



Retrograde intra-renal surgery (RIRS) A minimally invasive technology, gaining progressive popularity in Renal Stone Management

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Abstract

Retrograde intra-renal surgery (RIRS) has become an effective and safe treatment modality in the management of renal stone diseases. In 1987, Bagley first introduced RIRS and reported the results of a flexible RIRS procedure¹.

Recent developments and innovations in the flexible ureterorenoscope and auxiliary equipment have made this procedure easier and more effective with increased success rates. RIRS can be used as a primary treatment in patients with renal stones around 2 cm, prior unsuccessful shock wave lithotripsy, infundibular stenosis, renoureteral malformation, skeletal-muscular deformity, bleeding diathesis and obese patients.

Training for RIRS, fluoroscopy use, the concurrent or simultaneous use of RIRS in the treatment of various modalities like ESWL (Extracorporeal shock wave lithotripsy), PCNL (Percutaneous nephrolithotomy) etc. may be needed².

Preoperative assessment, possible stone free rate, the cost of this modality with probable auxiliary procedure need to be discussed with the patient and relatives are extremely important prior the procedure.

Keywords: RIRS, Minimally invasive technology, Renal Stone Management

Introduction

Stone formation is highly prevalent, with rates of up to 14.8% and it is increasing, and a recurrence rate of up to 50% within the first 5 years of the initial stone episode. Management of symptomatic kidney stones has evolved from open surgical lithotomy to minimally invasive endourological treatments leading to a reduction in patient morbidity, improved stone clearance rates and better quality of life. Prevention of recurrence requires behavioral and nutritional interventions, as well as pharmacological treatments that are specific for the type of stone³.

With the aid of the recent technological developments; there have been rapid increasing options in the management of renal urolithiasis. Minimally invasive

surgery such as ESWL, PCNL, RIRS and laparoscopic surgeries are commonly used for the treatment of kidney stones. The most important one of the various clinical parameters that can affect the success of stone removal is the stone size. Although ESWL and PCNL are mentioned in the guidelines as gold standard for the management of kidney stones, RIRS is accepted as another treatment modality in the European Association of Urology (EAU) guidelines.

The more commonly use of RIRS depends on not only the digital improvements in flexible Ureteroscopy (fURS) technology, but also the developments in deflection mechanism, mobility, ergonomics and durability. Meantime, with the addition of the developments in auxiliary devices and increase in

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surgical experience and compliance higher success rates have been achieved with RIRS in the management of renal stones. Today, reaching the stone via a natural route and achieving a high success rate with a lower morbidity have led RIRS to be popular day by day. The advantage of flexible ureteroscope over semirigid is the ability to inspect all renal collecting system and to diagnose and manage stones and even urothelial malignancies³.

Discussion

There are small number of studies that shows the learning curve for RIRS. Cho et al⁴.] A retrospective Study revealed; 100 patients with midium sized stone were underwent RIRS for single session. They identified the learning curve by using cumulative sum analysis for monitoring change in fragmentation efficacy. The study revealed that 56 cases were required for reaching a plateau in the learning curve, and the acceptable level of fragmentation was 25 mL/min.

Stone multiplicity and localization were found to be significant predictors for Stone free rate in RIRS.

Fluoroscopic imaging plays an important role in endourology. It is generally used for insertion of guidewire, retrograde contrast study, Double-J (DJ) stenting, stone localization, review of renal anatomy, ureteral balloon dilatation, orientation of flexible scope etc. So for protection against the harmful effects of radiation, RIRS with the guidance of reduced fluoroscopy or even without any fluoroscopy can be performed easily and efficiently by experienced surgeons.

Peng et al⁵. evaluated the fluoroscopy-free RIRS in 144 patients with a mean stone dimension of 1.4±0.4 cm. They required fluoroscopy in only 1 patient who had a duplicated collecting system. Stone-free status was achieved in 134 patients (95.7%) without any major complications. But minor complication rate was 3.6%.

Kýrac et al⁶. Performed RIRS in 76 patients with a stone dimension of 14.1±4.1 mm, in which single-shot fluoroscopy was used for only during insertion of guidewire. Additional fluoroscopy use was required in only 4 patients (5.2%) for localization of stone in 2 patients and identification of collecting system anatomy in 2 patients with a history of prior operation. They reported a SFR (Stone free rate) of 82.9%, no major complication, minor complication rate is of 6.6%.

Preoperative assessment of stone

Jung et al⁷. Developed scoring system for RIRS called the Modified Seul National University Renal Stone Complexity (S-ReSC) scoring system. The anatomical sites are classified into 9 subgroups, such as the renal pelvis (#1), superior and inferior major calyceal groups (#2-3), and anterior and posterior minor calyceal groups of the superior (#4-5), middle (#6-7), and inferior calyces (#8-9). If the stone is located in the inferior calyceal area (#3, #8-9), one additional point per site is added to the original score. The modified S-ReSC score, which differs between 1-12, is classified into low (1-2 points), intermediate (3-4) or high (>4) groups, where SFRs are 94.2, 84 and 45.5% for these groups respectively. The advantage of this scoring system is that it was externally validated for the first time and its predictive accuracy was shown to be better than that of other system.

Park et al⁸. Performed its external validation, and found SFRs as 86.7, 70.2 and 48.6% for low (1-2), intermediate (3-4) and high (5-12) score groups respectively. Both scoring systems have been helpful for separating patients into outcome groups and for determining treatment plans.

The Current Role of RIRS in the Treatment of Urolithiasis

In various studies, it has been emphasized that RIRS is an effective and reliable method in the treatment of kidney stones. The success rates of RIRS range between 65% and 92%.

Renal stones less than 2 cm

With the technological improvements, RIRS has become a routine option in the treatment of stones <2 cm. European Association of Urology (EAU) Guidelines also recommends RIRS, fURS and SWL are regarded as the first line treatment options, especially for the stones with a diameter of 11-20 mm. In 1990s, successful results have been published for fURS in the treatment of urolithiasis from centers with high case loads. Grasso and Ficazzola⁹ Reported a SFR of 94% and 95% for stones of d-10 mm and 11-20 mm, respectively.

In the studies comparing fURS with SWL and/or PCNL, it has been reported that fURS had a higher success rate than SWL, and a comparable success rate with lower morbidity when compared to PCNL (or MicroPerc)¹⁰. As the time passes, fURS will probably take the place of SWL in symptomatic stones of <2 cm.

Renal stones larger than 2 cm

Recent guidelines recommend PCNL as the first-line treatment for stones >2 cm. Although the success rates in PCNL can be as high as 95%, it has some major complications and disadvantages such as urinary extravasation (7.2%), hemorrhage requiring blood transfusion (11.2%–17.5%), postoperative fever (21%–32.1%), septicemia (0.3%–4.7%), colon injury (0.2%–0.8%), pleural injury (0%–3.1%), and prolonged hospitalization and convalescence for management of complications. For this reason, alternative options with less morbidity are more advantageous especially for patients with high risk is RIRS, may be staged.

In a matched-pair analysis, Akman et al¹¹. Evaluated fURS and PCNL groups, each including 34 patients. After first procedure, SFR was found 91.2% for PCNL and 73.5% for fURS with a significant difference in PCNL. However, this significant difference disappeared after the second fURS where SFR rose to 88.2% in fURS group. While PCNL was superior for operation time, fURS was superior regarding hospitalization time and low complication. Two patients in PCNL group needed blood transfusion, but no patient of RIRS group need blood transfusion.

Requirement of more than one session to achieve successful results for big kidney stones with fURS is the main concern; but this issue can be tolerated with lower complication rates and by this way, fURS can be a good and valuable alternative to PCNL especially for patients with high risk.

Contraindications for PCNL and SWL

Due to risk of severe hemorrhage. The efficiency and reliability of fURS with holmium:YAG laser have been showed in these patients. In a matched-cohort study of RIRS that compared 37 patients using anticoagulant treatment with normal patients, no difference was found for SFR, and intraoperative and postoperative complication rates.^{12 13}

RIRS for lower pole stones

Anatomical factors that affect the failure to access lower pole in fURS were evaluated. Although acute IPA (Infundibulo-pelvic angla) <30° and length of infundibulum >3 cm were found to be associated with lower SFRs, while width of infundibulum had no effect. Increase in deflection with technological developments and improvements in surgical technique have led flexible ureteroscopes to reach lower pole more easily.

Repositioning lower pole stones with tipless nitinol baskets to other calyces that are accessed easily has increased the treatment success of fURS in the management of lower pole stones. Chuster et al. published that SFR has increased for lower pole stones after repositioning when compared to in situ lithotripsy, in which the difference was more pronounced for stones of >1 cm (100% for repositioning vs. 29% for in situ). With improvements in surgical technique, similar SFRs both for repositioned and non-repositioned stones was published¹⁴.

RIRS in multiple unilateral stones

Multiple unilateral stones are seen 20%–25% of the urolithiasis patients. Alkan et al¹⁵. Published their results for 173 stones in 48 patients with multiple unilateral stones. RIRS was performed as a primary procedure in 81.2%, after SWL in 14.6% and after PCNL in 4.2% of the patients. SFRs in patients with a stone ≥2 cm (23 patients) and >2 cm (25 patients) were 100% and 84%, respectively. Residual stones e"4 mm were seen in 4 patients of whom all had a initial single stone of >2 cm.

RIRS for simultaneous bilateral stones

Bilateral kidney stones are detected in 20%–25% of urolithiasis patients. Alkan et al¹⁶. Treated simultaneously 201 bilateral stones in 44 patients, and found an overall SFR of 88.6%. When the patients grouped according to stone burden, SFR was 100% and 80% for stones smaller and larger than 25 mm, respectively. They concluded that a simultaneous bilateral approach had advantages of decrease in total procedure time, number of anesthesia and recovery time, while risk of bilateral ureteral injury was the probable disadvantage.

In a matched-pair analysis of 59 patients with simultaneous bilateral RIRS and 59 patients with unilateral RIRS, no significant difference was observed in SFRs (84.7% vs. 91.5%, respectively) and overall complication rates. The authors concluded that bilateral RIRS was as efficient and reliable as unilateral RIRS.

Simultaneous bilateral RIRS is an efficient and reliable treatment option in selected patients. Stone burden should be taken into consideration when estimating the SFR, and if not both at least one side should be stented after the operation.

Combined Treatment Methods

Use of RIRS with PCNL or SWL at the same session has been a new treatment modality recently. This combination has been developed to reduce access tract numbers and complications in the management of complex renal stones.

Hamamoto et al¹⁷. Compared the results of combined RIRS and mini-PCNL with those of only mini-PCNL and standard PCNL in the treatment of patients with high stone burden. All procedures were performed in prone position; and decreased operation time, increased SFR, and a slight decrease in hemoglobin were observed in the combined therapy group.

In another study comparing standard PCNL in supine position with combination of supine PCNL and RIRS, no difference was observed for complication rate and hospitalization duration, while success rate was higher in the combination group¹⁸.

Conclusion :

RIRS has gained an increasing popularity and in parallel to this, our knowledge and experience have increased. This treatment modality is an efficient and reliable method with lower complication, and higher success rates. Intrarenal access via a natural route without penetrating the parenchyma is its major feature. The length of this route as well as the delicacy and cost of the equipment are the major issues that should be overcome.

In the light of recent data, RIRS seems to be an ideal treatment modality in the management of patients with stones smaller than 2 cm, serious comorbidities, renal anomalies and bleeding disorders. High success rates can be achieved by only repeating sessions or combined treatments in patients with high stone volume. If the problematic issues can be overcome with the ongoing technological developments, RIRS has a potential to be the first-line treatment option in the management of kidney stones.

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