Original Article

Treatment Outcomes of Stone Free Rate of Retrograde Intrarenal Surgery for Lower Pole Renal Calculi

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Objective: The purpose of the present study is to provide data on the outcomes of ureterorenoscopic management of lower pole kidney stones in a variety of composition and size.

Materials and Methods: Data of patients with lower pole kidney stones who underwent retrograde intrarenal surgery (RIRS) in Siriraj hospital between 1st June 2012 to 30th April 2017 were retrospectively reviewed and analyzed data consists of demographic information, stone size, stone free rates, complications and auxiliary procedures.

Results: 103 patients with lower pole kidney stones from 423 patients who underwent RIRS in Siriraj Hospital. 61 patients (59.2%) achieve stone-free status within 3 months after surgery. Stone free rates of RIRS were 72.2%, 69.8% and 42.9% in stone size less than 10 mm, 10 to 20 mm and larger than 20 mm respectively.

Conclusion: RIRS is a safe and effective treatment in lower pole renal calculi with high success rate and low morbidity.

Keywords: Retrograde intrarenal surgery, Flexible ureterorenoscopy, Lower pole, Renal calculi, Stone free rate

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Flexible ureterorenoscopy and intracorporeal lithotripsy or retrograde intrarenal surgery (RIRS) have been established as a minimally-invasive mode for treatment of intrarenal stones which is recommended as a standard treatment in renal stone sizes smaller than 20 mm by Guidelines from the European Association of Urology (EAU) 2018 on urolithiasis[1].

Location of the stone in renal collecting system is a studied parameter affecting RIRS outcomes[2-5]. The presence of lower pole stone is one of the predicting factors that determine postoperative stone-free status[6]. From previous studies, stone free rates were about 40 to 90% in lower pole stone size less than 20 mm[7] following RIRS. However, there is little evidence that shows which are the most important factors to predict stone-free status after RIRS for lower pole renal calculi. Therefore, the present study was conducted to analyze the outcome of stone-free rates following retrograde intrarenal surgery (RIRS) for lower pole renal calculi of all size and composition.

Materials and Methods

After obtaining institutional board review approval (339/2560(EC3), the data of patients with lower pole renal calculi who underwent RIRS between June 2012 and April 2017 at Siriraj hospital were retrospectively collected and analyzed. Lower pole renal calculi defined as a stone that has more than 50% of stone burden located in lower calyces. Exclusion criteria were cases that have a renal stone in abnormal anatomy, staghorn stone and lock of follow-up. Data consists of demographic information, stone size, stone free rates, complications and auxiliary procedure.

Surgical procedure

All procedures were performed under general anesthesia using a 10 French (Olympus URF-V model) Flexible ureterorenoscope. Patients were placed on table in lithotomy position and draped in sterile fashion. Fluoroscopic guidance of a mobile multidirectional C-arm fluoroscopy was used in all procedures. A 0.035 or 0.038-inch guidewire was inserted into renal pelvis through ureter via a rigid cystoscope followed with a double ureteral catheter and stiff guidewire. Then a 11/13 or 12/14 French ureteral access sheath was passed over the stiff guidewire up to the ureteropelvic junction (UPJ) under the guidance of C-arm scope. If it was not possible to insert a ureteral access sheath, a 6 French double J stent was inserted into the ureter and the procedure was postponed for 4 to 8 weeks. A 200-micron high energy holmium YAG laser (100 watts, Lumenis laser) was used to fragment the stone. Relocation of the stone into renal pelvis was preferred in the patients with unfavorable anatomy. Tipless nitinol basket extraction of fragments was performed for stone composition analysis with Fourier Transform

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Infrared (FTIR) spectrometer. The decision of placing a double J stent was made based on the size and burden of residual stone, and also degree of mucosal injury. Stone-free status was defined as an absence of stone or any residual stones smaller than 2 mm without stone associated symptom on plain KUB film or ultrasonography within 3 months after the procedure[8].

Statistical analyses

Statistical analysis was performed using IBM Statistical Package for the Social Sciences Statistics v.21.0 (IBM SPSS Corp., Armonk, NY, USA). Quantitative values were shown as mean ± SD for parametric data and median ± range for non-parametric data. Qualitative values were shown as numbers and percentages. Chi-square test were used for the comparison of variables between stone free rate and renal stone size groups. The confidence interval was set at 95% and difference with *p*-value <0.05 was considered as statistically significant.

Results

423 patients were enrolled in the present study. There were 115 cases with lower pole renal calculi who met inclusion criteria. Demographic data shows in (Table 1). Mean age of the patients in this study was 56 years old (range 26 to 89 years). Fifty-one procedures were performed on male patients and fifty-two procedures were performed on female patients. Mean body mass index was 25.96 kg/sq.m. (16 to 38). Co-morbidity such as hypertension or diabetes mellitus was found in 75 patients. Mean pre-operative creatinine was 1.08 mg/dl (range 0.58 to 3.44 mg/dl), Mean urine pH is 6.33[5-8], positive urine culture was found in 21 cases. The most presenting symptom in this study was flank pain in 45 cases. Perioperative results were shown in (Table 2). There were 25 cases that had pre-operative stenting. Mean operative time is 56 minutes, (11 to 170 minutes), minor complication such as fever were found in 12 cases. Major complication was sepsis or septic shock in 8 cases. The median length of stay was 3 days (2 to 20 days). Significant residual stones after RIRS were found in 42 patients. Nearly half of the procedures were treated successfully by conservative treatment and other 22 procedures needed auxiliary treatment including repeated RIRS in 10 cases, ESWL in 5 cases, URSL in 6 cases, and PCNL in 1 case. The major stones composition in this study were Calcium oxalate monohydrate (Whewellite), Calcium Phosphate (Hydroxyapatite) and Calcium Oxalate Dihydrate (Weddellite) about 45.6%, 28.2%, and 12.6% respectively as shown in (Table 3). Stone free rates were 59.5%, 51.7% and 61.5% in Calcium oxalate monohydrate, Calcium Phosphate and Calcium Oxalate Dihydrate consequently.

The overall outcome of stone-free rate following RIRS in lower pole renal calculi is 59.2%, When we categorized by stone size, the result showed that patients with stone burden less than 20 mm had a higher stone free rates about 70.5% (72.2% in stone size smaller than 10 mm and 69.8% in stone size between 10 to 20 mm) compared with result of stone-free rate in stone size larger than 20 mm about 42.9% as shown in (Table 4). The predicting factor for residual stone is stone sizes larger than 20 mm, with a calculated odds ratio of 3.185 (95% CI: 1.4 to 7.25, *p*-value = 0.006).

Table 1. Demographic data

Mean age (years)	56 (26 to 89)
Male, n (%)	51 (49.5%)
Female, n (%)	52 (50.5%)
Mean BMI (kg/sq.m.)	25.96 (16 to 38)
Co-mobidit, n (%)	75 (72.8%)
Mean preoperative creatinine (mg/dl)	1.08 (0.58 to 3.44)
Mean urine pH	6.33 (5 to 8)
Positive urine culture	20.38% (21/103)
Presenting symptoms, n (%)	
Asymptomatic	16 (15.5%)
Flank pain	45 (43.7%)
Hematuria	5 (4.8%)
Residual stone	24 (23.3%)
UTI	13 (12.6%)

Table 2. Perioperative data

Preoperative stenting, n (%)	25 (24.3%)
Mean operative time (minutes)	56 (11 to 170)
Minor complications, n (%)	12 (11.6%)
Major complications, n (%)	8 (7.76%)
Median length of stay (days)	3 (2 to 20)
Retreatment rate, n (%)	22 (21.35%)

Table 3. Stone composition and outcome

Stone composition	Total,	Stone free rates, n (%)
Calcium oxalate monohydrate	47	28 (59.5%)
Calcium phosphate	29	15 (51.7%)
Calcium oxalate dihydrate	13	8 (61.5%)
Uric	7	5 (71.4%)
Struvite	4	2 (50%)
Cystine	2	2 (100%)

Discussion

The European Association of Urology (EAU) guidelines on urolithiasis recommend RIRS as a treatment of choice in lower pole renal stone size smaller than 20 mm, For larger stones, PCNL recommend as the standard treatment[1] but RIRS has gained popularity in recent years and is widely accepted as a treatment modality in renal stone disease even in stones larger than 2 cm regardless of stone location[8,9]. Therefore, more complicated and larger renal stones are managed by RIRS because of the advances in technology, and also refinement of flexible ureterorenoscope and laser fibers. Those can assure surgeons to performed the operation with lower morbidity to their patients[8].

In stone surgery, achieving a stone-free status is

Table 4. Stone burden and outcome

Stone burden	Residual stone		Odd ratio (95% CI)
	Yes	No	
Less than 20 mm (n = 61)	18 (29.5%)	43 (70.5%)	Reference
More than 20 mm (n = 42)	24 (57.1%)	18 (42.9%)	3.185 (1.4 to 7.25) *p*-value = 0.006

the main goal. However, the reported stone free rates (SFR) of RIRS in the literature varies between 45.6% to 96.7% for lower pole renal stones in all sizes even those greater than 20 mm[7]. In the present study, an overall stone free rate was about 59.2% which is comparable to the published studies. Subgroup analysis demonstrated stone free rates were 72.2%, 69.8% and 42.9%, in stone size less than 10 mm, 10 to 20 mm and larger than 20 mm group respectively. In larger stones, the lower stone free rates could be affected from the limitation in surgical technique to relocate the stone fragment into renal pelvis for better stone clearance. The authors demonstrated the acceptable stone free rates in major stone compositions such as Calcium oxalate monohydrate, Calcium Phosphate. Stone composition is predicted by stone attenuation measured as HU on non-contrast CT, which is thought to be another parameter affecting stone free rate. However, the study from Ito et al revealed stone attenuation was not found to be a predictor of stone-free status[10]. Unfortunately, some patients in the present study could not afford preoperative CT scan, stone composition analysis was evaluated and found to have no impact on stone-free status.

The present study has two limitations. First, the retrospective nature of the present study renders it vulnerable to missing or incomplete data. For example, one patient could not afford stone analysis, so their stone composition data were not included in our analysis. Second, we collected and included data from a single center, which is a national tertiary referral center that is often encounters complicated cases. Therefore, our results may not be generalizable to other healthcare settings.

Conclusion

RIRS is a safe and effective treatment in lower pole kidney stone with a high success rate and low morbidity. The most relevant predictive factor for residual stone is the stone size greater than 20 mm.

What is already known on this topic?

Retrograde intrarenal surgery (RIRS) is a standard treatment in lower pole kidney stone size of less than 1 centimeter. Percutaneous Nephrolithotripsy (PCNL) remain the major treatment in lower pole kidney stone size larger than 2 centimeters with higher stone-free rates but also higher rates of complications, greater blood loss, and longer length of hospital stay. Treatment for lower pole kidney stone size in between 1 to 2 centimeters is still controversial.

What this study adds?

Retrograde intrarenal surgery (RIRS) is a safe and effective treatment for lower pole kidney stone size up to 2 centimeters with high success rates. The stone composition is not found to be associated with stone-free status after RIRS.

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Potential conflicts of interest

The authors declare no conflict of interest.

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อัตราการหายของนิ่วในขั้วล่างของไตหลังการรักษาด้วยวิธีการส่องกล้องแบบปรับองศาได้ผ่านทางท่อไต

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วัตถุประสงค์: เพื่อศึกษาข้อมูลผลการรักษาของนิ่วในขั้วล่างของไตด้วยวิธีการส่องกล้องแบบปรับองศาได้ผ่านทางท่อไต (retrograde intrarenal surgery; RIRS) โดยแยกตามขนาดและชนิดของนิ่ว

วัสดุและวิธีการ: ศึกษาทบทวนข้อมูลย้อนหลังจากผู้ป่วยทั้งหมดที่ได้รับการวินิจฉัยว่าเป็นนิ่วในตำแหน่งขั้วล่างของไตและได้รับการรักษาด้วยวิธีส่องกล้องในไต ที่โรงพยาบาลศิริราช ระหว่างเดือนมิถุนายน พ.ศ. 2555 ถึง เดือนเมษายน พ.ศ. 2560 เพื่อนำมาใช้ในการวิเคราะห์ข้อมูลของการรักษาและอัตราการหายของนิ่ว

ผลการศึกษา: จากผู้ป่วยทั้งหมด 423 ราย ที่ได้รับการรักษานิ่วด้วยวิธีการส่องกล้องในไต ที่โรงพยาบาลศิริราช ระหว่างเดือนมิถุนายน พ.ศ. 2555 ถึง เดือนเมษายน พ.ศ. 2560 มี 103 ราย ที่ได้รับการวินิจฉัยว่ามีนิ่วในขั้วไตล่าง พบว่าผลการรักษาของผู้ป่วยที่มีนิ่วในขั้วไตล่างนั้นมี 61 คน (59.2%) หายจากภาวะนิ่วในไตภายในช่วง 3 เดือนแรกหลังการรักษา และพบว่าอัตราการหายของนิ่วในขั้วไตล่างนั้นเท่ากับ 72.2%, 69.8% และ 42.9% สำหรับนิ่วที่มีขนาดเล็กกว่า 10 มม., 10 ถึง 20 มม., และขนาดใหญ่กว่า 20 มม. ตามลำดับ

สรุป: การรักษานิ่วในขั้วไตล่างด้วยวิธีการส่องกล้องแบบปรับองศาได้ผ่านทางท่อไต (RIRS) มีความปลอดภัยสำหรับผู้ป่วย โดยมีอัตราความสำเร็จสูง และภาวะแทรกซ้อนต่ำ โดยเฉพาะนิ่วที่มีขนาดเล็กกว่า 20 มม.