almost equal in both groups (p = 0.721).

Table 2. *Procedure details, outcomes and complications*

Variables	Group A: RIRS (n = 70)	Group B: smPCNL (n = 70)	p-value
Anaesthesia	SA – 66, GA – 4	SA – 68, GA – 2	
Tract location (U : M : L)	NA	9 (12.8%) : 50 (70.1%) : 11 (15.7%)	
Tract size (A – 22, B –16.5)	NA	A – 13 (18.5%), B – 57 (81.4%)	
Primary : secondary	50 (71.4%) : 20 (28.5%)	NA	
UAS size (A – 10/12, B – 9/11)	A – 53 (75.7%), B – 17 (24.2%)	NA	
FANS	40 (57.1%)	NA	
Exit strategy	DJ – 70 (100.0%)	DJ – 70 (100.0%)	
Duration of surgery [min]	42.52 ±28.37	30.69 ±18.55	0.001
Haemoglobin drop [g/dl]	0.44 ±0.96	0.69 ±0.92	0.364
Transfusion rate	0 (0%)	0 (0%)	0.000
Mean hospital stay [days]	0.92 ±0.68	1.13 ±0.76	0.084
Stone-free rates	94.2%	98.57%	0.137
Complications (Calvien-Dindo ≥II)	2 (2.8%)	2 (2.8%)	0.275
Complications (Calvien-Dindo I) – fever	5 (7.1%)	1 (1.6%)	0.026
Complications (Calvien-Dindo I) – haematuria	3 (4.3%)	5 (7.1%)	0.059

DJ – Double J stent; FNAS – flexible navigable access sheath; GA – general anaesthesia; smPCNL – supine mini percutaneous nephrolithotomy; SA – spinal anaesthesia; RIRS – retrograde intrarenal surgery; UAS – ureteral access sheath

Table 3. *Patient reported outcomes*

Variables	RIRS (n = 70)	smPCNL (n = 70)	p-value
Postoperative pain (VAS) (1 hour : 24 hours)	2.59 ±0.87 : 0.43 ±0.54	3.72 ±1.15 : 1.24 ±0.89	0.013 : 0.017
Time to resume normal activities	3.58 ±3.63	6.16 ±4.24	0.002
Patient satisfaction	1.71 ±0.92	1.75 ±0.88	0.721

RIRS – retrograde intrarenal surgery; smPCNL – supine mini percutaneous nephrolithotomy; VAS – Visual Analogue Scale

DISCUSSION

There are a few papers comparing RIRS and prone mini PCNL for large upper ureteric stone, but studies comparing supine mini PCNL with RIRS are limited. Upper ureteric stones are a commonly encountered problem in everyday practise and they pose a serious threat to the function of the kidney because of the effect of impaction and obstruction [2, 6].

These stones need timely treatment to prevent irreversible damage to the kidney. Multiple modalities of treatment of these stones are available, but still uncertainty exists over which is best [3, 7]. Out of all available options, ESWL, RURS, RIRS, antegrade PCNL, laparoscopy, open surgery and pushback PCNL, we choose the 2 modalities which are probably more commonly used to treat the upper ureteric stone in this era, RIRS and smPCNL.

Efficacy of ESWL in upper ureteric stones measuring more than 10 mm is only 42.0%, and it does not provide complete relief of obstruction [8]. Patients often have to suffer from repeated colic episodes, flank pain and a substantial proportion require repeated treatment [4, 8]. The biggest disadvantage of RURS is stone retropulsion (28.0–60.0%) and poor stone clearance rates (68.0–76.0%), poor vision, with inflammatory and oedematous mucosa increasing the chances of injury and subsequent stricture [9].

The practice of prone PCNL for upper ureteric stones is common in India, which enables urologists to access the stone easily and avoid the supracostal, upper pole punctures. But this technique is associated with multiple fragments which can migrate into different calyces, requiring multiple punctures, leading to incomplete clearance [5, 10].

RIRS for stone surgery is recommended for renal and upper ureteric stones up to 2 cm and recently there has been a sharp rise in this modality due to availability of digital smaller flexible ureteroscopes and thulium fibre laser (TFL) [11].

RIRS has the advantage of being less invasive as it uses the natural passage, easier access to stone, less fluoroscopy exposure and shorter hospital stay. However, there are a few issues related to this procedure especially for the upper ureteric stones. There is associated ureteral mucosal edema distal to the stone limiting the working space, making lithotrip-

sy difficult. In less experienced hands this may lead to ureteric mucosal injury and subsequent stricture, urosepsis and procedural staging may be required in larger stones [6, 12]. We avoided in situ dusting of the stone in the upper ureter, these were disimpacted and relocated preferably to the upper calyx for dusting/fragmentation.

Antegrade approach to upper ureteric stones by PCNL is a safe and effective treatment, associated with high SFR. It provides access to stone from a dilated upper ureter, better visualisation, resulting in better and safe lithotripsy [5, 6, 13]. In smPCNL, there is no need to push the stone and less chances of stone migration, with a majority of these cases done with middle calyx puncture, and if the stone needs to be pushed, this can be done after the sheath is placed in the upper ureter [10].

There are a few disadvantages of PCNL such as its higher invasiveness due to puncture of the kidney, associated higher risk of bleeding, rare need for angioembolization, increased radiation exposure and slightly prolonged hospital stay [14]. Although most of these limitations are overcome by mini PCNL.

The mean age in our study population was 41.64 ±3.87 years, similar to Elgebaly et al. [6] and Gu et al. [8]. In our study, the mean stone size was 13.87 ±3.69 and 14.21 ±3.47 mm which was similar to the study by Zhang et al. [10] (15.6 ±2.5 and 14.9 ±2.3 mm) and Elgebaly et al. [6] (13.5 mm and 13.2 mm) but less than Gu et al. [8] (17.27 mm and 16.23 mm). The mean HU of stone was slightly more in our study (1,068 ±218.63 and 1,052 ±227.73) when compared to Elgebaly et al. [6] (979.4 and 871.4) and Mohey et al. [1] (980.9 and 989.5).

Few studies by Gu et al. [8], Mohey et al. [1] and Elgebaly et al. [6] included only impacted upper ureteric stones in their study, while Zhang et al. [10] included all upper ureteric stones. In our study 35.7% and 37.1% stones were impacted in the 2 groups. Most of our procedures were performed under spinal anaesthesia and patients were satisfied with the procedure, especially that they were able to see the stone on the monitor during the procedure. General anaesthesia was administered only for patients who demanded GA.

There is paucity of data regarding the tract location for accessing the upper ureteric stones, and we preferred the mid pole for access in most of our cases (70.1%) and avoided the polar calyces. Upper pole in supine position does not give similar access to the ureter as in the prone position because the accessed calyx is the upper lateral one. Lower pole approach creates slightly higher torque for accessing the upper ureter. We were able to perform primary RIRS in 71.4% patients, while Mahajan et al. [15] reported primary access in 94.5% patients and Yuk et al. [16] in 85.3% patients. We went for elective and informed staged RIRS in impacted stones to minimise infective complications.

Haemoglobin drop at 24 hours was slightly higher in smPCNL (0.44 vs 0.69 g/dl), but it was insignificant, similar to Moufid et al. [17] (0.23 vs 0.36). It signifies that both the procedures are safe in terms of blood loss. Though the duration of hospital stay was slightly lower in the RIRS group (0.92 vs 1.13 days), it was insignificant. Much higher stay was reported in several studies for PCNL, with Moufid et al. [17] (1.67 vs 2.27 days), Zhang et al. [10] (1.8 vs 4.2 days), and Güler et al. [18] (2.0 vs 4.1 days). Most of our patients were discharged within 24 hours in both the groups, with supine PCNL and mini tract size making the hospital stay shorter.

SFR were better for smPCNL group (98.5% vs 94.2%) but the difference was insignificant. Higher SFR of PCNL was consistently reported across various studies by Elgebaly et al. [6] (83.3% vs 60.0%), Mohey et al. [1] (90.3% vs 70.0%), Zhang et al. [10] (93.7% vs 84.1%), Moufid et al. [17] (95.5% vs 66.7%), Güler et al. [18] (97.4% vs 83.7%), and Gu et al. [8] (100.0% vs 89.7%). The SFR of RIRS group was better in our study probably due to use of FNAS and on table clearance.

Both the groups had very low rates of high-grade (Calvin-Dindo ≥II) complications at 2 each (2.8%), and overall complications were 14.2% vs 11.4%. Other studies have reported lower overall complications rates in RIRS, Moufid et al. [17] (13.3% vs 22.7%), Güler et al. [18] (20.9% vs 24.0%), Zhang et al. [10] (6.8% vs 12.5%), and Mohey et al. [1] (19.4% vs 23.4%). Fever was reportedly significantly higher in the RIRS group (6.0% vs 1.66%) in our study, but other studies have reported lower rates of fever in the RIRS group, with Moufid et al. [17] (3.3% vs 9.0%), and Güler et al. [18] (2.1% vs 5.3%). It is worth noting that sepsis and other complications were lesser in studies where supine mini PCNL was performed.

RIRS was superior in terms of postoperative pain (Visual Analogue Scale – VAS) both at 1 and 24 hours after the surgery, being (2.59 vs 3.72) and (0.43 vs 1.24), and it was a similarly reported in studies of Moufid et al. [17] (3.1 vs 4.7) and Güler et al. [18] (3.6% vs 4.8%). Patients in the RIRS group returned to their normal activities earlier than smPCNL (3.58 vs 6.16 days) in our study, similar to Sun et al. [19] (2.7 vs 7.8 days) and Yavuz et al. [20] (3.9 vs 9.3 days). Patients were overall satisfied with the procedure they underwent for the removal of their stones and if necessary they would select the same procedure again.

While this study shows an important aspect of management of upper ureteric stones, there are certain limitations. The study is not randomised and therefore there is inherent bias to the outcomes. Future studies should focus on multicentric, ideally randomised, studies with more patient numbers to evaluate and compare the outcomes between smPCNL and RIRS. These studies should also take into consideration the cost and quality of life using patient reported outcome measures, and the role guidelines play in this [21–23].

CONCLUSIONS

Both RIRS and smPCNL are safe and effective surgical alternatives for managing upper ureteric stones larger than 10 mm. RIRS is less invasive, associated with less postoperative pain, lesser bleeding and earlier patient recovery. On the other hand, smPCNL offers a single stage and a quicker solution for large upper ureteric stones with less febrile complications.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

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ETHICS APPROVAL STATEMENT

The study was approved by Ford Hospital Research Centre Institutional Ethics Committee in January 2023 (FHRC/IEC.JAN-2023/002).

References

1. Mohey A, Abdelfattah AA, Mohammed AE, Marzouk A, El-Dakhakhny AS. Comparative study between antegrade flexible ureteroscopy and reterograde intrarenal surgery in the management of impacted upper ureteric stones 1.5 cm or larger. World J Urol. 2023; 41: 3731-3736.
2. Feng F, Xu Z. A new perspective on the treatment of upper ureteric stones. World J Urol. 2024; 42: 66.
3. De S, Gupta S, Singh M, Chugh R, Bell H, Gupta M. The impacted ureteral stone: Factors predicting for successful outcome with endoscopic management. J Urol. 2017; 197: e683.
4. Jiang H, Yu Z, Chen L, et al. Minimally invasive percutaneous nephrolithotomy versus retrograde intrarenal surgery for upper urinary stones: a systematic review and meta-analysis. Biomed Res Int. 2017; 2017: 2035851.
5. Jayaprakash SP, Thangarasu M, Jain N, Bafna S, Paul R. In situ management of large upper ureteric calculus by mini-percutaneous nephrolithotomy in the era of retrograde intrarenal surgery. Res Rep Urol. 2020; 12: 633-638.
6. Elgebaly O, Abdeldayem H, Idris F, Elrifai A, Fahmy A. Antegrade mini-percutaneous flexible ureteroscopy versus retrograde ureteroscopy for treating impacted proximal ureteric stones of 1–2 cm: a prospective randomised study. Arab J Urol. 2020; 18: 176-180.
7. Long Q, Guo J, Xu Z, et al. Experience of mini-percutaneous nephrolithotomy in the treatment of large impacted proximal ureteral stones. Urolo Int. 2013; 90: 384-388.
8. Gu XJ, Lu JL, Xu Y. Treatment of large impacted proximal ureteral stones: randomized comparison of minimally invasive percutaneous antegrade ureterolithotripsy versus retrograde ureterolithotripsy. World J Urol. 2013; 31: 1605-1610.
9. Park H, Park M, Park T. Two-year experience with ureteral stones: extracorporeal shockwave lithotripsy v ureteroscopic manipulation. J Endourol. 1998; 12: 501-504.
10. Zhang Y, Yu CF, Jin SH, Zhu H, Na YQ. A prospective comparative study between minimally invasive percutaneous nephrolithotomy in supine position and flexible ureteroscopy in the management of single large stone in the proximal ureter. Urology. 2014; 83: 999-1002.
11. Jiao B, Lai S, Xu X, Zhang M, Diao T, Zhang G. The efficacy of flexible ureteroscopy lithotripsy and miniaturized percutaneous nephrolithotomy for the treatment of renal and proximal ureteral calculi of ≤2 cm: A retrospective study. Medicine (Baltimore). 2019; 98: e14535.
12. Chen Y, Wen Y, Yu Q, Duan X, Wu W, Zeng G. Percutaneous nephrolithotomy versus flexible ureteroscopic lithotripsy in the treatment of upper urinary tract stones: a meta-analysis comparing clinical efficacy and safety. BMC Urol. 2020; 20: 109.
13. Winter M, Lynch C, Appu S, Kourambas J. Surgery illustrated – focus on details: Access sheath-aided percutaneous antegrade ureteroscopy; a novel approach to the ureter. BJU Int. 2011; 108: 620-622.
14. Liu Y, Zhou Z, Xia A, Dai H, Guo L, Zheng J. Clinical observation of different minimally invasive surgeries for the treatment of impacted upper ureteral calculi. Pak J Med Sci. 2013; 29:1358-1362.
15. Mahajan PM, Padhye AS, Bhave AA, Sovani YB, Kshirsagar YB, Bapat SS. Is stenting required before retrograde intrarenal surgery with access sheath. Indian J Urol. 2009; 25: 326-328.
16. Yuk HD, Park J, Cho SY, Sung LH, Jeong CW. The effect of preoperative ureteral stenting in retrograde Intrarenal surgery: a multicenter, propensity score-matched study. BMC Urol. 2020; 20: 147.
17. Moufid K, Abbaka N, Touiti D, Adermouch L, Amine M, Lezrek M. Large impacted upper ureteral calculi: A comparative study between retrograde ureterolithotripsy and percutaneous antegrade ureterolithotripsy in the modified lateral position. Urol Ann. 2013; 5: 140-146.
18. Güler Y, Erbin A. Comparative evaluation of retrograde intrarenal surgery, antegrade ureterorenoscopy and laparoscopic ureterolithotomy in the treatment of impacted proximal ureteral stones larger than 1.5 cm. Cent European J Urol. 2021; 74: 57-63.
19. Sun X, Xia S, Lu J, Liu H, Han B, Li W. Treatment of large impacted proximal

ureteral stones: randomized comparison of percutaneous antegrade ureterolithotripsy versus retrograde ureterolithotripsy. J Endourol. 2008; 22: 913-917.

20. Yavuz A, Kilinc MF, Bayar G. Outcomes of different minimally invasive techniques in lower calyceal stones of 1 to 2 centimeters: A prospective, randomized study. Arch Esp Urol. 2020; 73: 307-315 [Article in Spanish].

21. Chapman RA, Somani BK, Robertson R, Healy S, Kata SG. Decreasing the cost of flexible ureterorenoscopy: single-use laser fiber cost analysis. Urology. 2014; 83: 1003-1005.

22. Hughes T, Ho HC, Pietropaolo A, Somani BK. Guideline of guidelines for kidney and bladder stones. Turk J Urol. 2020; 46 (Suppl 1): S104-S112.

23. Mehmi A, Jones P, Somani BK. Current status and role of patient-reported outcome measures (PROMs) in endourology. Urology. 2021; 148: 26-31.