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International Alliance of Urolithiasis (IAU) Guideline on Retrograde Intrarenal Surgery

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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/bju.15836

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ABSTRACT

Objectives: The International Alliance of Urolithiasis (IAU) is releasing a series of guidelines on the treatment of urolithiasis. The current guideline is the second document regarding retrograde intrarenal surgery (RIRS), and it is aimed to provide a clinical framework for urologists performing RIRS.

Materials and methods: After a comprehensive search of RIRS-related literature published between 01/01/1964 and 1/10/2021 from the Pub Med database, a systematic review and assessment were performed to inform a series of recommendations, which were graded using a modified GRADE methodology. Furthermore, the quality of evidence was classified using a modification of the Oxford Centre for Evidence-Based Medicine Levels of Evidence. Finally, related comments was provided.

Results: A total of 36 recommendations were developed and graded that covered the following topics: indications and contraindications, preoperative imaging, preoperative ureteral stenting, preoperative medications, perioperative antibiotics and management of anti-thrombotic therapy, anesthesia, patient positioning, equipment, lithotripsy, exit strategy and complications.

Conclusion: A series of recommendations regarding RIRS along with related commentary and supporting documentation offered here should provide safe and effective performance of RIRS.

Keywords: guideline, urolithiasis, treatment, retrograde intrarenal surgery, RIRS, flexible ureteroscopy

1. INTRODUCTION

1.1 Aims and scope

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 American Urological Association(AUA), European Urological Association (EAU) and Chinese Urological Association (CUA) and others have proposed guidelines on urolithiasis[1-2], but their focus is primarily an overview of the principles of stone management based on outcomes from the literature and expert opinion, rather than on the technical details of the procedure.

Retrograde intrarenal surgery (RIRS) is a long-established treatment modality for the management of upper urinary tract stones [3]. However, complications and non-standard application hinder the wide application of this technique. With the aim of rendering RIRS a safe and efficient modality therefore more widespread 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 document, with the goal to provide a clinical framework for surgeons performing RIRS, including perioperative evaluation, intraoperative procedural recommendations and follow-up strategies.

1.2. IAU guideline panel on RIRS

The IAU Guideline panel on RIRS is comprised of 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 two years in future.

2. MATERIALS and METHODS

2.1 Data identification

For the IAU guideline on RIRS, all recommendations were developed following the systematic review and assessment of literature. The comprehensive literature search covering all aspects of RIRS was performed using the Pubmed database. The key terms included "retrograde intrarenal surgery", "RIRS", "flexible ureteroscopy","fURS" and "ureteroscopy". The publication date ranged from 01/01/1964 to 01/10/2021.

2.2 Grade of recommendations and level of evidence

A modified GRADE 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 [6]. Level 1 was the highest and level 5 the lowest assigned according to the details and homogeneity of the studies.

3.GUIDELINE

3.1 Indications and contraindications

3.1.1 Indications

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

RIRS and SWL are both regarded as first line treatment options for intrarenal or proximal ureteral stones less than 20 mm[1-2,7-11]. However, RIRS is associated with a higher single procedure success rate and lower re-treatment rate compared to SWL[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].

RIRS is usually considered be part of Endoscopic Combined Intra-Renal Surgery (ECIRS) for complex stones larger than 2 cm when PCNL monotherapy is not feasible[12]. RIRS monotherapy may require staged procedures to treat stones with large burden[13-16].

3.1.2 Contraindications

- Acute symptomatic urinary tract infection (UTI). (LE: 1,GR: A)
- Patients unfit for general or regional anesthesia. (LE: 4,GR: A)

For these cases with acute symptomatic bacteriuria, if fever or even septic shock is noted, except antibiotics treatment, nephrostomy tube or JJ stent are required for a period of drainage before lithotripsy, or else it might bring life threatening sequelae[17-19].

General or regional anesthesia is generally required for RIRS[20-21]. Therefore, RIRS should not be administrated in patients with anesthetic contraindications.

3.2 Preoperative stenting

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

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

3.3 Preoperative imaging

- Low-dose non-contrast computed tomography (NCCT) is recommended prior to RIRS in cases where other radiological evaluation means (KUB and sonography) fail to give adequate information. (LE: 3, GR: B)
- Contrast-enhanced computed tomography (CTU) and IVU 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 modality to diagnose the urinary calculi with decreased radiation exposure[33-39], it allows an accurate determination of stone size and volume, stone multiplicity, stone density, state of the renal parenchyma in cases where other radiological evaluation means (KUB and sonography) fail to give adequate information on these parameters. Contrast-enhanced computed tomography (CTU) and IVU with excretory phases is recommended when renal pelvic-calyceal anatomy requires a detailed assessment, especially the renal collecting system anatomy,includinig infundibulopelvic angle (IPA) infundibular width (IW) and infundibular length (IL), which are important risk factor to predict SFR following RIRS[40-41]. Sometimes a three-dimensional helical computed tomography is required for complicated cases[42].

3.4 Preoperative medications

3.4.1 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 insertion of UAS in patients without pre-stenting and protect against potential ureteral wall injury during UAS insertion [43-46].

3.4.2 Antibiotics

- Urinalysis and urine culture should be performed prior to RIRS. (LE:1, GR: A)
- In patients with a positive preoperative midstream urine culture (MSU), antibiotic should be administered according to culture antibiogram test findings. (LE:1, GR: A)
- In patients with a negative MSU, 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 the universal consensus on the utilization of antibiotic prophylaxis and treatment of UTI before RIRS is reached 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, the controversial on the positive urinalysis for leukocytes and/or nitrites, asymptomatic and symptomatic bacteriuria keeps on. Although a positive urinalysis for leukocytes and/or nitrites is considered as an independent risk factor for post-operative urosepsis[50], well-designed multicentric RCTs are required to evaluate outcomes of preoperative antibiotic administration in patients with negative MSU but positive urinalysis for leukocytes and/or nitrites. For patients with asymptomatic bacteruria, adequate antibiotics are required to control the UTI prior to RIRS. However, for these cases 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.

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3.4.3 Management of anti-thrombotic therapy

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

RIRS is categorized as a procedure with low bleeding risk, it's a safe and efficient modality for the patients on anti-coagulation or anti-platelet therapy[51], discontinue of the anti-thrombotic therapy is not required prior to RIRS. However, some studies have suggested that anti-thrombotic therapy may increase the risk of procedure-related bleeding[52], especially anti-coagulation(e.g. warfarin, DOAC's, subcutaneous low molecular weight heparin) therapy, while anti-platelet therapy (e.g. aspirin, clopidogrel) does not [53-54]. Therefore, surgeons, anesthesiologists, physicians and patients should get sufficient communication prior to operation, and patients on anti-thrombotic therapy should better undertaken RIRS by experienced surgeons.

3.5 Anesthesia

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

For RIRS, both GA and are well accepted anaesthetic mordality[55-57]. Patients may benefit from RA in terms of less postoperative pain and economic factors[55-56], while GA would provide better intraoperative anaesthetic management and patient experience. GA is preferred as it allows to control the respiration if position holding in Ho:YAG laser lithotripsy for RIRS or puncture for ECIRS is needed[58]. Nevertheless, large-sample, multi-center RCTs with strict standards should be performed to confirm these findings.

3.6 Intraoperative position

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

Besides standard lithotomy position, other positions such as T-tilt position is also available for RIRS in special cases[59].In cases of ECIRS, RIRS may be performed in the supine (supine position and 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 have comparable SFRs [62].

3.7 Guide-wire

- Placement of a safety guide-wire 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 guide-wire may be omitted during RIRS, particularly when treating stones in the kidney[63-65], it is still generally recommended for the treatment of upper ureteral stones and/or if fragments will be manually extracted. The safety guide-wire can facilitate rapid and easy stent placement in case of bleeding or ureteral injury. Retrograde urogram prior to guide-wire placement would facilitate a well understanding of renal collecting system anatomy and location of guide-wire.

3.8 Ureteral access sheath and insertion

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

UAS may facilitate quick and multiple accesses to renal collecting system, and rapid extraction of stone fragments with basketing during RIRS . The UAS also could provide a continuous outflow of irrigation, and might reduce the intrarenal pressure and infectious complications [66-67]. However, studies have demonstrated that the utilization of UAS has no prominent impact on SFR or operative duration [68-69], but does bring an increased risk of ureteral injury[70-71]. Therefore, the application of UAS in RIRS may be considered a double-edged sword and should be carefully decided in each case, taking into consideration of pros, cons and surgeon's preference.

Although insertion UAS without x-ray utilization is feasible in uncomplicated cases [72], insertion of UAS should be performed routinely under fluoroscopic control due to the risk of ureteral injury [73]. Ureteral balloon dilation prior to UAS insertion should not be routine, however it can be considered in cases difficult access to the ureter [74]. Pre-stenting is believed to passively dilate the ureter, facilitate subsequent UAS insertion, and also reduce the risk of ureteral injury[22, 25].However, prestenting bring additional cost, radiation exposure and side-effects from prolonged stenting [32].

3.9 Irrigation

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

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

Manual hand pumps, automated irrigation pumps and gravity-based irrigation are the available options to provide variable pressure irrigation during RIRS. Although the manual hand pump method has the advantages of an easy control of irrigation flow and pressure, but the pressure might also reach high levels sometimes if without well management. Automated irrigation pumps provides a more consistent flow, however, a high continuous flow may cause high pressure resulting in pyelovenous backflow[80].

The comparison 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 certainly needed to evaluate the irrigation flow, intrarenal pressure and effect on post-procedure patient outcomes using different irrigation methods.

3.10 Flexible ureterorenoscope

3.10.1 Single-use flexible ureterorenoscope (su-FUS) vs. reusable flexible ureterorenoscope(re-FUS)

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

Single-use flexible ureterorenoscopes (su-FUS) overcome the main limitations of high initial acquisition and ongoing maintenance costs associated with reusable ureterorenoscopes [83-86].

Furthermore, su-FUS are well suited for anatomically complex and challenging cases, such as large stones (>2 cm), lower pole stone with steep IPA, urinary diversion or unusual renal anatomy, due to the risk of inadvertent damage to the flexible ureterorenoscopes [87-90]. Su-FUS may be more cost-effective in low-volume centers and in teaching hospital 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, given the topical nature of su-FUS versus re-FUS, carbon emissions and environmental pollution should be paid attention to, the recycling and recycling is required[91-92].

There is no difference in surgical outcomes between the use of su-FUS and re-FUS [93-96]. However, sometimes the manoeuverability of su-FUS seems to be inferior to re-FUS, fiber-optic FUS usually have better end-tip deflection and smaller caliber than digital FUS[94].

3.10.2 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 FUS provides similar deflection to the single-channel FUS, 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 FUS necessitates a larger caliber UAS if an access sheath is desired, which potentially may result in strain-induced ureteral injuries [97-99].

3.10.3 Miniaturization of the flexible ureterorenoscope

- Miniaturization of FUS 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 small caliber UAS, thereby reducing the risk of ureteral injury from an oversized UAS,especially in the case of a narrowed/tight ureter where a large caliber UAS can not access[100]. Small-caliber ureterorenoscopes provide increased outflow, lower intrarenal pressures and improved visibility when compared to large caliber ureterorenoscope, under the premise of the same caliber UAS[101-102].

3.10.4 Robotic ureterorenoscope

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

Preliminary evidence indicates that robotic-assisted RIRS fails to offer any substantive advantage with regard to maneuverability and operation results when compared to conventional RIRS[103-104]. Even though, 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].

3.11 Laser Lithotripsy

- Holmium:YAG (Ho:YAG) laser is the conventional treatment modality for lithotripsy in RIRS, while Thulium Fiber 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 [107-110].

Ho:YAG laser with lower frequency, higher energy and shorter pulse duration settings fragment stones, while the Ho:YAG laser using higher frequency, lower energy and longer pulse duration settings has the ability to generate dusting. [111-112]. However, the

Thulium Fiber Laser (TFL) is new modality for lithotripsy in RIRS, it has been shown to be both effective and safe. The versatility of TFL, including high frequencies and reduced retropulsion may result in higher ablation efficiency when compared to Ho:YAG laser[113-117].

However, the thermal effect with both Ho:YAG and TFL laser at higher setting should be taken into consideration, especially in the case of narrow room with inadequate irrigation, and a prolonged procedure. Further study is required to confirm these findings.

3.12 Stone retrieval

- Both dusting and fragmentation with stone basketing are equivalent modalities for stone clearance during RIRS. (LE:2,GR: 1)

● Suction UAS may reduce stone retropulsion, improve stone clearance, improve visibility and reduce the intrarenal pressure. (LE:3,GR:1)

There is little evidence to support one stone management strategy, whether dusting or fragmentation[118-119], individual decision making should base upon the stone characteristics and urologist's preference.Dusting has been associated with shorter procedural duration, however, stone-related adverse events may be higher, since stone fragments are left for spontaneous passage after RIRS [120]. Therefore, the lithotripsy strategy should be flexibly adjusted according to the intraoperative lithotripsy performance, try to powder the stone in a short time without leaving large debris in the kidney. The active removal of stone fragments with basketing or suction technique may provide a higher initial SFR, however, multicentric RCTs are lacking to support these observations [121-123].

3.13 Exit strategy

● UAS removal under direct vision as exit strategy is recommended. (LE:3, GR:A)

UAS removal under direct vision as an exit strategy is imperative to detect inadvertent and unrecognized ureteral injury [124]. JJ stent is usually placed in an attempt to assure adequate urine flow in the setting of ureteral 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 caliber ureters, greater ureteral edema and ureteral injury[126-127]. However, JJ stent may bring low urinary tract symptoms (LUTS) in some patients [128].

Therefore, the decision as to whether to leave a stent is based on surgical preference and patient factors. 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 through inability to access the upper tract adequately), then this may have benefits for avoiding the need for a post-operative stenting. A stent-on-string might alleviate the potential LUTS bring by the conventional JJ stent, α-blocker or anti-cholinergic agents are recommended to improve LUTS [129-131].

3.14 Postoperative imaging and stone-free status evaluation

● KUB and ultrasonography is adequate to identify evidence of residual stone fragments and dilatation suggestive of potential obstruction in follow-up. (LE:3, GR:A)

- SFR following RIRS should be evaluated in three months, and NCCT is the most accurate modality. (LE:1, GR:A)

Ultrasonography, KUB and NCCT are commonly used imaging modalities to assess SFR. KUB and ultrasonography is adequate 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 2mm [133]. Low-dose NCCT is adequate for non-obese patients (BMI<30) , with a similar detection rate but lower expose dose when compared to NCCT.

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

3.15 Complications

The modified Clavien-Dindo classification system has generally been used to evaluate the presence and severity of the complications following RIRS [136-138]. Most complications following RIRS are mild, the Clavien I to III take up 67.7% , 22.7% and 7.2% respectively, while the severe complication of Clavien IV only take up 2.4% [139].

3.15.1 Bleeding

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

The risk of vascular complications following RIRS is very low. The potential vascular injury during RIRS may come from perforation of the ureter or collecting system by instrumentation directly, including UAS insertion, Ho:YAG laser lithotripsy, guidewires or catheters, or it may be associated with chronic kidney disease (CKD), 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 are rare. However, the perforation of 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 from inadvertent thermal injury of the pelvic/calyceal mucosa, although this is generally self-limited. Temporarily capping the UAS may promote clot formation and facilitate bleeding cessation.

Perirenal hematomas, pseudoaneurysm formation or arteriovenous fistula have been reported following RIRS[142-146]. The risk increases in cases of urinary tract infection, intraoperative high intrarenal pressure and prolonged operation time. In these events, angiography and superselective embolization is recommended as the first choice, rarely nephrectomy maybe required[142-146].

3.15.2 Infectious complications

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

Postoperative infection is the most frequently noted complication following RIRS. Postoperative fever (4.9%), sepsis (0.5%) and septic shock (0.3%) are the most commonly noted clinical symptoms [147].

Positive mid-stream urine (MSU) culture, infection stone, large stone burden, forced irrigation and prolonged operation duration are the main risk factors for post-RIRS infection[148-152]. Emphasising the preoperative management of patients with bacteriuria, and avoidance of routine prolonged post-operative antibiotics when a single dose prophylactic antibiotic is sufficient for patients without UTI. Common tips to prevent infectious complications include culture-specific antibiotic therapy for documented pre-operative UTI, broad spectrum antibiotic prophylaxis for culture negative patients, ensuring good outflow during the procedure with an appropriately placed UAS, well irrigation management, minimizing intraoperative intrarenal pressure, avoiding prolonged operation time and leave a Foley's catheter[17,147,151]. RIRS with 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 an early and rapid identification take the appropriate management. Q-SOFA scores [altered mental status (Glasgow coma Scale<15), hypotension (systolic BP < 100mmHg), high respirator rate (>22/min)] can provide a quick and easy way to assess for potential urosepsis. White blood cell counts less than $3x10^9/L$ can also be an indicator of impending sepsis[152-153]. Early appropriate antibiotic therapy, resuscitation support, transfusion or vasopressor, intubation or mechanical ventilation may be required to treat septic shock [154-155].

3.15.3 Ureteral injury

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

Ureteral injury following RIRS is thought to be under-reported due to the fact that the ureter is not routinely inspected after removal of UAS[140,156]. Therefore, the ureter should routinely be directly inspected upon removing the ureterorenoscope and UAS following RIRS, and ureter wall injuries should classified according to the Endoscopic Classification System[125,157]. Indeed, ureteral wall injuries are much more frequently noted with this approach, occurring with an incidence of 30.4%-46.5%[125,157].

Mild mucosal abrasion and superficial lesions do not require special measures other than 10-14 days of ureteral stenting. However, the stent duration should be extended to up to 6 weeks for ureteral perforation[141,158]. Ureteral reconstruction is required in case of a complete ureteral avulsion[141,158].

4.CONCLUSION

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

Conflicts of Interest: None declared

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