Original Article

Comparison of the outcomes for retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL) in the treatment of renal stones more than 2 centimeters

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Abstract

Objective: Comparison of the treatment of large renal stone outcomes between PCNL and RIRS.

Material and Method: Retrospective study of patients with large renal calculi who underwent stone treatment at Siriraj Hospital between July 2012 and September 2016. Patients were reviewed and divided into group I (PCNL, n=73) and group II (RIRS, n=67). The outcomes, including operating time, length of hospital stay, complications, stone-free rates and retreatment rates, were collected and compared.

Result: Stone-free rates were 79.4% in group I and 74.6% in group II (p=0.497). Retreatment rates were 53.3% in group I and 47% in group II (p=0.723), while operative time (p=0.001), length of hospital stays (p<0.001), and complications (p<0.001) were statistically different. Main stone compositions were calcium oxalate monohydrate (38%) and calcium phosphate (23%).

Conclusion: Treatment of kidney stones 2-4 centimeters in size with PCNL or RIRS was comparable with satisfactory outcomes.

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Introduction

Kidney stones are one of the most common urological problems worldwide. The standard of care for renal calculi more than 2 cm is usually treatment by percutaneous nephrolithotomy (PCNL), which usually has the highest stone-free rate (up to 94%)[1] However, some serious and higher complications still occur (6.7%).[2] Minimally invasive techniques have led to a reduction in invasive procedures, such as open or percutaneous surgery for minimizing the surgical morbidity. In this new era, the flexible ureteroscopy provides clear images and easy rotation, especially in a limited space with different angles as renal calyx and capabilities for laser technology are suitable for treatment of all kinds of renal calculi[3] It is nowadays considered an option to treat large renal stones with retrograde intrarenal surgery. Recent studies show positive outcomes in retrograde intrarenal surgery (RIRS) and a decrease in PCNL complications. [1] A recent systematic review and meta-analysis of RIRS for treating large intrarenal stones (>2.5 cm) may offer an acceptable efficacy with low morbidity[1,2].

Material and Method

Between July 2012 and September 2016, 140 patients diagnosed with renal pelvic stones 2-4 cm in diameter by conventional film KUB, ultrasonography or low dose spiral CT scan, were treated in Siriraj Hospital and retrospectively studied. Patients with histories of abnormal anatomy of KUB system (ureteropelvic junction obstructions, horseshoe kidney), undergoing concomitant surgery (e.g. cystolithothipsy), or with unavailable data were excluded.

Ethics

The study was approved by Ethics Committee of the Faculty of Medicine Siriraj Hospital, Mahidol University. The medical records of 140 patients (73 PNL, 67RIRS) were retrospectively evaluated. Patients treated using PCNL were categorized into group I and those treated via RIRS in group II.

PCNL (Group I)

Standard PCNL treatment: ureteral catheter was placed, via rigid cystoscopy in the lithotomy position; next, percutaneous access in the prone position, dilatation tract with Amplatz dilator up to 30Fr, Nephroscope no (26Fr, Storz) and Dual Ultrasonic Lithotriptor (ShockPulse-SE, Olympus) for stone fragmentation.

RIRS (Group II)

All F-URS procedures were performed under general anesthesia with patients in the lithotomy position. Sensor safety guidewire (0.038-inch) was advanced to the renal pelvis with fluoroscopic assistance. Then, a ureteral access sheath (11/13 or 12/14F) was passed over the guidewire through the ureteropelvic junction. A flexible ureterorenoscope (URF-V2, Olympus) was inserted into the renal pelvis within the ureteral access and lithotripsy by holmium laser.

Outcomes including total operative time, length of hospital stay, complications, and stone-free rates (stone-free rates were followed up in the outpatient clinic for the next three month after surgery with plain film KUB or ultrasonography. CIRF is described as asymptomatic, noninfectious and non-obstructive stone fragments $\leq = 4$ mm[3,4]) were collected and compared.

Statistical analysis

Continuous variables were compared with Student's t and Mann-Whitney U tests as appropriate. Proportions of categorical variables were analyzed using the chi-squared or Fisher's exact test. Statistical significance was set at $P<0.05$, and all reported P-values were two-sided. The data analysis was performed using SPSS 16.0. Sample size calculation was conducted based on the SFR (primary outcome). The SFR was assumed to be 94% and 75% for PCNL and RIRS, respectively[5]. Type I error probability was fixed at 0.05 and the power was entered to be 80%.

Result

Of 140 patients, 73 were in the PCNL group (group I) and 67 in the RIRS group (group II). The location, age, gender of the patient, size, operative time, duration of hospital stay, stone-free rates and complications were compared between the 2 groups. See Table 1.

There were several significant differences in BMI and mean age. Group II was heavier and older than group 1; however, they were similar in the other parameters examined (gender, site, mean stone size, lower pole stone and previous open kidney surgery).

Perioperative and postoperative variables are presented in Table 2. The primary outcome, SFR, was similar in both groups (79.4% in group I and 74.6% in group II), whereas total operative time in group II (70 min) was significantly longer than in group I (60 min), but postoperative hospital stay in group II was significantly shorter than group I. Overall complications were reduced in group II (14.9%). All complications are shown in Table 3.

Table 1. Demographic characteristics of the patients and stones

Factors	Group I n, (%)	Group II n, (%)	P-value
Gender			
Female	38(52.1)	38(52.1)	0.299
Male	35(47.9)	35(47.9)	
Site			
Left	33(45)	33(49)	0.630
Right	40(55)	34(51)	
Mean Age (yr.)	54.3 $\pm$ 11.7	59 $\pm$ 10.6	0.013
BMI (kg/m^2)	25 $\pm$ 4	26.9 $\pm$ 4.8	0.012
Mean size (mm)	29.5 $\pm$ 5.4	27.8 $\pm$ 6	0.078
Lower pole stone	34(47)	42(63)	0.056
Previous open kidney surgery	10(14)	3(4)	0.060
Previous ESWL	1(1)	8(11)	0.011

Table 2. Treatment outcomes

Factors	Group I	Group II	P-value
SFR(%)	79.4%	74.6%	0.497
Operation time (min)	60(20-135)	70(15-155)	<0.001
Length of hospital stay (d)	4(2-17)	1(1-22)	<0.001
Overall complications	28.76%	14.92%	0.049

Table 3. Treatment complications

Complications	Modified Clavien	Group I N=73	Group II N=67
Fever	1	9(12.3%)	7(10.4%)
Blood transfusion	2	3(4%)	0
Urine leakage/Urinoma	3A	1(1.3%)	0
Pneumo/hemothorax	3A	1(1.3%)	0
renal pelvis injury	3A	1(1.3%)	0
Perinephric hematoma	3A	1(1.3%)	0
Urosepsis	4B	5(6%)	3(4%)

The modified Clavien system was used for reporting surgical complications.[6,7] The main complication in both groups was fever (modified Clavien grade 1). In group I, PCNL had a higher transfusion rate than group II and also had more severe complications, such as urinoma, pneumo/hemothorax, renal pelvis injury and perinephric hematoma. Although RIRS is a minimally invasive surgery, the serious complication of urosepsis was not significantly different between the 2 groups (P=0.5904).

There have been various reports in the literature.[11,12] Our SFR was relatively low in the PCNL group (79.4%) because the majority of the stones were complex. The main positive outcomes in the RIRS group were no blood transfusion and a lower complication rate than the PCNL group.

Subgroup analysis: there were better stone-free rates in patients with renal stones 20-29 mm in size in both groups (89.45% vs 84%). Stone-free rates decreased in the stones sized 30-39 mm (68.5% vs 56.5%), as described in Table 4.

Discussion

Nowadays, the operative technique for renal stones has been changed to minimally invasive surgery.[8] For renal stones more than 2 cm in size the usual surgical treatment is PCNL[9], which has high stone-free rates; however, some serious complications can still occur. In this new era of endoscopy technology, the flexible ureteroscopy is used in surgical treatments for renal stones in order to minimize morbidity and complications. Therefore, RIRS is an alternative treatment for high-risk invasive surgery or patients with a bleeding tendency.[10]

Table 4. Stone free rate of the patients for different renal stone sizes

Size	SFR (%) Group I N=73	SFR (%) Group II N=67
20-40 mm	79.4%	74.6%
20-29 mm	89.4%	84.0%
30-39 mm	68.5%	56.5%

The main complication in both groups was postoperative fever.[13] PCNL had a higher transfusion rate and more severe complications, whereas RIRS had a longer operative time and shorter length of hospital stay.[14] Although RIRS is a minimally invasive surgery, urosepsis[15] was not significantly different between the 2 groups (P=0.5904).

This study has several limitations, including bias because it is a retrospective single-center study with a limited number of patients. A prospective study should be designed and conducted in order to compare PCNL and evaluate long-term outcomes, complications, and the costs and benefits.

Conclusion

Treatment of kidney stones 2-4 cm in size with PCNL or RIRS was comparable and had satisfactory outcomes with high safety profiles in well selected cases, especially in stones 20-29 mm in size.

Conflict of interest

The authors report no conflicts of interest in this work.

References

1. Breda A, Angerri O. Retrograde intrarenal surgery for kidney stones larger than 2.5 cm. Curr Opin Urol 2014;24:179-183.
2. De S, Autorino R, Kim FJ, et al. Percutaneous nephrolithotomy versus retrograde intrarenal surgery: a systematic review and meta-analysis. Eur Urol 2015;67:125-137.
3. Resorlu B, Unsal A, Gulec H, et al. A new scoring system for predicting stone-free rate after retrograde intrarenal surgery: the "resorlu-unsal stone score". Urology 2012;80:512-518.
4. Osman MM, Alfano Y, Kamp S, et al. 5-year-follow-up of patients with clinically insignificant residual fragments after extracorporeal shockwave lithotripsy. Eur Urol 2005;47:860-864.
5. Bryniarski P, Paradysz A, Zyczkowski M, et al. A randomized controlled study to analyze the safety and efficacy of percutaneous nephrolithotripsy and retrograde intrarenal surgery in the management of renal stones more than 2 cm in diameter. J Endourol 2012; 26:52-57.
6. Tefekli A, Ali Karadag M, Tepeler K, et al., Classification of percutaneous nephrolithotomy complications using the modified clavien grading system: looking for a standard. Eur Urol 2008;53:184-190.
7. Oguz U, Resorlu B, Ozyuvali E, et al., Categorizing intraoperative complications of retrograde intrarenal surgery. Urol Int 2014;92:164-168.
8. Inoue T, Okada S, Hamamoto S, et al., Current trends and pitfalls in endoscopic treatment of urolithiasis. Int J Urol 2018;25:121-133.
9. Pradere B, Doizi S, Proiette S, et al. Evaluation of Guidelines for Surgical Management of Urolithiasis. J Urol 2018;199:1267-1271.
10. Sanguedolce F, Bozzini G, Chew B, et al. The Evolving Role of Retrograde Intrarenal Surgery in the Treatment of Urolithiasis. European Urology Focus 2017;3:46-55.
11. Kirac M, Bozkurt Of, Tunc L, et al., Comparison of retrograde intrarenal surgery and mini-percutaneous nephrolithotomy in management of lower-pole renal stones with a diameter of smaller than 15 mm. Urolithiasis 2013;41:241-246.
12. Akman T, Binbay M, Ozgor F, et al., Comparison of percutaneous nephrolithotomy and retrograde flexible nephrolithotripsy for the management of 2-4 cm stones: a matched-pair analysis. BJU Int 2012;109:1384-1389.
13. Gutierrez J, Smith A, Geavlete P, et al. Urinary tract infections and post-operative fever in percutaneous nephrolithotomy. World J Urol 2013;31:1135-1140.

14. Palmero Marti JL, Ganau Ituren A, Valls Gonzalez L. [Current results of RIRS and comparison with PCNL.]. Arch Esp Urol 2017;70:147-154.

15. Cindolo L, Castellan P, Scoffone CM, et al. Mortality and flexible ureteroscopy: analysis of six cases. World J Urol 2016;34:305-310.