Methylene Blue Injection via Percutaneous Renal Cyst Puncture Used in Flexible Ureteroscope for Treatment of Parapelvic Cysts: A Modified Method for Easily Locating Cystic Wall

Zhixian Wang, Xiaoyong Zeng, Chong Chen, Tao Wang, Ruibao Chen, and Jihong Liu

OBJECTIVE
To describe a modified technique for easily locating cystic wall during flexible ureteroscopic surgery for treatment of parapelvic renal cysts.

METHODS
Nineteen patients with symptomatic/asymptomatic parapelvic renal cyst were treated with modified or conventional flexible ureteroscopic surgery between February 2015 and March 2017, and the differences of the 2 techniques were compared. The detailed surgical procedures and results, postoperative complications, and patients’ follow-ups were evaluated.

RESULTS
All the patients received endoscopic management by flexible ureteroscope successfully, without requiring another complicated surgery. The cysts were seen clearly in 9 patients with modified method. Two of ten patients who underwent conventional ureteroscopic surgery changed to the modified surgery intra-operatively since it was difficult to identify the cyst. The total time of search and incision of cysts was 24.2 ± 6.2 minutes and 17.7 ± 2.5 minutes for conventional and modified technique respectively (P = .01), of which 11.4 ± 4.8 minutes and 5.1 ± 1.1 minutes to search the cysts, respectively (P = .002), and the mean time of the procedure of puncture was 8 ± 2.3 minutes. Duration of pure incising the cystic wall was 12.8 ± 3.3 minutes and 12.6 ± 2.5 minutes for patients who underwent conventional and modified technique, respectively (P = .859). All patients acquired relief from the presentation of flank discomfort after surgery. All of the patients were followed-up over 12 months and no serious complications and recurrence was observed.

CONCLUSION
The modified technique can decrease time of searching the renal cyst and decrease the total time in flexible ureteroscopic treatment of parapelvic cysts. The limitations of our study were also observed and further studies are needed.

Several approaches such as simple aspiration with or without using sclerosing agents, laparoscopic unroofing or cyst ablation, percutaneous resection or ablation, and transurethral endoscopic surgery have been reported thus far for the management of parapelvic renal cysts. Among them, a more minimally invasive flexible ureteroscopy with the Holmium laser has been reported to be a feasible and effective treatment option in patients with simple parapelvic renal cysts. Since parapelvic cysts are characterized by their complexity and proximity to the renal hilar structures, the endoscopic surgery can avoid the risk of damage to the renal hilar structures, and does not need complicated surgical skills to perform laparoscopic approaches. In addition, the results of this surgery are better than those of simple aspiration, which results in high recurrence rates and may provoke perirenal inflammation, even leading to ureteropelvic junction obstruction. Although endoscopic management by flexible ureteroscopy has many advantages, sometimes, the location of a peripelvic cyst cannot be identified accurately. If the renal cyst wall cannot be found during the operation, particularly the cyst wall that does not typically bulge into the collection system or

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the thickness of the tissue between the collecting system and the cyst, more challenging procedure might be performed. The thickness of the tissue between the collecting system and the cyst, more challenging procedure might be performed.6

To locate an endoscopic cyst accurately and thereby decrease complicated surgical interventions, we modified the procedures of conventional flexible ureteroscopic surgery for treatment of parapelvic cysts. A percutaneous renal cyst puncture guided by ultrasonography and further puncture to renal pelvic, then methylene blue to stain the renal cyst wall was injected into the cyst. Herein, we present the detailed surgical approach, results, and the findings from more than 12-month follow-ups in a cohort of 19 patients.

MATERIAL AND METHODS

Study Population

This study was approved by the Tongji Hospital, Huazhong University of Science and Technology Research Ethics Committee (Wuhan, China). Written informed consent was obtained from all patients after full explanation of the procedure and patient records and/or information were de-identified and anonymized before analysis. Nineteen cases with parapelvic renal cysts were reported in our center between February 2015 and March 2017. The inclusion criteria were: (1) symptoms such as lumbago, hematuria, history of repeated infection, renal stones and related symptoms, and rapidly increasing dimensions of the simple cysts with/without concurrent hypertension; (2) surgical intervention were selectively performed in asymptomatic patients with a cyst which was larger than 40 mm. Routinely, for these patients are not suggested to perform surgical treatment, but surgery was referred to younger patients with massive normal renal parenchymal reduction and pelvicalyceal dilation due to compression, in addition, combined with other comorbidities such as hypertension, diabetes mellitus and rheumatism which may lead the kidney function worse or they suffered chronic kidney diseases with a low eGFR. Patients with a Bosniak III -V complex renal cyst and suspicion of solid malignancy or hydatid, a simple renal cyst distant from the collection system as determined by imaging, history of ureteral stricture and cardiopulmonary insufficiency were not recommended for the surgery.

The procedure of percutaneous methylene blue injection as modified technique was to be chosen voluntarily but patients with uncorrectable coagulopathy and lack of safe percutaneous access were excluded.

All of the patients received an enhanced computed tomography (CT) examination preoperatively to distinguish between hydronephrosis and the potential malignant mass (Supplementary Fig. 1).

Surgical Techniques

Preoperative preparation: 6Fr Double-J stenting was preplaced for 3-5 days before the surgery to facilitate passage of the access sheath intraoperatively and to know whether there was stenosis in the urinary tract. However, the procedure could not be done routinely, alternatively, the procedure may start with a first-look using rigid ureteroscopy intraoperative, the whole ureter can be passively dilated and the most appropriate ureteral access sheath size chosen.12

Methylene blue stain: Patients were in the position of prone after the pre-placed 6Fr Double-J stenting was removed and a 6Fr ureter stenting was inserted into a ureter of the affected side in lithotomy position. The point of puncture was determined

Figure. 1. The schematic diagram of the surgery. (A) Location of parapelvic cyst via type B ultrasonography; (B) Percutaneous renal cyst-pelvic puncture was performed guided by B ultrasonography; (C) Return the puncture needle to the cyst and inject 2 ml of methylene blue; (D) Endoscopic identification of pelvis cyst and complete incision of the cyst and drainage to the collection system. (Color version available online.)
and signed by type B ultrasound imaging (Fig. 1A), a puncture was routinely performed through the 11th intercostal space or the 12th subcostal space between the posterior axillary line and scapula line. Local anesthesia was performed. Normal saline was injected through preplaced 6 Fr ureter stenting to dilate collecting system, simultaneously an 18-gauge needle (Cook Medical; Bloomington, IN) was injected well past the cyst into the renal pelvis (Fig. 1B), which was a key procedure in the modified technique and not used in conventional surgery. The needle was then returned into the cyst, clear cystic fluid (2-3 ml) extracted for exfoliocytology examination, and 1 ml of methylene blue injected (Fig. 1C). The needle was pulled out immediately to prevent the fluid from flowing out and pull out the needle.

Endoscopic procedures: The patients were placed in lithotomy position since finished the procedures of methylene blue stain. After successful general anesthesia, the preplaced 6 Fr ureter stenting was removed and a 0.035-inch Zebra guidewire (Boston Scientific Corp) was advanced to renal pelvis transurethrally. The procedure of the access sheath placement was as reported previously. A 12/14 Fr flexible ureteroscope access sheath (Inner Ø 3.96/4.62 mm, length 35/45 cm; Cook Medical, Bloomington, IN) was chosen, which can better decrease the pressure of collecting system. An 8.5/9.9 Fr fiber or electronic flexible ureteroscope (Olympus; Tokyo, Japan) was accessed to the renal pelvis through the sheath. It was easy to find blue cyst wall stained by methylene blue (Fig. 1D, 2A). A 200-μm holmium laser fiber (2.0–3.0 J/10–15 Hz; FlexiFib, LisaLaser; Katlenburg-Lindau, Germany) was used to completely incise the cystic wall (approximately 10-20 mm in diameter) and drain to the collection system extensively. The thinnest full-thickness wall was incised firstly and then around. Meanwhile, Ho:YAG laser was used for coagulating completely the incised margin (Fig. 2B,C), and lithotripsy or stone extraction with a 1.7 Fr stone basket (length 115 cm; Cook Medical, Bloomington, IN) was performed simultaneously (Fig. 2D). A Double-J stent was routinely placed with the proximal end coiled in the cyst cavity for drainage and pulled out after 1-2 months.

**RESULTS**

The clinical and surgical characteristics of the 19 patients with parapelvic renal cyst were under retrospective analysis but with prospective data, which are presented in Table 1. Nine patients volunteered to choose modified technique, while, another 10 patients opted to perform conventional flexible ureteroscopic surgery. All of the patients received endoscopic management by flexible ureteroscopy successfully, without requiring another complicated surgery. Five patients underwent lithotripsy simultaneously. Two patients who underwent the conventional surgery had to transform to the modified method to inject methylene blue intra-operation in the semisupine lithotomy position because of the difficulty of locating the cyst wall, and the other 9 patients who chose the modified method were observed keenly. All patients acquired relief from the presentation of flank discomfort and renal colic after surgery. Unfortunately, hypertension in one patient was still present, perhaps related to primary hypertension. No severe postoperative complications (such as pneumothorax) were detected, but the primary complication was lumbar and abdominal discomfort, which disappeared after the Double-J stent was removed, and the mild bleeding gradually improved after 3 days. The mean time of the procedure of puncture and duration of search and incision of the renal cyst was 8 ± 2.3 minutes and 21.1 ± 5.6 minutes, respectively. The mean time of searching the cyst was 11.4 ± 4.8 minutes and 5.1 ± 1.1 minutes for conventional and modified technique, respectively ($P = .859$). The mean time of incising the cyst wall omitting puncture process, search procedure and stone fragmentation was 12.8 ± 3.3 minutes and 12.6 ± 2.5 minutes for patients who underwent conventional and modified technique, respectively ($P = .859$). The mean time of searching the cyst was 11.4 ± 4.8 minutes and 5.1 ± 1.1 minutes for conventional and modified technique, respectively ($P = .002$), and the total time of...
searching and incision of cysts was 24.2 ± 6.2 minutes and 17.7 ± 2.5 minutes for conventional and modified technique respectively \((P = .01)\). All patients acquired relief from the presentation of flank discomfort after surgery. The follow-up with CT for 12-36 months showed no recurrence (Supplementary Fig. 2).

**DISCUSSION**

Renal cyst is the most common cyst disease in the body, accounting for 5% of the cysts in the general population, and age is the only risk factor for an increase in the diameter of the cysts.\(^\text{13,14}\) Most of the cysts are asymptomatic and characterized as Bosniak I & II according to the Bosniak classification.\(^\text{15}\) With the development of the imaging technology and its frequent application, approximately 75% of the adult patients are accidentally diagnosed with an increased cystic lesion diameter,\(^\text{14}\) but most of them do not require treatment.\(^\text{13}\) Peripelvic cysts are rare entities of renal cysts. However, parapelvic cysts may cause obstruction symptoms earlier than simple renal cysts,\(^\text{16,17}\), thus requiring earlier surgical intervention than simple kidney cysts.

Previous studies have also reported flexible ureteroscopic treatment of this disease and have been proven to be safe and feasible in selected patients with short and long follow-ups.\(^\text{3,7}\) This minimally invasive therapeutic technique has encouraged curative effects and lowered the risk of serious complications in comparison with pure aspiration with/without sclerosis agent, laparoscopic unroofing, and percutaneous resection or ablation.\(^\text{2,5,7,18,19}\) Pure aspiration with sclerotherapy are associated with low curative effects. In addition, the leakage of a sclerosing agent can lead to severe perinephritis, retroperitoneal abscess, fever, pain, and even secondary ureteropelvic junction obstruction.\(^\text{9,11}\)

However, methylene blue in our method can flow out of the body along the urinary tract after cystic wall being incised and without causing local inflammation. Other therapies needed percutaneous puncture, percutaneous unroofing and ablation, but the complication of persistent urine leak was reported\(^\text{10}\) in these techniques, the mean time of surgery was much longer\(^\text{14}\) and complicated procedures were needed, furthermore, the technique was not suitable for entirely endophytic cysts.

The location of the cystic wall is an important factor for endoscopic treatment of parapelvic cysts.\(^\text{7}\) Qizhan Luo et al\(^\text{21}\) reported that high-definition camera system, cystic feature of convex, and the color of cystic wall were helpful for location of cyst, however, these features were not detected in cyst with thick wall. Another study by Weiwen Yu et al\(^\text{7}\) excluded 2 patients who had to perform laparoscopic surgery because of thicker cyst walls. We found that 2 in 10 of the cysts could not be easily located in patients who underwent conventional surgery, either without characteristics of the typical bulging or the thickness of the tissue between the collecting system and the cyst and the influence of the blood clots.

The primary aim of this study was to present a modified method for easily locating cystic wall during flexible ureteroscopic treatment of parapelvic cysts. We found that the technique could extensively decrease the time to search the cyst, which was significantly reduced in patients using methylene blue preoperative compared with routine endoscopic surgery \((P = .002)\) but surgical

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**Table 1. Clinical and surgical characteristics of 19 patients, stratified by techniques**

<table>
<thead>
<tr>
<th></th>
<th>Overall (N = 19)</th>
<th>Conventional Technique (N = 10)</th>
<th>Modified Technique (N = 9)</th>
<th>(P) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, male</td>
<td>11 (57.9)</td>
<td>6 (60.0)</td>
<td>5 (55.6)</td>
<td>.845</td>
</tr>
<tr>
<td>Age at surgery, year</td>
<td>50.63 ± 12.6</td>
<td>52.7 ± 13.4</td>
<td>48.3 ± 19.1</td>
<td>.568</td>
</tr>
<tr>
<td>Side left</td>
<td>10 (52.6)</td>
<td>5 (50.0)</td>
<td>5 (55.6)</td>
<td>.586</td>
</tr>
<tr>
<td>Combine with renal stone</td>
<td>Yes</td>
<td>5 (26.3)</td>
<td>3 (30.0)</td>
<td>.701</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>14 (73.7)</td>
<td>7 (70.0)</td>
<td></td>
</tr>
<tr>
<td>Size of stone, mm</td>
<td>0.6 ± 0.2</td>
<td>0.7 ± 0.2</td>
<td>0.6 ± 0.2</td>
<td>.668</td>
</tr>
<tr>
<td>Symptom*</td>
<td></td>
<td></td>
<td></td>
<td>.958</td>
</tr>
<tr>
<td>Incidental</td>
<td>5 (26.3)</td>
<td>2 (20)</td>
<td>3 (33.3)</td>
<td></td>
</tr>
<tr>
<td>Calculus related symptom (renal colic)</td>
<td>5 (26.3)</td>
<td>3 (30)</td>
<td>2 (22.2)</td>
<td></td>
</tr>
<tr>
<td>Flank uncomfortable</td>
<td>8 (42.1)</td>
<td>5 (50)</td>
<td>3 (33.3)</td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>3 (15.7)</td>
<td>2 (20)</td>
<td>1 (11.1)</td>
<td></td>
</tr>
<tr>
<td>Concurrent hypertension</td>
<td>1 (5.2)</td>
<td>1 (10)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Size of cysts, mm</td>
<td>50.9 ± 7.0</td>
<td>51.7 ± 7.9</td>
<td>50.0 ± 6.6</td>
<td>.622</td>
</tr>
<tr>
<td>Duration of search and incision of the renal cyst, minute</td>
<td>21.1 ± 5.6</td>
<td>24.2 ± 6.2</td>
<td>17.7 ± 2.5</td>
<td>.01</td>
</tr>
<tr>
<td>Time of incision of the renal cyst, minute</td>
<td>12.7 ± 2.8</td>
<td>12.8 ± 3.3</td>
<td>12.6 ± 2.6</td>
<td>.859</td>
</tr>
<tr>
<td>Time of search the renal cyst, minute</td>
<td>8.4 ± 4.6</td>
<td>11.4 ± 4.8</td>
<td>5.1 ± 1.1</td>
<td>.002</td>
</tr>
<tr>
<td>Time for puncture</td>
<td>-</td>
<td>-</td>
<td>8.0 ± 2.3</td>
<td>-</td>
</tr>
<tr>
<td>Hospital stay, day</td>
<td>4.0 ± 0.7</td>
<td>4.1 ± 0.2</td>
<td>3.8 ± 0.8</td>
<td>.553</td>
</tr>
<tr>
<td>Severe complications postsurgery</td>
<td>-</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>-</td>
</tr>
</tbody>
</table>

Continuous variables and categorical variables were expressed as mean ± standard deviation and n (%), respectively. Independent-sample t test for continuous variables and a Fisher exact test for categorical variables.

* Several patients had more than one symptom at presentation.
time of incising the cyst wall was not significantly different \( (P = .859) \). However, prospective large-sample studies are needed to identify the need to treat parapelvic cysts with such a method. The modified technique is helpful for cysts with thicker wall and/or without the characteristics of bulging. First of all, it is a safe and minor invasive technique for patients to finish the procedure of puncture under local anesthesia, which was reported by prior technique of percutaneous aspiration and unroofing or ablation.\(^3,9,10\) Second, we can't decide whether the cyst is easy to be determined or not just by imaging before surgery. The image characteristics of the 2 cysts that failed to be located had no different form features from other cysts. If it is difficult to find the cyst intraoperatively, it will not only waste a lot of time to search but may also lead to the failure of the operation and need other complicated techniques. In addition, if it is punctured intraoperatively after inability to find the cyst, it will take a lot of time to reposi
tion and resterilize the body. In this study, we found we can spend a little time (8 ± 2.3 minutes) to puncture before the endoscopic procedures to avoid a dilemma during the operation.

Our study was limited by its relatively small patient sample and inherent defects of retrospective study and lack of long-term follow-up, but the data were prospective. We could not assess which patients required the methylene blue injection preoperatively, therefore, a prospective study with a large sample is needed to make an evaluation system to avoid unnecessary punctures.

CONCLUSION

In the considered series of cases, we presented a modified method of flexible ureteroscopic surgery for treatment of renal pelvis and proved that the endoscopic treatment of parapelvic cysts by flexible ureteroscopy was effective and safe on the basis of the results of a short follow-up. The injection of methylene blue to renal cyst through a percutaneous renal cyst-pelvic puncture before operation of flexible ureteroscopy can make it easy to locate the cyst and decrease other complicated interventions. Further studies and a longer follow-up are required to assess the long-term curative effects and possible surgical complications.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.urology.2018.11.014.

Supplementary Figure 1. Manifestations of renal pelvis cyst in computed tomography.

Supplementary Figure 2. Computed tomography examination was performed 1 year after the surgery. It showed the renal pelvis cyst disappeared.

References