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An Early Experience of Retrograde Intrarenal Surgery (RIRS) in National Institute of Kidney Diseases and Urology

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Conflicts of interest: None

Abstract

Background: *Advancements in the endoscopic armamentarium, retrograde intrarenal surgery has become a viable and attractive option for the treatment of renal stones because of its high stone-free rates (SFRs) and low morbidity.*

Objective: *To describe our experience and outcome of RIRS for the treatment of renal stones and to assess its effectiveness and safety.*

Design, setting, and participants: *A retrospective analysis of 60 patients who underwent RIRS for renal stones at our institute between January 2018 to December 2018 was performed.*

Surgical procedure: *Flexible ureteroscopy and laser lithotripsy using a standardized technique with last-generation flexible ureteroscopes (Flex-X^c) using Holmium-YAG laser.*

Outcome measurements and statistical analysis: *Clinical data were collected and intraoperative and postoperative outcomes were assessed (Ureteral access sheath placement, operation time, hospital stay, stone free rate, post-operative blood transfusion & fever, need for second session of RIRS. A descriptive statistical analysis was performed.*

Results and limitations: *The mean overall stone size was 13±3 mm. Pre stenting done in all cases. Ureteral access sheath placement was possible in 54(90%) patients. At 1 month follow-up, the overall primary SFR was 86.67% (52 cases), the secondary SFR was 96.67% (58 cases).The mean operative time was 91.96±18.7 min. Mean hospital stay was 1.86±1.02 days. Complications were reported in 8 (13.33%) patients overall, with fever in 6 patients (10%), steinstrasse in 2(3.33%) patients need for second session RIRS in 6 patients (10%).No patient needed blood transfusion. The main limitation of the study is the retrospective nature.*

Conclusions: *RIRS performed using a flexible ureterorenoscope marked the beginning of a new era in urology. It is safe and effective procedure and an alternative to extracorporeal shock wave lithotripsy (ESWL) and Percutaneous nephrolithotomy (PCNL) in the treatment of selected renal stones.*

Keywords: Flexible ureteroscopy, Renal stones, Retrograde Intrarenal Surgery (RIRS), Holmium YAG Laser.

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Introduction:

With the aid of the recent technological developments, there have been rapidly increasing options in the treatment of kidney stones. Kidney stones historically treated with open surgery, are often managed recently by endoscopic surgeries. Nowadays minimally invasive modalities such as ESWL, antegrade [percutaneous nephrolithotripsy (PCNL) i.e conventional, mini, ultramini and micro], and retrograde endoscopic interventions [ureteroscopy (URS), retrograde intrarenal surgery (RIRS)] are commonly used for the treatment of kidney stones.

The treatment of urinary stones throughout the whole urinary tract via an endoscopic approach has gained widespread acceptance due to technical advancements in endoscope and lithotripter techniques.

Extracorporeal Shock Wave Lithotripsy (ESWL) has revolutionized the treatment of renal stones but stone free rate is not satisfactory. Percutaneous Nephrolithotomy (PCNL) is now the gold standard for the treatment of kidney stone bigger than 2 cm in size but with a possibility of substantial morbidity.

Although PCNL is mentioned in the guidelines as gold standard treatment modalities for the management of kidney stones, RIRS is accepted as another treatment modality in the European Association of Urology (EAU) guidelines.[1] RIRS is more frequently used, thanks to the digital improvements in flexible ureteroscopy (fURS) technology, in addition to the developments in deflection mechanism, mobility, ergonomics and durability of the equipment used. Meanwhile, with developments in auxiliary devices – such as miniaturized holmium laser fibers, nitinol baskets, guidewires and ureteral access sheath and increase in surgical experience and compliance, higher success rates have been achieved with RIRS in the management of kidney stones. Accumulated evidence have demonstrated that RIRS can be performed for stones >2 cm.[2,3] Today, reaching the stone via a natural route and achieving a high success rate with a lower morbidity have led RIRS to become a commonly used and important treatment modality.

RIRS is tremendously helpful in the management of renal stones less than 1.5cm, failed ESWL, stones in calyceal diverticula, residual stones after PCNL or open surgery and stones in anomalous kidney.[4,5]

Material and methods

Data were collected retrospectively from the medical record of a consecutive series of 60 patients who underwent RIRS for renal stones at our institution from January 2018 to December 2018. Patients were apprised of the benefits and risks of RIRS, possible alternative treatments, and the potential need for a staged procedure to achieve satisfactory stone clearance. All patients signed informed consent before the surgery.

Inclusion criteria:

- Either sex.
- Age 25–65 years.
- Renal stones 2 cm or less in diameter. Single renal stone ≤20mm or multiple stones the conglomerate diameter (additive maximal diameter of all stones on plain x-ray or axial imaging of computed tomography) up to 20 mm.
- Normal renal function

Exclusion criteria:

- Pregnancy.
- Uncorrected coagulopathy and active urinary tract infection (UTI).
- Patients who underwent transplant or urinary diversion.
- Congenital abnormalities (Urinary tract abnormality).

We reviewed demographic and stone characteristics, outcomes, and complications related to the procedure. Routine preoperative work-up included history, physical examination and investigations including complete blood count, renal function test , serological investigations, urine culture, intravenous urogram or CT-urogram, chest x-ray and electrocardiogram were done in all patients.

In our routine practice pre stenting for 2 weeks was done for all patient for passive dilatation of ureter and we use prophylactic 3rd generation cephalosporin preoperatively for all patients with a negative urine culture.

The procedure was performed under general anesthesia for adequate relaxation of the ureters and avoidance of uninhibited variable breathing movements.

The patient was placed in the dorsal lithotomy position. The stent removed and a guide wire (Zebra guide wire 0.035 inch) placed in the ureter by cystoscopy under fluoroscopic guidance after that we advanced the 6 Fr

semi-rigid ureteroscope towards the renal pelvis through the ureter under direct vision. By this way, co-incidental ureteral stone can be treated, and the ureter can be dilated mechanically. After the renal pelvis is reached, the semi-rigid ureteroscope is removed.

In our practice we used dual lumen ureteral access sheath (UAS , Rocamed 10 / 12fr, 35 – 45cm) for all patient. UAS is advanced over the guide wire under fluoroscopic control and the tip of the UAS keep below the PUJ. A second guide wire (safety wire. Terumo guide wire 0.035 inch) passed through the side channel of dual lumen UAS. Now the UAS is removed and now only two guide wire in ureter. UAS is re inserted over a Zebra guide wire under fluoroscopic control.

Patients with failed ureteral access sheath (UAS) insertion were stented with 6 Fr double-J (DJ) stent and procedure was postponed for 2 weeks.

Now Zebra guide wire was removed only the safety guide wire kept outside the UAS. A 8 Fr BMI feeding tube placed in the bladder for the drainage of the bladder during the operation. We used digital Flex-X^C flexible ureteroscope. (Storz, Digital, FLEX-X^C, Ventral deflexion 270^0, Dorsal deflexion 270^0, working channel 3.6 fr, Tip 8.5 fr Shaft 8.5fr, Proximal 8.5fr) is advanced via a UAS.

Pelvicalyceal system was observed under direct vision until the stone is found. Sometimes fluoroscopic vision or addition of a contrast agent can facilitated access to the stone. Especially repositioning of lower calyx stones brought to more accessible calyx (either middle or upper) with a basket catheter facilitated access to the stone and prolong the lifetime of the flexible device.

After the stone was reached, the laser fiber was advanced with keeping the flexiscope straight. Ho-YAG laser was applied using 200 and 365 micron fiber. Fragmentation was more appropriate for the stones >10 mm, as dusts worsen the vision and it may be difficult to find the fragments. In dusting technique it was difficult to find the fragment. The stone was fragmented with the laser until clinically unimportant residual fragments were left. Once stones were pulverized completely and not visualized under C-Arm procedure was ended with insertion of 6 Fr DJ stent which was removed after 4 weeks.

The power of holmium laser was generally set at 0.5-1.2 Joule and 5-15 Hertz (10 to 15 Watt). Moreover, the settings can be changed according to the desired lithotripsy method and the surgeon can perform the dusting technique by increasing the frequency while maintaining the same energy.

The diameters of the laser fibers used for RIRS range between 200 and 365 ìm. The irrigation and deflection would be less affected with smaller diameter (200-270 ìm) besides it has the same fragmentation effect compared to thicker fibers.

Normal evaluation were performed after 2 weeks, postoperatively. Small stone fragments (<4 mm) generally fall out after the stent was taken out with the help of the passive dilatation performed with a DJ stent.

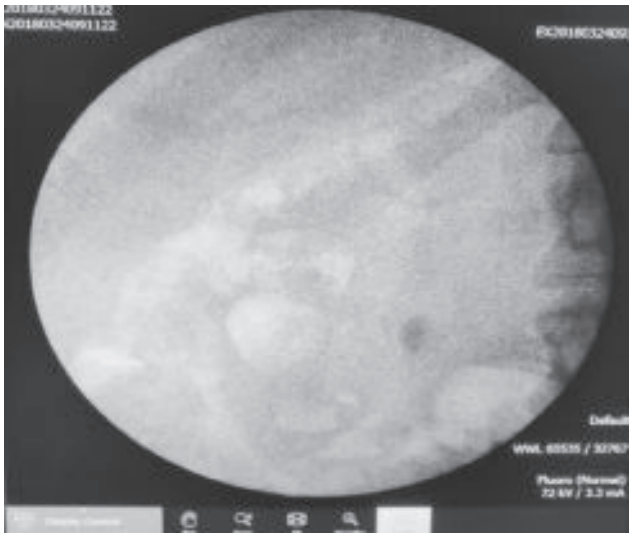

Fig.: Fluroscopic view of Right renal stone

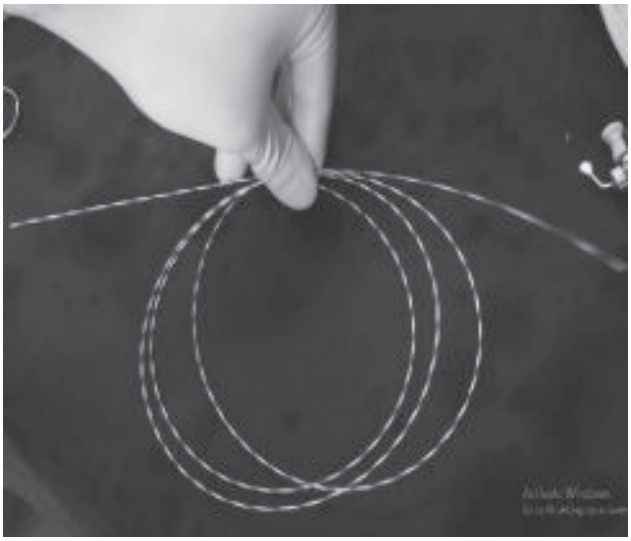

Fig.: Zebra Guide wire

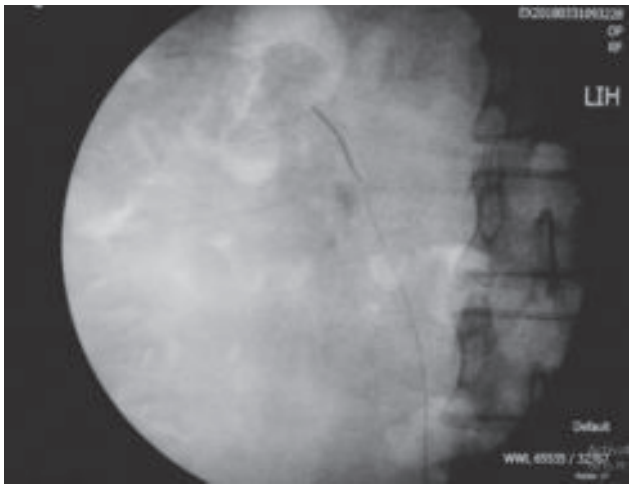

Fig.-3: Fluroscopic view of stone & zebra guide wire.

Fig.-4: Placement of access sheath.

Fig: Flexible URS (Flex-X^{c})

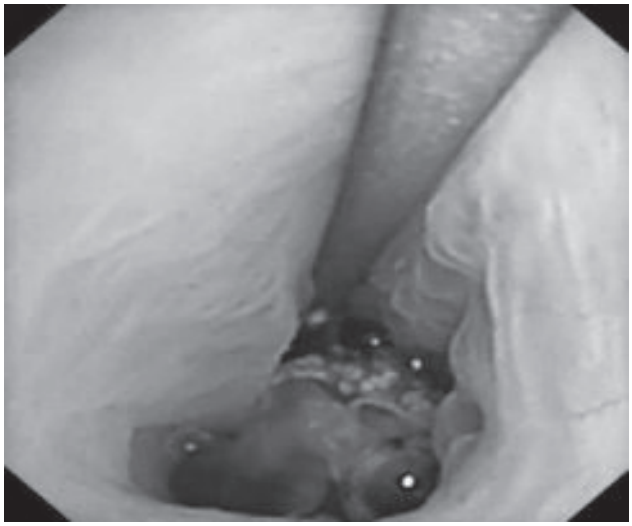

Fig: Endoscopic view of stone & safety guide wirwe.

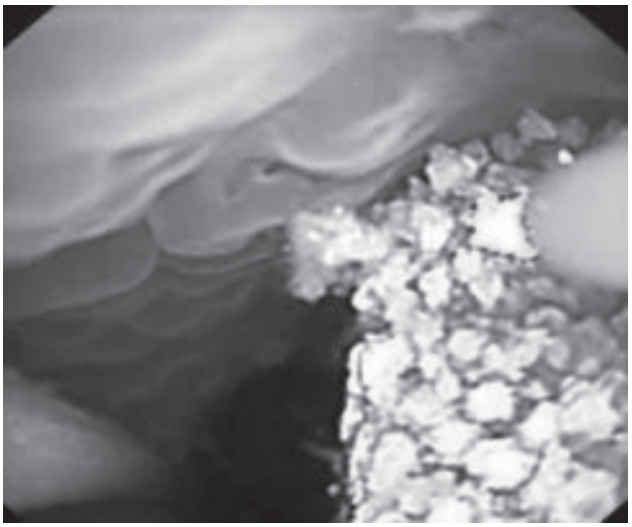

Fig: Endoscopic view of stone & laser fiber

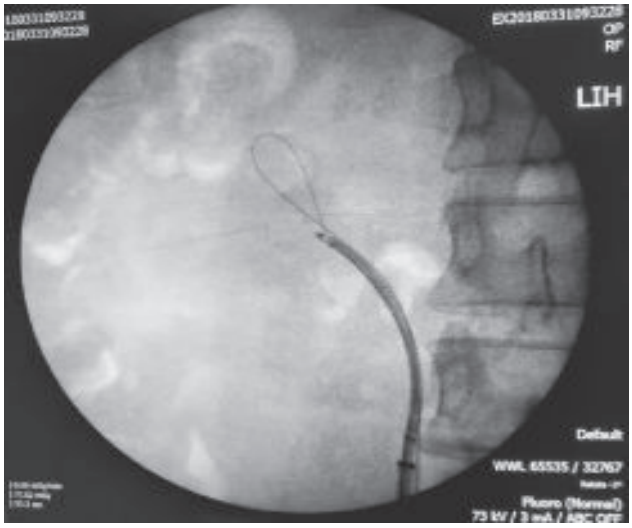

Fig: Fluroscopic view after stone clearance

A descriptive statistical analysis was performed.

Results

A total of 60 renal stones with a mean age of 40.1±12.6 years underwent RIRS in our institute. Female to male ratio was 1:1.8 and mean stone size was 13±3 mm . Stones were located in renal pelvis in 26(43.33%), upper calyx in 5(8.33%), middle calyx in 7(11.67%), lower calyx in 16(26.67%), pelvis and lower calyx in 3(5%)and more than one calyx in 3 cases (5%). Side of stones was almost similar in both sides, Right 46.67% and left 51.67 % while bilateral renal stones were found in 1.66% patients. Single renal stone was in 86.67% cases and multiple were 13.33%.

In our study preoperative DJ stenting was placed in all patient.

UAS placement was possible in 90% and the remaining 10% the ureter was not negotiable.

Operative time was calculated from the time of the first endoscope insertion (cystoscope or ureteroscope) to the completion of stent placement. The mean duration of surgery was 91.96±18.7min.

The mean hospital stay was significantly shorter 1.86±1.02days.

Stone-free rate (SFR) was defined as residual fragments up to a maximum of 2 mm in diameter detected on ultrasound or NCCT scan after 4 weeks. The stone-free rate was 86.67% for one entry and 96.67% for two entries.

Peri- and postoperative complications were recorded.None of the patients required blood transfusions. Postoperative fever was seen in 6(10%) patients. The patients with postoperative fever were administered antibiotics according to their urinary culture results.

Stone street (steinstrasse) formation was seen in 2(3.33%) patients. These patients underwent ureteral stone surgery using a semi-rigid ureteroscope in another session.

Primary RIRS was done in 86.2% cases and residual of previous surgery done in 13.8% cases.

Demographic and stone characteristics by group are reported in table 1. Intraoperative and postoperative data and complications are shown in tables 2 respectively.

Table-I : *Demographic and stone characteristics (n=60)*

Age(Years)	Me3an	40.1±12.6
	20-30	16
	31-40	17
	41-50	13
	51-60	12
	61-70	2
Sex	Ratio(M:F)	1.8:1
	Male	39
	Female	21
Size (mm)	Mean	13±3 mm
	d”10 mm	17
	>10 mm	43
Side	Right	28 (46.67%)
	Left	31(51.67%)
	Bilateral	1(1.66%)
Location	Pelvis	26(43.33%)
	Upper calyx	5(8.33%)
	Middle calyx	7(11.67%)
	Lower calyx	16(26.67%)
	Pelvis and lower calyx	3(5%)
	More than 1 calyces	3(5%)
Numbers	Single	52(86.67%)
	Multiple	8(13.33%)
Preoperative DJ stent placement	All cases	
Indication for RIRS	Primary	52(86. 67%)
	Residual of previous surgery	8(13. 33%)

Table-II : *Intraoperative and postoperative outcomes (n=60)*

UAS placement	Possible	54(90%)
	Fail to negotiate	6(10%)
Operation time	Mean	91.96±18.7 min.
	d”90 min	22
	>90 min.	38
Hospital stay	Mean	1.86±1.02 days
	d”2 days	52
	>2 days	8
Stone free rate (SFR)	Primary SFR	52 (86.67%)
	Secondary SFR	58(96.67%)
Post-operative blood transfusion.		0
Post-operative fever		6(10%)
Stone street (steinstrasse) formation		2(3.33%)
Need for second session of RIRS(Secondary RIRS)		6(10%)

Discussion:

Urinary system stone disease is the third most common pathological condition following urinary tract infections and prostate disorders that affects the urinary tract. The size, site, and number of stone, characteristics of the urinary system, comorbidities, age, and activity of the patient are important for the treatment plan. The aim of the urinary stone treatment is achieving the highest stone-free rate with the lowest morbidity. Thus, currently, less invasive endourological methods are used in urinary stone treatment. PCNL is the treatment of choice for stones larger than 3 cm as well as for complex renal stones.[6] Although this procedure has a high stone-free rate but it has significant complications despite technological advancements.[8,9,10]

The 2013 European Association of Urology guidelines determined a breakthrough in endourology because, for the first time, fURS was considered the first treatment option for all stones <2 cm, skipping ESWL, which was considered the mandatory initial step until that time.[7]

RIRS has been widely adopted and used by urologists worldwide in the management of renal stones due to less invasiveness and efficacy, especially in small to moderate-sized renal stones. RIRS has several advantages over ESWL for stones less than 2 cm diameter. Most importantly, removing the stone in one session without the need for other treatment modalities.

Furthermore, the application of RIRS has expanded to larger stones reaching up to 35 mm in some cases, in spite of not being the first line therapy for the larger stones. RIRS has advantages over the PCNL especially concerning complications. Namely lower or no bleeding events and the less invasiveness of RIRS.

New design of flexible ureterorenoscope, improved visibility and smaller size but more durable than previous models has made possible the treatment of different intrarenal pathology.[11] Flexible ureteroscopy in prepubertal age also is a safe procedure.[11-13] Its maximum use in adults is treatment of primary or after failed ESWL and residual stones after PCNL or open surgery. In case of complex renal anatomy where multiple punctures are required during PCNL, RIRS is better alternative.

Though some studies were unable to prove significant difference between ESWL and RIRS in stone clearance but use of Ho-YAG laser energy is able to fragment any type of hard renal stones and it is safe and effective in the treatment of lower calyceal stones.[14]In patients with high body mass index (BMI) where stone free rates (SFR) are less with ESWL, RIRS is the better option. Turhan C et al in their study had shown that in patient with normal BMI or Obese patient, SFR after RIRS is not significant.[24]

In study by Johnson BG et al[25] SFR after single and second RIRS for stones between 10 to 20 mm successes was achieved in 89% and 91% respectively but in our study primary SFR was achieved in 86.67% patient and secondary SFR was achieved in 96.67% patients.

Better SFR in our study can be due to cases selected with normal intrarenal structure and relatively small sized stones in our early experience. So now RIRS has also become a viable alternative to ESWL and PCNL.

Ureteric stricture post RIRS ranges from 0.2 to 1.9% and ureter avulsion during ureteroscopy range from 0% to 0.6%.[15-17] but in our study we have not found any injury of the ureter. To see the rate of ureteric stricture associated with RIRS needs long term follow up. Grasso et al[25] found in their 352 RIRS, only 11% required preoperative stenting or any form of ureteral dilatation but in our study preoperative stenting was done in 100% cases. Herndon CD et al[26] in their study had only 21% post-ureteroscopy stenting but in our study in 100% cases post-ureteroscopy stenting was done.

RIRS has been introduced in Bangladesh as a new technique on a regular basis. May be in our learning period we are more skeptical to dilate and use force to insert UAS, So pre-stenting and post-operative DJ stenting was done in 100% cases. Study published by Sabnis et al[21] has also shown that requirement of preoperative DJ stenting may be due to relatively small size ureter in Indian population.

The cost of flexible ureteroscope is also a very important issue.[18] With the advancement in technology and experience of urologists maintenance cost of flexible ureteroscope has come down. Use of UAS during RIRS prolongs not only life of flexible ureteroscope but also helps to decrease the intrarenal pressure during surgery and to remove stone fragments.[19,20] Keeping flexible ureteroscope in its straight position during stone fragmentation by relocating stones to upper or middle calyces also reduces the chance of instrument damage.[23] In present

study stones analysis was not done because stones were dusted and left in situ to be passed spontaneously. Till date ESWL and PCNL were used for the treatment of such stones but now RIRS is a viable alternative.

This study had shown that RIRS is safe and effective treatment for less than 15 mm renal stones of any location. Preoperative DJ stenting is only prerequisite of the treatment in learning period. Randomized control trial with more number of cases will address the real necessity for preoperative DJ stenting.

Conclusion:

Retrograde intrarenal surgery (RIRS) is an efficient and reliable method with lower complication, and higher success rates. Intrarenal access via a natural route without penetrating the parenchyma is its major feature. The length of this route as well as the delicacy and cost of the equipment are the major issues that should be overcome. However, considering the potential limitations of this study, further large-scale, well-conducted RCTs are required to verify our findings.

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