



Mini-Percutaneous Nephrolithotomy is the Optimal Treatment for Proximal Impacted Ureteral Stones Wrapped with the Ureteral Polyps Compared to Ureteroscopic Lithotripsy

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Abstract

Objective: To compare the safety and effectiveness between Ureteroscopic Lithotripsy (URSL) and Mini-Percutaneous Nephrolithotomy (MPCNL) to treat 1 cm to 2 cm proximal impacted ureteral stone wrapped with inflammatory ureteral polyps stones.

Methods: A retrospective study was performed to analysis the outcomes from the prospectively maintained stone patients database. Only patients undergoing URSL and MPCNL for 1 cm to 2 cm ureteral stones wrapped with ureteral polyps were included. Patient demographics, operative details, stone burden, hospital stay, complications and stone clearance were recorded and analyzed.

Results: A retrospective patient cohort was reviewed and compared URSL (n=147) and MPCNL (n=129). MPCNL group obtained a higher initial SFR (99.22% vs. 65.99%, p<0.05) in a shorter lithotripsy time (17.7 min ± 8.7 min vs. 45.3 min ± 9.6 min, p<0.05) compared to URSL group. The URSL group had higher fever rate (8.16% vs. 4.65%) and more urosepsis (1.36% vs. 0%) than the MPCNL group, but there was no statistical significance. Four patients occurred subscapular hematoma in MPCNL group, and one patient need blood transfusion, but there is no statistical significance compared to URSL group. In terms of ureteral stricture, MPCNL had a lower ureteral stricture rate compared to URSL group (5.44% vs. 0.78%, p<0.05). But MPCNL need longer hospital stays than URSL (7.2 ± 1.2 days vs. 2.6 ± 0.7 days, p<0.05).

Conclusion: Although generally MPCNL occurred more subscapular hematoma compared to URSL, for 1 cm to 2 cm proximal ureteral stones wrapped with ureteral polyps, MPCNL can be first considered because it can achieve a higher initial SFR in a shorter lithotripsy time and lower ureteral stricture rate despite of more subscapular hematoma and longer hospital stays.

Introduction

Impacted stones are regarded as those remaining in the original position for at least 2 months and the rest part of ureter below them cannot be visualized on the intravenous urography even 3 h after the contrast being injected [1]. If the stones cannot be removed in time, they may result in pain, urinary tract infection, hydronephrosis, and even loss in renal function. Because some of the impacted proximal ureteral stones have larger transverse diameter than that of the ureter, ureteral mucosa inflammation often occurs, followed by enfolding ureteral polyps and stricture [2]. For proximal ureteral stones between 1 cm to 2 cm, the European Association of Urology (EAU) Guidelines on urolithiasis and the NICE guideline all demonstrate that Ureteroscopic Lithotripsy (URSL) is an first option, while PCNL could be considered for larger stones with dilated renal collecting system or URSL failed [3,4]. But how to handle the proximal impacted ureteral stones wrapped with ureteral polyps is still not mentioned.

So we retrospectively compared the effectiveness and complications of mini PCNL or URSL treated for the proximal impacted ureteral stones between 1 cm to 2 cm with ureteral polyps in our center, and to clarify the advantages of each surgical procedure. It is related closely to clinical

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practice and provides urologists with some helpful suggestion on surgical choice.

Methods and Patients

We firstly chose the records of all patients who underwent mini PCNL or URSL between January 2016 and December 2020. For every patient underwent mini PCNL or URSL, we furtherly confirmed the size and location ureteral stone through the ultrasound or CT before surgery and chose the patients with 1 cm to 2 cm proximal ureteral stone. At last, we selected the patients of the stone with ureteral polyps through the surgical record and follow-up time more than 6 months since DJ removed. So we gained the patients met to our criteria. For these patients, we collected the data of urine test, serum Creatinine (Cr), Hemoglobin (Hb) detection, and Computed Tomography (CT) preoperatively. The assessed variables were the age, sex, laterality, Body Mass Index (BMI), stone size, Hounsfield units (<900 or ≥900) [5], and degree of hydronephrosis (no to mild or moderate to severe), and previous ipsilateral PCNL. Stone-free status is defined as the absence of any residual stone fragments or the presence of clinically insignificant residual stone fragments in the kidney or ureter, which were defined as ≤4 mm, asymptomatic, non-obstructive and non-infectious stone particles for 3 months on low-dose non-contrast CT imaging for all patients in both groups. Complications were recorded according to modified Clavien classification during the hospitalization [6], and especially focusing on the incidence of the fever and ureteral stricture in 6 months after surgery.

The study was approved by the Institutional Research Ethics Committee of the Shanghai Tenth People's Hospital of Tongji University School of Medicine and all patients were given their informed consent before surgery, and the data were analyzed anonymously.

Mini PCNL technique

The scheme of the MPCNL was performed in a standard fashion under general anesthesia in the prone position after retrograde catheterization. The targeted renal calyx was punctured under ultrasound guidance. Tract dilatation was carried out to 16F by fascial dilators. The stone lithotripsy was performed using holmium: yttrium-aluminum-garnet (Ho:YAG) laser. At the end of procedure, a JJ ureteric stent was placed and removed 3 months later. No nephrostomy tube was placed after the lithotripsy.

URSL technique

All the URSL procedures were performed under general anesthesia in a lithotomy position. A hydrophilic-coated guide-wire was advanced into the renal collecting system. An F6/7.5 Wolf ureteroscope was inserted guided by the guide-wire. Irrigation was delivered by irrigation pump with a pressure of 60 mmH₂O. The stones were dusted with a 272 μm holmium-YAG laser fiber until they were deemed small enough for spontaneous passage. At the end of the procedure, a JJ ureteric stent was regularly placed. It was removed 3 months later. If significant residual stones were checked out by CT scans after operation.

Statistical analysis

First, the operative characteristics between URSL and mini PCNL group were compared including the age, gender, BMI, laterality, stone size, the max CT value of stone, urine culture, hydronephrosis, and major stone composition. Then the lithotripsy time, hemoglobin change, initial and final SFR, auxiliary procedures, hospital stays,

and the incidence of complications including ureteral stricture, fever, bleeding were compared between these two matched groups. Continuous variables were analyzed by independent t test or Mann-Whitney U test, and categorical variables were assessed with the Chi square test or Fisher exact test. All p values were estimated and p<0.05 was considered statistically significant.

Results

A total of 276 cases (mini-PCNL in 129, URSL in 147) were carried out into the final analysis. The mean stone size of URSL group was smaller than that of PCNL group (p<0.05). Other factors of the patient demographics and basic renal stone characteristics were similar between the MPCNL and URSL groups (p>0.05, Table 1). Perioperative and postoperative parameters are compared in Table 2. The URSL group had longer lithotripsy time, but less hemoglobin drop, shorter hospital stays than those in mini-PCNL group. In the mini-PCNL group, the initial SFR after a single procedure is significantly higher than that of URSL group, and fewer patients need other auxiliary procedures to remove the stones. Fortunately, the final SFR had no significant difference after other auxiliary procedures such as flexible URSL or ESWL. In terms of fever after operation, there is no significant difference despite there was higher fever rate in URSL group. Consider of bleed after operation, the subscapular hematoma of kidney was founded in 4 patients, the rate of subscapular hematoma was significantly higher in mini-PCNL group than that in URSL, but the difference between these two groups is not significant and only one patient needed transfusion. After 6 months of follow-up, 8 patients in URSL group and one patient in mini-PCNL group

Table 1: Patient and stone characteristics.

Variables	mini-MPCNL	URSL	P value
n	129	147	
Mean age (years, mean ± SD)	47.7 ± 10.8	48.3 ± 12.06	>0.05
Gender, no. (%)			>0.05
Male	82	94	
Female	47	53	
Mean BMI (kg/m ² , mean ± SD)	25.7 ± 3.0	25.9 ± 3.7	>0.05
Laterality, no. (%)			>0.05
right	60(46.51%)	73 (49.66%)	
left	69(53.49%)	74 (50.34%)	
Stone size (mm, mean ± SD)*	14.3 ± 0.4	15.2 ± 0.5	>0.05
CT Value (Hu, mean ± SD)	944 ± 297	879 ± 316	>0.05
CT Value, no. (%)			>0.05
<901	58 (44.95%)	72 (48.98%)	
≥901	71 (55.04%)	75 (51.02%)	
Positive urine culture, no. (%)	17 (13.18%)	21 (14.29%)	>0.05
Degree of hydronephrosis, no. (%)			>0.05
No and mild	88 (68.22%)	101 (68.71%)	
Moderate and severe	41 (31.78%)	46 (31.29%)	
Major stone composition, no. (%)			>0.05
Calcium oxalate	91 (70.54%)	105 (71.43%)	
Uric acid	20 (15.50%)	23 (15.65%)	
Carbonate apatite	11(8.53%)	13 (8.84%)	
Others	7 (5.43%)	6 (4.08%)	

*The difference was statistically significant

Table 2: Operative characteristics.

Variables	mini-PCNL	URSL	p value
n	129	147	
lithotripsy time (min)	17.7±8.7	45.3±9.6	<0.05
HB drop (g/l)	0.6±0.4	0.4±0.1	>0.05
Hospital stays (days)	7.2±1.2	2.6±0.7	<0.05
Initial SFR (n, %)	128 (99.22%)	97 (65.99%)	<0.05
Auxiliary procedures (n, %)	2 (1.55%)	22 (14.97%)	<0.05
Final SFR	129 (100.00%)	145 (98.64%)	>0.05
Fever (n, %)	6 (4.65%)	12 (8.16%)	>0.05
Transient fever (grade 1)	4 (3.10%)	6 (4.08%)	>0.05
Fever (grade 2)	2 (1.55%)	4 (2.72%)	>0.05
Urosepsis (grade 3)	0 (0.00%)	2 (1.36%)	>0.05
bleeding	5 (3.88%)	0 (0.00%)	<0.05
Subscapular hematoma (n, %) (grade 1)	4 (3.10%)	0 (0.00%)	<0.05
Transfusion (n, %) (grade 2)	1 (0.78%)	0 (0.00%)	>0.05
Ureteral stricture (n, %)	1 (0.78%)	8 (5.44%)	<0.05

occurred ureteral stricture judged by hydronephrosis through B-type ultrasound test, and the difference between these two groups was significant.

Discussion

With the widespread use of ureteroscopy, the secondary ureteral polyps have been found in more and more patients with ureteral stone especially in the patients with the impacted ureteral stone. A ureteral polyp has been considered to be one of the characteristics of incarcerated ureteral stones [7]. If the stone stays in the same position for too long time, causing inflammatory hyperplasia of the ureteral mucosa, forming the secondary ureteral polyps, even scar formation and ureteral stricture, which can lead to hydronephrosis and renal function damage, so it should be managed in time. For the proximal ureteral stone 1 cm to 2 cm, it can be recommended to manage using PCNL or URSL, but it is still not clear whether there are differences between PCNL and URSL for ureteral stones wrapped with polyps. So, we retrospectively compared the effectiveness and complications of mini-PCNL and URSL to treat the ureteral stone wrapped with polyps.

In our data, we found that mini-PCNL group had the shorter lithotripsy time than URSL group. Compared to URSL, during the mini-PCNL, the better water circulation makes the surgical vision clearer, the greater lithotripsy power can crush the stones in a short time, and the crushed stones have promptly been removed through the passage sheath. Therefore, mini-PCNL can lead to shorter lithotripsy time than URSL. Wang and his colleagues also thought that mini-PCNL were more suitable for proximal ureteral impacted stones larger than 15 mm [8].

Stone Free Rate (SFR) is an important factor to evaluate the effectiveness of surgery. Bozkurt IH found that URSL has lower initial SFR than mini-PCNL, and usually needs more procedures to deal the ureteral stone for patients with proximal ureteral stone wrapped ureteral polyps [9]. One published meta-analysis stated that mini-PCNL should be considered as the preferred technique for proximal impacted ureteral stones with a higher Stone-Free Rate (SFR) and similar complications compared with URSL [10]. We also found that

mini-PCNL group had the higher initial SFR than URSL group based on our data.

Consider of complications, we found mini-PCNL had lower fever rate after surgery compared to URSL, but there is no statistical significance. We also found mini-PCNL had a higher bleeding rate, but blood transfusion rate is similar to URSL.

In our data, we also found that mini-PCNL group had the significant lower incidence of ureteral stricture than URSL group. Ureteral stricture is believed to be a rare but serious complication of surgery for ureteral stone because it usually is a silent process and leads to progressive loss of ipsilateral renal function [11,12]. The risk factors leading to ureteral stricture were found in some researches, such as impacted stone [13], ureteral perforation [14,15], thermal injury towards the ureteral wall [16,17], larger stone size [14].

It also has been known that impacted ureteral stone wrapped with polyps can lead to ureteral edema and hypertrophy as well as secretion of an adhesive fibrinous exudate have been described with stone impaction [18]. These changes can lead to more challenging retrograde access to the stone, greater adherence of stone fragments to the mucosa, increased risk of bleeding, perforation, and finally lead to stricture formation [19].

The ureteral polyp's secondary to ureteral stone usually locates on the distal side of the stone. During URSL, the stone is hidden behind ureteral polyps, which hampers the guidewire passing the stone. Furtherly, the edematous and inflamed mucosa surrounding the stone also easily makes ureteral perforation and avulsion, which makes it difficult to perform the lithotripsy and results impede visualization during the operation [20,21]. It has to damage the polyps before dealing ureteral stone. But when performing mini-PCNL, the ureteral stone was firstly seen otherwise ureteral polyps and ureteral polyps were not be damaged during surgery. The more damages of ureteral polyps and mucosa during URSL maybe one of the important factors leading ureteral stricture.

Furthermore, ureteral stone with polyps usually leads to complete ureteral obstruction, poor local water circulation, unclear vision and more thermal damage during URSL, which may be another cause leading to ureteral stricture after surgery. In addition, residual stones sticking to the damaged ureteral mucosa are also important factors leading to ureteral stricture. On the contrary, during the mini-PCNL, the good water circulation makes the surgical vision clearer, the heat damage more minor. The crushed stones have promptly been removed, and ureteral polyps are only seen after the stones are crushed, so the crushed stones are not easy stick to the damaged mucosa which reduced the possibility of ureteral stricture.

Conclusion

Based on our respective study, we could get useful information as follow: for treatment 1 cm to 2 cm ureteral stone wrapped with ureteral polyps, mini-PCNL showed shorter lithotripsy time and higher initial SFR compared to URSL, and can achieve a lower ureteral stricture rate with the similar safety. So, we believe that mini-PCNL maybe a better surgical choice for patients with proximal ureteral wrapped with ureteral polyps compared to URSL despite these conclusions only concluded from a retrospective study from a single institution.

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