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Ureteral Stenting after Ureteroscopy for Stone Treatment, Prospective Study on Indications and Outcomes

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Abstract: Ureteroscopy (URS), is an appropriate option for the management of ureteral stones. Advances in working instruments and lithotripsy devices have enabled urologists to perform successful URS rendering the patient stone-free without complications. The need to place a DJ after URS is controversially discussed in literature and depends on the subjective discretion of the treating urologist. However, the majority of studies suffer from retrospective design and low patient number. **Aims:** The aim of this work is to analyse the postoperative ureteral stenting strategy in clinical practice after URS for stone treatment looking at the indications, outcome, types of stents used and the duration of stenting after ureteroscopy for stone treatment. **Place and duration of the study:** This study was carried out at the Department of Urology, the University of Tanta, Egypt, between March 2019 and February 2020. **Methodology:** This was an observational study that was carried out on 600 consecutives candidates for ureteroscopy to evaluate indications, outcomes of post-operative stenting. **Results:** In our department we followed the AUA guide lines for placement of double-J stent post URS as we placed it for the following reasons dilation of the ureteric orifice either by balloon (89.8%) or UAS (4.9%), intraoperative complications as following traumatic injury of the mucosa (15.3%), migrated stones in (4.3%) and perforation in (3.1%). Other reasons included; edema at the site of stone impaction (8.98%) stricture ureter (4.92%) solitary kidney (3.7%) impaired renal function (9.8%) large fragment that left for spontaneous passage (5.5%), surgeon's 's preference at the end of procedure (4.9%) and long operative time in (12.5%). In our series we found that (53%) of the presented patients didn't require stenting post ureteroscopy. It was also noted that balloon dilation was the main reason for post-ureteroscopy stenting. **Conclusion:** From this study we suggested that the use of post uretroscopic stenting is justified only in complicated cases, impaired renal function, single kidney, or a need for additional intervention as mentioned by the AUA guidelines. The use of post ureteroscopy double JJ stents should be judicious, because most of the candidates are at the working age and the indiscriminate routine use of stents would not only affect the quality of life, add cost, but would also affect the career of the patient.

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Keywords: Ureteric stones, ureteroscopy (URS), Double J (JJ) stents, Ureteicballon dilation, and ureteric edema.

1. Introduction

Stone disease is a common problem, about 7% of women and about 11% of men will develop stone sometime in their life.[1] The management of stone disease consumes a lot of economic resources per year.[2]

The optimal choice of ureteral calculus management depends on various factors including: stone size, composition, location, degree of obstruction, treatment cost, available equipment and surgeon skills.[3]

Ureteroscopy is an appropriate option for management of ureteral stones. Advances in working instruments and lithotripsy devices have enabled urologists to perform successful URS rendering the patient stone-free without complications.[4]

In 1999 Hosking et al, raised the question of the rationale for the routine use of post ureteroscope stents, and since then, such use has been debatable.[5]

Stenting after ureteroscopy thought to guard against renal colic and ureteral obstruction that may occur as a result of edema or inflammation of ureteral mucosa at the stone location.[6] Stenting is thought to promote healing of mucosal injuries, passage of stone fragments, and may reduce the incidence of late complications such as ureteral stricture.[7]

The use of these stents is not free of limitations and complications including hematuria, urinary tract infection, stent migration within the urinary tract, stent encrustation and retained stents. Rare complications include stent migration out of the urinary tract, such as into the inferior vena cava,

reflux anuria following removal of bilateral ureteral stents, and arterial-ureteral fistula.[8]

In two published meta-analyses concluded that UTIs, ureteral strictures, unplanned emergency visits, stone-free rates were not appreciably different between stented and unstented patients. Also, patients without stents also typically reported less flank pain and fewer lower urinary tract voiding symptoms. [910]

According to AUA guidelines stenting post URS is indicated in the following situations; traumatic injury during URS, those with evidence of ureteral stricture or other anatomical impediments to stone fragment clearance, such as ureteral wall edema, a large stone burden (>1.5 cm), those who have an anatomically or functionally solitary kidney or renal functional impairment, and in those in whom another ipsilateral URS is planned, stent placement should be strongly considered.[11]

The aim of this work is to analyse the postoperative ureteral stenting strategy in clinical practice after URS for stone treatment looking at the indications, outcome, types of stents used and the duration of stenting after ureteroscopy for stone treatment.

2. Patients and methods

1. Study design

This was observational study that was carried out on 600 consecutives candidates for ureteroscopy to evaluate indications, outcomes of post-operative stenting. All procedures were performed at the department of urology of Tanta University Hospital between February 2018 to March 2020 the data was interpreted as following.

1-Patients

Patient selection

1. Inclusion criteria:

Adult Patients >18 years old who were candidate for ureteroscopic treatment of a ureteric stone.

2. Exclusion criteria:

- Patients <18 years old.
- Patients unfit for surgery.
- Pregnancy.

Patient evaluation

All patients included in our study were subjected to:

1-Baseline characteristics including:

Demographic data including age, gender and BMI.

Medical history including history of urological diseases or surgery and other comorbid conditions e.g Diabetes Mellitus, Hypertension or cardiac disease.

2- Clinical examination including:

- Vital data.
- Systemic examination.
- Local examination.

3-Laboratory investigation as:

- Renal function test.
- CBC.
- Urine analysis.
- Urine culture when indicated.
- Liver function test.
- Coagulation profile.
- Fasting and PP blood sugar.

4- Radiological evaluation as

- PUT plain urinary tract.
- Pelvi-abdominal Ultrasound.
- NCCTUT: to evaluate stone site, size, number, stone burden and presence of hydronephrosis.

2-Methods:

1-Preoperative Preparations:

All patients were instructed to sign an informed consent explaining the procedure and potential complications. Preoperative antibiotics were administered as single dose of 1gm broad spectrum potential antibiotics (third generation cephalosporin) for all patients one hour prior to the procedure.

2- Operative Technique:

A. Anesthesia: General or spinal anesthesia was used according to the patient suitability.

B. Sterilization: Sterilization of the genitalia and toweling was done before the procedure.

C- Positioning of the patient: Ureteroscopy was done in the dorsal lithotomy position.

D- Visualizing urethro-cystoscopy: Visualizing cystoscopy was performed to identify the ureteric orifice. The targeted ureteric orifice was cannulated via insertion of ureteric catheter over (0.035 inch) guide wire under fluoroscopic assistance into the renal pelvis (Fig.1). Then in most cases a retrograde pyelography was done to determine the upper tract anatomy. In many cases two wires placed into the renal pelvis; one wire was the working wire, used for the passage of the ureteroscopy. The other wire was a safety wire, which provides continuous access to the kidney if there were any difficulties.

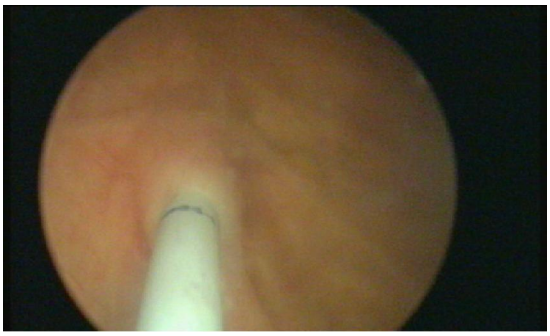

Figure 1 insertion of open ureteric catheter over guide wire

E - Ureteral dilation:

It was done by dilating balloon which were passed over the guide wire or by UAS. Passive dilation was also practiced by placement of DJ 1-2 weeks prior to URS.

F-Scope used:

Either semi-rigid (9) Fr ureteroscope (KARL STORZ SE & Co. KG, Tuttlingen, Germany) or flexible URS 8 Fr. (KARL STORZ Flex-x^{c}, Germany.) were used.

G- Stone manipulation:

Figure 2 holmium 100 wv versa pulse device

The stones were removed as intact stone, fragmented using pneumatic lithotripter " (EMS SA, Nyon, Switzerland) or holium: yttrium-aluminum-garnet (Ho:YAG) (Versa Pulse Power Suite 100w) (Fig.2). A 200-µm holmium laser fiber was used (Fig.3). The settings adjusted on 0.6 J pulse energy at a rate of 6 to 8 Hz. The pulse energy can be raised up to 0.8 J or 1.0 J for tough stones, and the frequency can be increased up to 20 Hz if necessary. The fiber tip should be visualized few millimeters away from the tip of the ureteroscope before firing the laser (Fig.4). The fragments extracted under vision using ureteral forceps, dormia basket or left for spontaneous

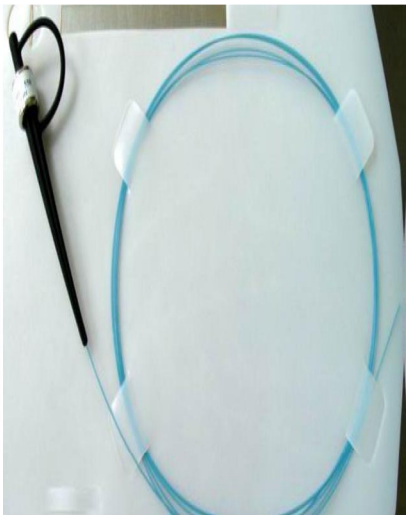

Figure 3A Slimline SIS 200-µm Reusable Laser Fiber

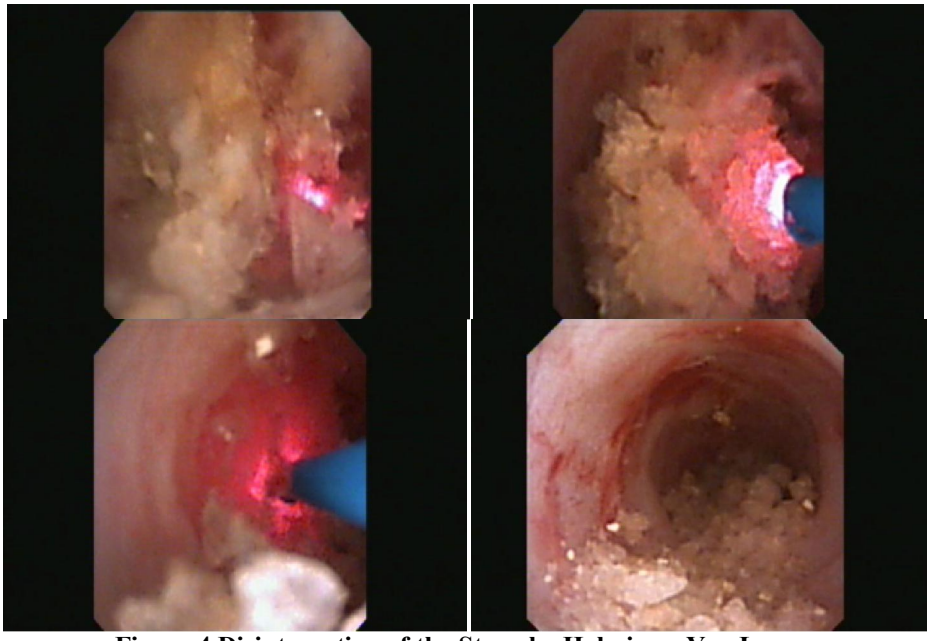

Figure 4 Disintegration of the Stone by Holmium: Yag Laser.

H-Post-operative stenting:

Post-operative stent strategies were recorded as (no stent/JJ/ ureteric catheter) if yes; reason for stenting was recorded.

Also stent type, length, size and duration were recorded.

3- Operative data:

The operative data we rerecorded:

- Type of the scope used.
- Type of ureteral dilatation.
- Duration of procedure: from insertion of the URS till stenting of the ureter.
- Intraoperative complications.
- Stone free state by visual evaluation at the end of the surgery (yes, no)
- Stone extraction method.
- Fragmentation type (pneumatic, LASER)

4-Postoperative data:

- **Analgesics** were given when indicated. (dose, and type NSAID or narcotic)
- **Pain**: Using the numerical rating scale (NRS) to evaluate its intensity. Pain was described as mild (0-3), moderate (4-6) and severe (7-10).
- **Hospital stay:** Length of hospital stay (days): The length of postoperative hospital stay for each patient was recorded.
- **Post-operative complications**: during the follow up period.
- **Assessment of the stone free status and need for additional intervention** was carried out at the time of stent removal by PUT or NCCT when indicated.
- **Evaluation of stent related symptoms**

The evaluation of the stent related symptoms was done two weeks after surgery or at time of stent removal, all patients asked to come again into the hospital to assess stent related symptoms using validated Arabic linguistic version of the ureteral stent symptoms questionnaire.[12]

5-Stent removal

Stent removal: Duration of stenting were recorded. Stent removal occurred in the operative room under general or local anaesthesia.

Statistical Analysis

Continuous variables were summarized using means or medians based on the normality; normally distributed variables were summarized using the mean and standard deviation (SD), while the non-normally distributed variables were summarized using the median. Categorical data were summarized as the frequency and percentages. All data are collected from the registry system of Tanta urology department powered by file maker pro 2017 and analysis and statistics were done by IBM SPSS software (version 21)

3. Results

Six hundred successive uretroscopic procedures were evaluated to analyse the postoperative indications and outcomes of ureteral stenting. Of those 600 patients, 255 patients didn't need double- J stent and the procedure of those patients ended either by insertion of nothing (n=81) or open tip ureteric catheter for 48 hours (n=174). Double -J stent placement was required in the others 345 patients.

The data of the 600 cases was interpreted as following.

1. Pre-operative data:

A-Demographic Data

In our study, 402 patients were males (67%), while 198 patients were females (33 %), age ranged from 23 to 69 years, mean ± SD was (42.63 ± 12.19). Mean body mass index (BMI) ±SD was 28.94 ± 4.09.

B-Medical history and comorbidities:

In our series, 240 patients (40%) had no medical problem. 65 patients (10.8%) known to be hypertensive, and 108 patients (18%) known to be diabetic. 67 patients (11.16%) were known to have BPH, 412 patients (68.6%) were treated by MET. Impaired kidney function was recorded in 34 patients (5.6%) (Fig.5)

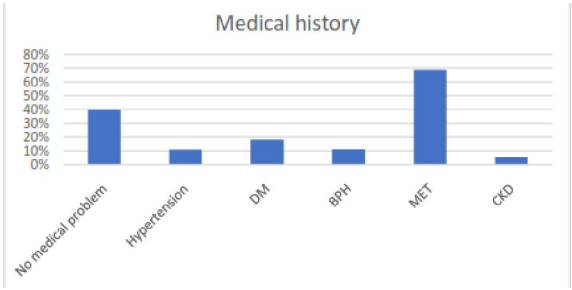

Figure 5Medical History

C-Operative history of previous stone management:

Figure 6 depicts the operative history of our patients

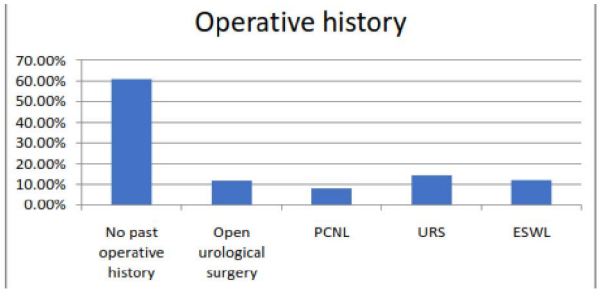

Figure 6Operative history of stone management

D- Preoperative radiological data:

Regarding the side of the stone, two hundred fifty-six patients (42.6%) had right sided stone, 289

patients (48.1%) had left side stone, and bilateral ureteric stones were reported in 55 patients. Single stone was found in 496 patients (82.6%) while multiple stones were found in 104 patients (17.3%). In three hundred seventy-one patients (61.8 %), the stone was located at distal ureter VS. 157 and 72 patients had mid ureteric stones and proximal ureteric stones respectively. As regard the pre-operative hydronephrosis, 337 patients (56.1%) had mild hydronephroses, 141 patients (23.5%) had moderate HUN, and 122 patients (20.3%) had severe HUN. The stone size was ranged from 0.7 mm to 2.5mm with mean ± SD of 8.53±3.1 mm.

E-Placement of ureteric stent prior to URS

Double-J stent placement in the ureter before ureteroscopy was reported in our study in 109 cases (18.1%) for the indications shown in (table 1).

Table 1 Reason for placement of stent prior to URS

Total number 109 patients		
	Number	**Percent**
Drainage of infected hydronephrosis	42	38.5%
Passive dilation	22	20.1%
Calcular anuria	38	34.8%

It was noted that in cases in whom placement of stent before URS was performed (n=109), 58 patients didn't require stenting (Fig. 7).

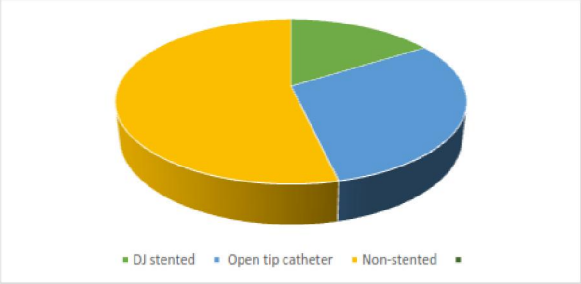

Figure 7 Impact of presenting on postoperative stenting

As regard to indwelling duration in cases where double-J was placed prior to URS for passive dilation it varied as shown in (Table 8). 87.5% of urologists maintained the stent for 7 days VS 12.5% for 8-14 days.

2. Intra-operative data:

A-Scope used

Semi-rigid 9 Fr. ureteroscope (KARL STORZ SE & Co. KG, Tuttlingen, Germany) was used in (85.5%) of cases, while flexible URS (Karl Storz 8 Fr.) was used in (14.5%) of cases. In our series, in the cases where the flexible URS was used postoperative stenting was performed in 58% of cases. While in those where semirigid URS was used postoperative stenting was performed in 67% of cases.

B- Dilatation of UO

In the current study, balloon dilation was performed in 468 cases (78%). While UAS (12/14 in 17 cases, 10/12 in 6 cases) and prestenting was performed in 23 cases (3.8%) and 109 cases (18.1%) respectively.

C-The operative time

Mean operative time plus or minus standard deviation for stented patients was 42 ± 15 minutes and 37± 20 non-stented patients. Thus, operative time was not significantly longer when a stent was placed (*p value=0.516).*

It was noted that 28% of the urologist considered placement of double-J stent post-operative (n=43 cases) when operative time is prolonged more than 60 min.

D-Intraoperative complications:

Complications were encountered in 81 cases (14.5%) The details of these complications were as followings:

1-Bleeding:

Bleeding was reported in nine patients (1.6%) due to trauma to the ureter during fragmentation of the stone. In three patients the procedure was stopped as the bleeding obscured the vision which treated with stent placement for 2 weeks and 2nd session URS**,** while in the other six patients double-j stent was inserted after the completion of the procedure.

2- Perforation:

Perforation was reported in 11 patients (1.8%). Perforation of the ureter treated by stent placement for 4 weeks. Two cases underwent revision URS after 1 month.

3-Stone migration:

The stone was migrated proximally in 15 patients (2.5%) and they were treated either by ESWL in 9 patients or FURS in 6 cases, placement of stent was performed in all cases.

4- Mucosal damage:

In the current study, ureteral major mucosal injury that required stenting was reported in 44 patients (7.3%). And post-operative stent was inserted for two weeks, while minor trauma occurred in 67 cases and was managed by ureteric catheter for 48 hours.

E- Stone free rate by visual evaluation at the end of the operation

In the current study, the overall stone free rate by visual evaluation at the end of the operation was (93.5%).

F - Reason for DJ stenting post URS (Table 5)

3-Post-operative data:

At the first day:

A-Post-operative need for analgesia

The need for analgesics was reported at the evening of the operation and 24-hour post-operative. It was noted that unstented patient needed more antalgics than double-J stented, or open tip stented patients and this difference was statistically significant. The analgesics were given in the form of in the form of (Diclofenac Potassium 75 mg amp PRN). Narcotics was used in 34 cases who had impaired renal function and were excluded from the comparison.

Table 2 Reason for placement of DJ stent post-operative

Reason for placement of DJ stent post-operative (n=60)		
Reason for Stenting	**Number**	**Percent**
Intraoperative complications		
- **Traumatic injury of the mucosa**	53	15.3%
- **Migrated stone**	15	4.3%
- **Perforation**	11	3.6%
After balloon dilation	310	89.8%
Edema at the site of stone impaction	31	8.9%
Stricture ureter	17	4.9%
Impaired renal function	34	9.85%
Single kidney	13	3.7%
Significant residual fragments	19	5.55%
Surgeon's preference at the end of surgery	17	4.9%
Use of UAS	17	4.9%
Long operative time	43	12.5%

B-Post-operative pain

The pain was evaluated by numerical rating scale and it was descried as mild (0-3), moderate (4-6) and severe (7-10). In our series, it was noted that the mean pain score at the evening of the operative day was 4.82 ± 0.96 in the double-J stented patients, 5.23 ± 0.95 in the open tip stented group, and 6.23 ± 0.67 in the non-stented patients. However, after 24-hour post-operative non-stented patients had higher pain scores stented than open tip stented or double-J stented cases (8.9 ±3.2 vs 4.5 ±3.2 and 3.9 ±1.9).

D-Post-operative follow up:

During the follow up period 89 cases missed follow up. Of those 89 cases 32 cases were stented patients and they were excluded at this point of the study. Interpretation of the post-operative data as follow.

1- Post-operative complications table

Figure8 depicts postoperative complications.

2- Evaluation of stone free rate and the need for additional intervention:

All the stented patients performed PUT at month post-operative to detect the position of the double-J and stone free status. NCCT was done in 36 patients who had preoperative radiolucent stones. and the overall stone free rate was 94%. In the current study, 33 cases needed additional intervention to achieve stone free status post URS. It was reported that after additional intervention the stone free status was 100%.

Stent removal:

The duration of stents in our study ranged between two to seven weeks with a mean 2.6 ± 1.6. All those cases stents were removed in the operative theater by cystoscopic forceps under either general anesthesia (87.3%) or local anesthesia in (13.7%) all were female patients.

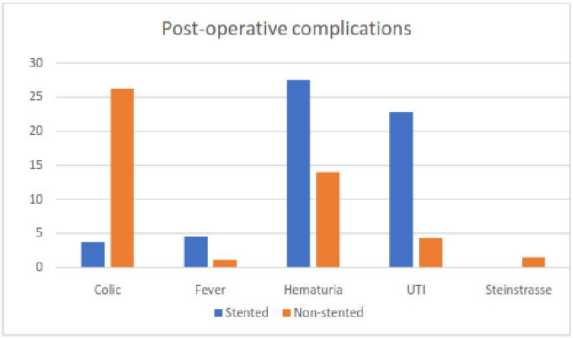

Figure 8 Post-operative complications

4. Discussion

Since their first description in 1967 by Zimskind et al,[13]the double-J catheters and their further modifications have been a useful addition to the

urologic armamentarium. In 1999 Hosking et al, [5] raised the question of the rationale for the routine use of post ureteroscope stents, and since then, such use has been debatable.[5]

According to AUA guidelines stenting post URS is indicated in the following situations; traumatic injury during URS, those with evidence of ureteral stricture or other anatomical impediments to stone fragment clearance, such as ureteral wall edema, a large stone burden (>1.5 cm), those who have an anatomically or functionally solitary kidney or renal functional impairment, and in those in whom another ipsilateral URS is planned, stent placement should be strongly considered.[11]

Preoperative placement of double-J stent to improve the operative outcomes is debatable. Rubenstien reported higher stone-free rates in patients with prior stenting.[14] On the other hand, the AUA panel recommended against the routine placement of a stent prior to ureteroscopy with the aim of increasing the stone-free rate, as this is likely to increase the cost of surgery and reduce the patient's quality of life.[11]

Similar to the AUA guidelines, none of our cases had a routine preoperative stent placed. Out of 109 cases underwent preoperative placement of JJ stent, forty-two were stented for the drainage of infected hydronephrosis, twenty-two cases for difficulty passing the ureteroscope even after dilation and thirty-eight cases to drain calcular anuria. The pre-stented patients in our study showed a stone-free rate of 98%. It was noted that in cases where stent placement was performed before URS 58 patients (53%) didn't require stenting.

Balloon dilation of the ureteric orifice is a common practice in our department, performed in 78% of cases in our study, to facilitate passage of the scope and to allow for more rapid, less forceful access, which is important if multiple passes of one or multiple ureteroscopes are necessary.

The pattern of stent placement after ureteral dilation is still controversial. Başeskioğlu et al,[15] reported that balloon dilation is not a significant reason for stent placement after ureteroscopy as patients without stents had similar ureteral stricture rates.

In our study, it was noted that in cases where balloon dilation was done (n=486), post-operative DJ-stenting was performed in most cases (89%). Similarly, in Auge survey, it was observed that if the ureteral orifice was dilated, 50.3% of urologists would place a stent in the ureter 100% of the time.[16]

In the current study, pneumatic lithotripsy was used in 293 patients (48.8%) while LASER lithotripsy was used in 190 (31.6%) patients. In one hundred and two patients (17%) the stone was extracted without fragmentation as intact stone, either by dormia basket or grasper.

The correlation between the type of lithotrite and complication rate is questionable. Electrohydraulic lithotripters were known to be more traumatic to ureteral mucosa when compared to other methods (ultrasonic, or laser devices).[17]The literature is not clear regarding whether stent placement can be eliminated safely by using one of these technologies in head-to-head comparison with the others. Sun et al,[18] suggested placing a double-J stent after pneumatic fragmentation in order to avoid ureteral obstruction secondary to mucosal edema, hemorrhage or tear. On the other hand, Hosking et al,[5]concluded that stent placement is unnecessary as long as there is no major trauma to the ureter. In our series, pneumatic lithotripsy was used in 293 patients (48.8%) while LASER lithotripsy was used in 190 (31.6%) patients, of those 322 underwent DJ stenting post URS (62.7% after pneumatic lithotripsy VS 51% after LASER) and this was found to be statistically significant.

Intraoperative bleeding occurred in nine (1.6%) of our patients. This was likely due to trauma to the ureter especially during fragmentation of the stone. Bleeding obscured proper visualization and the procedure was aborted in three cases and double-J stent was inserted for a second session URS three weeks later. However, as many previous reports, bleeding did not preclude completion of the procedure.[1920]

Ureteric perforation occurred in eleven of our patients (1.8%). This was managed by stent placement for 4 weeks. Revision URS was required in two cases because of large stone burden, stone impaction and longer operative time. Similar results were reported by in many studies.[18]

In our series, stone migration occurred in 15 patients (2.5%). In two cases the stone had an upper location, in one patient stone impaction was recorded, and 12 cases had severe hydroureteronephrosis. The reported figures in the literature for similar groups of patients, ranged between 0.4% to 9 %, with the same risk factors as in our cases.[19 20]

Mucosal laceration existed in forty-four patients in our series. This represents 7.3% of the candidates for ureteroscopy and 15.3% of the stented group. According to the AUA guidelines, mucosal edema and laceration indicate stenting.[11]It's worth mentioning that the presence of such mucosal damage did not preclude completion of the procedure. Similar findings were reported by many authors.[19 20]

Post-operative ureteric stricture is a serious complication that may eventually lead to renal failure. No case of post-operative ureteric stricture was recorded in our series. This may be partially explained by the short postoperative follow-up course in our

series. The reported figures in the literature range between 0.4% to 7.8%.[19 20]

In our study, the stone-free rate assessed after one month was 93.5%. The reported figures in the literature, ranges between 83% and 95%. 106 102 Following auxiliary procedures, our final stone-free rate reached 100%. Stone-free rate is related to stone location, stone burden, and the method of lithotripsy.

In our study, in the early post-operative period, it was observed that non-stented patients experienced pain more than stented patients and they required more analgesics to relieve the pain and the difference was statistically significant.

In our study we readmitted 2 stented cases and one non-stented case to control fever. The management was empiric broad spectrum antibiotics for 3 days pending culture results. The infection subsided and didn't necessitate intervention except in one non-stented patient who required percutaneous nephrostomy to drain the obstructed infected system.

Stent duration in our study varied from 2-4 weeks. Currently, there are no reports on the effects of long-term use of DJ stents after URS. However Canepa et al,[21] suggested that DJ stents should be removed within 3–7 days after uretroscopy, Katsumi et al,[22] suggested that we need to study shorter durations of DJ stenting prospectively in cases without ureteral injury.[22]

Routine placement of a ureteral stent after URS adds an extra procedure for stent removal. In our study, stents were removed in the operative theater by cystoscopic forceps under either general anesthesia (87.3%) or local anesthesia in (13.7%).

Our study has some limitations; short follow up period and the absence of cost consideration.

Conclusion

From this study we suggested that the use of post uretroscopic stenting is justified only in complicated cases, impaired renal function, single kidney, or a need for additional intervention as mentioned by the AUA guidelines. The use of post ureteroscopy double JJ stents should be judicious, because most of the candidates are at the working age and the indiscriminate routine use of stents would not only affect the quality of life, add cost, but would also affect the career of the patient.

Competing interests

All authors declare that no competing interests exist.

Consent

All authors declare that "a written informed consent was obtained from each patient".

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