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Review

Indications, Efficacy, Safety and Complications of Retrograde Intrarenal Surgery

Mustafa Tayeb [1], Mohammed Alghamdi [2], Mohammed Alhazmi [2], Enad Alqurashi [3], Abdulhadi Alsubaie [2], Awnallah Alotaibi [4], Ahmed Mobaraki [2], Abdulaziz Abdulmajeed [2], Abdulrahim Alamri [5], Abdulrahman Alamri [6], Ahmad Aboukhshaba [7]

[1] *Department of Urology, Alnoor Specialist Hospital, Mecca, Saudi Arabia*
[2] *Department of Urology, King Fahad General Hospital, Jeddah, Saudi Arabia*
[3] *Department of Urology, King Abdulaziz Specialist Hospital, Taif, Saudi Arabia*
[4] *Department of Urology, King Fahad General Hospital, Medina, Saudi Arabia*
[5] *Department of Urology, Wadi Aldawasir Armed Forces Hospital, Wadi Aldawasir, Saudi Arabia*
[6] *Department of Urology, Armed Forces Hospital Southern Region, Abha, Saudi Arabia*
[7] *Department of Urology, National Guard Health Affairs (NGHA), Jeddah, Saudi Arabia*

Correspondence should be addressed to **Mustafa Tayeb**, Department of Urology, Alnoor Specialist Hospital, Mecca, Saudi Arabia. Email: dr.motty@ymail.com

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Abstract

Kidney stones are one of the most prevalent disorders associated with significant morbidity. Initially the renal stones were treated with open surgery but with the advancements in technology shift towards the minimally invasive therapeutic procedures is observed. Recent technological advances in the field of urology have led to more prevalent use of retrograde intrarenal surgery for the treatment of urolithiasis. The introduction of new laser systems and advanced flexible ureteroscopy with a small ureteroscope have contributed to increase in indications for intrarenal surgery to include not only larger kidney stones > 2 cm, but also urothelial carcinoma of the upper urinary tract, urethra, and idiopathic renal haematuria. Retrograde intrarenal surgery is one of the most safe and effective minimally invasive technique which due to its positive outcomes and less rate of complications has gained much popularity in the field of urology with the passage of time. The purpose of this research is to review the available information about the indications, efficacy, safety and complications of retrograde intrarenal surgery. Retrograde intrarenal renal surgery is indicated in various cases including lower calyx stones and stones greater than 2 cm among many others. Evidence from the literature suggests retrograde intrarenal surgery as quite a safe and effective method with high success rate and minimum and minor complications being reported. In future more randomized trial studies on retrograde intrarenal surgery can however significantly contribute to literature and benefit clinical practice also.

Keywords: *retrograde, renal, surgery, safe, stone*

Introduction

Renal stones are one of the most frequent disorders, resulting in patient misery, lost labour, and morbidity, all of which have socioeconomic effects. Urolithiasis is prevalent in 2.8% of Americans and 1.5% of Europeans. In addition, the high chance of recurrence associated with urinary tract disease is observed to be about 50% within ten years. Renal calculi treatment has greatly improved over the past decade accompanied by advances in kidney stone technology. As a result of which higher stone-free rates and lower morbidity have been achieved. Renal stones were previously treated with open surgery while in today's time several minimally invasive therapeutic procedures are in use (1). The beginning of new era in urology was significantly marked by use of a flexible ureterorenoscope to perform retrograde intrarenal surgery (RIRS). Small kidney stones are easily accessible through RIRS, and serious urinary tract infections can be treated with minimally invasive procedures. The first application of RIRS was to treat minor kidney stones. The approach drew a lot of interest, and it was proposed that larger stones may be treated as well, however with longer operative durations. RIRS was used to treat medium stones in the beginning and then larger stones. Percutaneous nephrolithotomy (PNL and PCNL) is the standard treatment for large stones, which has a high success rate but also a high risk of morbidity. As RIRS is accompanied with fewer complications and morbidity many urologists believe that RIRS should be used to treat large stones (2).

The concept of endoscopic access to the renal collecting systems and description of navigation in the renal pelvis with a rudimental flexible fiberscope was first introduced by Marshall in 1964 for the purpose of diagnostic evaluation and treatment of upper urinary tract diseases. Miniaturization and technological advancements have only allowed for a gradual improvement in procedures and their widespread use in clinical practice over the last 30 years. RIRS with flexible ureterorenoscopes is now regarded as one of the first-line therapy choices for active renal stone removal (3). Urologists face a major challenge in treating renal calculi in people with one active kidney. Complete removal of stones without damaging kidney tissue or having adverse effects on kidney function requires careful and selective treatment options. Due to the remarkable advances in flexible ureteroscopes and holmium lasers, RIRS has grown popular as an alternative to PCNL and Shock wave lithotripsy (SWL) in the treatment of renal calculi less than 20 mm. RIRS has a low rate of complications and a high number of stone-free patients. If large kidney stones are present, this surgery may need to be repeated. For patients with a solitary kidney, RIRS offers the advantage of preventing renal parenchyma injury (4).

Kidney calculi are a common urological condition that has a high recurrence rate. Kidney function loss could happen from stone migration leading to renal colic and calculi blockage. Urologists in charge of urolithiasis now have access to high-tech devices, resulting in safer and more effective lithotripsy. RIRS is another minimally invasive procedure for treating upper urinary calculi like PCNL. RIRS has been proposed as an alternative to percutaneous techniques for the treatment of lower pole stones because of its minimal trauma, quick recovery, ease of operation, and lack of complications. RIRS is a less invasive technique with less blood loss, shorter hospital stays, and a lower stone-free rate than PCNL (5).

RIRS is becoming more common for treating urolithiasis as a result of recent technological developments in endourology. In addition, since the advent of various new laser systems and advanced flexible ureteroscopy with a small ureteroscope, RIRS indicators have continued to expand to include not only larger kidney stones> 2 cm, but also urothelial carcinoma of the upper urinary tract, the intensity of -ureter. , and idiopathic renal haematuria. In the fast-developing field of endourology, clinicians must stay up with these advances and make effective use of these tools. At the same time, certain risks and complications are also associated with the procedure such as burns from laser use, damage to the urethra, and radiation exposure during intrarenal retrograde surgery under fluoroscopic guidance (6). The purpose of this research is to review the available information about the indications, efficacy, safety and complications of retrograde intrarenal surgery.

Methodology

This study is based on a comprehensive literature search conducted on May 23, 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the information about the indications, efficacy, safety and complications of retrograde intrarenal surgery. There

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were no restrictions on date, language, participant age, or type of publication.

Discussion

In recent years, RIRS has grown in popularity and also contributed to an increase in the knowledge and experience of surgeons with it. This method of treatment is effective and trustworthy, with fewer complications and better success rates. Its main characteristic is intrarenal access via a natural route without piercing the parenchyma. The length of the trip, along with the delicate nature and high cost of the equipment, are however some important obstacles that must be addressed. RIRS appears to be an effective treatment for the management of patients with stones less than 2 cm, with viral infections, kidney failure, and bleeding disorders, according to the current literature. In individuals with large stone volume, only recurring sessions or combining treatments can result in high success rates. RIRS has been shown to be a successful and dependable approach for treating kidney stones as per several research studies. The success rates for RIRS are between 65% and 92% (7).

Indications for the RIRS

Failure of prior SWL, lower calyx stones, and stones smaller than 1.5 cm were all signs of RIRS in the beginning. However, the limitations on the RIRS indications have recently been reduced and can now be used as a first-line treatment with SWL of stones smaller than 2 cm, and as an alternative to PCNL stones in the lower calyx and those more than 2 cm. Although no absolute signs have been documented, the following are possible indications: Stones of a medium size that are not suited for SWL or PCNL. Stones that are resistant to SWL or non-transparent stones. Anatomical anomalies are present. Coexistence of renal and ureteral stones. Treatment of bilateral renal stones in a single session is required. Nephrocalcinosis with several kidney stones. Patients with obesity, musculoskeletal abnormalities, renoureteral anomalies, infundibular stenosis, urinary diversion, combined or auxiliary procedures after PCNL , and bleeding disorder also who have exhausted all other treatment options are candidates for retrograde intrarenal surgery (8).

Evidence from literature for efficacy and safety of RIRS

RIRS can be utilized as an alternative to PCNL in case of large renal stones. Author further suggested that however there is a need of more randomized trials to corroborate these findings (9). Findings of a Spanish study in 2016 reported that bilateral single-stage RIRS is a safe and efficient therapy option for patients with bilateral renal stones. The average number of stones per renal unit was 2.7 with range 12, and the majority (40%) being situated in the renal pelvis with a mean size of 16.08±8.06 mm and a mean stone burden of 258.54 ± 242.59 mm^2. At three months, the stone-free rate was 83.33%. The average operation time duration was 75 minutes, with a two-day hospital stay. There were no major complications reported (10).

According to the existing evidence in literature, RIRS for stone treatment is equally safe and effective as compared to SWL or PCNL. Findings of a cross-sectional study in 2017 reported that overall, stone free rate was 90.6%. The mean stone size was 0.8 cm, with an 89.7-minute procedure time duration. The average stay in the hospital was 2.7 days. By single RIRS, the stone free rate of stone load between 2.0 cm and 3.0 cm was 80.2%, and the stone-free rate of stone burden over 3.0 cm was 45% in the large stones size subgroups. The stone-free rate of ten of the 22 patients who received two-staged RIRS improved from 45.0% to 76.5%. In the study groups, no major complications were observed (11). Results of a retrospective study in 2018 concluded that among the available, minimally invasive therapeutic procedures both PCNL and RIRS are considered safe and effective choices for removal of renal stone in patients with horse shoe kidney (12).

Findings of another meta-analysis in 2019 showed that when compared to RIRS, PCNL had a significantly greater stone-free rate but was accompanied by a longer hospital stay. The groups did not differ significantly in terms of operating time or complication rate. When the results from various studies were pooled, PCNL had a similar stone-free rate as RIRS. RIRS had a lower stone-free rate along with shorter hospital stay, but the same operation time and complication rate as PCNL. It is thus believed that RIRS could be a viable option for PCNL in terms of efficacy and complication rates for renal stones (13). Results of a comparative study in 2020 revealed that RIRS group had less haemoglobin drop along with shorter hospital stays as compared to ultra-mini percutaneous nephrolithotomy group and no significant difference in complications were observed in both groups (14). Findings of a meta-analysis in 2020 concluded that the RIRS method is both safe and effective. It can effectively treat patients with stones larger than 2 cm, resulting in a high stone-free rate and a shorter hospital stay without increasing complications.

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Gokcen reported that the RIRS method could be used as an effective and safe treatment for kidney stones in patients over the age of 65, with hospitalization and stone-free rates as indicated in younger patients as there were no major complications with the procedure observed in the study (15). Results of a comparative study in 2020 reported the amount of bleeding during surgery, the amount of haemoglobin loss after surgery, the total cost of hospitalization, and the time spent in hospital after surgery were all lower in the RIRS group than in the PCNL group, and the surgical time was longer. The RIRS group had a lower incidence of complications than the PCNL group (20% vs.45%) (16). Results of a retrospective study in 2013 showed that in patients with bilateral renal stones, single-session RIRS and laser lithotripsy can be executed effectively and safely, with a high rate of success and low complication rate. The average stone size was 24.09± 6.37 mm, with a 51.08±15.22-minute operative time. After the first and second procedures, the stone-free rates were 92.8% and 97.6%, respectively. The average length of stay in the hospital was 1.37± 0.72 days. There were no major complications or blood transfusions observed in the study group (17). Studies from the available literature support that RIRS is a safe and effective procedure.

Complications of RIRS

Yahsi states that RIRS surgery is a safe and effective procedure for the treatment of renal stones, with a high success rate and low complication rate. The majority of complications are minor and can be addressed conservatively. Fever, flank pain, urinary infection, transitory haematuria, acute urinary retention, ureteral and pelvicalyceal abrasion, stone street, subcapsular hematoma, fornix rupture, extravasation, urinoma, ureter avulsion, transfusion-dependent haemorrhage, and sepsis are the most common sequelae of RIRS. According to various studies, reported complication rates range from 0% to 25% (18). Xu reported that among 322 RIR surgeries, there were 26.1% complications. Complications were reported in Grades I, II, IIIb, and IVb at a rate of 67.7%, 22.7%, 7.2%, and 2.4%, respectively. Fever over 38°C was the most common complication. Following the operation, 13.4% experienced febrile episodes. Only antipyretics were needed in 28 individuals (8.7%), while antibiotics were needed in 15 patients (4.7%). The next most prevalent complication was postoperative haematuria, which occurred in 23 patients (7.7%) (19).

Zhang reported that after RIRS, 7.14% developed infection complications. Operative time was found to be an independent risk factor for infection. Early antibiotic treatment and vigorous fluid management, according to research, may reduce the likelihood of infection complications after RIRS. Author further suggests that longer operative times and larger stones may be risk factors for infection complications following RIRS (20). Lai reported that minor complications occurred in 15% of patients, and no one required a blood transfusion. For single kidney patients, the 1% rate of serious complications was also lower than PCNL. The more challenging consequences with RIRS were ureteral perforation and stricture (21). Factors that increase the likelihood of complications after RIRS have been thoroughly investigated, and people at different risk have been identified. Females, diabetes, kidney failure, heart disease, aging, history of recurrent UTI, incomplete stone removal, urinary incontinence, paraplegia, and charleston comorbidity index higher, in addition to the positive culture of pre-surgery urine and indwelling urinary drains all of which are among the risk factors for developing RIRS complications. Other variables that increase the risk of complications after surgery include immunosuppression, recent chemotherapy or steroid treatment, poor nutrition, and long hospital stay. In order to prepare for RIRS, such populations require specific consideration (22). Well-established literature is available regarding the indications and efficacy of RIRS however in future more randomized control trials should be conducted which will further significantly contribute to highlighting the importance of RIRS and strengthen the literature.

Conclusion

RIRS is a well-established treatment that is constantly evolving as technique with the advancements in technology. It has achieved widespread popularity as a result of its low invasiveness and positive results. Future advances will be required to improve its cost-effectiveness and expand its application to a broader variety of indications.

Disclosure

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Non-applicable.

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Data availability:

Data that support the findings of this study are embedded within the manuscript.

Authors' contribution:

All authors contributed equally to the drafting, writing, sourcing, article screening and final proofreading of the manuscript.

References

1. Topaktaş R, Ürkmez A. Retrograde Intrarenal Surgery for the Management of Kidney Stones Smaller than 20 mm: A Single-Center Experience of 452 Cases. Haydarpasa Numune Med J. 2020;60(1):85-90.

2. Zengin K, Tanik S, Karakoyunlu N, Sener NC, Albayrak S, Tuygun C, et al. Retrograde Intrarenal Surgery versus Percutaneous Lithotripsy to Treat Renal Stones 2-3 cm in Diameter. BioMed Research International. 2015;2015:914231.

3. Sanguedolce F, Bozzini G, Chew B, Kallidonis P, de la Rosette J. The Evolving Role of Retrograde Intrarenal Surgery in the Treatment of Urolithiasis. European urology focus. 2017;3(1):46-55.

4. Mahmood SN, Babarasul MH, Fakhralddin SS, Tawfeeq HM. Retrograde intrarenal surgery for the treatment of renal stones in patients with a solitary kidney: Does access sheath matter? African Journal of Urology. 2021;27(1):35.

5. Jiang H, Yu Z, Chen L, Wang T, Liu Z, Liu J, et al. Minimally Invasive Percutaneous Nephrolithotomy versus Retrograde Intrarenal Surgery for Upper Urinary Stones: A Systematic Review and Meta-Analysis. BioMed Research International. 2017;2017:2035851.

6. Inoue T, Okada S, Hamamoto S, Fujisawa M. Retrograde intrarenal surgery: Past, present, and future. Investigative and clinical urology. 2021;62(2):121-35.

7. Kılıç Ö, Akand M, Van Cleynenbreugel B. Retrograde intrarenal surgery for renal stones - Part 2. Turkish journal of urology. 2017;43(3):252-60.

8. Van Cleynenbreugel B, Kılıç Ö, Akand M. Retrograde intrarenal surgery for renal stones - Part 1. Turkish journal of urology. 2017;43(2):112-21.

9. Zheng C, Xiong B, Wang H, Luo J, Zhang C, Wei W, et al. Retrograde Intrarenal Surgery versus Percutaneous Nephrolithotomy for Treatment of Renal Stones >2 cm: A Meta-Analysis. Urologia Internationalis. 2014;93(4):417-24.

10. Bauzá JL, Pieras E, Tubau V, Sabaté A, Guimerá J, Martínez A, et al. [Efficacy and safety of bilateral RIRS for renal lithiasis.]. Archivos espanoles de urologia. 2016;69(9):654-8.

11. Lin C-F, Wu C-T, Huang S-S, Chen W-H, Wu LS-H, Lin C-C. Safety and efficacy of staged retrograde intrarenal surgery for large stone burden of renal stones in selected patients: A single-center experience. Urological Science. 2017;28(2):94-6.

12. Eryildirim B, Kucuk EV, Atis G, Ozturk M, Senkul T, Tuncer M, et al. Safety and efficacy of PNL vs RIRS in the management of stones located in horseshoe kidneys: A critical comparative evaluation. Archivio Italiano di Urologia e Andrologia. 2018;90(3):149-54.

13. Zhu M, Wang X, Shi Z, Ding M, Fan D, Wang X, et al. Comparison between retrograde intrarenal surgery and percutaneous nephrolithotripsy in the management of renal stones: A meta-analysis. Exp Ther Med. 2019;18(2):1366-74.

14. Li Z, Lai C, Shah AK, Xie W, Liu C, Huang L, et al. Comparative analysis of retrograde intrarenal surgery and modified ultra-mini percutaneous nephrolithotomy in management of lower pole renal stones (1.5–3.5 cm). BMC Urology. 2020;20(1):27.

15. Gokcen K, Dundar G, Bagcioglu M, Karagoz MA, Gokce G, Sarica K. Safety and Efficacy of RIRS in Geriatric Patients: A Comparative Evaluation on an Age Based Manner. Urology journal. 2020;17(2):129-33.

16. LYU. YQH. Efficacy and safety of percutaneous nephrolithotomy and retrograde intrarenal surgery in the treatment of staghorn calculi. Chinese Journal of Primary Medicine and Pharmacy. 2020;12:1307-11.

17. Atis G, Koyuncu H, Gurbuz C, Yencilek F, Arikan O, Caskurlu T. Bilateral single-session retrograde intrarenal surgery for the treatment of bilateral renal stones. International braz j urol : official journal of the Brazilian Society of Urology. 2013;39(3):387-92.

 http://dx.doi.org/10.52533/JOHS.2022.2702

18. Yahsi S, Tonyali S, Ceylan C, Yildiz KY, Ozdal L. Intraparenchymal hematoma as a late complication of retrograde intrarenal surgery. International braz j urol : official journal of the Brazilian Society of Urology. 2017;43(2):367-70.

19. Xu Y, Min Z, Wan SP, Nie H, Duan G. Complications of retrograde intrarenal surgery classified by the modified Clavien grading system. Urolithiasis. 2018;46(2):197-202.

20. Zhang H, Jiang T, Gao R, Chen Q, Chen W, Liu C, et al. Risk factors of infectious complications after retrograde intrarenal surgery: a retrospective clinical analysis. The Journal of international medical research. 2020;48(9):300060520956833.

21. Lai D, Chen M, He Y, Li X, Wan S. Safety and efficacy of retrograde intrarenal surgery for the treatment of renal stone in solitary kidney patients. Renal failure. 2018;40(1):390-4.

22. Khusid JA, Hordines JC, Sadiq AS, Atallah WM, Gupta M. Prevention and Management of Infectious Complications of Retrograde Intrarenal Surgery. Frontiers in Surgery. 2021;8

http://dx.doi.org/10.52533/JOHS.2022.2702