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ABOUT COVER

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AIM AND SCOPE

World Journal of Clinical Cases (*World J Clin Cases*, *WJCC*, online ISSN 2307-8960, DOI: 10.12998) is a peer-reviewed open access academic journal that aims to guide clinical practice and improve diagnostic and therapeutic skills of clinicians.

The primary task of *WJCC* is to rapidly publish high-quality Autobiography, Case Report, Clinical Case Conference (Clinicopathological Conference), Clinical Management, Diagnostic Advances, Editorial, Field of Vision, Frontier, Medical Ethics, Original Articles, Clinical Practice, Meta-Analysis, Minireviews, Review, Therapeutics Advances, and Topic Highlight, in the fields of allergy, anesthesiology, cardiac medicine, clinical genetics, clinical neurology, critical care, dentistry, dermatology, emergency medicine, endocrinology, family medicine, gastroenterology and hepatology, geriatrics and gerontology, hematology, immunology, infectious diseases, internal medicine, obstetrics and gynecology, oncology, ophthalmology, orthopedics, otolaryngology, pathology, pediatrics, peripheral vascular disease, psychiatry, radiology, rehabilitation, respiratory medicine, rheumatology, surgery, toxicology, transplantation, and urology and nephrology.

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ORIGINAL ARTICLE

Retrospective Study

Retrograde intrarenal surgery *vs* miniaturized percutaneous nephrolithotomy to treat lower pole renal stones 1.5-2.5 cm in diameter

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Author contributions: All authors helped to perform the research; Li MM contributed to the data collection and manuscript writing; Yang HM contributed to the data analysis; Liu XM contributed to performing experiments and data analysis, Qi HG contributed to the data collection and statistical analysis; Weng GB contributed to the drafting conception and design.

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Institutional review board statement: This study was reviewed and approved by the Ethics Committee of the Ningbo Urology and Nephrology Hospital.

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Abstract

AIM

To compare the outcomes of retrograde intrarenal surgery (RIRS) and miniaturized percutaneous nephrolithotomy (mini-PCNL) in treating lower pole (LP) renal stones with a diameter of 1.5-2.5 cm.

METHODS

A total of 216 patients who underwent mini-PCNL (n = 103) or RIRS n = 113) for LP stones with a diameter of 1.5-2.5 cm were enrolled between December 2015 and April 2017 at the Urology Department of Ningbo Urology and Nephrology Hospital.

RESULTS

Significant differences were found in the hospital stay (9.39 ± 4.01 *vs* 14.08 ± 5.26, P < 0.0001) and hospitalization costs (2624.5 ± 513.36 *vs* 3255.2 ± 976.5, P < 0.0001) between the RIRS and mini-PCNL groups. The mean operation time was not significantly different between the RIRS group (56.48 ± 24.77) and

the mini-PCNL group (60.04 ± 30.38, P = 0.345). The stone-free rates at the first postoperative day (RIRS *vs* mini-PCNL: 90.2% *vs* 93.2%, P = 0.822) and the second month postoperatively (RIRS *vs* mini-PCNL: 93.8% *vs* 95.1%, P = 0.986) were not significantly different.

CONCLUSION

RIRS and mini-PCNL are both safe and effective methods for treating LP stones with a diameter of 1.5-2.5 cm. RIRS can be considered as an alternative to PCNL for the treatment for LP stones of 1.5-2.5 cm.

Key words: Retrograde intrarenal surgery; Percutaneous nephrolithotripsy; Lower pole kidney stones; Miniaturized percutaneous nephrolithotomy

Core tip: This retrospective study aimed to compare the outcomes of retrograde intrarenal surgery (RIRS) and miniaturized percutaneous nephrolithotomy (mini-PCNL) in treating lower pole (LP) renal stones with a diameter of 1.5-2.5 cm. The results showed that the hospital stay (9.39 ± 4.01 *vs* 14.08 ± 5.26, P < 0.0001) and hospitalization costs (2624.5 ± 513.36 *vs* 3255.2 ± 976.5, P < 0.0001) in the RIRS patients were much lower than those of the mini-PCNL group. No significant differences were found in the mean operation time or stone-free rates between the RIRS and mini-PCNL groups. RIRS can be considered as an alternative to PCNL for the treatment of LP stones of 1.5-2.5 cm.

Li MM, Yang HM, Liu XM, Qi HG, Weng GB. Retrograde intrarenal surgery *vs* miniaturized percutaneous nephrolithotomy to treat lower pole renal stones 1.5-2.5 cm in diameter. *World J Clin Cases* 2018; 6(15): 931-935 Available from: URL: http://www.wjgnet.com/2307-8960/full/v6/i15/931.htm DOI: http://dx.doi.org/10.12998/wjcc.v6.i15.931

INTRODUCTION

Retrograde intrarenal surgery (RIRS) is rapidly becoming an effective and safe treatment modality in the surgical treatment of urinary system stone disease[1]. Small kidney stones and upper urinary tract tumours can be effectively treated by RIRS using minimally invasive methods[2]. RIRS was first reported for the treatment of small kidney stones in 2002. In recent years, urologists also suggested using this approach to treat large stones, because of the fewer complications and reduced morbidity[3]. Indeed, the European Association of Urology (EAU) guidelines mentioned that RIRS is a valid choice of some surgeons for the treatment of larger stones[4].

Percutaneous nephrolithotomy (PCNL) is recommended for the treatment of larger stones, since it has a good success rate; however, the complication rates have been reported to be up to 25%[5]. With advancements in techniques and technologies, miniaturized PCNL (mini-PCNL), defined as a PCNL involving the use of smaller nephroscopes[6], can be performed effectively to manage kidney stones with high stone free rates and low complications[7]. The two surgical procedures have different advantages associated with the treatment of stones of different sizes affecting the urinary system[8-10]. However, few studies have compared the results of mini-PCNL to RIRS for the treatment of lower pole stones (LP stones) with a 1.5-2.5 cm diameter. In this study, we reviewed retrospectively 216 patients who underwent mini-PCNL (n = 103) or RIRS (n = 113) for LP stones with a 1.5-2.5 cm diameter between December 2015 and April 2017. Specifically, we compared the operation time, stone-free rate, complications, hospital stay, and hospitalization costs in patients treated by these two minimally invasive methods.

MATERIALS AND METHODS

Patients

We performed a retrospective analysis of 216 patients who underwent mini- PCNL (n = 103) or RIRS (n = 113) for LP stones with a 1.5-2.5 cm diameter by the same doctors between December 2015 and April 2017 at the Urology Department of Ningbo Urology and Nephrology Hospital. Patients were evaluated by plain radiography, intravenous urography, ultrasonography, and/or computed tomography (CT), urinalysis, urine culture, complete blood cell count, and coagulation tests before the procedure. Stone size was calculated according to the EAU guidelines. We determined the operation technique according to the LP pelvicalyceal anatomy, as well as the surgeon's and patient's choice. Patients with abnormal renal anatomy (horseshoe, pelvic, and malrotated kidneys, bifid pelvis, ectopic pelvic fusion anomaly), patients with non-opaque stones, and paediatric patients (< 18 years) were excluded from the study.

RIRS technique

All the patients undergoing the RIRS surgery were performed under general anaesthesia and were located at the lithotomy position. First, rigid ureteroscopy was used to passively dilate the ureter and to place a hydrophilic safety guidewire (0.038-inch) and advance to the renal pelvis by fluoroscopic assistance. Second, we used a ureteral access sheath (12/14 F) to traverse the guidewire through the ureteropelvic junction. We used a flexible ureterorenoscope (Flex-X2, Karl Storz, Tuttlingen, Germany) to insert into the renal pelvis within the ureteral access sheath. Kidney stones were fragmented using a Ho YAG laser (Dornier MedTech, Munich, Germany).

Mini-PCNL technique

All procedures were performed with the patient under general anaesthesia. At the beginning of the procedure,

Table 1 Stone characteristics and demographic data of patients

Characteristic	RIRS group	Mini-PCNL group	*P* value
Number	113	103	
Age (yr)	49.59 ± 12.66	49.89 ± 13.09	0.864
Man (%)	67 (59.3)	75 (72.8)	0.051
BMI (kg/m^2)	24.3 ± 3.21	23.24 ± 3.11	0.014
Side (right/left)	47/66	49/54	0.583
Stone size (mm)	18.27 ± 2.91	17.51 ± 5.29	0.218

Data presented are as means ± SD. BMI: Body mass index; PCNL: Percutaneous nephrolithotomy; RIRS: Retrograde intrarenal surgery.

placement of a 6 Fch ureteral catheter up to the renal pelvis was performed by means of rigid cystoscopy. Subsequently, patients were placed in the prone position, and percutaneous access was achieved by a urologist under ultrasonography guidance using an 18-gauge needle and guidewire. We used a 0.038-mm J-tipped guidewire to insert through the calyceal puncture into the renal pelvis. The first three Alkan dilators were used to dilate the tract (8F-14F-16F). Next, we inserted a 16-F sheath and introduced a rigid 10-F ureteroscope. The stone fragmentation was performed using a Ho:YAG laser (365-μm fibre; energy 2.5 Jd; frequency 20 Hz). A 16-F nephrostomy tube was inserted into the calyceal system at the end of the procedure. Three days after the surgery, the nephrostomy tube was removed. The double J ureteral stent was removed under local anaesthesia 2 wk later.

Assessment of outcomes

The outcomes including operative time, stone-free rate, complications, mean decrease in haemoglobin levels, hospital stay, and hospitalization costs for the patients who underwent these two minimally invasive methods were compared in this study.

Abdominal low-dose helical CT examination was performed before operation. Patients were re-evaluated using CT 2 mo after surgery to examine residual stone status. Residual stones size less than 2 mm in diameter were considered "clinically insignificant residues".

Statistical analysis

The chi-square test was applied to compare the proportions between two groups. Continuous variables are presented as means ± SD and were compared using the Student's *t*-test when the data followed a normal distribution. Where the distribution of the continuous variables was not normal, the Wilcoxon signed-rank test was used. The *P*-value was adjusted for gender and BMI. The adjusted calculation was performed using SPSS package with binary logistic regression. Statistical significance was defined as $P < 0.05$. All statistical analyses were performed using Statistical Product and Service Solutions (SPSS) 17.0 (SPSS, Inc., Chicago, United States).

RESULTS

The characteristics of the study patients are provided in Table 1. A total of 103 patients who underwent mini-PCNL and 113 patients who underwent RIRS were enrolled in the study. The mean age of the patients was 49.66 ± 12.66 years (range 19-75 years) and the mean follow-up time was 8.7 ± 3.4 mo (range 4-16 mo). No significant differences were found between the two groups in terms of age, sex, BMI, onset position, or stone size ($P > 0.05$).

As shown in Table 2, significant differences between the RIRS and mini-PCNL groups were found in the duration of hospital stay (9.39 ± 4.01 *vs* 14.08 ± 5.26, $P < 0.0001$) and hospitalization costs (2624.5 ± 513.36 *vs* 3255.2 ± 976.5, $P < 0.0001$). The mean operative time was not significantly different between the RIRS group (56.48 ± 24.77) and the mini-PCNL group (60.04 ± 30.38, $P = 0.345$). The stone-free rates at the first postoperative day (RIRS *vs* mini-PCNL: 90.2% *vs* 93.2%, $P = 0.822$) and the second postoperative month (RIRS *vs* mini-PCNL: 93.8% *vs* 95.1%, $P = 0.986$) were not significantly different between the two groups. The complications and Hb levels were not different between the two groups ($P > 0.05$).

DISCUSSION

Urinary stones are a common condition in the Chinese population. PCNL is recommended as the first line of therapy for treating large kidney stones by the EAU[11]. Some studies of LP renal stones showed that there was a high success rate and a low complication rate for all stone sizes using PCNL[10,12]. PCNL has the advantage of a high stone-clearance rate[13]. Despite advances in technology, PCNL was an invasive surgery with the potential to cause many serious complications[14]. Although doctors have compared either PCNL or RIRS to shock wave lithotripsy to determine which is more suitable for patients with a diameter less than 2 cm, there are still relatively few studies comparing the results of mini-PCNL and RIRS in the treatment of LP renal stones[9]. In this study, we evaluated two of these treatment modalities in the management of LP renal stones. Such management option remains very controversial.

RIRS is considered an acceptable treatment for LP calculi but not a first-line treatment for calculi of 1.0-2.0 cm in diameter. Since the adoption of RIRS in the urological field, its success rate has been studied by many urologists. Grasso reported that[15] they treated LP renal calculi by retrograde ureteroscopy and the stone free rate was 82% for patients with stones 0.1-1.0 cm, 71% for patients with stones 1.1-2.0 cm, and 65% for patients with stones > 2.0 cm. Bozkurt *et al*[16] showed that the stone-free rate was 94.6% in patients who were treated (diameter 1.5-2.0 cm) using RIRS. In our study, the results suggested that both techniques were safe and equally effective, with stone-free rates following a single session at a 1-d follow-up being 93.2% in the mini-

Table 2 Intraoperative and postoperative parameters and surgical complications in study groups

Variable	RIRS group	Mini-PCNL group	*P* value
Operative time (min)	56.48 ± 24.77	60.04 ± 30.38	0.345
Stone-free rate (postoperative 1 d) (%)	102/113 (90.2)	96/103 (93.2)	0.822
Stone-free rate (postoperative 2 mo) (%)	106/113 (93.8)	98/103 (95.1)	0.986
Hospital stay (d)	9.39 ± 4.01	14.08 ± 5.26	< 0.0001
No. of Clavien complications			0.643
Grade 0	89	76	
Grade Ⅰ	18	19	
Grade Ⅱ	6	7	
Grade Ⅲ	0	1	
Grade Ⅳ/Ⅴ	0	0	
Preoperative Hb (g/dL)	137.12 ± 15.57	140.15 ± 16.04	0.161
Postoperative Hb (g/dL)	128.05 ± 16.87	125.34 ± 16.68	0.237
Hospitalization costs ($)	2624.5 ± 513.36	3255.2 ± 976.5	< 0.0001

Data are presented as mean ± SD. The *P*-value was adjusted by gender and BMI. Grade 0: No complication; Grade Ⅰ: Any deviation from the normal postoperative course without the need for pharmacologic treatment or surgical, endoscopic and radiographic interventions, and acceptable therapeutic regimens are drugs such as antiemetics, antipyretics, analgetics, diuretics and electrolytes and physiotherapy; Grade Ⅱ: Requiring pharmacologic treatment with drugs other than those allowed for grade Ⅰ complications, blood transfusions and total parenteral nutrition are also included; Grade Ⅲ: Requiring surgical, endoscopic, or radiographic intervention; Grade Ⅳ: Life-threatening complication requiring IC/ICU management; Grade Ⅴ: Death of a patient due to a complication. PCNL: Percutaneous nephrolithotomy; RIRS: Retrograde intrarenal surgery.

PCNL group and 90.2% in the RIRS group. Two months after the operation, the results showed that the efficacy of both techniques was similar. In the near future, with the improvement of lasers and the combination of less invasive anterograde-retrograde techniques, the residual rate will be further reduced. In this study, the hospitalization stay was longer for patients in the mini-PCNL group than in the RIRS group. This apparent delay may be attributed mainly to the nephrostomy tube placement for drainage. RIRS is typically an outpatient procedure. Our results showed that RIRS had a clear advantage in postoperative hospital stay compared with mini-PCNL. Patient recovery tends to be faster with RIRS, which was also supported by the studies of Bai *et al*[17] and Alazaby *et al*[18] The hospitalization cost was an important issue when comparing the different treatment modalities. RIRS surgery at our institution costs $2624 compared to $3255 for mini-PCNL technique, which translates into a savings of $631 per case. Pan *et al*[19] reported that the hospitalization cost of RIRS were much lower than that of mini-PCNL and suggested that RIRS was also a safe and reliable choice for patients with single renal stones 2.0-3.0 cm in diameter. Our study added another argument for making RIRS the optimal choice in an increasing number of stone cases. Our results showed that RIRS was an effective treatment option for LP calculi with a diameter of 1.5-2.5 cm.

This study has some limitations. First, X-rays and ultrasound were used to determine stone-free rates in the postoperative period although CT is a more specific and sensitive procedure. Second, the sample size was comparatively small. Third, there were potential differences in the preparation and management protocols of the patients in this retrospective study. Prospective studies controlling for such variables with large samples will allow a more robust evaluation of these phenomena.

In conclusion, out results suggest that both RIRS and mini-PCNL are safe and effective methods for treating LP stones with a diameter of 1.5-2.5 cm. RIRS can be considered as an alternative to PCNL for the treatment of LP stones of 1.5-2.5 cm.

ARTICLE HIGHLIGHTS

Research background

Retrograde intrarenal surgery (RIRS) is rapidly becoming an effective and safe treatment modality in the surgical treatment of urinary system stone disease.

Research motivation

The two surgical procedures have different advantages associated with the treatment of stones of different sizes affecting the urinary system. However, few studies have compared the results of miniaturized percutaneous nephrolithotomy (mini-PCNL) to RIRS for the treatment of lower pole stones (LP stones) with a 1.5-2.5 cm diameter.

Research objectives

This retrospective study aimed to compare the outcomes of RIRS and mini-PCNL in treating LP renal stones with a diameter of 1.5-2.5 cm.

Research methods

In this study, we reviewed retrospectively 216 patients who underwent mini-PCNL (n = 103) or RIRS (n = 113) for LP stones with a 1.5-2.5 cm diameter between December 2015 and April 2017. Specifically, we compared the operation time, stone-free rate, complications, hospital stay, and hospitalization costs in patients treated by these two minimally invasive methods.

Research results

Significant differences were found in the hospital stay (9.39 ± 4.01 *vs* 14.08 ± 5.26, P < 0.0001) and hospitalization costs (2624.5 ± 513.36 *vs* 3255.2 ± 976.5, P < 0.0001) between the RIRS and mini-PCNL groups. The mean operative time was not significantly different between the RIRS group (56.48 ± 24.77) and the mini-PCNL group (60.04 ± 30.38, P = 0.345). The stone-free rates at the first postoperative day (RIRS *vs* mini-PCNL: 90.2% *vs* 93.2%, P = 0.822) and the second month postoperatively (RIRS *vs* mini-PCNL: 93.8% *vs* 95.1%, P = 0.986) were not significantly different.

Research conclusions

Our results showed that both RIRS and mini-PCNL are safe and effective methods for treating LP stones with a diameter of 1.5-2.5 cm. RIRS can be considered as an alternative to PCNL for the treatment of LP stones of 1.5-2.5

cm. RIRS can be considered as an alternative to PCNL for the treatment of LP stones of 1.5-2.5 cm. Our study added another argument for making RIRS the optimal choice in an increasing number of stone cases.

Research perspectives

First, we used X-rays and ultrasound to determine stone-free rates in the postoperative period although CT is a more specific and sensitive procedure. Second, the sample size was comparatively small. Third, there were potential differences in the preparation and management protocols of the patients in this retrospective study. Prospective studies controlling for such variables with large samples will allow a more robust evaluation of these phenomena. RIRS can be considered as an alternative to PCNL for the treatment of LP stones of 1.5-2.5 cm. Future studies with larger sample sizes are required to replicate and extend these findings.

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