

Original Research Article

Retrograde intrarenal surgery in the management of solitary large renal stones, 2-3 cm: a single center experience

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ABSTRACT

Background: Nephrolithiasis represents a major health burden worldwide. Several treatment options are available for renal stones such as open stone surgery, percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS), and extracorporeal shockwave lithotripsy. PCNL is considered the gold standard treatment for large renal stones (>2 cm); however, it is associated with higher blood loss, complication rates, and longer hospitalization. In this setting, we aimed to assess the value of RIRS in the management of single large renal stones between 2-3 cm.

Methods: The database of our center was reviewed to include all the patients who underwent RIRS for single large renal stone (2-3 cm) between February 2018 and April 2019. All the patients were evaluated by preoperative computed tomography to evaluate the stone size, site, and density. Furthermore, the following variables were also collected; pre- and post-operative hemoglobin and creatinine, the operative time, stone free rate (SFR), and duration of hospital stay. All the statistical analysis was performed using SPSS version 20.

Results: Overall, the data of 31 patients were retrieved for the current study. The mean age of the patients was 56.9±12.9 years, and the mean stone size was 22.6±7 mm. The mean operative time was 96.4±37.3 minutes and the SFR was 74.2% after single session of RIRS. No major postoperative complications were reported in the current series.

Conclusions: RIRS is a safe and efficient alternative to PCNL in the management of single renal stones between 2-3 cm; however, further prospective studies are required to confirm these findings.

Keywords: Retrograde intrarenal surgery, Renal stones, Minimally invasive, RIRS

INTRODUCTION

Nephrolithiasis represents a major health burden worldwide that affects 7-13, 5-9 and 1-5% of the population in North America, Europe and Asia respectively. Moreover, it is characterized by increasing annual incidence and annual management costs over the past decades.^{1,2} Furthermore, it is associated with high recurrence rates (60%) within a decade after initial treatment.³ Several factors may play a role in the pathogenesis of renal stones including diet, geography, temperature variation, fluids intake, genetics, gender,

comorbidities, age and occupation.¹ Several treatment options are available for renal stones such as open stone surgery, percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS), and extracorporeal shockwave lithotripsy (ESWL).⁴ However, the ideal management of renal stones aims to deliver high stone free rate (SFR), while reducing the procedure time, hospital stay and associated morbidity.⁵ In these setting, the standard PCNL was introduced in 1976, and since then, it became the gold standard for large renal stones (>2 cm), as it provides significantly higher SFR, but it is associated with higher complication rates, more blood

loss and longer hospital stay compared to ESWL and RIRS.^{6,7} To reduce the PCNL morbidity, miniaturized percutaneous access devices have been proposed and successfully tested in endourological practice.⁵ However, the increasing interest in less invasive maneuvers, which, can be observed in the increased number and percentage of cases undergoing RIRS overtime.⁸ Together with the technological advancements in the laser systems and flexible ureteroscopes allowed better stone disintegration and shorter operative times, thus allowed the use of RIRS in the management of larger renal stones.⁹ In this setting, this study aimed to assess the safety and efficacy of RIRS in the management of large solitary renal stones between 2-3 cm.

METHODS

Study design

This is a retrospective single center study carried in Tanta university hospital. The current study was approved by the ethical committee in Tanta university (30905/04/16).

Patients

In the current study, the database at our center was reviewed to include all the consecutive adult patients (>18 years old) with solitary large renal stone (between 2-3cm) who were treated with RIRS between February 2018 to April 2019. Patients with impaired renal function, abnormal coagulation profile and pyonephrosis were excluded from the current study. All the included patients signed an informed consent.

Patients' evaluation

All the stones were evaluated by computed tomography (CT) to assess the stone size (the largest diameter of the stone on CT), site, and density (HU). Laboratory investigations included pre-operative hemoglobin, and creatinine. Patients' history and comorbidities were also extracted from our database.

Variables

Operative time was defined as the time from the insertion of the cystoscope to the completion of the procedure. Conversion was defined as the intra-operative conversion from RIRS to another procedure for different reasons including difficult access and large stone size. On other hand, failed procedure was defined as patients who did not reach a stone free status after a single session of RIRS. Furthermore, stone free was defined as patients having no residual stones or residual stones ≤ 4 mm.

Postoperative follow up

All the patients made a kidney ureter and bladder X-ray (KUB) on the first post-operative day and a NCCT two weeks after the procedure. Furthermore, all the patients

perform a post-operative blood picture and creatinine. The Foley catheter was removed on the first post-operative day and most of the patients were discharged within 2-4 days if there were no complications. The post-operative complications were classified using the Clavien grading system.

Statistical analysis

The statistical evaluation of the current study was done using SPSS software (ver. 20.0; IBM Corp., USA). The normality of the distribution in both groups was assessed using Shapiro-Wilk test. Numerical variables of the population were summarized using the mean and standard deviation (SD). On the other hand, proportions (percentages) were used for summarizing categorical variables. Furthermore, paired sample T-test was used to assess the difference between preoperative and postoperative variables. $P < 0.05$ were considered to be statistically significant.

RESULTS

A total of 31 patients met our inclusion criteria and were included in our study. The mean age of patients was 56.9 years (SD=12.9). The mean stone size was 22.6 mm (SD=7), while stone density was 834 (SD=268). The stone was located in the pelvis in 42%, the upper calyx in 6.5%, middle calyx in 19.4%, and the lower calyx in 32.3%. The demographic data of the patients and the stone characters are summarized in Table 1.

The mean operative time for was 96.4 minutes (SD=37.3). A Double J (DJ) stent was placed in all the patients at the end of the procedure. None of the patients required conversion to any other treatment modality.

Intra-operative complication was reported in only one patient (3.2%) in the form of perforation of the renal pelvis, which resulted in the placement of a DJ stent and termination of the procedure. The mean postoperative hemoglobin and creatinine were 13 (SD=1.8), and 1 (SD=0.3), respectively. No major complications were reported post-operatively. The SFR was 74.2% and the mean duration of hospital stay was 2.3 days (SD=1.4). The operative data, postoperative data and the complications are summarized in Table 2.

Comparing the pre-operative hemoglobin versus the post-operative hemoglobin, there was significant drop of hemoglobin ($p=0.011$). As regards the pre-operative and post-operative creatinine, there was no significant drop of creatinine in the included patients ($p=0.066$)

The SFR was analyzed in relation to stone size and HU as summarized in Table 3. RIRS showed a SFR of 81.8 and 55.6% in stones < 25 and ≥ 25 mm, respectively. When considering the stone density, the SFR was 89.5 and 50% in stones with HU < 1000 , and ≥ 1000 , respectively.

Table 1: Patients and stones characters.

Variable	RIRS (31 patients)
Age in years (mean ± SD)	56.9±12.9
Sex (%)	
Females	14 (45.2)
Males	17 (54.8)
Previous surgery (%)	
None	16 (51.6)
URS	2 (6.5)
ESWL	1 (3.2)
PCNL	3 (9.7)
DJ stenting	6 (19.4)
RIRS	3 (9.7)
Comorbidities (%)	
None	21 (67.7)
Cardiac	5 (16.1)
Hypertensive	3 (9.7)
Diabetic	2 (6.5)
Preoperative laboratory (%)	
Hemoglobin (mean ± SD)	13.3±2
Creatinine (mean ± SD)	0.98±0.28
Stone characters	
Size in mm (Mean ± SD)	22.6±2.4
Stone side (%)	
Right	14 (45.2)
Left	17 (54.8)
Stone site (%)	
Pelvis	13 (42)
Lower calyx	10 (32.3)
Middle calyx	6 (19.4)
Upper calyx	2 (6.5)
Density HU (mean ± SD)	834±268
Hydronephrosis n (%)	3 (9.7)

Table 2: Operative, postoperative data and complications.

Variables	RIRS (31 patients)
Conversion (%)	0
Stenting (%)	31 (100%)
Operative time in minutes (mean ± SD)	96.4±37.3
Intraoperative complications (renal pelvis perforation)	1 (3.2)
Postoperative laboratory	
Hemoglobin	13±1.8
Creatinine	1±0.3
Hospitalizations in days (mean ± SD)	2.3±1.4
SFR	23 (74.2)
Postoperative complications	
None	25 (80.6)
Fever (Clavien I)	2 (6.5)
UTI (II)	4 (12.6)

Table 3: SFR in relation to stone size.

Stone size	Number (%)	SFR	Intraoperative complications
According to size (mm)			
<25	22 (71)	18/22 (81.8)	1 (4.5)
≥25	9 (29)	5/9 (55.6)	0
According to HU			
<1000	19 (61.3)	17/19 (89.5)	0
≥1000	12 (38.7)	6/12 (50)	1 (8.3)

DISCUSSION

The introduction of flexible ureteroscopies and holmium laser fragmentation of the stones improved the success rates of stone treatment and increased the available options for treatment of nephrolithiasis.^{9,10} A recent systematic review and meta-analysis of four randomized controlled trials (RCTs) and 13 cohort studies accounting for 1,717 patients demonstrated that PCNL was associated with higher SFR compared to RIRS among different stone sizes; however, on the sub-group analysis of the RCTs only, there was no significant difference in the SFR between PCNL and RIRS.¹¹ Similarly, another meta-analysis reported a comparable SFRs, and a lower complication and hospitalization rates between RIRS and PCNL in the management of renal stones larger than 2 cm.¹² In these settings, we decided to analyze the safety and efficacy of RIRS in the management of solitary large renal stones (2-3 cm), showing that RIRS could be a valuable treatment option of large renal stones.

The SFR following RIRS in our patients was 74.2%, which is in line with the SFR following a single session of RIRS (67.2%) reported by Chen et al.¹³ Yet, this result is lower than the findings of Goldberg et al, who reported that the SFR following RIRS for stones ≥15 mm was 85%; however, it should be noted that in their series the upper limit of stone size was 2 cm, which represents the lower limit for our stone series.¹⁴ Interestingly, Abd el Hamed et al, showed that the SFR following a single session of RIRS for management of 2-3 renal stones, was 67%; however, when they analyzed the patients based on the stone density, the SFR was 95 vs 40% for patients with HU of <1000 and >1000, respectively.¹⁵ Our results supported these findings, where only 38.7% of patients in the current series had stones with HU >1000 and the SFR for this group of patients was 50% compared to 89.9% for stones with HU of <1000. Likewise, a systematic review of the studies considering RIRS for the management of large renal stones >2.5 cm, demonstrated a SFR of 89.3%, which is higher than the SFR in our series. However, in the current study we considered only single RIRS session, unlike other studies that considered >1 session.¹⁶ The operative time for RIRS in our study was comparable to the operative time reported by Chen et al (96.4 vs 92.8 minutes, respectively).¹³ Intraoperative complications were reported in only one patient (3.5%) in the form of perforation of the renal pelvis. On the other hand, the most common complication following RIRS is

sepsis resulting from the entry of endotoxins and bacteria in the blood stream with the increasing intrarenal pressure; however, the UAS has been advocated to reduce the intrarenal pressure during RIRS.¹⁷ In our series, UAS was used in most of the cases (87%), yet UTI was reported in four patients, in three of them UAS was not used. Interestingly, a recent review of literature showed that RIRS was associated with intrarenal pressures ranging from 8.27-199.35 cm H₂O in the absence of UAS, while a UAS of more than 10/12 Fr may potentially keep the intrarenal pressure below 30 cm H₂O at irrigation pressures of ≤ 100 cm H₂O. On the contrary, UAS fail to maintain the intrarenal pressure below 30 (usually reaches >40 cm H₂O) when the irrigation pressure is increased to ≥ 200 cm H₂O. It is worth to mention that manual 60 ml syringe irrigation may increase the intrarenal pressure during RIRS up to 469.2-557.6 cm H₂O.¹⁸ Noteworthy, the rise of the intrarenal pressure above 30 cm H₂O is hazardous to the kidney and should be kept in mind while performing any endourological procedure and should also be considered an indication to limit the operative time.^{18,19} The pre- and post-operative creatinine were comparable, while there was significant drop of hemoglobin in the included patients; however, none of them required blood transfusion.

The current study is not devoid of limitations including the small sample size, and the retrospective nature of the study. however, this study may be considered as a contribution to the literature as there are only few studies about the use of RIRS in the management of large renal stones (2-3 cm) in adult populations.

CONCLUSION

Our study demonstrates that RIRS could be a valuable option in the management of solitary large renal stones (2-3 cm). Furthermore, it is associated with low perioperative morbidity and short hospitalization period. Further studies are required to confirm these results.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

- Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, Lotan Y. Epidemiology of stone disease across the world. *World J Urol.* 2017;35(9):1301-20.
- Bonzo JR, Tasian GE. The Emergence of Kidney Stone Disease During Childhood-Impact on Adults. *Curr Urol Rep.* 2017;18(6):44.
- Yasui T, Okada A, Hamamoto S, Ando R, Taguchi K, Tozawa K et al. Pathophysiology-based treatment of urolithiasis. *Int J Urol.* 2017;24(1):32-8.
- Moreno-Palacios J, Avilés-Ibarra OJ, García-Peña E, Torres-Anguiano JR, Serrano-Brambilia EA, López-Sámamo VA et al. Rearrangement of the Guy's stone score improves prediction of stone-free rate after percutaneous nephrolithotomy. *Turk J Urol.* 2018;44(1):36-41.
- Jones P, Elmussareh M, Aboumarzouk OM, Mucksavage P, Somani BK. Role of Minimally Invasive (Micro and Ultra-mini) PCNL for Adult Urinary Stone Disease in the Modern Era: Evidence from a Systematic Review. *Curr Urol Rep.* 2018;19(4).
- ElSheemy MS, Elmarakbi AA, Hytham M, Ibrahim H, Khadgi S, Al-Kandari AM. Mini vs standard percutaneous nephrolithotomy for renal stones: a comparative study. *Urolithiasis.* 2019;47(2):207-14.
- De S, Autorino R, Kim FJ, Zargar H, Laydner H, Balsamo R et al. Percutaneous nephrolithotomy versus retrograde intrarenal surgery: A systematic review and meta-analysis. *Eur Urol.* 2015;67(1):125-37.
- Chung KJ, Kim JH, Min GE, Park HK, Li S, Del Giudice F. Changing Trends in the Treatment of Nephrolithiasis in the Real World. *J Endourol.* 2019;33(3):248-53.
- Erkoc M, Bozkurt M. Comparison of Mini-Percutaneous Nephrolithotomy and Retrograde Intrarenal Surgery for Renal Pelvic Stones of 2-3 cm. *J Laparoendosc Adv Surg Tech.* 2020;2020:0860.
- Dretler SP, Watson G, Parrish JA, Murray S. Pulsed dye laser fragmentation of ureteral calculi: Initial clinical experience. *J Urol.* 1987;137(3):386-9.
- 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).
- Barone B, Crocetto F, Vitale R, Di Domenico D, Caputo V, Romano F et al. Retrograde intra renal surgery versus percutaneous nephrolithotomy for renal stones >2 cm. A systematic review and meta-analysis. *Minerva Urol e Nefrol.* 2020;72(4):441-50.
- Chen HQ, Chen ZY, Zeng F, Li Y, Yang ZQ, He C et al. Comparative study of the treatment of 20–30 mm renal stones with miniaturized percutaneous nephrolithotomy and flexible ureterorenoscopy in obese patients. *World J Urol.* 2018;36(8):1309-14.
- Goldberg H, Golomb D, Shtabholtz Y, Tapiero S, Creiderman G, Shariv A et al. The “old” 15 mm renal stone size limit for RIRS remains a clinically significant threshold size. *World J Urol.* 2017;35(12):1947-54.
- Abd El Hamed AM, Elmoghazy H, Aldahshoury M, Riad A, Mostafa M, Farag F et al. Single session vs two sessions of flexible ureteroscopy (FURS) for dusting of renal pelvic stones 2-3 cm in diameter: Does stone size or hardness play a role in number of sessions to be applied?. *Turk J Urol.* 2017;43(2):158-61.
- Breda A, Angerri O. Retrograde intrarenal surgery for kidney stones larger than 2.5cm. *Curr Opin Urol.* 2014;24(2):179-83.

17. Zhu Z, Cui Y, Zeng F, Li Y, Chen Z, Hequn C. Comparison of suctioning and traditional ureteral access sheath during flexible ureteroscopy in the treatment of renal stones. *World J Urol.* 2019;37(5):921-9.
18. Tokas T, Skolarikos A, Herrmann TRW, Nagele U. Pressure matters 2: intrarenal pressure ranges during upper-tract endourological procedures. *World J Urol.* 2019;37(1):133-42.
19. Tepeler A, Akman T, Silay MS, Akcay M, Ersoz C,

Kalkan S et al. Comparison of intrarenal pelvic pressure during micro-percutaneous nephrolithotomy and conventional percutaneous nephrolithotomy. *Urolithiasis.* 2014;42(3):275-9.

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