Minimally Invasive Surgeries in the Management of Renal Parapelvic Cysts: A Retrospective Comparative Study

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Purpose: To compare the efficiency and safety of two minimally invasive surgeries, laparoscopy and flexible ureteroscopy (fURS), in the management of renal parapelvic cysts.

Materials and Methods: Between January 2013 and April 2019, patients who suffered from parapelvic cysts and received fURS or laparoscopy at our hospital were recruited for this study. All patients underwent biopsies of the cyst wall. Primary outcome was treatment success, which was defined as symptomatic and radiological. During follow-up, telephone contact and CT scans were used to record any relevant symptoms and any recurrence, respectively.

Results: A total of 33 patients (22 in fURS; 11 in laparoscopy) were included in this study. Flank pain prior to the procedures were reported by 14/22 patients and 6/11 in fURS and laparoscopy, respectively ($P = .62$), and patients had complete pain relief after the operation. The complication rate was significantly lower in the fURS group than in the laparoscopy group ($P = .01$). Minor complications were observed in 3/22 and 5/11 patients (Grade 1 and 2) in the fURS and laparoscopy group, respectively. All patients were controlled by conservative treatment. However, 1/11 major complication (Grade 3b) was detected in the laparoscopy group and managed by ureteroscopy to remove the obstruction under general anesthesia. Significant differences were found in operative time ($P = .01$) and postoperative hospital stay ($P = .01$), while medical expenses were similar between the two groups ($P = .42$). During follow-up, no recurrence was detected in CT scans.

Conclusion: In the management of parapelvic cysts, two minimally invasive surgeries were comparable in efficiency. However, fURS was superior to laparoscopic unroofing with regard to the complication rate, operative time, and postoperative hospital stay.

Keywords: laparoscopy; parapelvic cyst; ureterorenoscopy

INTRODUCTION

Renal cysts are common with a prevalence of 5%. Most renal cysts are asymptomatic and a benign disease in regard to the Bosniak Classification. Thus, non-conservative treatment is not necessary for such cysts.[1] However, renal parapelvic cysts, accounting for a small part of renal cysts, may be accompanied by symptoms such as lumbago, hematuria, and infection.[2] Moreover, it not only represents a diagnostic challenge due to its rarity and misdiagnosis as hydronephrosis by imaging,[3] but also leads to treatment difficulties due to its complexity and proximity to the renal hilum.[4]

In the past decades, multiple minimally invasive treatment options including sclerotherapy, percutaneous aspiration, and laparoscopic unroofing have been explored by urologists.[5] For sclerotherapy, the potential risk factor is sclerosing agent extravasation into the retroperitoneum. As a result, severe perinephric inflammation, abscess or ureteropelvic junction obstruction (UPJO) may develop. Moreover, aspiration is associated with a relatively high recurrence rate. Laparoscopic unroofing remains the most advantageous technique for the management of this disease, especially in complicated cases.[6] More recently, internal drainage by flexible ureteroscopy (fURS) has been reported as an effective, feasible, and safe treatment option for parapelvic cysts.[7] However, there have been no studies comparing the efficacy and safety of the two minimally invasive surgeries, laparoscopic unroofing and fURS in the management of parapelvic cysts. Thus, we performed a cohort study to address this topic based on our single-center experience.

MATERIALS AND METHODS

Patients

With the approval of the First Affiliated Hospital of Chongqing Medical University Research Ethics Committee (Chongqing, China), we retrospectively reviewed all patients suffering from renal parapelvic cysts between January 2013 and April 2019 at our hospital. Written informed consent was obtained from all patients.

The inclusion criteria were: (1) patients with symptoms such as flank pain, infection and/or hematuria,

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Table 1. Demographics and baseline characteristics of the patients.

Characteristic	fURS (N=22)	Laparoscopy (N=11)	*P*-value [a]
Age, year	54.0 (45.0 - 63.0)	58.0 (53.0 - 64.0)	.32
Gender, Male (%)	12 (54.6%)	6 (75. 0%)	.11
BMI	24.1 (21.8 - 26.5)	23.5 (23.3 - 25.0)	.91
Flank pain (%)	14 (63.6%)	6 (54.5%)	.62
Cyst			
Size, mm	5.6 (4.8 - 7.0)	4.9 (4.0 - 5.8)	.10
Laterality, L (%)	15 (68.2%)	5 (62.5%)	.80

Abbreviations: BMI, body mass index.
Values are presented as median (IQR) or number (percent). a Categorical variables were compared by Chi-square test.

(2) asymptomatic patients with large cysts which compressed the collecting system and caused urinary obstruction and hydronephrosis, which was described in a prior study in detail[7],(3) patients treated with fURS or laparoscopy. All patients received preoperative computed tomography (CT) scans and intravenous urogram (IVU) to identify the characteristics of the parapelvic cysts (**Figure 1**). Patients whose cysts were suspected of malignancy in CT scans or patients with cardiopulmonary insufficiency or coagulation disorders or ureteral stricture history were excluded from this study.

Surgical procedures

Based on our experience and published literature, there are three subtypes of parapelvic cyst, including exogenous, mixed, and endogenous.[8] The classification was defined by the topographical relationship between cyst and the renal surface and the pelvis. The treatment modality, fURS or laparoscopy, was decided by active discussion with patients, regardless of the subtype of the cysts.

Two surgeons with more than five-year surgical experience performed one type of operation each.

In the fURS group, patients were given general anesthesia and were placed in the lithotomy position. An 8-Fr fURS was inserted into the renal pelvis and the cyst wall (with typical characteristics, such as thin wall, pale blue membrane) could be observed. Once the wall was identified, a 200-μm Holmium Laser fiber was adopted to incise the wall and coagulate the incision margin. Subsequently, the inner cyst wall was examined to avoid the misdiagnosis of cystic renal cell carcinoma. If there was any partition in the cyst, it was cut with the laser to avoid recurrence. Then, a 6-Fr ureteral stent, which was removed one month post operation, was routinely placed with the proximal end inside the cyst to drain the cystic fluid.

In the laparoscopic group, patients were given general anesthesia and were placed in the lateral decubitus position. The retroperitoneal approach was performed in all patients. Primarily, three ports were placed as the way reported in a previous study.[9] With careful dissection, the parapelvic cyst was identified and then the cyst wall was incised with an ultrasonic scalpel and the cystic fluid was aspirated. Then, the incision margin was coagulated with ultrasonic scalpel and the placement of a drainage tube and the wounds were sutured.

Ureteroscopic and laparoscopic biopsies were performed in all patients, and the specimens were sent for further pathological examination.

Baseline characteristics and outcomes

Baseline characteristics and outcome measurements were retrieved from the electronic medical record system. The former included gender, age, body mass index (BMI), size/side of cysts, and number of patients with symptoms. The size of cyst was measured by using its longest axis in the CT scans. Outcomes were classified into primary and secondary. The primary outcome was defined as treatment success, which included symptomatic and radiological success. Symptomatic success was defined as complete postoperative pain relief, and radiological success was defined as a decrease in cyst size by more than half of its previous size according to CT scans performed during follow up.

Pre- and postoperative flank pain intensity of patients were quantitatively evaluated by a 10-point visual analog scale ranging from 0 (no pain) to 10 (severest pain). Meanwhile, pain was classified into three grades according to the score: slight (0-3), moderate (4-6), and severe (over 6). Patient with a pain score > 3, or with a residual pain rating, was regarded as symptomatic failure. The others were categorized as having symptomatic success.

Secondary outcomes were regarded as operative time, length of hospitalization, complications, and medical expenses. Complications were classified into minor (Grade 2 or lower) and major (Grade 3a or higher) according to the Clavien-Dindo Classification.[10]

The patients were followed up by telephone after discharge to record any symptom related to parapelvic cyst. On August 31, 2019, the deadline of our study, all patients were advised to have CT scans performed to detect any recurrences.

Statistical analyses

Chi-square test was performed to analyze dichotomous variables. For continuous variables, Shapiro-Wilk test was carried to analyze data for normality. We noticed that most continuous variables were not subject to a normal Gaussian distribution. Hence, non-parametric Mann-Whitney U test was used for the analysis of continuous variables. SPSS 22.0 was used to perform the statistical analyses. Two-tailed $\boldsymbol{P} < .05$ were considered statistically significant.

RESULTS

In total, 33 consecutive patients (22 in fURS group and 11 in laparoscopic group) were included in the study. Overall, more than 50% of patients presented with flank pain (63.6% vs. 54.5%, $P = .62$) and others had their parapelvic cysts revealed incidentally. There was no significant difference between the two groups with respect to age ($P = .32$), BMI ($P = .91$), gender ($P = .11$), cyst size ($P = .10$), laterality of cyst ($P = .80$). **Table 1** summarizes the demographics and baseline characteris-

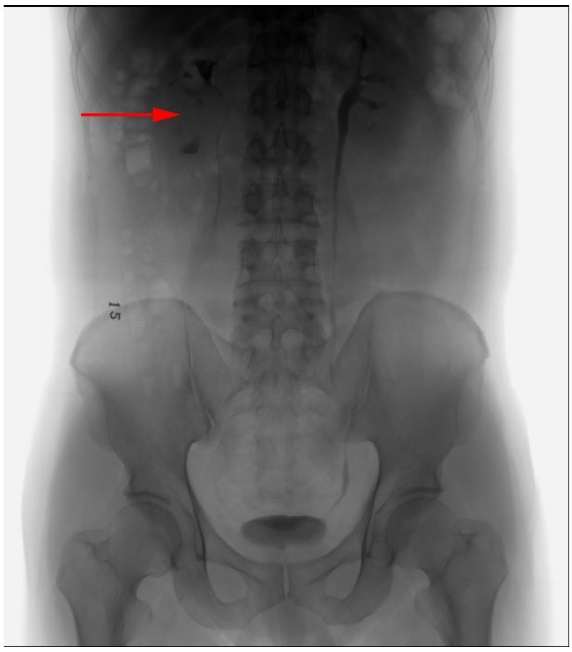

Figure 1. IVU demonstrated that the parapelvic cyst (arrow) compressed the collecting system and no contrast media entered the cyst.

tics of the participating patients.

In the fURS group, one patient suffered from parapelvic cyst in the solitary kidney, and the renal function did not deteriorate after the procedure. One carried bilateral parapelvic cysts (right: 2.52 cm; left: 5.8 cm), and cyst at left side was managed (Supplementary Figure 1). The cyst of one case was difficult to be found with direct vision of fURS alone. And around 2 ml methylene blue was injected into the cyst through percutaneous approach to dye the fluid. Then, the cyst wall was located and incised successfully. One concomitant with ipsilateral large simple renal cyst (8 cm at diameter) was treated with laparoscopic unroofing simultaneously (Supplementary **Figure 2**).

Patients in the fURS group had significantly shorter length of operative time and postoperative hospital stay than those in the laparoscopic group ($P = .01$, $P = .01$, respectively). The cost of hospitalization was similar between the two groups ($P = .42$).

The complication rate was statistically lower in the fURS group than that in the laparoscopic group ($P = .01$) (**Table 2**). There was no intraoperative complication (massive bleeding, transfusion, etc.) recorded in the fURS group. However, two cases (9.09%) of fever (Grade 2) and one (4.55%) case of abdominal discomfort (Grade 1) were recorded after the procedure, which were managed by intravenous antibiotics and conservative treatment, respectively. In the laparoscopic group, the mean blood loss was 95 ml. Intraoperative massive hemorrhage (ranging from 150 to 400 ml) occurred in 4/11 (36.4%) patients (Grade 1). One-unit blood transfusion was required by one (25%) patient (Grade 2). 2/11 (18.2%) patients suffered from persistent postoperative urine leakage (more than 72 hours). One (50%) patient with fever was controlled by intravenous antibiotics (Grade 2). Another patient (50%) was suspected to have an obstruction in the ureter and received ureteroscopy and ureteral stenting under general anesthesia (Grade 3b).

All patients had negative pathologic findings in the cyst wall for malignancy. Postoperatively, complete pain relief was observed in all patients with lumbago before the operation. During follow up, radiological success was observed in all patients (**Figure 2**).

DISCUSSION

This was the first study to compare the efficacy and safety of laparoscopy and fURS in the management of parapelvic cysts. The results revealed that both procedures were efficient. However, patients in the laparoscopic group had a statistically higher incidence of complications than those in the fURS group. Moreover, significantly longer operative time and postoperative hospital stay were seen in the laparoscopic group.

Through published studies investigating the treatment of parapelvic cysts, we noticed that most studies with a sample size of more than 10 cases were conducted in China,[1,2,9,11-21] while in western countries, most studies were case reports. Firstly, the population of Chinese studies was larger than that in western countries, indicating that more patients suffered from parapelvic cyst even though its rate of occurrence is rare. Secondly, urologists in western countries performed surgery for symptomatic cysts, which were a small part of overall parapelvic cysts. While for asymptomatic cysts, active follow-up was recommended.[14-16,19-21] In China, ac-

Table 2. Outcome measures

Outcomes	fURS (N=22)	Laparoscopy (N=11)	*P*-value [a]
Treatment success	22	11	
Operative time, min	45.0 (28.8-56.3)	80.0 (70.0-95.0)	.01
Postoperative hospital stay, day	2.0 (1.8-3.0)	4.0 (3.0-7.0) .01	
Hospitalization expense, CNY	37491.6 (20302.7-63842.8)	27293.5 (19495.3-46307.6)	.42
Pain score			
Preoperation	5 (1-9)	6 (2-8)	.45
Postoperation	1 (1-2)	2 (1-3)	.37
Complications			.01
<= Grade 2	3 (13.6%)	5 (45.5%)	
>= Grade 3[a]	0	1 (9.1%)	
F/u, mon	42.5 (20.5 - 53.5)	19.0 (9.0 - 55.0)	.21

Abbreviations: F/u, follow up. CNY, Chinese Yuan.

Values are presented as median (IQR) or number (percent). [a] Categorical variable was compared by Chi-square test. *P* values in Bold indicate significant results.

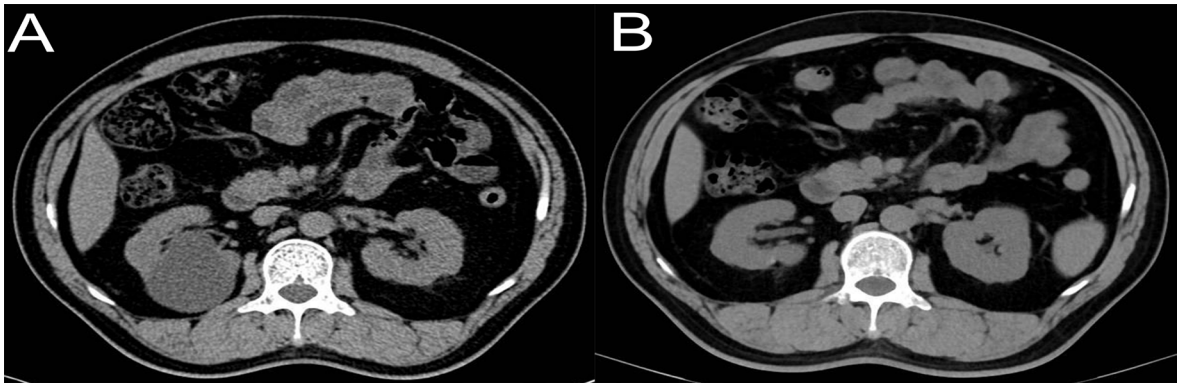

Figure 2. The CT imaging of one parapelvic cyst in the fURS group before surgery **(A)** and 22 months after surgery **(B)**.

cording to the recommendations of Chinese Urology Association (CUA) Guidelines in 2014 and the latest edition of Wu Jieping Urology in 2019, active management should be applied for asymptomatic patients with large (cut-off not defined) parapelvic cysts that caused massive normal renal parenchymal reduction, hydronephrosis, and/or urinary obstruction. Additionally, Wang et al.[7] performed fURS for selective asymptomatic cyst larger than 4 cm, and a study by Mao et al.[17] included asymptomatic patients with a cyst size larger than 3 cm. The cyst sizes in our study ranged from 3.8 cm to 9.5 cm.

Treatment success was achieved in all patients in our study. The result revealed that both two minimally invasive surgeries were efficient, and our result was conformant with previous studies.[1,2,9,11-13,17,18] However, the sample size was relatively small with weak statistical power, and the duration of the follow-up period may not be sufficient.

The complication morbidity favored fURS. Overall, most intra- and post-operative complications were minor (Grade 2 or lower) and could be managed by conservative treatment. The only single major complication (Grade 3b) occurred in the laparoscopic group. The patient developed persistent urine leakage, caused by a suspected obstruction in the ureter. Thus, 5 days post laparoscopy, ureteroscopy and ureteral stent placement were performed with the patient under general anesthesia. During the procedure, calculus was discovered at the site of ureteropelvic junction and was pushed back into the pelvis with a ureteral stent. Considering that the patient was suffering urine leakage and multiple kidney stones, lithotripsy was not performed.

36.4% of patients in the laparoscopic group developed intraoperative massive hemorrhage (blood loss amount over 100 ml). Moreover, a single patient (25%) required blood transfusion. This may be due to the following: (1) two cysts were relatively large with sizes of 8.9 cm and 6.8 cm and(2) a further two cysts were strongly attached to the surrounding tissue, inducing extensive dissection and causing blood seepage. Bleeding events may appear more serious compared with those reported in previous studies. However, the mean blood loss in our study was 95 ml, which is comparable to that in other studies.[15]

No large number of hemorrhages were reported in the fURS group. Although the incision in the cyst in the fURS group was performed blind, we adopted following key-steps to avoid hemorrhaging. First, the incision site was performed away from the renal calyceal and was at the most bulging site of the cyst. Second, we performed the incision into the wall with an initial diameter of 0.5 cm, and the incision was broadened once the cyst was identified. Third, the incision did not exceed the cyst-pelvic junction.

Demonstrated by the result in this study, patients in the fURS group had a significantly shorter operation time and more rapid postoperative recovery compared to those in the laparoscopy group. However, in the laparoscopic approach, the surgeon had to place trocars (usually 3) and carefully dissect before the surgeon was able to incise the cyst wall, while the fURS surgeon had direct access to the cyst wall through a natural orifice. This led to the advantage of shorter operation and hospitalization times. Wang et al. reported their experiences in further shortening the operation time by modifying the fURS procedure.[7]

However, it is important to remember that the fURS could not always identify the parapelvic cysts with untypical features (thick wall, ill-defined border, etc.). One cyst in our study was not identified using a ureteroscope alone. A modified procedure with methylene blue injection, which was reported in a previous study,[7] was adopted to dye the cystic fluid. Although the cyst was successfully discovered and excised, the procedure took over two hours (median operative time was 45 minutes in fURS group) to complete all the steps (re-sterilization, re-position, puncture and re-fURS). Kang et al. and Wang et al. studied the modified strategy for locating the cyst and found that cysts with typical characteristics could be located with a ureteroscope alone, while those without, required multiple auxiliary procedures to help localization. Disappointingly, we could not distinguish the two kinds of cysts by preoperative CT scans or IVU alone, suggesting that identification of the kind of cyst requires modified procedures and complicated techniques, which were unknown before the operation. Thus, an evaluation system is required to avoid unnecessary punctures and complicated procedures.

This study had several limitations. First, a small sample size with a retrospective nature was the main drawback, which may have resulted in potential selection bias. However, as one of the largest teaching hospitals in the southwest of China, our hospital patient number was large, and many patients from surrounding cities sought medical attention, indicating that the selection bias might be minimized. Second, renogram was not applied to demonstrated urinary obstruction. Third, even though no massive hemorrhage was reported in the lit-

erature for patients undergoing fURS, we must keep in mind that the incision of the cyst wall was blindly performed and a CT angiogram or endoluminal Doppler ultrasound should have been performed to avoid vessels in the common wall. In the future, well-designed, multiple-center studies with large sample size are required to further validate our findings.

CONCLUSIONS

To the best of our knowledge, this is the first head-to-head comparative study conducted to explore two most commonly used minimally invasive surgeries in urological practice, fURS and laparoscopy, in the management of renal parapelvic cysts. The results revealed that the two approaches were comparable in regard to the treatment efficiency, while the complication rate, operative duration, and length of postoperative hospital stay, favored fURS. However, it should be noted that fURS could not be used for the treatment of cortical cysts and the power of our study was not strong. For patients with parapelvic cysts, our initial experience could be applied in future decision making on the most applicable surgical technique.

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CONFLICTS OF INTEREST

The authors report no conflicts of interest

APPENDIX

https://journals.sbmu.ac.ir/urolj/index.php/uj/libraryFiles/downloadPublic/27

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