







Review

International Alliance of Urolithiasis guideline on retrograde intrarenal surgery

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Objectives

To set out the second in a series of guidelines on the treatment of urolithiasis by the International Alliance of Urolithiasis that concerns retrograde intrarenal surgery (RIRS), with the aim of providing a clinical framework for urologists performing RIRS.

Materials and Methods

After a comprehensive search of RIRS-related literature published between 1 January 1964 and 1 October 2021 from the PubMed database, systematic review and assessment were performed to inform a series of recommendations, which were graded using modified GRADE methodology. Additionally, quality of evidence was classified using a modification of the Oxford Centre for Evidence-Based Medicine Levels of Evidence system. Finally, related comments were provided.

Results

A total of 36 recommendations were developed and graded that covered the following topics: indications and contraindications; preoperative imaging; preoperative ureteric stenting; preoperative medications; peri-operative antibiotics; management of antithrombotic therapy; anaesthesia; patient positioning; equipment; lithotripsy; exit strategy; and complications.

Conclusion

The series of recommendations regarding RIRS, along with the related commentary and supporting documentation, offered here should help provide safe and effective performance of RIRS.

Keywords

guideline, urolithiasis, treatment, retrograde intrarenal surgery, RIRS, flexible ureteroscopy, #KidneyStones, #UroStone, #EndoUrology

Introduction

Urolithiasis is one of the most common benign urological conditions, and as such, guidelines regarding surgical treatment are advisable in order to promote evidence-based treatment decisions and reduce variability in practice. A number of international associations, including the AUA, the European Urological Association and the Chinese Urological Association and others, have proposed guidelines on urolithiasis [1,2], but their focus is primarily on providing an overview of the principles of stone management based on outcomes reported in the literature and expert opinion, rather than on the technical details of the procedure.

Retrograde intrarenal surgery (RIRS) is a long-established treatment method for the management of upper urinary tract stones [3]. However, complications and non-standard application hinder the widespread application of this technique. With the aim of rendering RIRS a safe and efficient treatment method, and therefore more widely utilized, evidence-based step-by-step procedure guidelines are urgently needed in clinical practice. The International Alliance of Urolithiasis (IAU) has undertaken to develop a series of urolithiasis management guidelines, primarily involving surgical management. The first IAU series guideline, on percutaneous nephrolithotomy (PCNL), has been published [4], and the present guideline on RIRS is the second in this series. The aim of this guideline was to provide a clinical framework for surgeons performing RIRS, including peri-operative evaluation, intra-operative procedural recommendations and follow-up strategies.

The IAU Guideline Panel on RIRS comprises a group of international experts in stone disease, with particular expertise in RIRS. No members of this panel declared a conflict of interest with regard to these recommendations. The panel and the released guidelines will be updated every 2 years in future.

Methods

Data Identification

For the IAU guideline on RIRS, all recommendations were developed after systematic review and assessment of the literature. A comprehensive literature search for studies covering all aspects of RIRS and published between 1 January 1964 and 1 October 2021 was performed using the PubMed database. Key terms included ‘retrograde intrarenal surgery’, ‘RIRS’, ‘flexible ureteroscopy’, ‘fURS’ and ‘ureteroscopy’.

Grading of Recommendations and Level of Evidence

A modified GRADE (Grading of Recommendations, Assessment, Development and Evaluations) methodology was used to grade the recommendations (GR) [5]. According to this system, the body of evidence was assigned a rating of A (high-quality evidence; high certainty), B (moderate-quality evidence; moderate certainty), or C (low-quality evidence; low certainty) according to the evidence that was reviewed.

The level of evidence (LE) was graded using a classification system modified from the Oxford Centre for Evidence-Based Medicine Levels of Evidence system [6]. Level 1 was the highest and Level 5 the lowest, with these levels assigned according to the details and homogeneity of the studies.

Guideline

Indications

- Intrarenal or proximal ureteric stones less than 20 mm in diameter (LE:1, GR:A).
- Intrarenal or proximal ureteric stones larger than 20 mm when PCNL is ill-advised or contraindicated (LE:2, GR:B).

Retrograde intrarenal surgery and shock wave lithotripsy are both regarded as first-line treatment options for intrarenal or proximal ureteric stones <20 mm [1,2,7–11]. However, RIRS is associated with a higher single-procedure success rate and a lower re-treatment rate compared to shock wave lithotripsy [8–11].

Lower pole stones can be challenging for RIRS in the case of narrow lower pole infundibular, acute infundibulopelvic angle or other associated renal anatomical abnormalities [8–11].

Retrograde intrarenal surgery is usually considered to be part of endoscopic combined intrarenal surgery (ECIRS) for complex stones larger than 2 cm when PCNL monotherapy is not feasible [12]. RIRS monotherapy may require staged procedures to treat large stone burdens [13–16].

Contraindications

- Acute symptomatic UTI (LE:1, GR:A).
- Patient unfit for general or regional anaesthesia (LE:4, GR:A).

For patients with acute symptomatic bacteriuria, if fever or septic shock is noted, with the exception of antibiotic treatment, a nephrostomy tube or JJ stent are required for a

period of drainage before lithotripsy, otherwise RIRS in patients with acute symptomatic bacteriuria might bring about life-threatening sequelae, such as urosepsis [17–19].

General or regional anaesthesia is generally required for RIRS [20,21]; therefore, RIRS should not be administered in patients with anaesthetic contraindications.

Preoperative Stenting

- Routine ureteric stenting prior to RIRS is not recommended (LE:1, GR:A).
- In case of failed access to the upper urinary tract during RIRS, placement of a stent is advisable to allow passive ureteric dilatation and subsequent attempt at second RIRS (LE:1, GR:A).

Although there is little evidence that preoperative stenting improves stone-free rates (SFRs), several studies have shown that preoperative stenting for a duration of 1–2 weeks may allow passive dilatation of the ureter, increasing the success of ureteric access sheath (UAS) placement and reducing the risk of high-grade ureteric injuries [22–31]. Additionally, preoperative stenting may be necessary to drain an obstructed and/or infected renal unit prior to RIRS [32]. However, routine ureteric stenting in all patients prior to RIRS is not recommended because of the additional cost and risk of a second anaesthetic procedure, additional radiation exposure and side effects from prolonged stenting [32].

Preoperative Imaging

- Low-dose non-contrast CT (NCCT) is recommended prior to RIRS in cases where other radiological evaluation means (plain abdominal film of kidney, ureter and bladder [KUB] and sonography) fail to give adequate information (LE:3, GR:B).
- Contrast-enhanced CT and intravenous urography with excretory phases is recommended when renal pelvic-calyceal anatomy requires a detailed assessment (LE:3, GR:C).

Low-dose NCCT is the most sensitive imaging method to diagnose the urinary calculi, with decreased radiation exposure [33–39]. It allows accurate determination of stone size and volume, stone multiplicity, stone density and state of the renal parenchyma since other means of radiological evaluation (KUB and sonography) fail to give adequate information on these variables. Contrast-enhanced CT and intravenous urography with excretory phases is recommended when the renal pelvic-calyceal anatomy, especially the renal collecting system anatomy, requires detailed assessment. For example, they can be used to assess infundibulopelvic angle, infundibular width and infundibular length, which are important risk factors used to predict SFR after RIRS [40,41]. Three-dimensional helical CT is sometimes required for complicated cases [42].

Preoperative Medications

Use of α -Blockers

- The short-term administration of oral alpha blockers may be considered prior to RIRS (LE:2, GR:A).

Limited evidence suggests that 3–7 days of preoperative oral α -blockers may facilitate successful UAS insertion in patients without pre-stenting and protect against potential ureteric wall injury during UAS insertion [43–46].

Antibiotics

- Urine analysis and urine culture should be performed prior to RIRS (LE:1, GR:A).
- In patients with a positive preoperative midstream urine culture, antibiotic treatment should be administered according to culture antibiogram test findings (LE:1, GR:A).
- In patients with a negative midstream urine culture, a single dose of antibiotic prophylaxis according to the prevalent local antibiotic resistance patterns should be administered before RIRS (LE:1, GR:A).

Currently, despite universal consensus on the utilization of antibiotic prophylaxis and treatment of UTI before RIRS as presented in the above statements [47–49], the optimal type and duration of pre-procedure antibiotic administration remains uncertain due to lack of high-level evidence. Furthermore, there is ongoing controversy regarding positive urine analysis for leukocytes and/or nitrites, asymptomatic and symptomatic bacteriuria. Although a positive urine analysis for leukocytes and/or nitrites is considered an independent risk factor for postoperative urosepsis [50], well-designed multicentre randomized controlled trials (RCTs) are required to evaluate outcomes of preoperative antibiotic administration in patients with negative midstream urine culture but positive urine analysis for leukocytes and/or nitrites. For patients with asymptomatic bacteriuria, adequate antibiotics are required to control the UTI prior to RIRS. However, for patients with acute symptomatic bacteriuria, if fever or even septic shock is noted, nephrostomy tube or JJ stent are required for a period of drainage before lithotripsy.

Management of Antithrombotic Therapy

- Cessation of antithrombotic therapy is not mandatory in patients undergoing RIRS (LE:3, GR:B).

Retrograde intrarenal surgery is categorized as a procedure with low bleeding risk, it is a safe and efficient modality for patients on anticoagulation or antiplatelet therapy [51], and discontinuation of antithrombotic therapy is not required prior to RIRS. However, some studies have suggested that antithrombotic therapy may increase the risk of procedure-

related bleeding [52], especially anticoagulation therapy (e.g., warfarin, direct oral anticoagulants, subcutaneous low-molecular-weight heparin), while antiplatelet therapy (e.g., aspirin, clopidogrel) does not [53,54]. Therefore, there should be sufficient communication among surgeons, anaesthesiologists, physicians and patients prior to surgery, and patients on antithrombotic therapy should undergo RIRS by experienced surgeons.

Anaesthesia

- Both general anaesthesia and regional anaesthesia are acceptable anaesthetic techniques for RIRS (LE:3, GR:A).
- Regional anaesthesia may be an alternative to general anaesthesia, and patients may benefit from regional anaesthesia in terms of less postoperative pain and economic factors (LE:3, GR:B).

For RIRS, both general and regional anaesthesia are well accepted anaesthetic modalities [55–57]. Patients may benefit from regional anaesthesia in terms of less postoperative pain and economic factors [55,56], while general anaesthesia may provide better intra-operative anaesthetic management and patient experience. General anaesthesia is preferred as it allows respiration to be controlled if position holding in holmium:YAG (Ho:YAG) laser lithotripsy for RIRS or puncture for ECIRS is needed [58]. Nevertheless, large-sample, multicentre RCTs with strict standards should be performed to confirm these findings.

Intra-operative Positioning

- Standard lithotomy position is the most commonly used position for RIRS (LE:5, GR:A).

Besides the standard lithotomy position, other positions, such as the T-tilt position, are also available for RIRS in special cases [59]. In cases of ECIRS, RIRS may be performed in the supine (supine or Galdakao-modified supine Valdivia position) or prone split-leg position [60,61]. Both prone split-leg position and supine positions are equally feasible in ECIRS, and are associated with similar SFRs [62].

Guidewire Placement

- Placement of a safety guidewire as the first step in RIRS is recommended for the majority of ureteroscopic procedures (LE:3, GR:B).

Although some studies have demonstrated that placement of a safety guidewire may be omitted during RIRS, particularly when treating stones in the kidney [63–65], it is still generally recommended for the treatment of upper ureteric stones and/or if fragments will be manually extracted. The safety guidewire can facilitate rapid and easy stent placement in case of bleeding or ureteric injury. Retrograde urogram prior to

guidewire placement would facilitate good understanding of the renal collecting system anatomy and location of the guidewire.

Ureteric Access Sheath Insertion

- Placement of a UAS may facilitate RIRS, but there is no consistent evidence that it improves SFRs or reduces complication rates (LE:1, GR:A).

Ureteric access sheath placement may facilitate quick and multiple access to the renal collecting system and rapid extraction of stone fragments with basketing during RIRS. UAS placement could also provide a continuous outflow of irrigation and might reduce intrarenal pressure and infectious complications [66,67]. However, studies have demonstrated that use of a UAS has no prominent impact on SFR or operation duration [68,69], but does bring an increased risk of ureteric injury [70,71]. Therefore, the placement of a UAS in RIRS may be considered a ‘double-edged sword’ and should be carefully decided on in each case, taking into consideration its advantages and disadvantages, and surgeon’s preference.

Although the insertion of a UAS without use of X-ray is feasible in uncomplicated cases [72], this should be performed routinely under fluoroscopic control because of the risk of ureteric injury [73]. Ureteric balloon dilatation prior to UAS insertion should not be routine, however, it can be considered in cases of difficult access to the ureter [74]. Pre-stenting is believed to passively dilate the ureter, to facilitate subsequent UAS insertion, and to reduce the risk of ureteric injury [22,25]. However, pre-stenting brings additional cost, radiation exposure and side effects from prolonged stenting [32].

Irrigation

- Normal saline is the standard irrigation solution for RIRS (LE:3, GR:A).
- Manual hand and automated irrigation methods provide similar operation times, SFRs and complication rates (LE:2, GR:B).

Although some studies demonstrated that irrigation with sterile water during endourological procedures can improve endoscopic vision [75–77], normal saline remains the preferred standard irrigation fluid as use of a non-isotonic solution increases the risk of haemolysis, hyponatraemia, and heart failure if sufficient volume is absorbed [78,79].

Manual hand pumps, automated irrigation pumps and gravity-based irrigation are the options available to provide variable pressure irrigation during RIRS. Although the manual hand pump method has the advantages of easy control of irrigation flow and pressure, the pressure might

still reach high levels if not well managed. Automated irrigation pumps provide a more consistent flow, however, a high continuous flow may cause high pressure, resulting in pyelovenous backflow [80].

Comparisons of operation time, SFR, complications and volume of irrigation fluid used in RIRS with a manual hand pump versus an automated irrigation pump are not well clarified [81,82]. Further studies are needed to evaluate the irrigation flow, intrarenal pressure and effect on post-procedure patient outcomes associated with using different irrigation methods.

Flexible Ureterorenoscopy

Single-Use Flexible Ureterorenoscopes vs Reusable Flexible Ureterorenoscopes

- Single-use flexible ureterorenoscopes (su-fURS) are comparable to reusable flexible ureterorenoscopes (re-fURS) with regard to clinical effectiveness (LE:2, GR:A).
- The durability and surgical outcomes of fibre-optic and digital flexible ureterorenoscopes (fURS) are comparable, while fibre-optic fURS usually have better end-tip deflection and smaller calibre (LE:2, GR:B).

Single-use flexible ureterorenoscopes overcome the main limitations of high initial acquisition and ongoing maintenance costs associated with re-fURS [83–86]. Furthermore, su-fURS are well suited to anatomically complex and challenging cases, such as large stones (>2 cm), lower pole stone with steep infundibulopelvic angle, urinary diversion or unusual renal anatomy, due to the risk of inadvertent damage to the fURS [87–90]. The use of su-fURS may be more cost-effective in low-volume centres and in teaching hospitals with residents [89,90]. These ureterorenoscopes are suitable for immunocompromised patients or patients with multidrug-resistant bacterial infection to avoid the risk of cross-infection [86–90]. However, regard should also be paid to the carbon emissions and environmental pollution associated with the use of su-fURS versus re-fURS; the recycling is required [91,92].

There is no difference in surgical outcomes between the use of su-fURS and re-fURS [93–96]. However, the manoeuvrability of su-fURS may be inferior to that of re-fURS, and fibre-optic fURS usually have better end-tip deflection and smaller calibre than digital fURS [94].

Working Channel (Single Channel vs Dual Channels)

- Ureterorenoscopes with dual working channels may provide superior irrigation flow and visibility compared to single-channel ureterorenoscopes (LE:3, GR:2).

The dual-channel fURS provides similar deflection to the single-channel fURS, but with more room in the working channel. Consequently, these ureterorenoscopes have better flow and visibility, particularly when employing instruments in the working channel. However, the large diameter of dual-channel fURS necessitates a larger-calibre UAS if an access sheath is desired, which potentially may result in strain-induced ureteric injuries [97–99].

Miniaturization of the Flexible Ureterorenoscope

- Miniaturization of the fURS will facilitate insertion of the ureterorenoscope and promote lower intrarenal pressure and improved visibility due to enhanced irrigation flow (LE:2, GR:1).

Miniaturizing ureterorenoscope size could facilitate insertion into a small-calibre UAS, thereby reducing the risk of ureteric injury from an oversized UAS, especially in the case of a narrowed/tight ureter which cannot be accessed with a large-calibre UAS [100]. Small-calibre ureterorenoscopes provide increased outflow, lower intrarenal pressure and improved visibility when compared to large-calibre ureterorenoscopes, with the premise of a UAS with the same calibre [101,102].

Robotic Ureterorenoscope

- Robot-assisted RIRS provides similar outcomes to classic RIRS (LE:2, GR:2).
- Robot-assisted RIRS reduces occupational radiation exposure, but with high acquisition and maintenance costs, as well as space requirements (LE:2, GR:2).

Preliminary evidence indicates that robot-assisted RIRS fails to offer any substantive advantage with regard to manoeuvrability and operation results when compared to conventional RIRS [103,104]. Although robot-assisted RIRS reduces occupational radiation exposure and manpower demand, the high acquisition and maintenance costs, as well as the space requirements within operating facilities, limit the widespread adoption of a robotic system for ureteroscopy [105,106].

Laser Lithotripsy

- Holmium:YAG laser is the conventional treatment modality for lithotripsy in RIRS, while the thulium fibre laser is a new, promising and viable alternative (LE:2, GR:B).

High-power Ho:YAG laser devices used in RIRS may be associated with shorter operation time and higher SFR when compared to lower-power Ho:YAG laser devices [107–110].

Holmium:YAG laser with lower frequency, higher energy and shorter pulse duration settings fragment stones, while the Ho:YAG laser uses higher frequency, lower energy and longer

pulse duration settings and has the ability to generate dusting [111,112]. The thulium fibre laser is a new modality for lithotripsy in RIRS and has been shown to be both effective and safe. The versatility of the thulium fibre laser, including high frequencies and reduced retropulsion, may result in higher ablation efficiency when compared to the Ho:YAG laser [113–117]. However, the thermal effect with both Ho:YAG and thulium fibre lasers at higher settings should be taken into consideration, especially in case of narrow room with inadequate irrigation, and a prolonged procedure. Further study is required to confirm these findings.

Stone Retrieval

- Both dusting and fragmentation with stone basketing are equivalent modalities in terms of stone clearance during RIRS (LE:2, GR:1)
- Suction UAS may reduce stone retropulsion, improve stone clearance, improve visibility and reduce intrarenal pressure (LE:3, GR:1)

As there is little evidence to support one stone management strategy over another (dusting or fragmentation) [118,119], individual decision making should be based on the stone characteristics and urologist preference. Dusting has been associated with shorter procedural duration, however, the number of stone-related adverse events may be higher because stone fragments are left for spontaneous passage after RIRS [120]. The active removal of stone fragments with a basketing or suction technique may provide a higher initial SFR, however, multicentre RCTs are lacking to support these observations [121–123].

Exit Strategy

- Removal of the UAS under direct vision as an exit strategy is recommended (LE:3, GR:A).

Removal of the UAS under direct vision as an exit strategy is imperative to detect inadvertent and unrecognized ureteric injury [124]. A JJ stent is usually placed to ensure adequate urine flow in the setting of ureteric injury and stone fragments [125]. The duration of postoperative stenting is contingent on the state of the ureter after the procedure, with longer stent duration for smaller-calibre ureters, greater ureteric oedema and ureteric injury [126,127]. However, JJ stenting may lead to LUTS in some patients [128].

The decision as to whether to leave a stent is therefore based on surgeon preference and patient factors. The JJ stent can be omitted in straightforward cases, or if the patient already has a stent *in situ* (following a previous primary treatment or stent insertion because of inability to access the upper tract adequately); this may have the benefit of avoiding the need for a postoperative stenting. A stent-on-string might alleviate the potential LUTS caused by conventional JJ stenting. Use of

α -blockers or anticholinergic agents are recommended to improve LUTS [129–131].

Postoperative Imaging and Stone-Free Status Evaluation

- Ultrasonography and KUB are adequate methods to identify evidence of residual stone fragments and dilatation suggestive of potential obstruction in follow-up (LE:3, GR:A).
- Stone-free rate should be evaluated 3 months after RIRS, and NCCT is the most accurate method for this (LE:1, GR:A).

Ultrasonography, KUB and NCCT are commonly used imaging methods to assess SFR. KUB and ultrasonography are adequate methods to identify evidence of residual stone fragments and dilatation suggestive of potential obstruction in follow-up [132], while NCCT is highly recommended in the determination of stone fragments less than 2 mm [133]. Low-radiation dose NCCT is adequate for non-obese patients (BMI <30 kg/m²), with a similar detection rate but lower expose dose when compared to NCCT.

Currently, stone-free status is poorly defined in the literature, and the optimal timing of SFR evaluation remains undetermined. Further controlled studies with large samples are needed to define acceptable residual fragment size, timing and imaging modality to evaluate stone-free status [134,135].

Complications

The modified Clavien–Dindo classification system has generally been used to evaluate the presence and severity of complications following RIRS [136–138]. Most complications associated with RIRS are mild, with Clavien–Dindo grades I to III comprising 67.7%, 22.7% and 7.2% of complications, respectively, and severe complications (grade IV) representing only 2.4% [139].

Bleeding

- Post-RIRS bleeding is generally self-limited, with severe bleeding complications being rare (LE:4, GR:A).
- Severe bleeding is generally attributable to renal collecting system perforation from instrumentation, directly or indirectly, and sudden decompression after increased intrarenal pressure (LE:4, GR:A).

The risk of vascular complications after RIRS is very low. Potential vascular injury during RIRS may be the direct result of perforation of the ureter or collecting system by instrumentation (e.g., UAS insertion, use of Ho:YAG laser lithotripsy, guidewires or catheters) or it may be associated with chronic kidney disease, anticoagulation therapy or

sudden decompression after high intrarenal pressure [136,137,140].

Ureteric perforation or avulsion have been reported most commonly during semi-rigid ureteroscopy [141], although serious bleeding following these events is rare. However, perforation of the renal collecting system due to forcible insertion of a UAS may cause severe bleeding. The use of Ho:YAG laser lithotripsy can also cause bleeding through inadvertent thermal injury of the pelvic/calycal mucosa, although this is generally self-limited. Temporarily capping the UAS may promote clot formation and facilitate bleeding cessation.

Perirenal haematomas, pseudoaneurysm formation or arteriovenous fistula have been reported following RIRS [142–145]. The risk increases in cases of UTI, intra-operative high intrarenal pressure and prolonged operation time. In these events, angiography and superselective embolization is recommended as the first choice and, rarely, nephrectomy may be required [142–145].

Infectious Complications

- Intrarenal pressure and operating time should be limited in RIRS (LE:3, GR:A).

Postoperative infection is the most frequently noted complication resulting from RIRS. Postoperative fever (4.9%), sepsis (0.5%) and septic shock (0.3%) are the most commonly noted clinical symptoms [146].

Positive mid-stream urine culture, infection stone, large stone burden, forced irrigation and prolonged operation duration are the main risk factors for post-RIRS infection [147–151]. Emphasizing the preoperative adequate antibiotic treatment in patients with symptomatic bacteriuria, and avoidance of routine prolonged postoperative antibiotic use since a single-dose prophylactic antibiotic is sufficient for patients without UTI. Common tips to prevent infectious complications include culture-specific antibiotic therapy for documented preoperative UTI, broad-spectrum antibiotic prophylaxis for culture-negative patients, ensuring good outflow during the procedure with an appropriately placed UAS, good irrigation management, minimizing intra-operative intrarenal pressure, avoiding prolonged operation time and leaving a Foley catheter in place [17,146,150]. Performance of RIRS using a suction device was reported to decrease intrarenal pressure and shorten operation time [122], and warrants further study as a measure to decrease the risk of postoperative infection.

Generally, postoperative fever due to UTI should resolve with culture-specific antibiotics, while urosepsis and septic shock require early and rapid identification so that the appropriate action can be taken. Q-SOFA scores (altered mental status

[Glasgow Coma Scale score <15], hypotension [systolic blood pressure <100 mmHg], high respiratory rate [$>22/\text{min}$]) can provide a quick and easy way to assess potential urosepsis. White blood cell counts $<3 \times 10^9/\text{L}$ can also be an indicator of impending sepsis [151,152]. Early appropriate antibiotic therapy, resuscitation support, transfusion or use of vasopressors, intubation or mechanical ventilation may be required to treat septic shock [153,154].

Ureteric Injury

- Pre-stenting may result in passive dilatation of the ureter and therefore decrease the risk of UAS insertion-related ureteric injury (LE:2, GR:A).

Ureteric injury following RIRS is thought to be under-reported because the ureter is not routinely inspected after removal of UAS [140,155]. The ureter should therefore be directly inspected routinely on removal of the ureterorenoscope and UAS following RIRS, and ureter wall injuries should be classified according to the Endoscopic Classification System [125,156]. Indeed, ureteric wall injuries are much more frequently noted with this approach, with an incidence rate of 30.4–46.5% [125,156].

Mild mucosal abrasion and superficial lesions do not require special measures other than 10–14 days of ureteric stenting. However, stent duration should be extended to up to 6 weeks for ureteric perforation [141,157]. Ureteric reconstruction is required in case of a complete ureteric avulsion [141,157].

Conclusion

The series of recommendations regarding RIRS along with the related commentary and supporting documentation provided here should help provide safe and effective performance of RIRS.

Disclosures of Interest

None declared.

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Abbreviations: ECIRS, endoscopic combined intrarenal surgery; Ho:YAG, holmium:YAG; IAU, International Alliance of Urolithiasis; KUB, plain abdominal film of kidney, ureter and bladder; NCCT, non-contrast CT; PCNL, percutaneous nephrolithotomy; RCT, randomized controlled trial; RIRS, retrograde intrarenal surgery; ru-fURS, reusable flexible ureterorenoscope; SFR, stone-free rate; su-fURS, single-use flexible ureterorenoscope; UAS, ureteric access sheath.