Original Article

The impact of surgical experience on outcomes of retrograde intrarenal surgery for kidney stones

Ukrit Rompsaithong, Varat Woranisarakul, Tawatchai Taweemonkongsap, Sithiporn Srinualnud, Chaiyong Nualyong, Ekkarin Chotikawanich

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

Keywords:
retrograde intrarenal surgery,
kidney stone,
surgical experience

Abstract

Objective: To evaluate the impact of surgical experience on the outcomes of retrograde intrarenal surgery (RIRS) to treat kidney stones.

Material and Method: Retrospective chart review of patients who underwent RIRS between November 1st, 2014 and January 11th, 2017; the outcomes were divided into 2 groups. Group 1 was the less experienced surgeons (fewer than 30 cases for each surgeon) whereas group 2 was the highly experienced surgeon (more than 300 cases). The surgical outcomes, including operative time, stone-free rates, complications and scope damage, were compared between the 2 groups.

Results: There were 6 surgeons in group 1 and a single surgeon in group 2. Seventy-four procedures were performed by group 1. Group 2 included the first 30 procedures after the surgeon had passed the learning curve. Patient demographic data, including age, sex and location of the stone, were not different between group 1 and group 2. Group 1 had a smaller stone size than group 2 (1.59 cm vs. 2.34 cm; p=0.006). The outcomes of group 2 were better than group 1, including operative time (80.48 minutes vs. 43.50 minutes; p<0.001) and stone-free rates (52.05% vs. 90%; p<0.001). Serious complications were determined to be sepsis or a high degree of ureter injury that required surgical correction. Sepsis occurred in 6 patients in group 1 (8.10%), whereas no sepsis was found in group 2 (p=0.013). There was no high degree of ureteric injury in either group. Three scopes were damaged in group 1 whereas no scope damage occurred in group 2 (p=0.045).

Conclusion: RIRS is a popular procedure for the treatment of kidney stones. Surgical experience is mandatory to achieve excellent outcomes.

Corresponding author: Ukrit Rompsaithong
Address: Division of Urology, Department of Surgery, Khon Kaen University
E-mail: ukritro@kku.ac.th
Received: June 22, 2020
Revision received: July 8, 2020
Accepted after revision: November 9, 2020

Introduction

Nowadays, retrograde intrarenal surgery (RIRS) is a popular treatment for kidney stones. It is a less invasive procedure compared with percutaneous nephrolithotomy (PCNL). However, due to the small instruments, RIRS is not as suitable for large kidney stones as PCNL, but it is still useful in selected cases[1]. Other disadvantages of this procedure are the ureteroscopes can be easily damaged and the high cost of the instruments. Furthermore, the procedure requires a steep learning curve. Berardinelli et al. reported that surgical experience (<100 procedures vs. >400 procedures) had an impact on operative time and complications. However, there was no significance in stone-free rates (SFR) and no data about damage to the ureteroscope[2]. Therefore, this study was conducted in order to evaluate the impact of surgical experience in our center on the outcomes of RIRS for the treatment of kidney stones in terms of patient outcomes and instrument breakage.

Material and Method

Patient Data

This was a retrospective study; patient charts were reviewed. The study was approved by Siriraj SIRB No 118/2560 (EC2). Patients aged 18 years and older who underwent RIRS for kidney stone at Siriraj Hospital between November 1st, 2014 and January 11th, 2017 were included in the study. Patients who were stented without an operation or pregnant, and had undergone simultaneous bilateral ureterorenoscopy were excluded. There were 6 surgeons in group 1, and these surgeons had little experience for RIRS (fewer than 30 cases for each surgeon). In group 2, there was a single surgeon with significant experience for this procedure (more than 300 cases).

Surgical Steps for RIRS

Intravenous antibiotic was given 30-60 minutes before the administration of general anesthesia. The patient was positioned in the dorsal lithotomy position. Careful cystoscopy was performed. Ureteric orifice was examined. Safety guidewire was inserted under the fluoroscopy. Double lumen catheter was passed over the safety guidewire (0.038-in PTFE-Nitinol guidewire with hydrophilic tip, Boston Scientific, Natik, MA, USA) using a railroad technique, then stiffwire (Cook Medical, Bloomington, IN, USA) was placed in order to facilitate insertion of a ureteral access sheath in all cases. An appropriate ureteral access sheath (diameter 11/13 F or 12/14 F and length 36 cm or 46 cm, Cook Medical, Bloomington, IN, USA) was chosen and deployed just below the ureteropelvic junction. Patients with ureteric stricture or narrow ureter were stented for 2 to 4 weeks before the procedure.

A flexible ureteroscope (URF-V model, Olympus Europe, Germany) was passed through the sheath. A systematic inspection of the pelvicalyceal system to reach the targeted stones was performed using pressurized saline irrigation. For lower pole stones, we used a zero-tipped nitinol basket (Cook Medical, Bloomington, IN, USA) and relocated stones into the more accessible calyx. For Holmium laser lithotripsy (VersaPulse, LumenisTM, Santa Clara, CA, USA): dusting effect using a high frequency and low power setting was applied for the stone surface; fragmenting effect using a low frequency and high power setting was applied for lithotripsy of the stone core. At the end of the procedure, ureteral access sheath was withdrawn gradually along with ureteroscope. The ureter was examined for degree of injury and classified as low grade (mucosal petechiae or erosion) or high grade (smooth muscle injury, perforation or ureteral avulsion)[3]. A double J ureteral stent 6 or 7 F was placed according to the degree of injury and surgeon preference.

Outcome Measurements

Patient demographic data, including age, sex, stone size, and stone site, were collected. The surgical outcomes were operative time, SFR, complications, and scope damage. Stone size and location were evaluated using the preoperatively existing plain film,

ultrasonography or computed tomography scan of the urinary system, and measured by the longest diameter. Operative time was calculated from insertion of the endoscope into the urethra till the completion of the operation. Stone-free status was determined as absence or having residual stone fragments less than 4 mm in diameter using plain film or ultrasonography evaluated at 1 month after the procedure.

Significant complication was determined according to the modified Clavien-Dindo classification grade II to IV[4]. For example, the septic complication which required prolonged intravenous antibiotic was defined as grade II; high degree of ureteral injury which required another surgical intervention was defined as grade III. Low degree of ureteral injury, that which did not require surgical intervention, was not included in the significant complications. Scope damage was defined as the need for repair. Scopes were inspected and tested for leakage after every procedure, and thus this can establish which procedure damaged the scope. These outcomes were collected and compared between the 2 groups.

Statistical Analysis

To assess the surgical outcomes, Berardinelli et al. reported that there was no significant difference of SFR between the low and high experienced groups; thus, the sample size calculation was based on the difference in operative time between the 2 groups (76.3 ± 35.6 minutes vs. 53.1 ± 26.5minutes)[2], with a 2-sided level of significance of 0.05, power of 90% and the ratio 2:1. Expecting group 1 to include 53 procedures and 27 procedures for group 2, we initially planned to include all 74 procedures performed by the surgeons in group 1 during that period; each surgeon performed RIRS ranging from 7-25 procedures and the first 30 procedures in group 2 after the surgeon has passed the learning curve.

Statistical analysis was conducted using SPSS Statistics for Windows, version 16.0 (SPSS Inc., Chicago, Ill., USA). For patient demographic data: categorical variables were presented in frequencies and percentages and continuous variables were presented in mean and range. Characteristics: surgical outcomes and complications were compared using the Chi-squared for categorical data and t-test for continuous data. Statistical significance was set at a p-value less than 0.05.

Result

Patient demographic data, including age, sex, and location of the stone (lower calyx), were not different between group 1 and group 2; see Table 1. Group 1 had a smaller stone size than group 2 (1.59 cm vs. 2.34 cm; p=0.006). The outcomes of group 2 were better than group 1, including operative time (group 1=80.48 minutes vs. group 2=43.50 minutes; p<0.001) and the stone-free rate (group 1=52.05% vs. group 2=90%; p<0.001). The serious complication was sepsis. There was no major degree of ureteral injury. Sepsis occurred in 6 patients in group 1 (8.10%) while no sepsis was found in group 2 (p=0.013). There were 3 scopes damaged in group 1 while no scope damage occurred in group 2 (p=0.045); see Table 2.

Table 1. Patient demographic data and stone characteristics

Variable	Group 1 (n=74)	Group 2 (n=30)	p-value
Sex (Male: Female)	30: 44	13: 17	
Age (year, mean; min-max)	(57.9; 26-84)	(59.9; 40-89)	0.465
Stone size (cm, mean)	1.59	2.34	0.006
Stone site (% of lower calyx)	43.24%	36.66%	0.542

Table 2. Surgical outcomes and complications

Variable	Group 1	Group 2	p-value
Time (minutes)	80.48	43.50	<0.001
Stone-free rates (%)	52.05	90.00	<0.001
Complication (%)	8.10	0	0.013
Scope damage (number of repair)	3	0	0.045

Discussion

This study revealed the impact of surgical experience on the outcomes of RIRS for the treatment of kidney stones. There was a difference in many parameters in the outcomes between the 2 groups of surgeons. Operative time of the surgeon who had high experience (group 2) was shorter than in the group of surgeons who had low experience (group 1), even though the stone size in group 2 was larger (2.34 cm vs. 1.51 cm; p=0.006). According to the procedure, there were two major steps that could affect the operative time: Orientation of endoscopy to find the targeted stones, and using the laser to do lithotripsy. In the low experience group, more time was needed to do the orientation inside the kidney. A shorter time will be achieved after doing more cases, especially for access to the lower calyx.

Laser lithotripsy is mandatory for the procedure and the laser setting for each type of stone is usually important. To have the appropriate laser setting for each situation requires more experience. There were various laser settings in this study; however, the group 2 surgeon used 0.5 Joules and 20 Hertz for soft stones and 1 Joules and 20 Hertz for hard stones. Stone-free status is a goal for stone treatment. There was higher SFR in group 2 than group1, with statistical significance (90% vs. 52.05%; p<0.001). To have high SFR requires good skill in order to access all the calices after doing lithotripsy. The irrigating fluid usually makes the fragments migrate into other calices while doing laser lithotripsy. Therefore, access to all calices after that is essential in order to determine whether there are any large residual fragments remaining in any of the calyx.

Complications in this procedure were not uncommon, but serious ones seldom occurred[5,6]. This study did not have a high grade of ureteral injury, according to the surgeons. However, a low grade of ureteral injury that could be managed with a retaining ureteral stent was reported by some surgeons. Therefore, low-grade ureteral injury was not included in the significant complications. Sepsis was the most serious complication in the study. Operative time is one of the risk factors for sepsis. Prolonged duration of the procedure enhanced absorption of the irrigating fluid and infective substance[7]. Thus less operative time may have less sepsis.

The most interesting issue for RIRS is the expensive and delicate instruments required, especially the flexible ureteroscope. For the low experience surgeons, 3 scopes were broken in 74 procedures. This was calculated to 24.6 procedures for repair. In group 2, the surgeon could use the scope for 30 procedures without repair. However, this study could not reveal how many procedures could be performed for one repair in group 2.

Berardinelli et al. reported surgical experience can affect the operative time and complications[2], while it had similar SFR. Low surgical experience in their study was defined as a surgeon who had less than 100 cases of RIRS, while in our study it was defined

as less than 30 cases. The limitation of our study is that no matched pair analysis on stone size was conducted. Nonetheless, compared to their study, our study had less SFR in the group with low experience (52.05% vs. 70%), but higher SFR in the group with high surgical experience (90% vs. 77.9%), even though the stone size was significantly larger. Finally, further studies should be conducted in order to address how many procedures are necessary to reach the plateau in terms of stable outcomes.

Conclusion

RIRS is a popular procedure for the treatment of kidney stones. Surgical experience is mandatory to achieve excellent outcomes.

Conflict of interest

The authors declare no conflict of interest.

References

1. Zheng C, Xiong B, Wang H, Luo J, Zhang C, Wei W, et al. Retrograde intrarenal surgery versus percutaneous nephrolithotomy for treatment of renal stones >2 cm: a meta-analysis. Urol Int. 2014;93(4):417-24.
2. Berardinelli F, Cindolo L, De Francesco P, Proietti S, Hennessey D, Dalpiaz O, et al. The surgical experience influences the safety of retrograde intrarenal surgery for kidney stones: a propensity score analysis. Urolithiasis. 2017;45(4):387-92.
3. Traxer O, Thomas A. Prospective evaluation and classification of ureteral wall injuries resulting from insertion of a ureteral access sheath during retrograde intrarenal surgery. J Urol. 2013; 189(2):580-4.
4. Dindo D, Demartines N, Clavien P-A. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004; 240(2):205-13.
5. Berardinelli F, De Francesco P, Marchioni M, Cera N, Proietti S, Hennessey D, et al. Infective complications after retrograde intrarenal surgery: a new standardized classification system. Int UrolNephrol. 2016;48(11):1757-62.
6. Berardinelli F, Proietti S, Cindolo L, Pellegrini F, Peschechera R, Derek H, et al. A prospective multicenter European study on flexible ureterorenoscopy for the management of renal stone. Int Braz J Urol Off J Braz Soc Urol. 2016; 42(3):479-86.
7. Guzelburc V, Balasar M, Colakogullari M, Guven S, Kandemir A, Ozturk A, et al. Comparison of absorbed irrigation fluid volumes during retrograde intrarenal surgery and percutaneous nephrolithotomy for the treatment of kidney stones larger than 2 cm. SpringerPlus. 2016;5(1):1707.