



Flexible URS: An efficacious treatment for Renal stones of ≤ 2 cms

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The approach to treating renal stones has undergone noteworthy progressions in recent times. RIRS has surfaced as a viable alternative for addressing renal stones ranging from 1 to 2 centimeters in size. This study seeks to assess various parameters, including stone-free rates, overall surgical duration, the requirement for supplementary procedures post-surgery, and the incidence of complications associated with RIRS. To present a single center experience using F-URS in the field of kidney stones of ≤ 2 cm, we conducted this study. The continuous improvement in technology has made the F-URS associated with less complication rate and comparative SFR to mini PCNL in treating kidney stones ≤ 2 -cm in size. This is a retrospective study and the data was collected from the Medical Record of the patients admitted during 1st January 2021 till 31st March 2023 in The Department of Urology at The Kidney Centre, Karachi. Around 150 patients underwent Flexible URS for treatment of kidney stones of ≤ 2 cm. The study encompasses 150 patients, demonstrating a female-to-male ratio of 1:1.6 and an average age of 44.7 ± 13.6 years. Among whom the stone clearance achieved in 78.7% of cases. Postoperative complications affected only 11 out of the 150 patients (7.3%), while ancillary procedures were necessary for 32 patients (21.3%) RIRS emerges as a highly effective treatment option for managing renal stones ranging from 1 to 2 centimeters, characterized by a limited occurrence of post-operative complications.

Keywords: Flexible URS, RIRS, Renal Stones, and Ureteroscopy.

INTRODUCTION

Urinary tract stones have a worldwide prevalence of about 14%, and this rate varies depending on factors such as age, gender, and ethnicity (Hughes T, 2020). The recurrence rate of kidney stones is high and up to 50% of patients are reported to experience multiple episodes during their lifetime (Ferakis, 2015).

Kidney stones can be effectively treated through distinct methods, including *Retrograde Intrarenal Surgery (RIRS)*, *Extracorporeal Shockwave Lithotripsy (ESWL)*, and *Percutaneous Nephrolithotomy (PCNL)*. Larger stones (>2 cm) are preferably managed with PCNL, while RIRS offers a competitive alternative to SWL for smaller stones. EAU guidelines recommend RIRS as an optimal treatment option for stones measuring ≤ 2 cms. Only when PCNL is not feasible, RIRS is advised for stones larger than 2 cm (Zeng, 2022).

Described for the first time in 1964 by Marshall, flexible Ureteroscopy did not gain widespread popularity in its initial days (Marshall, 1964). However, advancements in technology and the miniaturization of ureteroscopes have substantially improved the

maneuverability and image clarity of flexible ureteroscopes, making them a commonly utilized method for both diagnostic and therapeutic purposes in the upper urinary tract (Legemate, 2019).

Flexible URS (F-URS) is a minimally invasive procedure and has been compared to show less complication rates than PCNL and better stone removal rates over ESWL (Ozgor, 2019).

In this article we shall delve into the effectivity and success rates of FURS by evaluating stone free rates (SFR), total time of surgery, need for ancillary procedures post-surgery and associated complications.

MATERIALS AND METHODS

After obtaining ethical review committee approval from the hospital, a retrospective analysis carried out at The Kidney Centre Post Graduate Training Institute in Karachi, Pakistan. The study centered on 150 patients who underwent RIRS within the timeframe of 1st January 2021 to 31st March 2023.

A dedicated proforma formulated for gathering individualized demographic details from patients. This encompassed information such as age, gender, stone

location, quantity and dimensions of stones, surgical duration, hospitalization period, requirement for DJ insertion, necessity for supplementary procedures, and occurrences of post-operative complications. In order to uphold patient privacy, the medical record numbers were substituted with study codes, and sole access to the original data granted to the Primary Investigator. Throughout the phases of data collection and examination, there was no direct engagement with any patients.

Patients with renal stones measuring between 1-2 centimeters, of both sexes, between the ages of 16 and 60, were included in this study. Nevertheless, certain categories were excluded from the study, specifically individuals aged ≤ 16 years or ≥ 60 years, patients with renal stones < 1 cm or > 2 centimeters in size, those with a history of Pyelolithotomy, established chronic kidney disease (CKD), pregnant women, individuals with bleeding disorders or unresolved coagulopathy, untreated urinary tract infections (UTIs), musculoskeletal irregularities, and individuals possessing only one functioning kidney.

After general anesthesia was induced, the patient was placed in the dorsal lithotomy posture. A rigid URS was done on the pertinent side, and a 0.035 Fr ureteric guide wire was placed under vision. A 9.5-11.5-Fr ureteric access sheath was placed over the guide wire. Flexible ureter scope introduced into the collecting system through the access sheath. Following stone localization, laser lithotripsy is used to break stones using a Holmium YAG laser and a 200 μ m fiber. In the

event of ureteral damage, pelvic or ureteral edema or a lengthy procedure, a JJ stent was placed at the conclusion of the treatment. Fluoroscopy was used intraoperative to look for radiopaque stones and flexible URS was used to evaluate all calices for residual stone. Two weeks after the procedure, the JJ catheters were withdrawn under local anesthesia.

A KUB X-ray performed on the 1st postoperative day to verify the proper positioning of the DJ stent and to ascertain the absence of stones in the patient. Following the surgery, ultrasonography conducted after a span of one month. The determination of stone-free status hinged on the absence of any remaining fragments detected during the ultrasonography assessment in the first month post-surgery. Stones measuring ≤ 4 mm that remained deemed clinically insignificant residual fragments (CIRF).

The data was collected, coded, cleaned, and analyzed on the IBM SPSS version 26. Mean with STD was evaluated for continuous variables while frequency with percentage was calculated for categorical data. Chi-square test was applied to observe any association between the variables and p-value of ≤ 0.05 was set as significant level.

RESULTS

Our study included 150 patients with a female-to-male ratio of 1: 1.6 and the mean age was 44.7 ± 13.6 years. The majority of the patients had stones on the right side 79(52.7%) and 1 to 1.5 cm in size 117(78%).

Table: 1 Demographic and Clinical parameters of the patients n=150

		Mean \pm STD/ n (%)
Age in years		44.7 \pm 13.6
Gender	Male	92(61.3)
	Female	58(38.7)
Site of stone	Right	79(52.7)
	Left	40(26.7)
	Bilateral	31(20.7)
Size of stone	1-1.5	117(78)
	1.6-2	33(22)
Number of stone	Single	70(46.7)
	Multiple	80(53.3)
Operative time	< 1 hour	4(2.7)
	1 hour	61(40.7)
	2 hours	67(44.7)
	3 hours	18(12)
DJ insertion		133(88.7)
Postoperative clearance		118(78.7)
Postoperative complications		11(7.3)
Ancillary procedures		32(21.3)
Hospital stay	Daycare	8(5.3)
	1 day	128(85.3)
	2 days	14(9.3)

Table: 2 Association of size and number of stone with the complete stone clearance n (%)

Variables		Complete stone clearance		P - value
		Yes =118(78.7)	No=32(21.3)	
Size of stone	1 - 1.5 cm	95(80.5)	22(68.8)	0.154
	1.6 - 2 cm	23(19.5)	10(31.2)	
Number of stone	Single	62(52.5)	8(25)	0.006
	Multiple	56(47.5)	24(75)	

We observed that 133(88.7%) needed DJ insertion and the stone clearance was 78.7% in those patients.

We observed that among all the patients, who had complete stone clearance, the majority of them had stone size of 1-1.5 cm, although the p value was not significant 95(80.5%). On the contrary, the number of stone had significant impact on stone clearance ($p=0.006$), as we found that, incomplete stone removal had the preponderance of the patients with multiple stones as compared to single stone {24(75%) v/s 8(25%)}

DISCUSSION

Urinary stones pose significant clinical and economic challenges for healthcare systems leading to intense flank or abdominal pain often accompanied by symptoms like blood in the urine, vomiting, and painful urination. Furthermore, the recurrence rates for urinary stones are considerable, with a 7% chance of recurrence within a year and a striking 50% recurrence rate within a decade. While treatments for urinary stones have shown success, these high recurrence rates underscore the importance of addressing Urinary stones as a critical health concern that demands additional therapeutic approaches (Kim, 2020).

Three different approaches *SWL*, *RIRS*, and *PCNL* are employed for the treatment of renal stones (Karim SS, 2020). The advancements in flexible Ureteroscopy technology have led to a notable rise in the utilization of *RIRS*. The enhancements in equipment, including deflection mechanism, mobility and durability, have played a significant role in the increased adoption of *RIRS*. Furthermore, the introduction of auxiliary devices like miniaturized holmium laser fibers, nitinol baskets, guide wires, and ureteral access sheaths, combined with growing surgical expertise, has resulted in higher success rates for kidney stone management through *RIRS* (Van Cleynenbreugel, 2017).

The Resorlu-Unsal stone score (RUSS), developed by Resorlu et al. and the modified Seoul National University Renal Stone Complexity score (S-ReSC), proposed by Jung et al. is an effective tool for estimating SFR in kidney stone treatment. However, it is important to note that neither of these scoring systems can precisely predict the overall outcome of *RIRS* (Xiao, 2017).

In a multicenter study conducted by (Gauhar et al.2023) the average stone size was 10.04 ± 6.84 mm.

With reported mean surgical duration of 62.40 ± 17.76 minutes (Gauhar et al.2023). In contrast, our study observed a range of operative times, spanning from under an hour to 3 hours with the average being about two hours for 67 patients (44.7%) and up to three hours for 18 patients (12%).

Carlo et al. conducted a study involving 2946 patients, where data was retrospectively analyzed from 20 different centers, and they determined a mean hospital stay of 3.55 days (Giulioni, 2023). In contrast, our study exhibited notably superior outcomes, revealing an average hospital stay of 1 day for the majority of patients (85.3%). A slightly extended hospital stay of 2 days was observed in only a small portion of patients (9.3%).

The findings from the study conducted by Orazio et al. demonstrated a stone-free rate of 92.3% in group 1 (stone size: < 1 cm), 88.3% in group 2 (stone size: $> 1 \leq 2$ cm), 56.7% in group 3 (stone size: 2-3 cm), and 69.6% in group 4 (multiple stones). These results clearly illustrated a reduction in the stone-free rate as the stone size increased (Maugeri, 2021). The analysis of our result indicates a relatively lower rate of complete stone clearance. Among the patients, approximately 118 (78.7%) achieved complete clearance for stone sizes ranging from 1 to 2 cm, out of which 70 patients (46.7%) had solitary stones, while the remaining 80 (53.3%) had multiple stones. In addition to that, out of 118 patients who achieved complete stone clearance 95 (80.5 %) patients had stone size of 1-1.5 cm and 23 (19.5%) patients had stone size of 1.6-2 cms.

Ozden et al. (2021) conducted a study wherein approximately 190 patients (26.9%) encountered postoperative complications, predominantly marked by occurrences of fever and hematuria (Ozden, 2021). In contrast, Francesco et al. reported complications in a mere 31 patients (7.7%) out of 403, encompassing instances of fever in 18 (4.4%), SIRS in 7 (1.7%), and sepsis in 3 (0.7%) (Berardinelli, 2016). Our own investigation yielded more favorable outcomes, as post-operative complications were observed in only 11 patients (7.3%) out of a total of 150. Out of 11 patients, 9 patients had UTI and only 2 patient had hematuria.

In our study, 32 patients (21.3%) out of 150 required ancillary procedures, 28 of them required single session of *ESWL*, with only a four requiring two sessions.

CONCLUSIONS

RIRS is indeed an effective treatment option for the management of renal stones measuring 1-2cm with limited post-operative complications. Given the contemporary status of RIRS as a relatively recent approach, especially relevant to developing countries, the journey towards attaining proficiency and expertise necessitates a substantial duration due to its dynamic evolution. The gradual refinement of techniques, the accumulation of experience will increase as the time progresses resulting in steadily improving outcomes.

Supplementary materials

The supplementary material / supporting for this article can be found online and downloaded at: <https://www.isisn.org/article/10.3390/antiox12081524/s1>,

Author contributions

HMA: Objective, Final approval, Surgery, Ethical considerations, Results interpretation, Write-up OKS: Data collection, Surgery, Methodology, Write-up SEK: Supervision of data and Surgery, Final approval, Write-up AZ: Data collection and entry WF: Data collection and entry, Follow up ZZ: Data analysis, Results interpretation, Follow up

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Institutional Review Board Statement

The study was approved by the Ethical Review Committee of The Kidney Centre Postgraduate Training Institute.

Informed Consent Statement

Not applicable.

Data Availability Statement

All of the data is included in the article/Supplementary Material.

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Conflict of interest

The authors declared that present study was performed in absence of any conflict of interest.

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