The Clinical Efficacy and Safety of Flexible Ureteroscopic Treatment for Parapelvic Renal Cyst and Secondary Renal Stone

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Purpose: To explore the efficacy and safety of flexible ureteroscopic incision and drainage and flexible ureteroscopic lithotripsy for treatment of parapelvic renal cyst combined with secondary renal stone.

Materials and Methods: 28 patients with parapelvic renal cyst combined with renal stone were treated with flexible ureteroscopic incision and drainage and flexible ureteroscopic lithotripsy simultaneously from May 2010 to December 2016. The follow-up was made 1, 3, 6□12 months and 2 years after surgical treatment in our outpatient department. Ultrasonic examination and CT were used to detect the residual stone and recurrence of renal cyst.

Results: The mean age of the patients was 45.3 ± 18.6 years. The average size of the parapelvic renal cysts was 4.3 ± 1.6 cm, including 27 with Bosniak category I and 1 patient with Bosniak II renal cysts. The mean size of the renal stones was 14.3 ± 3.9 mm. The mean operative time was 53.4 ± 20.7 minutes and the mean blood loss was 10.8 ± 5.6 ml. The mean hospitalization time was 3.2 ± 0.7 days. No severe complications were encountered. The complications included transient fever (> 38°C) in 3 patients and significant hemorrhage in 1 patient. The stone-free rates one month and three months after operation were 89.3% and 96.4%, respectively. During the 2 years follow-up, the cyst recurrence rate was 14.3% and the stone recurrence rate was 7.1%.

Conclusion: In this study, we firstly demonstrated that it is safe and effective to treat both renal stone and parapelvic renal cyst simultaneously by flexible ureteroscopic lithotripsy and flexible ureteroscopic incision and drainage, with satisfactory stone free rate and low cyst recurrence rate.

Keywords: parapelvic renal cyst; renal stone; flexible ureteroscopy; retrograde intrarenal surgery; holmium laser

INTRODUCTION

Renal cyst is a very common renal disease with increased incidence following by age. It is reported that 33% of people suffer from this disease at the age of 60 years old[1,2]. Generally, most of the renal cysts are asymptomatic and do not require any treatment[3,4]. For the symptomatic renal cyst, the most common symptoms include renal obstruction, hematuria and lumbar discomfort[5]. At present, the main therapeutic strategies for symptomatic renal cyst with relatively larger size include laparoscopic unroofing and ultrasound guided percutaneous sclerotherapy.

Parapelvic renal cyst easily become symptomatic which may cause urinary obstruction, hydronephrosis and hemorrhage, and also vascular compression, renin-mediated hypertension and complicated stone formation as observed in some cases[1,4]. The treatments of parapelvic renal cysts with laparoscopic unroofing and ultrasound guided percutaneous sclerotherapy are challenges and with high risk since they are close to the renal pelvis and hilar structures. The recurrence rates are extremely high after surgical treatments[4,6,7]. Recently, Basiri et al. reported the application of ureteroscopic treatment for parapelvic renal cyst. The results indicated that ureteroscopic treatment was feasible and safe in selected patients with simple parapelvic renal cyst[8]. Mao et al. and Yu et al. have confirmed the clinical feasibility of flexible ureteroscopic management for parapelvic renal cyst in a larger number of patients. They found that flexible ureteroscopic incision and drainage with the holmium laser was a safe and effective therapeutic choice for parapelvic renal cyst, with multiple advantages such as minimal trauma, rapid recovery, and a definite curative effect[1,4].

Urinary obstruction and stone formation are common complications associated with parapelvicrenal cyst. Based on the guideline, shock wave lithotripsy (SWL), flexible ureteroscopic lithotripsy and percutaneous nephrolithotomy (PCNL) are recommended for the treatment of renal stones. SWL is recommended as the first-line treatment option by EAU and AUA for renal calculi < 20mm[9,10]. However, for renal stones associated with parapelvic renal cyst, SWL could not generate satisfactory stone-free rate due to the obstruction caused by parapelvic renal cyst. For the same reason, flexible ureteroscopic lithotripsy may also not achieve satisfactory stone free rate without treatment of parapelvic renal cyst and obstruction caused by parapelvic renal cyst may affect the entry of flexible ureteroscopy toward the target calyxes. Thus, it is essential to treat the parapelvic renal cyst in order to get better stone free rate for stone treatment. Hu et al. reported that PCNL com-

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Table 1. Patients' clinical characteristics

Characteristics [a]	Value (n=28)
Age (Years)	45.3±18.6
Gender	
Male (%)	15(53.6)
Female (%)	13 (46.4)
Body mass index (kg/m^2)	21.69 ± 3.82
Location	
Right kidney (%)	12 (42.9)
Left kidney (%)	16 (57.1)
Mean cyst size (cm)	4.3 ± 1.6
Bosniak classification of renal cysts	
Bosniak I (%)	27 (96.4)
Bosniak II (%)	1 (3.6)
Stone size (mm)	14.3 ± 3.9
Stone CT Density (HU)	867.8 ± 209.7

[a]Data are presented as mean ± SD or number (percent)

bined with cyst laser intrarenal incision and drainage is a feasible and safe approach for treatment of renal and upper ureteral stones with ipsilateral renal cyst[11]. However, very rare study was found to clarify whether it is possible to treat both renal stone and parapelvic renal cyst simultaneously by flexible ureteroscopic lithotripsy and flexible ureteroscopic incision and drainage. To test this possibility, flexible ureteroscopy was used to treat 28 patients with parapelvic renal cysts combined with renal stones in this study. Patients were follow-up to determine the clinical safety and efficacy.

PATIENTS AND METHODS

Study population

From May 2010 to December 2016, 28 patients diagnosed with parapelvic renal cysts combined with renal stones were treated with flexible ureteroscopic incision and drainage and flexible ureteroscopic lithotripsy simultaneously. The diagnosis of parapelvic renal cysts and renal stones was achieved by ultrasonic examination and computerized tomography. Retrograde pyelography was performed if necessary.

Study design

We applied surgical treatment for these patients based on the following indications: (a). free renal stones larger than 6 mm; (b). flank pain; (c). parapelvic renal cysts larger than 3cm; (d).urinary obstruction and hydronephrosis caused by parapevic cyst were detected. (e). hemorrhage, vascular compression, renin-mediated hypertension and some other complications caused by parapevic renal cyst. Patients suspected as cystic renal cell carcinoma were excluded in our study. The average age of these patients was 45.3 ± 18.6 years old, including 15 men and 13 women.

Table 2. Patients' clinical characteristics

Main outcome	Value (n=28)
Mean operative time (min)	53.4 ± 20.7
Blood loss (ml)	10.8 ± 5.6
Hospitalization time (days)	3.2 ± 0.7
Flank pain release (%)	26 (92.9)
The stone-free rate	
Postoperative first month (%)	25 (89.3)
Postoperative third month (%)	27 (96.4)
The two years cyst recurrence rate (%)	4 (14.3)
The two years stone recurrence rate (%)	2 (7.1)

[a]Data are presented as mean ± SD or number (percent)

Surgical technique

Before surgical treatment, urinary culture was routinely done and antibiotics treatment was administered to the patients with positive findings. A double J stent was placed two weeks before surgery for the dilation of ureter. The surgery was performed under general anesthesia in lithotomy position. For the flexible ureteroscopy (URF-V, OLYMPUS), a ureteral access sheath (Flexor 12/14F, Cook) was placed through a 0.035-in guidewire to facilitate flexible ureteroscopy. For the fragmentation of the stones, we used holmium laser (Power Suite 100W Plus, Lumenis) through a 200 um fiber with the frequency from 20-30 Hz and energy from 0.8 to 1.0J based on the stone rigidity. The renal stones were fragmented to less than 4mm and large fragments were removed by a stone basket.

The incision and drainage of parapelvic renal cysts was finished by holmium laser (Power Suite 100W Plus, Lumenis) through a 200 um fiber under flexible ureteroscopy, the frequency of holmium laser was 20 Hz and the energy was 0.8 J. The typical morphological representation of parapelvic renal cyst under flexible ureteroscopy is shown in **Figure 1**. The incision was performed on thin cyst wall and vascular injury avoided. A window was opened by using holmium laser as large as possible. After the surgical procedure, double J stents were placed which were removed 7-14 days later.

Outcome assessment

The follow-up was made at 1, 3, 6 and 12 months and 2 years after surgical treatment in our outpatient department. Ultrasonic examination and CT were used to detect the residual stones and recurrence of renal cyst. Clinically significant residual stone was defined as > 4 mm in largest diameter. Patients without cyst detected by CT scan and ultrasonic examination on 6 months were considered as curative. For the pain evaluation before and after surgery, a pain visual analog scale score was used to identify the severity of the pain.

Table 3. Patients' major intraoperative and postoperative complications

Complications [a]	Value (n=28)	Clavien Classification
Overall complication rate (%)	4 (14.3)	I-II
Splanchnic injury	0 (0)	
Urine leakage	0 (0)	
Significant hemorrhage (%)	1 (3.6)	II
Transfusion (%)	0 (0)	
Fever > 38 °C(%)	3 (10.7)	II

aData are presented as mean ± SD or number (percent)

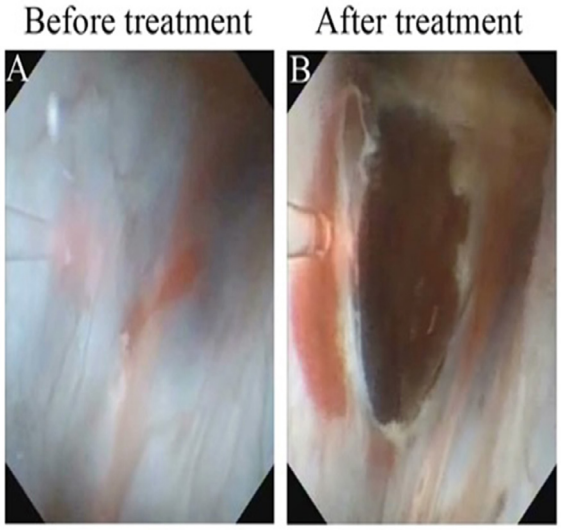

Figure 1. Image of parapelvic renal cyst before and after flexible ureteroscopic incision and drainage.

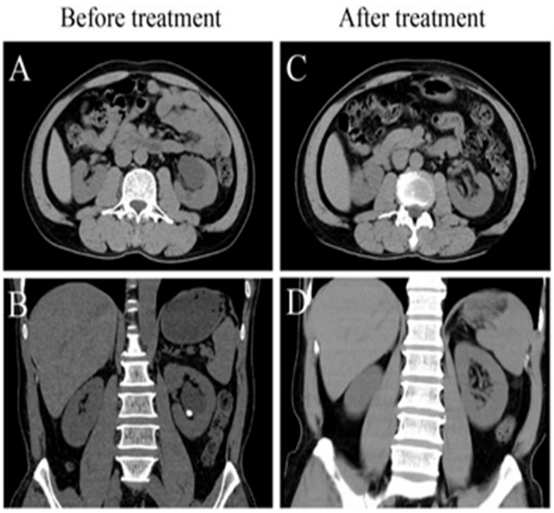

Figure 2. The CT images before and after surgical treatment from typical patient. Renal stone and parapelvic renal cyst were shown in left kidney **(A and B)**, which disappeared after flexible ureteroscopic treatment **(C and D)**.

Statistical analysis

For the statistical analysis, we used SPSS software to calculate the mean, standard deviation and rate for the clinical data. Data are presented as mean ± SD or number (percent).

RESULTS

A total of 28 patients with renal stones associated with parapelvic renal cysts were involved in our study, including 13 women and 15 men. The mean age of these patients was 45.3 ± 18.6 years. The diagnosis of renal stones and parapelvic renal cysts was achieved by ultrasonic examination and computerized tomography. The average size of the parapelvic renal cysts was 4.3 ± 1.6 cm, including 27 with Bosniak category I and 1 patient with Bosniak II renal cysts[7]. The mean size of the renal stones was 14.3 ± 3.9mm. Total of 35 calyxes (2 upper calyxes, 5 middle calyxes and 28 lower calyxes) were located with renal stones. The average stone CT density for all of the stones was 867.8 ± 209.7 HU. The clinical characteristics of these patients are shown in **Table 1**.

All 28 patients presented with the symptom of different degrees of flank pain, the mean pain score before treatment was 4.5. Intermittent gross hematuria was present in 5 patients. Hydronephrosis was detected in 11 cases, including 8 mild, 2 moderate and 1 severe. All operations for these patients were successful. The mean operative time was 53.4 ± 20.7 minutes. The mean blood loss was 10.8 ± 5.6 ml, which was determined by measuring mass of hemoglobin in the intraoperative irrigation fluid[12]. The mean hospitalization time was 3.2 ± 0.7 days (**Table 2**). Typical CT pictures for one patient before and after treatment are shown in Figure 2.

The perioperative complication rate is low for the treatment. No severe complications were found. The complications included 3 transient fever (> 38°C), which was sensitive to antibiotic treatment based on urine culture findings. 1 patient showed significant hemorrhage lasting for one day after operation, which did not require blood transfusion. No splanchnic injury or urine leakage was found in our series of patients (**Table 3**).

Ultrasonic examination and CT were used to determine the stone-free rate and the cyst recurrence rate on each follow-up. 3 months after the operation, the mean pain score after operation was 1.5. 26 patients (92.9%) showed significant relief of flank pain. Gross hematuria disappeared in all patients one month after the operation. Hydronephrosis was not detected in all 8 patients with mild hydronephrosis and alleviated for patients with moderate or severe hydronephrosis. The stone-free rate one month after operation was 89.3% and three months after operation was 96.4%. Only one case with significant residual stones three months after operation was treated with one session of ESWL treatment and finally achieved stone free status. During the 2years follow-up, no cyst was found in 24 patients through ultrasonic examination and CT scan. Renal cyst was detected in 4 patients. The mean diameter of recurrent cyst was 1.8 cm on the 6 months follow-up and 2.1 cm on the 12 months follow-up and 2.4 cm on the 2 years follow-up. Overall, all of the patients felt satisfied with the treatment.

DISCUSSION

Both parapelvic renal cysts and renal stones are very common diseases in urological system. Urinary obstruction and stone formation are complications of parapelvic renal cyst. In some specific patients, renal stone may be secondary to renal cyst. For some of our previous patients, we firstly treated the renal stone with flexible ureteroscopic lithotripsy and during our follow-up, residual stones were observed in many patients due to the obstruction caused by parapelvic renal cyst. To generate satisfactory stone free rate, a second session of operation was normally required to treat the parapelvic renal cyst, such as laparoscopic unroofing. Based on the development of retrograde intrarenal surgery and early experience, it is possible to treat both renal stones and parapelvic renal cysts simultaneously by flexible ureteroscopic lithotripsy and flexible ureteroscopic incision and drainage. After review of the clinical data of 28 patients mentioned in this study, we have firstly demon-

strated that the transurethral flexible ureteroscopic incision and drainage is safe and effective method to treat parapelvic renal cysts, which could improve the stone free rate of flexible ureteroscopic lithotripsy for the combined renal stones, with less patient discomfort and hospitalization expenses.

Simple renal cyst is usually asymptomatic. However, parapelvic renal cysts are intimately associated with the vessels of the renal hilum and symptoms of obstruction due to their locations [13]. In our study, urinary obstruction and hydronephrosis were detected in 11 patients (39.3%). For patients with renal cyst induced urinary obstruction, it may be a challenge for the flexible ureteroscopy to reach the target calyxes to treat the stones. Meanwhile, flexible ureteroscopic lithotripsy could not generate satisfactory stone free rate due to the obstruction and the stone may easily get recurrent. Thus, it is meaningful to treat the urinary obstruction and hydronephrosis before the stone treatment. In this study, we generate very satisfactory stone free rate for the 28 patients by performing flexible ureteroscopic incision and drainage simultaneously and the stone recurrence rate is 7.1% during 2 years follow-up.

The major treatments for renal cyst include laparoscopic unroofing, sclerotherapy and percutaneous ablation with various clinical outcomes[14,15]. Nasseh et al. reported that laparoscopic unroofing is an effective treatment option for skilled surgeons with low recurrence rate and complication rate[16]. Recently, Chen et al. reported that modified mini-laparoscopic decortication of renal cyst have more comprehensive advantages and reduces incisional pain compared with conventional laparoscopic surgery. However, laparoscopic unroofing is not feasible and safe for parapelvic cysts unless operators have advanced surgical skills[17]. Recent studies by Bas et al. have compared the laparoscopic decortication to percutaneous aspiration-sclerotherapy for treatment of renal cyst. They found that laparoscopic decortication has high success rates, a low recurrence rate and minimal morbidity and percutaneous aspiration-sclerotherapy is an outpatient procedure with a higher recurrence rate[18]. Liaconis and Basiri firstly reported the application of flexible and semi-rigid ureteroscopy for the management of parapelvic renal cyst[19,20]. However, very few cases were reported and the follow-up period is lack. More recently, Mao et al. and Yu et al. have confirmed the clinical feasibility of flexible ureteroscopic management for parapelvic renal cysts by a larger number of patients, they found that flexible ureteroscopic incision and drainage with the Holmium laser was a safe and effective therapeutic choice for parapelvic renal cysts, with multiple advantages such as minimal trauma, rapid recovery, and a definite curative effect[1,4].

A big misgiving for the flexible ureteroscopic incision and drainagewith the Holmium laser is intraoperative bleeding. Identification of renal cyst wall under flexible ureteroscopy is very important. Incision should be applied to the thin wall to avoid injuring the renal parenchyma or renal vessels. Normally, during the incision, three layers should be presented: the first layer is mucous membrane of renal pelvis; the second layer is connective tissue between cyst wall and mucous membrane of renal pelvis; the third layer is cyst wall. For some cases with thick wall between parapelvic renal cysts and renal pelvis, we firstly made tentative incision for the mucous membrane of renal pelvis based on the CT result and then separated the mucous membrane of renal pelvis from cyst wall by flexible ureteroscopy until the thin and avascular cyst wall was presented for incision. In our center, the incision for all of the patients was performed by a skilled surgeon. Only 1 patient displayed significant hemorrhage lasting one day after operation, which did not require specific treatments.

However, there are some limitations for this study. This is a single center study with a relatively small series of patients and some data were collected retrospectively without a control group. And also a long time follow-up should be made to determine the long-term reoccurrence rate for the parapelvic renal cysts.

CONCLUSIONS

For the parapelvic renal cysts combined with renal stones patients, flexible ureteroscopic lithotripsy may not generate satisfactory stone free rate without treatment of parapelvic renal cysts. In this study, we demonstrated that it is safe and effective to treat both renal stones and parapelvic renal cysts simultaneously by flexible ureteroscopic lithotripsy and flexible ureteroscopic incision and drainage, with satisfactory stone free rate and low cyst recurrence rate.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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