Laparoscopic ureterolithotomy: bridging the gaps between open surgery and ureteroscopy and/or shock wave lithotripsy

Hani Nour, Mohamed Wishahi, Khaled Elesaily, Mohamed Badawy

Department of Urology, Theodor Bilharz Research Institute, Cairo, Egypt

Correspondence to Hani Nour, MD, Department of Urology, Theodor Bilharz Research Institute, El Nile Street, Embaba, Giza, PO Box 30, Cairo 12411, Egypt
Tel: +20 122 224 7437;
e-mail: haninour75@gmail.com

Received: 30 November 2020
Revised: 21 December 2020
Accepted: 21 December 2020
Published: 18 May 2021

The Egyptian Journal of Surgery 2021, 40:393–398

Background
Ureteroscopic procedures together with shock wave lithotripsy are the standard of care for patients with symptomatic ureteral stones; in cases with large (>20 mm) and/or impacted stones, laparoscopic ureterolithotomy can be considered an alternative to open surgery, as it is less morbid with high stone-free rates.
Patients and methods
A retrospective study of patients enlisted for active ureteral stone treatment was conducted. Files of 945 patients were reviewed and analyzed in term of stone size, number, and history of previous stone procedures. A total of 73 patients were included; they had transperitoneal ureterolithotomy for either proximal or distal ureteral stone(s).
Results
Mean stone size was 31.7±8.5 mm, and median stone number was 1 (1–3). A total of 48 patients had proximal ureteric stones, whereas 25 had distal ones. Mean operative time was 96±19.2 min, stone-free rate was estimated to be 97%, and procedure was aborted in two patients. Complications were reported in 16%, with no grade 3 complications according to Clavian–Dindo classification. Mean hospital stay was 3.2±1.1 days.
Conclusion
Laparoscopic ureterolithotomy is to be considered for the treatment of large ureteric stone when other minimally invasive modalities are not available; it can bridge the gap between the minimally invasive procedures and conventional open surgery.

Keywords:
laparoscopy, ureteric stone, ureterolithotomy

Egyptian J Surgery 40:393–398

1110-1121

Introduction

Urinary stone disease represents a major bulk of urological practice. It is considered the third most common urological condition after urinary tract infection and prostate diseases [1], with incidence and prevalence steadily increasing across the world, with peak age of incidence between 30 and 55 years, presenting a huge economic burden, especially in developing countries [2].

Various interventional and noninterventional treatments exist, yet the need and type of intervention depends upon several factors, including site of the stone, its size, density and composition, patient presentation, anatomy, and associated comorbidities, as well as availability of equipment and urologist training [3].

Endourological procedures and shock wave lithotripsy (SWL) are the main surgical options for stone disease. Percutaneous nephrolithotomy achieves stone-free rate (SFR) up to 90% for large (>2 cm) renal stones [4], whereas SWL achieves similar results in stone smaller than 2 cm located within the kidney [5].

Stone located in the ureter can be classified according to their anatomical site. Proximal ureter is defined as the part of the ureter extending from the pelviureteric junction to the pelvic inlet, whereas distal ureter extends from the pelvic inlet to the ureterovesical junction [6].

Medical expulsive therapy can be considered as the first step in the management of noncomplicating ureteral stones, whereas in case of stones with a low likelihood of spontaneous passage and/or complications (fever, intractable renal colic, and failure to pass), surgical intervention become a must [3,7]. Semirigid URS with stone removal is the standard of care in distal ureteric stones, whereas SWL or flexible URS is used for more proximal stones achieving comparable SFR in most of series, although flexible URS has the advantage of less auxiliary procedures [8].

 DOI: 10.4103/ejs.ejs_372_20

In patients with large (>20 mm) ureteric stones, SWL is a validated option for proximal stone, although reported lower SFRs, and multiple auxiliary procedures in comparison with URS. Flexible URS depends upon availability of the equipment, with the need of laser machine for stone disintegration with its related costs [9]. Another management dilemma is the presence of impacted ureteral stone, defined as stone that remained in the same position for at least 2 months with failure in visualization of the contrast material in the ureter distal to it; these impacted stones are difficult to manage, and usually multiple procedures are required [10].

Open surgery for ureteric stones has its drawbacks, with negative effect on patient's quality of life in relation to minimally invasive endoscopic procedures and SWL. It is usually reserved for complex cases or in area where modern endourological equipment are not available [11]. Laparoscopic ureterolithotomy can bridge the gap between endourology and conventional surgery. Laparoscopic surgery mimics conventional surgery with less morbidity. Laparoscopic equipment is widely available in almost all surgical suites, and laparoscopic training for urologist is now part of their clinical training program in most of the centers; moreover, it can be acquired under supervision of more experienced general surgeon [12].

Patients and methods

A observational study was conducted following the tenets of Helsinki declaration. The files of 945 patients enlisted for active stone management in the Urology Department, Theodor Bilharz Research Institute, were retrieved and reviewed.

Inclusion criteria

The following were the inclusion criteria:

(1) Age more than 18 years.
(2) Ureteral stone(s).
(3) Laparoscopic ureterolithotomy.

Exclusion criteria

The following were the exclusion criteria:

(1) Nonlaparoscopic stone management.
(2) Concomitant kidney stones.
(3) Congenital renal and/or ureteric anomalies at the stone site.
(4) Incomplete files.

Stone(s) site was classified according to its anatomical location into proximal ureteric stone(s), extending from just below the ureteropelvic junction reaching the upper edge of sacral promontory, and distal ureteric stone(s), extending from the sacral promontory to the ureterovesical junction (Fig. 1).

All patients had preoperative non-contrast-enhanced computed tomography of the abdomen and pelvis. Contrast pyelography was done when enhancement and visualization of the collecting system was needed. Sterile urine culture was documented before intervention; patients with positive culture or presence of nephrostomies were treated for 48 h before intervention, and treatment continued to a total of 14 days.

The study characteristics included patient's age, sex, stone (size, site, number, density, and laterality), and history of stone surgeries or extracorporeal SWL on same site. Collected operative data included operative time, volume of intraoperative blood loss, and need for transfusion, together with the frequency of conversion to open surgery.

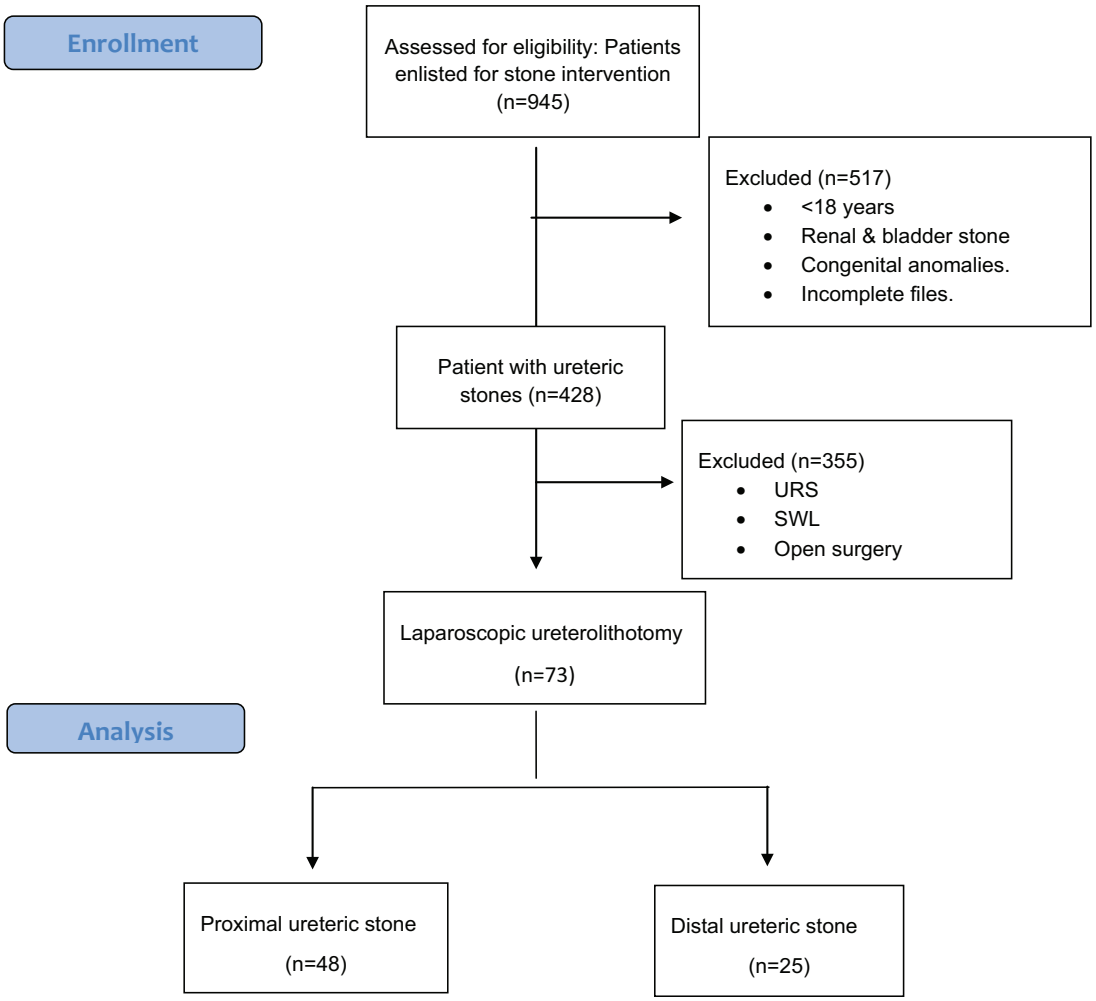
Surgical technique

The procedure started by performing cystoscopy, and insertion of an open-tip ureteric catheter either below the level of the stone(s) or passing it was done if feasible. Care was taken not to push the stone(s) upward inside the kidneys.

All procedures were done using a transperitoneal approach; for proximal ureteric stone, patient is put on the lateral position, secured to the table. Pneumoperitoneum was created in an open technique with a 12-mm camera port at the umbilicus. This was followed by insertion of two ports 10 and 5 mm; these trocars were placed at 6–8 cm in a lateral position from the first one along the anterior axillary line in a triangulation technique. A fourth port was rarely needed for traction.

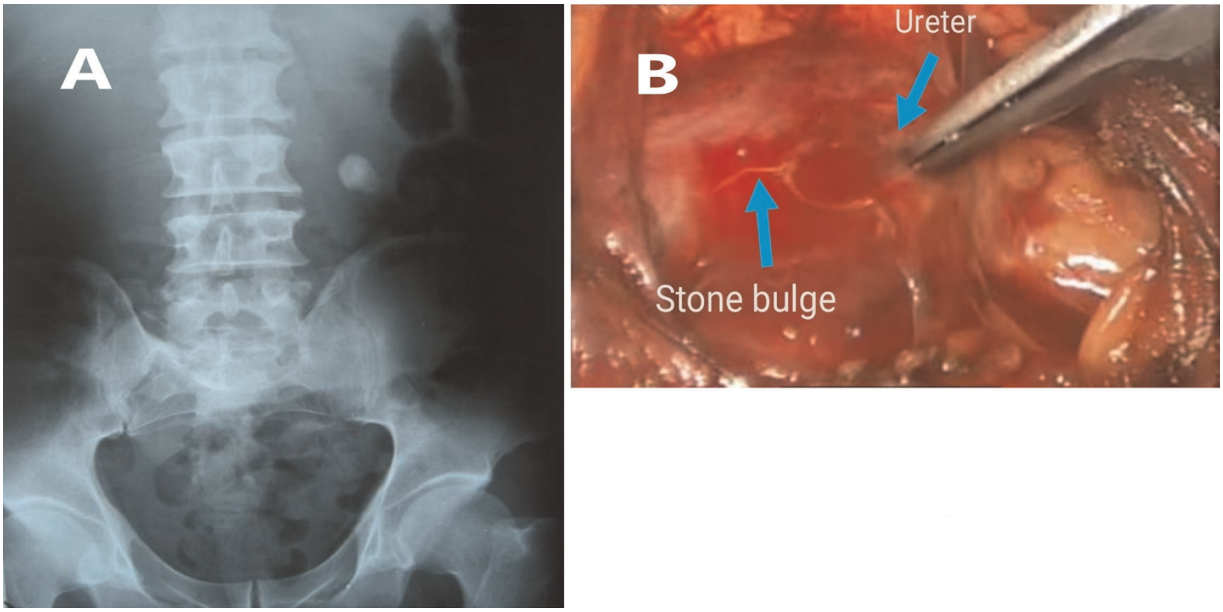
The colon was reflected, and the ureter is identified along the psoas muscle. The stone(s) was usually identified either by an obvious bulge or pinched by atraumatic forceps (Fig. 2). Upward stone migration was prevented by applying a laparoscopic Babcock forceps on the ureter above the stone site. This was followed by ureterotomy and stone extraction. A 6-Fr JJ stent was then inserted either by a retrograde or antegrade fashion via the port, and the ureterotomy was closed with 4/0 polyglycolic-acid sutures.

Figure 1



Cases enrollment. SWL, Shock wave lithotripsy. URS, ureteroscopy.

Figure 2



Laparoscopic ureterolithotomy: (a) KUB showing a 28-mm stone in the upper left ureter. (b) Intraoperative photograph of laparoscopic ureterolithotomy showing the ureter and the stone bulge.

For distal ureteric stones, after the insertion of ureteric catheter, the patient is tilted 30–45° on the stone site. Transperitoneal approach is used. Pneumoperitoneum is created using the open technique, with 12-mm port at the umbilicus, 10 mm port was inserted in the ipsilateral iliac fossa along the anterior axillary line, whereas 5 mm one was inserted at the suprapubic area. The colon was reflected, and ureter was identified along its anatomical landmarks, and procedure continues as in proximal stones. At the end of the procedure, a nonsuction drain was put and left until drainage was less than 50 ml/day.

Postoperative data included time till resumption of oral intake, time till first mobilization, and duration of hospital stay. SFR was evaluated on postoperative day 1 using a combined plain radiograph of the abdomen and ultrasound of urinary tract.

Complications were classified according to modified Clavian–Dindo [13] classification for surgical complication.

Statistical analysis

Data of the study were collected, tabulated, and statistically analyzed using Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA) software, version 17. The data were expressed as median and range, mean±SD, and number and percent according to their type.

Results

A total of 73 patients were included in the study, and the median age was 39 (22–64). There were 41 males and 32 females. Mean BMI was 24.64±4.36. Proximal ureteral stone(s) were present in 48 (65.5%) patients, whereas 25 (34.5%) patients had distal stone(s). A total of 29 (39.5%) patients had single stone, whereas multiple stones were seen in 44 (60.5%) patients. Stone size was calculated along the largest diameter on radiology. In case of multiple stones, the sum of their largest diameter was calculated. Mean stone size was 31.7±8.5 mm, with a median stone number of 1 (1–3) (Table 1).

Table 1 Patients' characteristics

Age (median/range)	39 (22–64)
Sex (male/female) [*n* (%)]	41/56–32/44
BMI (mean±SD)	24.64±3.36
Size (mm) (mean±SD)	31.7±8.5
Number (median/range)	1 (1–3)
Density (HU) (mean±SD)	1245±236
Site [*n* (%)]	
Proximal	48 (65.5)
Distal	25 (34.5)
Laterality [*n* (%)]	
Right	33 (45)
Left	40 (55)
History of stone surgery on same site [*n* (%)]	21 (28)
Open	3 (4)
Endoscopic	14 (19)
ESWL	4 (5)

ESWL, extracorporeal shock wave lithotripsy.

Operative time was calculated from time of cystoscopy until the securing the drain site. Mean operative time was 96±19.2 min. Mean blood loss was estimated to be 110±12 ml; there was no need for transfusion in any of the patients.

Failed (aborted) procedure that was converted to open surgery was needed in one (1.2%) patient. The patient had a 31-mm distal ureteric stone with history of left ureteric reimplantation. Stone migration into the kidney was seen in one patient with multiple proximal ureteric stones. JJ stent was inserted, and the patient was scheduled for planned percutaneous nephrolithotomy. At the end of the procedure, all but one patient with preoperative nephrostomy, had ureteric stent (either internal or external) inserted.

SFRs were evaluated using combined plain radiograph KUB and US KUB at day 1 postoperative and were estimated to be 97% (Table 2).

Postoperative oral intake was resumed within 24 h in 67 (93%) patients, whereas 69 (96%) patients resumed regular diet within 48 h. In absence of complications, patients with external ureteric catheter had their stent removed within 48 h postoperatively, whereas patient with DJ stents were given appointment for follow-up within 2 weeks from discharge where stents were removed as outpatient procedure.

Complications were classified according to the modified Clavian–Dindo classification and occurred in 16 (22%) patients. All had grades 1 and 2

Table 2 Operative outcome

Operative time (min) (mean±SD)	96±19.2
Blood loss (ml) (mean±SD)	110±12
Aborted procedure [*n* (%)]	2 (2.4)
Conversion [*n* (%)]	1 (1.2)
Stone migration [*n* (%)]	1 (1.2)
Ureteric stent [*n* (%)]	70 (95.8)
JJ stent [*n* (%)]	41 (56)
Ureteric catheter [*n* (%)]	29 (44)
SFRs [*n* (%)]	71 (97)
Proximal [*n* (%)]	47 (97.9)
Distal [*n* (%)]	24 (96)

SFR, stone-free rate.

Table 3 Postoperative outcome and complication

Time to oral intake [*n* (%)]	
<24 h	67 (93)
<48 h	69 (96)
Time to first mobilization (h) (mean±SD)	11.5±1.3
Fever [*n* (%)]	13 (13.6)
Ileus [*n* (%)]	3 (4.1)
Urine leak [*n* (%)]	2 (2.7)
Clavien–Dindo classification [*n* (%)]	16 (21.6)
Grade 1	9 (12)
Grade 2	7 (9.5)
Hospital stay (days) (mean±SD)	3.2±1.1

complications. Postoperative fever was the most common complication that occurred in 13 (13.6%) patients, and prolonged ileus requiring insertion of nasogastric tube occurred in three patients. Prolonged urine leak (>48 h) in absence of obstruction was observed in two (2.7%) patients with concomitant postoperative fever, and both were managed conservatively (Table 3 and Fig. 2).

Discussion

Urinary stone management has shifted in the past two decades into the use of highly sophisticated expensive equipment. This puts burden on the health care system, especially in developing countries, where the availability of the material and investment in physician training are hindered by their expensive costs and limited resources [14].

In 1992, Raboy *et al.* [15] performed the first transperitoneal laparoscopic ureterolithotomy, and since then, multiple studies have evaluated the efficacy and safety of the procedure, yet it remains shyly used, maybe owing to the revolutionary miniaturization of scopes allowing easier access to the upper urinary tract [12,16].

In our study, we retrospectively analyzed the use of laparoscopy, usually available in most of hospitals, to bridge the gap between the highly morbid conventional surgery and relatively expensive endourological management of large ureteral stone.

In our analysis, the mean stone size was 31.7±8.5 mm, with more than 60% of our patients presenting with more than one stone. Our SFR was estimated to be 97%. In the ureteroscopy global study [9], SFR reached 98%, yet for stones larger than 10 mm, this incidence dropped to as low as 81%. This high SFR achieved during laparoscopy reflects the similarity of the procedure to conventional surgery, even in patients with recurrent stone surgery.

SWL is used in the management of either proximal or distal ureteric stone with high SFR, yet for stones larger than 10 mm. multiple sessions with prior insertion of ureteral stents may be required [17].

Laparoscopic procedures are considered minimally invasive procedures in comparison with conventional open surgery [18]. In our study, complications, according to Clavien–Dindo [13] classifications, occurred in 21% of the patients with no grade 3 complications. Overall reported complication rate of laparoscopic transperitoneal ureterolithotomy was estimated between 4 and 18% in different series [19–21]. Nour *et al.* [20] reported an overall 11% complication rate in their series on laparoscopic ureterolithotomy for distal ureteric stones, El-Feel *et al.* [21] reported 4%, and Basiri *et al.* [22] reported 18% complication rates. In a recent meta-analysis of randomized controlled trials comparing laparoscopic ureterolithotomy with ureteroscopic management of upper ureteric stones, there were no significant differences in terms of overall or major complications [12].

Long hospital stay will always be a disadvantage for laparoscopic ureterolithotomy. In our study, the mean hospital stay was 3.2 days. Riad *et al.* [20] reported an average hospital stay of 3.8 days, El-Feel *et al.* [21] reported 4.1 days, and Basiri *et al.* [22] reported a mean hospital stay of 5.8±2.3 days. However, this relatively low hospital stay will still be shorter when compared with open surgery for large stones.

Laparoscopic surgery is not and will not substitute endourology and SWL; however, we think that it has to be present in the urological armamentarium for the management of large complex stones, especially in absence of modern technologies and as an alternative to open surgery.

This study shows limitations. It has a retrospective nature, relatively small patient volume, there is no long-term follow-up for complications, and both distal and proximal stones are not separately analyzed.

Conclusion

Laparoscopic ureterolithotomy is a valid option in the management of large ureteric stone, whatever its site; it shows a high SFR, with an acceptable safety profile. It can bridge the gap between the minimally invasive ureteroscopy and SWL and the highly morbid conventional open surgery.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Kittanamongkolchai W, Vaughan LE, Enders FT, Mehta RA, Krambeck AE, McCollough CH, *et al.* The changing incidence and presentation of urinary stones over 3 decades. Mayo Clin Proc 2018; 93:291–299.

2 Curhan GC. Epidemiology of stone disease. Urol Clin North Am 2007; 34:287–293.

3 Türk C, Pet⊠ík A, Sarica K, Seitz C, Skolarikos A, Straub M, Knoll T. EAU guidelines on interventional treatment for urolithiasis. Eur Urol 2016; 69:475–482.

4 Chung DY, Kang DH, Cho KS, Jeong WS, Jung HD, Kwon JK, Lee SH, Lee JY. Comparison of stone-free rates following shock wave lithotripsy, percutaneous nephrolithotomy, and retrograde intrarenal surgery for treatment of renal stones: a systematic review and network meta-analysis. PLoS ONE 2019; 14:e0211316.

5 Shinde S, Al Balushi Y, Hossny M, Jose S, Al Busaidy S. Factors affecting the outcome of extracorporeal shockwave lithotripsy in urinary stone treatment. Oman Med J 2018; 33:209–217.

6 Lauerman M, Shackelford S. Trauma of the kidney, ureter, and bladder: techniques. In: Scalea TM, (editor). The shock trauma manual of operative techniques. Cham: Springer; 2021. 117–119.

7 Wood KD, Gorbachinsky I, Gutierrez J. Medical expulsive therapy. Indian J Urol 2014; 30:60–64.

8 Nguyen DP, Hnilicka S, Kiss B, Seiler R, Thalmann GN. Optimization of extracorporeal shock wave lithotripsy delivery rates achieves excellent outcomes for ureteral stones: results of a prospective randomized trial. J Urol 2015; 194:418.

9 De la Rosette J, Denstedt J, Geavlete P, Keeley F, Matsuda T, Pearle M, *et al.* CROES URS Study Group. The clinical research office of the endourological society ureteroscopy global study: indications, complications, and outcomes in 11, 885 patients. J Endourol 2014; 28:131–139.

10 Khalil M. Management of impacted proximal ureteral stone: extracorporeal shock wave lithotripsy versus ureteroscopy with holmium: YAG laser lithotripsy. Urol Ann 2013; 5:88–92.

11 Garg M, Singh V, Sinha RJ, Sankhwar SN, Kumar M, Kumar A, *et al.* Prospective randomized comparison of open versus transperitoneal laparoscopic ureterolithotomy: experience of a single center from Northern India. Curr Urol 2013; 7:83–89.

12 Li J, Chang X, Wang Y, Han Z. Laparoscopic ureterolithotomy versus ureteroscopic laser lithotripsy for large proximal ureteral stones: a systematic review and meta-analysis. Minerva Urol Nefrol 2020; 72:30–37.

13 Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004; 240:205–213.

14 Hyams ES, Matlaga BR. Economic impact of urinary stones. Transl Androl Urol 2014; 3:278–283.

15 Raboy A, Ferzli GS, Ioffreda R, Albert PS. Laparoscopic ureterolithotomy. Urology 1992; 39:223–225.

16 Skolarikos A, Papatsoris AG, Albanis S, Assimos D. Laparoscopic urinary stone surgery: an updated evidence-based review. Urol Res 2010; 38:337–344.

17 Ur Rehman MF, Adnan M, Hassan AIII, Humayun Akhtar F, Javed N, Ali F. Comparison of ureteroscopic pneumatic lithotripsy and extracorporeal shock wave lithotripsy for proximal ureteral calculi. Cureus 2020; 12:e7840.

18 Prakash J, Singh V, Kumar M, Kumar M, Sinha RJ, Sankhwar S. Retroperitoneoscopic versus open mini-incision ureterolithotomy for upper- and mid-ureteric stones: a prospective randomized study. Urolithiasis 2014; 42:133–139.

19 Saussine C, Lechevallier E, Traxer O. Urolithiasis and laparoscopy. Treatment of ureteral stones. Prog Urol 2008; 18:943–947.

20 Nour HH, Elgobashy SE, Elkholy A, Kamal AM, Roshdy MA, Elbaz AG, Riad E. Laparoscopic management of distal ureteric stones in a bilharzial ureter: results of a single-centre prospective study. Arab J Urol 2015; 13:182–186.

21 El-Feel A, Abouel-Fettouh H, Abdel-Hakim AM. Laparoscopic transperitoneal ureterolithotomy. J Endourol 2007; 21:50–54.

22 Basiri A, Simforoosh N, Ziaee A, Shayaninasab H, Moghaddam SM, Zare S. Retrograde, antegrade, and laparoscopic approaches for the management of large, proximal ureteral stones: a randomized clinical trial. J Endourol 2008; 22:2677–2680.