Flexible versus Rigid ureteroscopy in the management of proximal ureteric stones

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ABSTRACT

Objectives: Our study aims at researching the operative outcomes after using Flexible ureteroscopy (F.URS) versus rigid ureteroscopy (R.URS) lithotripsy for the management of patients with symptomatic proximal ureteric stones (PUS).

Materials and Methods: The (390) patients aged between 18 and 67 who underwent URS (F. vs. R.) for upper ureteric stones (From June 2017 to June 2018) at Prince Hussein Urology Center were found eligible to be enclosed during this retrospective study. Patients were divided into two equal groups with regard to the number of examined patients, (F.URS); the number of patients for group-1 was 195, (R.URS); the number of patients for group-2 was 195 as well. A number of chosen "Demographic characteristics" and "stones sizes" were collected at baseline; in addition to that, the categorical data were analyzed by SPSS version / 24. The Follow up period was estimated for at least 3 months. The Operative time was also calculated; the intraoperative and the post-operative complications were expressed by the "Clavien-Dindo" classification system.

Results: It was found that of the total number of the 390 patients, no statistical significant differences at baseline were found regarding ages, gender, stone sizes, laterality and opacity of the stones when both groups' results were compared: (the stone sizes P value was estimated at 0.36), (the laterality P value was estimated at 0.14) and (the opacity P value was estimated at 0.98). The mean operative time was shorter in the (R.URS) group in comparison to the (F.URS) group (40.9± 16.4, 52±13.81, P= 0.018). The (F.URS) group had a higher proportion for the stone clearance rate (P =0.007); the Perioperative complication rate was not statistically different (P= > 0.05).

Conclusion: The Operative time was less in (R.URS) and the stone clearance rate was considerably higher in (F.URS). Therefore, it was concluded that (R.URS) was less successful in the stone clearance rate, and hence should be used only as a second option as regards F.URS which must be used as the first viable option.

Keywords: ureteroscopy, flexible, rigid, lithotripsy, stones.

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Introduction

One of the most common types or sorts of urinary calculi could be the ureteral calculus; what makes this type most projecting is the manifestations of hematuria and renal colic; this sort of stone

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Has become and proved to be the reason for the deterioration of renal function; this is due to two main causes: obstructive uropathy and progressive hydronephrosis [1].

Ureteral stones are divided into three types in line with their location within the ureter; proximal (upper), mid and distal (lower) ureteric stones [2]. The Management of the upper ureteric stones includes medical intervention through the use of extracorporeal shock wave lithotripsy (ESWL) which will provide potential advantages when compared with different procedures in stones less than 1 cm in size; the second preferred option, particularly in stones more than 1 cm in size is ureteroscopy (Flexible, Semi vs. Rigid URS) which involves percutaneous nephrolithotomy (PCNL); taking into consideration that there is rarely any need for surgical open intervention or laparoscopic surgery [3].

While the well-preferred technique by specialists for removal of mid and distal ureteric stones is the URS, which mainly uses a rigid, semi-rigid, or flexible endoscope, improved ureteroscopes techniques and sizes have increased the employment of this modality for stone disintegration. Additionally, the ESWL can be used for the management of those stones; however, in case ESWL has become unsuccessful, or in the event that there have been factors precluding lithotripsies such as: pregnancy, coagulopathy, or morbid obesity, the employment of ureteroscopy becomes helpful [4]. Besides that, the comparison between the ESWL and the URS for ureteric stones has resulted in a lower stone-free rate in the ESWL group [5, 6].

On the one hand, the success rate of stone clearance by the URS is more or less (95-100%) for distal ureteric stones; it was (90-95%) as well for mid ureteric calculi; however, it was (70-100%) for upper ureteric calculi [7].

On the other hand, the use of the URS as a procedure itself is not without complications; based of clinical observation, there are a number of minor complication involved such as: (flank pain, dysuria, hematuria, "pushed back" stone, fever, urinary tract infection, and residual stones) ; however, there are also some major complications present such as: (stricture, perforation, and avulsion). Regardless of that, these complications have significantly been utterly weakened by the use of the flexible URS apart from the rigid URS primarily in proximal ureteric stones; yet, concerning the distal ureteric stones; the rigid URS remains in favor for being the most flexible one on account of easier stone manipulation and larger working channel as well for better irrigating flow and visualization [8].

The comparison between the flexible and the rigid URS (F. URS vs. R. URS) in reference to the upper ureteric stones will be discussed in this study according to the results that will be shown in the results section. We hypothesized there are no significant differences between (F.URS) and (R.URS) in operative outcomes which include (stone clearance rate, operative time, intra-and post-operative complications).

Materials and Methods

The medical files of the (390) patients (200 males and 190 females) with symptomatic proximal ureteric stones were found eligible to be enclosed during this quasi-experimental retrospective study from June 2017 to June 2018. These patients underwent URS (F. vs. R.) in Prince Hussein Urology Center at the Royal Medical Services of Jordan. These patients were divided into two teams respectively; group-1 (F. URS) which included (195) patients and group-2 (R. URS) which included the same number of patients (195).

The location of the stone was determined by the distance between the ureteropelvic junction and also the higher border of the sacroiliac joint. The exclusion criteria were: impaired renal functions, uncorrectable coagulopathy, pregnant, associated urinary tract pathology, and multiple ureteric stones.

Patients were diagnosed according to their records by detailed history and physical examination, laboratory results; (complete blood count, kidney function tests, urine analysis, and culture) and radiology investigations; (kidney, ureter and bladder X-ray (KUB) and non-contrast renal computed tomography CT).
The URSs were done in a lithotomy position after scrubbing all patients who were given general or spinal anesthesia. The third-generation cephalosporins (ceftriaxone 1 gr intravenous single dose) were given also to all patients before all operations. Then, a diagnostic cystoscopy was done by a 17Fr cystoscope that was used for retrograde pyelogram by retrograde angiocatheter 5Fr which facilitated the insertion of a 0.038 floppy-tipped hydrophilic guide wire through its lumen under the monitoring of fluoroscopy. After discharging the cystoscope and the angiocatheter, R. URS size 8 Fr (Karl Storz) or F. URS 7.5 Fr (Karl Storz) was inserted alongside the guide wire, then, after the visualization of the stone, the process of the disintegration of the stones was completed by a pneumatic lithotripter (R. URS) or a 230-micron holmium laser fiber at an energy level of 0.6-1.2 J and at a rate of 10Hz for both (R. and F. URS) beside the using of URS forceps to extract the fragments of stones which were more than 2 mm in size. If the stone was pushed back to the kidney and all manipulations have failed or any major complication may have occurred during the process, then, double j catheter (DJC) size 5-7 Fr was inserted inserted then follow up by (KUB or CT) to decide for alternative management option later.

F. URS was done by the same steps that mentioned in R. URS technique till the discharging of the cystoscope and the angiocatheter, then a Flexible ureteral access catheter was used for insertion of a second 0.038 inch guidewire over which a ureteral access sheath was introduced, then F. URS was inserted to the ureter to disintegrate the stones by using 230-micron holmium laser fiber at an energy level of 0.6-0.8 J and at a rate 10-25Hz. Residual fragments < 2mm were left in place and DJC was inserted for complicated procedures.

A Follow up of the patients once the procedures was done by KUB was done instantly post operations then, another follow up was made by nonenhanced renal CT three months later.
Perioperative (minor complications from grade 1 to 2) such as: hematuria, fever, urinary tract infection and renal colic ;(major complications from grade 3 to 5) such as: the ureteral perforation, avulsion, stricture, and even patient death) have all been assessed with reference to the Clavien-Dindo classification of surgical complications [9].
The Categorical data have been expressed in percentages, quantitative data have been expressed in mean ± SD; moreover, Normality has been assessed by Kolmogorov–Smirnov test; in addition, the equality of variances was tested by the Levene's test. An independent t-test was used for groups' differences in scale outcome, the Chi-square was used for proportional differences, the alpha level (P-value) set at 0.05 was considered statistically significant, and a study power of 80% with medium effect size and SPSS version 24 was used to analyze data.
The Ethical committee approval was granted from our Royal Medical Services institution for the publication of this study.

RESULTS

The total number of patients was 390 divided into two groups; every group contains 195 patients. Their age range was from 18 to 67 years; group-1 (18-62 years), group-2 (20-67 years). The information that was collected from the patients' files was retrospectively analyzed; we have arrived at a number of conclusions and the subsequent results were found:

Firstly, the number of male patients is two hundred, while the number of females patients is one hundred ninety; the right side ureteral stones were 183, whereas the left side stones were 207; the stones sizes were from 0.7 to 1.7 cm (group1 0.7-1.4 cm vs. group2 0.9-1.7 cm); The stone opacity was radiopaque in a number of 357 patients and radiolucent in the remaining 33 patients respectively for the total number of patients. Detailed results with percentages regarding the total number of patients, mean± SD and significant P-value < 0.05 for each group were presented in **Table I** (Demographic data).

Table I: The Demographic data of the patients.

Variables	**Group-1**	**Group-2**	**P-value**
Mean age (year)± SD	38.7± 11.58	40.4± 12.7	0.67
Gender M-F (N*/ %)	87-108/22%-28%	113-82/29%-21%	0.29
Stone size (mean± SD) cm	(1.04± 0.225)	(1.25± 0.256)	0.36
Laterality of the stones (N\ %) RT. LT.	 (97/25%) (98/25%)	 (86/22%) (109/28%)	0.14
Stone opacity (N/ %) Radiopaque Radiolucent	 (177\45.4%) (18\4.6%)	 (180\46.1%) (15\3.9%)	0.98

*Number of the patients

In **Table II**, we have a tendency to place the categorical data of the patients concerning every group in relation to: success rate of stone clearance, operative time and perioperative complications (intraoperative and postoperative) from grade-2 such as: hematuria ("43" patients in group-1 vs. "61" patients in group2), fever ("11" patients in group-1 and "13" in group-2), urinary tract infection ("2" patients in group-1 vs. "1" patient in group-2) and renal colic ("5" patients in group-1 and "7" patients in group-2) ; concerning grade 3b such as: the ureteral stricture ("1" patient in group-1 vs. "1" patient in group-2); with regard to perforation ("0" patients in group-1 and "2" patients in group-2). They were presented by mean± SD and P-value considered statistically significant < 0.05.

Table II: The Categorical data of the patients.

Variables	Group-1	Group-2	P-value
Stone clearance rate (N/ %*)	(176/90.3%)	(140/72%)	0.007
Complication rate (N\ %)	(62/32%)	(85/44%)	0.21
Operative time/ minutes (mean± SD)	(40.9± 16.43)	(52± 13.81)	0.018

*Percentages according to the number of patients for each group

DISCUSSION

In the above mentioned results, we have a tendency to notice that F.URS took an extended operative time for the management of the proximal ureteric stones and a higher success rate for stone clearance, whereas there have been no significant variations between both techniques (F. vs. R.URS) regarding the perioperative complication rate. Consequently, to increase the stone free rate, using the F.URS is highly preferable and advisable.

Karadag MA et al. reported that the F.URS is a favorable option for the treatment of the upper ureteric stones due to a higher stone free rate that supports our analysis [10]. Additionally, Galal EM and colleagues suggested that because the R.URS is less successful for the treatment of proximal ureteric stones, it should be used cautiously with the availability of the F.URS [11].

On the one hand and due to the high cost and the less availability of the F.URS in some centers, semi or R. URS can be an acceptable alternative option for the clearance of upper ureteric stones despite the less success rate than the F.URS, Kotb YM et al. and Yuskel OH et al. [12, 13].

On the other hand, Alkan E and colleagues recommended the employment of the F.URS as a primary option of treatment of the upper ureteric stones because of the less complication rate, while there was no statistical distinction within the effectuality between each teams of the study, that within the contrary of our results [14].

Takazawa R et al. and other literature reported that F.URS has become the more effective and safer treatment selection of the whole upper urinary tract stones, however, the stone clearance rate decreases once the size of stone becomes larger [15, 16].

Oitchayoma and associates also noted that the size of the upper ureteric stone plays a role in the operative time, and both procedures (F. vs. R. URS) can be carried out in outpatient department [17].

Therefore, R. or semi rigid URS with holmium YAG laser can be used as a day case operation for upper ureteric stones, but patients should be informed about the slightly high risks with this technique [18].

Finally, to avoid additional ESWL, combination of both techniques after the proximal ureteric stone had been pushed to the kidney could be efficacious [19].

CONCLUSION

The R.URS has a shorter operative time when compared to the F.URS and fewer effective rates regarding stone clearance rates, while in different variables such as: the complication rate and patients vs. the stone characteristics, there have been no significant variations. This makes the F.URS as the most popular and viable possibility and option for the management of the upper ureteric stones due to the higher stone free rate which decreases the requirement for one more endoscopic session or alternative surgical treatments.

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