Perioperative Outcomes of Retrograde Intrarenal Surgery (RIRS) Treatment of Renal Calculi in Siriraj Hospital

Thitipat Hansomwong MD*, Chaiyong Nualyong MD*, Tawatchai Taweemonkongsap MD*, Teerapon Amornvesukit MD*, Kittipong Phinthusophon MD*, Siros Jitpraphai MD*, Chalairat Suk-ouichai MD*, Wichien Sirithanapol MD*, Ekkarin Chotikawanich MD*

** Division of Urology, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*

Objective: *To review the efficacy of retrograde intrarenal surgery for treatment of renal calculi performed in Siriraj Hospital.*
Material and Method: *Retrospectively reviewed of 111 RIRS that been performed in Siriraj Hospital between June 2012 and November 2015. Residual stone was assessed at 1 month post-operatively by plain films (KUB) or urinary tract ultrasonography (US). Success rate of the procedure was defined as the stone-free status or presence of residual fragments less than 3 mm.*
Results: *From 111 patients, average stone size was 11.8±0.6 mm. There were 73 patients whom previously been treated with other modalities.Stone free was accomplished in 90 patients (81.1%) with only 4 patients with residual stone that needed retreatment (3.6%). Stone burden and stone numbers showed significant influence on the success rate. Average operative time was 62.3±2.4 minutes. The mean hospitalization was 3.0±0.3 days. Sepsis was found in 6 patients, which successfully treated with intravenous antibiotic with no mortality. During the study, we used total 5 flexible ureterorenoscopes. We noticed that each scope could be used in approximately 22.2 cases (15-33) before requiring equipment maintenance.*
Conclusion: *RIRS is a minimally invasive treatment for renal calculi with a high success rate and low morbidity.*

Keywords: *Retrograde intrarenal surgery, RIRS, Renal calculi, Renal stone*

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Nowadays, for renal calculi, multimodalities treatment included extracorporeal shock wave (ESWL), percutaneous nephrolithotomy (PCNL), and retrograde access with flexible ureteroscopy have become the standard of care[1-3]. In parallel with the technological advance of flexible ureteroscope and laser lithotripter, retrograde intrarenal surgery (RIRS) is increasing as another option of renal calculi treatment. RIRS is able to treat all stone composition, while it has no incision neither at skin nor kidney. The technique is also appropriate for patients with morbid obesity, renal anomalies and solitary kidney[4]. RIRS is able to treat the stone up to 20 mm and recommended for treating patient with bleeding diathesis[5-7]. RIRS has had a great impact in active stone removal and is performed increasingly worldwide. Currently, 25.2% of ureteroscopic procedures were performed for renal calculi[8]. In accordance with other investigators, the authors would like to report experience with RIRS in 111 renal calculi patients, which might offer Thai people a valuable choice of treatment for renal calculi. This study also evaluated the frequency and cause of repairs of flexible ureteroscopes since cost of ureteroscope remains a major consideration.

Correspondence to:
Chotikawanich E, Division of Urology, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, 10700, Thailand.
Phone.:+66-2-4198010, Fax:+66-2-4112011
E-mail: ekkarin.cho@mahidol.ac.th

Material and Method

This study was approved by Siriraj Institutional Review Board, number SI 197/2016. The outcomes of 111 patients who underwent RIRS for renal calculi at Siriraj Hospital between June 2012 and November 2015 were retrospectively analyzed.

Preoperatively, all patients were evaluated with routine serum creatinine, urinalysis (UA), midstream urine for bacterial culture and plain X-rays of the kidney-ureter-bladder (KUB) film. Stone size was e valuated by measuring the longest stone diameter. All patients were evaluated for stone size, stone number, stone composition, operating time, success rate and

complications.

The procedures were all performed in lithotomy position under general anesthesia. Prophylaxis antibiotic had been given 30-60 minutes before the operation in all cases. Antibiotic drug choice depended on recent urine culture and history of drug allergy. All patients underwent cystoscopy for bladder evaluation and ureteral guide wire insertion. Ureteral access sheath was used in all patients, railed over the guide wire under fluoroscopic guidance. Patient with narrow or stricture ureter, which access sheath could not be safely inserted, was passively dilated with the ureteral stent and scheduled for reevaluation in 2-6 weeks. Flexible ureteroscopes (Olympus, URF-V model) were utilized for all procedures. Stones were fragmented with Holmium: YAG laser (VersaPulse, Luminis™). Renal stones were subjected to 200-µm or 376-µm laser fiber. The laser energy and pulse frequency were modulated on the basis of stone characteristics and surgeon preference. Stone fragments were collected by nitinol basket for stone composition analysis with FTIR spectrometer. At the end of procedure, JJ ureteral stent 6 or 7 Fr was placed in selected cases.

Success rate was evaluated at 1 month using plain KUB film or ultrasonography. Stone less than 3 mm with no stone associated symptom was determined as clinically insignificant and considered as successful treatment.

Statistical analysis was obtained by using IBM SPSS 22.0 program.

Results

A total of 111 patients with renal calculi were treated with RIRS during June 2012 and November 2015, including 48 males and 63 females. Patients presented with residual stone from previous treatment (51%), flank pain (25%), asymptomatic (10%), hematuria (8%) and urinary tract infection (UTI) (5%).The mean of the longest stone diameter was 11.8±0.6 mm (3-30). There were 71 patients who had stone located in lower pole of kidney and 27 patients who had stone located in multiple calyces. Fifty percent of patients had 2 or more renal stones. Bilateral RIRS were performed in 3 patients. Of all renal calculi, the most common stones composition was calcium oxalate monohydrate (36.8%). The remaining were calcium phosphate (34.2%), calcium oxalate dihydrate (15.8%), uric (10.5%), cysteine (1.3%) and struvite stone (1.3%).With a mean BMI of 26.8 recorded, the study group was on average of normal weight. Patient and stone characteristic are summarized in Table 1 and 2.

Preoperatively, 33 patients had JJ ureteral stent insertion for ureteral dilatation (12/33) or urinary diversion (21/33). Stent was averagely placed for 6

Table 1. Patient Characteristics

Patient characteristics	
Gender	
Male	48 (43%)
Female	63 (57%)
Mean age (year)	53.2±2.0
BMI (kg/m^2)	26.8±0.7
Serum creatinine	1.13±0.8
Presentation	
Residual stone	57 (51.4%)
Flank pain	28 (25.2%)
UTI	6 (5.4%)
Hematuria	9 (8.1%)
Asymptomatic	11 (9.9%)
Associate findings	
Ureteral calculi	19 (17.1%)
UPJ obstruction	2 (1.8%)
Infundibular stenosis	7 (6.3%)
Calyceal diverticulum	3 (2.7%)
Bilateral renal calculi	3 (2.7%)
Previous treatment	
ESWL	28 (25.2%)
PCNL	4 (21.6%)
RIRS	25 (4.5%)
Ureteral JJ stent	
For dilatation	12 (36.4%)
For diversion	21 (63.6%)
Pre-op stent time (week)	6 (4-16)

Table 2. Stone characteristics

Stone characteristics	
Stone diameter (mm)	11.8±0.6
Location	
Lower pole	71 (64%)
Multiple calyces	27 (24%)
Calyceal diverticulum	3 (3%)
Number	
Single	55 (50%)
Multiple	56 (50%)
Main stone composition	
Calcium oxalate monohydrate	36.8 %
Calcium phosphate	34.2 %
Calcium oxalate dihydrate	15.8 %
Uric	10.5 %
Cystine	1.3 %
Struvite	1.3 %

weeks (4-16) prior to RIRS. There were 59 (51%) patients who previously unsuccessfully treated with ESWL (25.2%), PCNL (21.6%), and RIRS (4.5%), respectively.

Success rate was affected by stone burden and number of stone, which showed in Table 3. At one month the success rate was 90.0% for non-lower pole stone, 76.1% for lower pole stone, whereas overall success rate was 81.1%. All 3 patients with bilateral renal calculi were successfully treated with simultaneously bilateral RIRS. Mean operative time was 62.3±2.4 minutes (15-150). Adjunctive infundibulotomy and endopyelotomy were performed in 11 patients. Fever was the most frequent post-operative complication that found in 18% of all patients underwent RIRS. There were 2 serious complications, 1 patient experienced septic shock and the other had perioperative myocardial infarction, which successfully treated with medication.The mean length of hospital stay was 3.0±0.3 days (1-19) (Table 4). The mean pain score were 2.18, 0.72 and 0.47 on post-operative day (POD) 0, 1 and 2 respectively. There were 21 patients those unsuccessfully treated with RIRS. In these patients, the mean diameter of residual stone was 8.0±0.9 mm (4-18) with only 4 patients those needed retreatment. Three patients were successfully treated with RIRS and only 1 patient needed more invasive stone treatment with PCNL (Table 5).

In this study, 5 flexible ureteroscopes had been used. Time to repair was 5 to 33 procedures before each repair. There were totally 5 repairs for 111 cases; therefore the mean of repair was 22.2 cases/repair. Out of 5 repairs, 4 repairs were due to working channel leakage with the other due to image lost.

Table 3. Success rate

Success rate		*p*-value
Stone diameter (mm)		
<10	85.7%	0.026
10-20	82.3%	
>20	42.9%	
Stone location		
Lower pole	76.1%	0.072
Non-lower pole	90.0%	
Multiple calyces	74.1%	0.285
Single calyx	83.8 %	
Number of stone		
Single	89.1%	0.033
Multiple	73.2%	
Overall success rate	81.1%	

Table 4. Perioperative outcome

Perioperative outcome	
Operative time (min)	62.3±2.4
Length of hospital stay (day)	3.0±0.3
Adjunctive procedure	27
Semi-rigid URSL	16 (14.4%)
Infundibulotomy	9 (8.1%)
Endopyelotomy	2 (1.8%)
Pain score	
POD 0	2.2±0.2
POD 1	0.72
POD 2	0.47
Analgesic usage	
Paracetamol (500mg) (tab)	4.6 (0-20)
Morphine (mg)	0.5 (0-6)
Complication	27
Fever	20 (18%)
Septic shock	1 (0.9%)
Ureteral injury	5 (0.9%)
Myocardial infarction	1 (0.9%)

Table 5. Residual stones

Residual stone	
Longest diameter (mm)	8.0±0.9
Treatment	
Observation	81 %
RIRS	14 %
PCNL	5 %

Discussion

RIRS, ESWL and PCNL are currently the treatment of renal calculi. ESWL offers short convalescence and may not require general anesthesia. However, many factors influence the outcome, such as stone location, size, number, composition, and patient's BMI[9,10]. PCNL is another treatment option that offer the highest stone free rate. However, with the more invasive nature of PCNL, complications from renal puncture or dilatation of a nephrostomy tract are inevitable. Multiple access tracts may be needed in patient with multiple stones[11]. Of all treatment options, RIRS offer the minimally invasive procedure with high success rate. Recently, some author reported as high as 90% stone free rate (SFR) after RIRS for large renal calculi (>20 mm)[12].

In this study, there was slightly female predominance of 56.7% which different from previous studies[8,15,16]. The mean longest stone diameter was

11.8 mm. According to EAU guidelines for renal calculi, patients in this study were suitable for active stone management with whether ESWL or RIRS. Fifty percent of the patients had been underwent other active stone management before treating with RIRS. The EAU guideline also recommends RIRS for patient who taking anticoagulant/antiplatelet drug. However, in this study, all patients were asked to stop anticoagulant/ antiplatelet drug before the procedure. With RIRS use of natural orifices, it has become one of the most popular treatments for renal calculi.Ureteral dilatation was needed in only 11% of patients which lower than previously reported[8,13]. The mean BMI of this study group was 26.8 which on average of normal weight. However, patient with higher BMI or morbid obesity might be the one that has benefit from this natural orifice procedure. The use of a ureteral access sheath improves the operative vision, decreasing the intrarenal pressure and potentially reduces the operating time[14]. In our study, mean operative time was 62.3 minutes, which is slightly shorter than previous reports[19,20].

The overall success rate of this study was 81.1%. While stone location showed non-statistically significant outcome on RIRS (90% vs. 76%, p-value 0.072), the success rate was impacted by stone size and stone number. Renal stones, the impact of stone size on success rate is well accepted with the stone size being inversely proportional to the success rate[15]. Evidences implies that no significant difference in success rate exist between lower pole and non-lower pole renal stones[16,18]. A success rate of 78.4% and 83.6% were reported in previous studies those performed RIRS in the similar stone size to our study[19,20].With our study reported the mean stone size of 11.8 mm, theirs were 13.5 mm and less than 20 mm respectively.The success rate was expected to be increased after 6 months compare to the primary success rate at 1 month[20].

According to the EAU guideline recommendation on renal calculi larger than 20 mm, PCNL is currently the procedure of choice. There were many authors attempted to treat renal calculi larger than 20 mm with RIRS, however, success rate were lower than PCNL[20-23]. In favor of less invasive procedure and increased success rate after the later retreatment with RIRS, many urologists still preferred to use RIRS even in stone larger than 20 mm. In this series, many patients might have cumulated stone burden > 20 mm because only the longest stone diameter been reported while 50% of patients had multiple stones.

In this study, the success rate was higher in patients who had small (≤20 mm) stone burden or stone that located in non-lower pole than the other. Takazawa et al, revealed the cumulated stone diameter and the presence of impacted stones were the factors significantly influencing the treatment outcome while stone location did not have a strong influence on the outcome[24].

The overall complication rate in this study was 24.3%. Fever was the most frequent reported complication that found in 18% of all patients even though the routine use of prophylactic antibiotic. This was higher than reported in other studies[20,24,25].Ureteral avulsion and ureteral perforation were considered threatening complication of RIRS, 5 patients had superficial ureter injury in this study. All could be managed by ureteral stent placement without serious event.

The factors affected the flexible ureterorenoscope out of order, including surgeon experience, sterilization process and the type of procedure performed[26-28]. In this study, the mean number of cases for each repair was 22.2 (5-33). Working channel leakage was the major cause to be repaired (4 out of 5 times), the remaining was signal lost. The number of cases/repair was better than previous reported from other studies. However, the frequent cause of repair in those studies was lens cloudiness problem[29,30].

The limitation of this study was to determine the residual stone that we use the plain x-ray. CT scan can detect the residual stone more accurately; therefore we mentioned the success rate rather than the stone free.

Conclusion

RIRS is a minimally invasive treatment for renal calculi with a high success rate and low morbidity.

What is already known on this topic?

Retrograde intrarenal surgery (RIRS) has been used increasingly worldwide to treat kidney stone. Success rate of this treatment depends on experience of the centers.

What this study adds?

Initial experience of Siriraj Hospital, RIRS is a preferable treatment for stone less than 2 cm in diameter regardless to stone location or composition.

Potential conflicts of interest

None.

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ผลการรักษานิ่วในไตโดยวิธีส่องกล้องผ่านท่อไตชนิดโค้งงอและใช้เลเซอร์สลายนิ่ว (Retrograde intrarenal surgery; RIRS) ในโรงพยาบาลศิริราช

ฐิติภัท หาญสมวงศ์, ไชยยงค์ นวลยง, ธวัชชัย ทวีมั่นคงทรัพย์, ธีระพล อมรเวชสุกิจ, กิตติพงษ์ พินธุโสภณ, ศิรส จิตประไพ, ชลัยรัชฎ์ สุขอวยชัย, วิเชียร ศิริธนะพล, เอกรินทร์ โชติกวาณิชย์

วัตถุประสงค์: *ศึกษาทบทวนประสิทธิภาพการรักษานิ่วในไตด้วยวิธีส่องกล้องผ่านท่อไตชนิดโค้งงอและใช้เลเซอร์ สลายนิ่วในโรงพยาบาลศิริราช*

วัสดุและวิธีการ: *ศึกษาทบทวนผู้ป่วยจำนวน 111 ราย ที่ได้รับการรักษาโดยวิธีวิธีส่องกล้องผ่านท่อไตชนิดโค้งงอ และใช้เลเซอร์สลายนิ่วในโรงพยาบาลศิริราชระหว่างเดือนมิถุนายน พ.ศ. 2555 ถึง เดือนพฤศจิกายน พ.ศ. 2558 โดยวัดขนาดนิ่วที่เหลือหลังผ่าตัดด้วยภาพถ่ายรังสีหรือการตรวจด้วยคลื่นเสียงความถี่สูง ผลการรักษาถือว่าสำเร็จ ในกรณีนิ่วที่เหลือขนาดเล็กกว่า 3 มิลลิเมตร*

ผลการศึกษา: *จากผู้ป่วยทั้งหมดจำนวน 111 ราย พบขนาดนิ่วโดยเฉลี่ย 11.8±0.6 มม. ผู้ป่วย 73 ราย ได้รับการรักษานิ่ว โดยวิธีอื่นมาก่อนจะได้รับการผ่าตัด ผู้ป่วย 90 ราย (81.1%) ประสบความสำเร็จในการรักษานิ่วโดยวิธีส่องกล้อง ผ่านท่อไตชนิดโค้งงอและใช้เลเซอร์สลายนิ่วโดยมีผู้ป่วยเพียง 4 ราย (3.6%) ที่จำเป็นต้องได้รับการรักษานิ่วซ้ำ พบว่าขนาดและจำนวนของเม็ดนิ่วมีผลต่อความสำเร็จในการกำจัดนิ่วเวลาผ่าตัดโดยเฉลี่ยคือ 62.3 นาที ผู้ป่วยอยู่ในโรงพยาบาลตลอดการรักษาเฉลี่ย 3 วัน พบผู้ป่วยจำนวน 6 รายมีการติดเชื้อในกระแสเลือดหลังการรักษาโดยผู้ป่วยทั้ง 6 ราย สามารถหายจากภาวะติดเชื้อในกระแสเลือดอย่างปลอดภัยหลังได้รับยาปฏิชีวนะทางหลอดเลือดดำระหว่างการรักษาผู้ป่วยทั้งหมดใช้ flexible ureterorenoscope จำนวน 5 ตัว โดยกล้องแต่ละตัวสามารถใช้รักษานิ่วในไตของผู้ป่วย 22.2 ราย ก่อนจำเป็นต้องส่งบำรุงรักษา*

สรุป: *การผ่าตัดโดยวิธีส่องกล้องผ่านท่อไตชนิดโค้งงอและใช้เลเซอร์สลายนิ่วเป็นการรักษาชนิดบาดเจ็บน้อยที่มีผลสำเร็จสูง ในขณะที่มีภาวะแทรกซ้อนของการรักษาอยู่ในระดับต่ำ*