Effective ureteral access sheath insertion during flexible ureteroscopy: Influence of the ureteral orifice configuration

Raed A. Azhar[1,2], Musab M. Alghamdi[2], Abdullah A. Khawaji[2], Anmar M. Nassir[3], Sameer Munshi[4], Waseem Tayeb[4], Mohamed A. Elkoushy[4,5]

[1]Department of Urology, King Abdulaziz University, Jeddah, Saudi Arabia; [2]Department of Urology, International Medical Center, Jeddah, Saudi Arabia; [3]Department of Surgery, Umm-Alqura University, Mecca, Saudi Arabia; [4]Department of Surgery, King Abdullah Medical City, Mecca, Saudi Arabia; [5]Department of Urology, Suez Canal University, Ismailia, Egypt

Cite as: Azhar RA, Alghamdi MM, Khawaji AA, et al. Effective ureteral access sheath insertion during flexible ureteroscopy: Influence of the ureteral orifice configuration. *Can Urol Assoc J* 2022;16(7):E375-80. http://dx.doi.org/10.5489/cuaj.7656

Published online February 28, 2022

Abstract

Introduction: We sought to determine the possible predictors for effective insertion of the ureteral access sheath (UAS) during flexible ureteroscopy (fURS) in virgin ureters and their impact on postoperative ureteral wall injury and the procedural outcome.
Methods: A retrospective review of prospectively collected data was performed for all consecutive patients scheduled for fURS of virgin ureters at two tertiary care centers between 2018 and 2020. Demographics, stone characteristics, and perioperative data, including the configuration of the ureteral orifice (UO) over introductory guidewire insertion, were collected. Multivariate logistic regression was used to detect possible predictors of successful UAS insertion.
Results: In total, 128 patients who underwent primary fURS were included, with a mean age of 43.3±12.3 years and a stone burden of 12.3±6.9 mm. One hundred and ten patients (85.9%) achieved successful ureteral access insertion, including 81 (63.3%) without ureteral dilatation and 35 with dilation, of which 29 (22.7%) had a successful UAS afterward, while six failed. Total patients who underwent ureteral orifice dilatation were 35. 29 had a successful UAS afterward, while 6 failed.Patients who underwent successful UAS placement into virgin ureters were significantly older and had a lower body mass index (BMI). A tent-shaped UO over the guidewire led to successful UAS insertion. In multivariate regression analysis, cases with BMI <30 kg/m^2 (odds ratio [OR] 1.89, 95% confidence interval [CI] 1.28–7.03) and those with a tent-shaped UO over the introductory guidewire (OR 6.60, 95% CI 3.8–7.2) maintained their significance to predict successful UAS insertion into virgin ureters. Nine patients (8.2%) had ureteral mucosal injuries, and the overall stone-free rate was 78.2%.
Conclusions: Patients with normal BMIs and tent-shaped UOs over the introductory guidewires are more likely to achieve primary UAS insertion without the need for ureteral dilation.

Introduction

Flexible ureteroscopy (fURS) has dramatically changed and improved the minimally invasive management of complex nephrolithiasis. This technology was further supported by the introduction of the ureteral access sheath (UAS), which improved the cost-effectiveness of the procedure. The UAS improves operative vision, enables repeated passage of the ureteroscope while minimizing damage to the ureter, improves the irrigation fluid, facilitates extraction of small stone fragments, and decreases intrarenal pressure.[1-4] However, UAS remains challenging for some urologists,[5] and its usefulness during ureteroscopic stone removal is still debatable. The results from a meta-analysis did not support the use of a UAS during fURS due to increased postoperative complications despite comparable stone-free rates (SFRs), operative times, and intraoperative adverse events.[6] Furthermore, placement of the UAS carries an increased risk of ureteral wall ischemia and injury with consequent ureteral strictures. Nevertheless, preoperative ureteral stenting seems to increase the success rate of UAS placement during retrograde intrarenal surgery (RIRS), with a tendency to use a larger sheath.[7]

Some authors have reported improved SFR with UAS placement before fURS,[8] while others support its systematic use,[3,9] with an 8.6–22% failure rate of insertion.[10,11] Effective insertion of UAS is significantly associated with preoperative ureteral stenting and a history of previous ipsilateral URS;[10,11] however, no factors have been identified to predict UAS insertion in virgin ureters.[12]

We believe that other perioperative variables may influence effective UAS insertion, including the surgeon's experience and preoperative medication with α-adrenergic blockers, which would relax and relatively dilate the intramural distal ureter. In addition, some experts have reported the impact of the ureteral orifice (UO) shape over a stiff guidewire on the success of UAS introduction, which has not been investigated. If the UO stays round and narrow around the stiff wire, there is no need to try UAS placement, but if the UO opens like a tent, this is a good indicator for UAS placement. Furthermore, determining whether UAS insertion will be successful might also have financial implications.

The aim of this study was to assess the predictors for effective UAS insertion and to assess their impact on the outcome of the procedure, which may improve patient counselling and guide surgeons in deciding whether to proceed, apply pre-stenting, or abort the procedure.

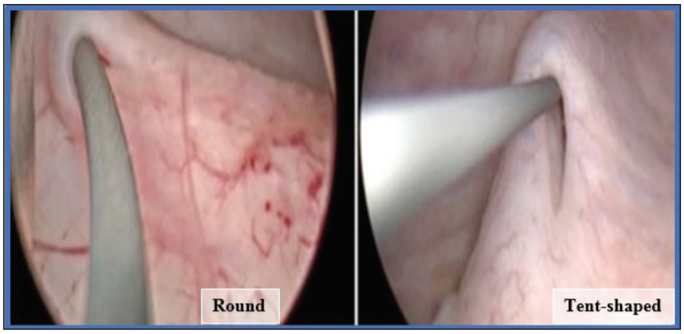

Figure 1. Shape of the ureteral orifice over the stiff guidewire.

Methods

Study design

A retrospective review of prospectively collected data was performed for all consecutive patients undergoing primary fURS for the management of renal stones at two tertiary care centers between 2018 and 2020. Experienced and fellowship-trained endourologists carried out all interventions.

Patients over 18 years old who were considered good surgical candidates and were able to provide written informed consent were included. Patients were excluded if they had ipsilateral ureteral stones or strictures, previous ipsilateral URS or ureteral stents, history of bilharziasis or tuberculosis, or complete ipsilateral ureteral duplication. Patients with active urinary tract infections were also temporarily excluded until they had proven negative urine cultures.

All patients underwent a preoperative, complete laboratory workup to assess comorbid conditions and fitness for anesthesia, including complete urinalysis and culture, complete blood count, kidney and liver function tests, random blood sugar analysis, bleeding profiles, and electrocardiography. Preoperative non-enhanced spiral computed tomography (NECT) was also performed on all patients.

Data collection

Demographic data, including age, sex, body mass index (BMI), concomitant preoperative use of α-adrenergic blockers, history of previous ipsilateral URS or ureteral stenting, American Society of Anesthesiology (ASA) score, stone size (the largest stone diameter calculated on NECT), number of stones, and stone location (coded as pelvis, inferior calyx, middle calyx, and upper calyx), were collected. Perioperative parameters included operative time, use of a UAS, need for ureteral dilatation, shape of the ureteral orifice (UO) over an introductory guidewire (Figure 1), intracorporeal laser lithotripsy (ICLT), postoperative stenting, and perioperative complications.

Operative procedure

All patients received preoperative prophylactic parenteral antibiotics, and all procedures were performed under general anesthesia. Cystoscopy was started with identification of the shape of both UOs pre- and post-introduction of guidewires. Retrograde ureteropyelography was performed to check the status of the ureter, with the introduction of a safe hydrophilic guidewire in the upper tract in all cases. Alongside a second safety guidewire, a UAS (Navigator 11/13Fr, Boston Scientific, Natik, MA, U.S.) was passed up to the proximal ureter under fluoroscopy guidance. If UAS placement was impossible, atrial ureteral dilatation was performed, and if this in turn was not possible, a sheathless procedure was attempted. If this last attempt failed, a pigtail, double-J ureteral catheter was left in place for passive dilatation, and the procedure was postponed. After successful insertion of the UAS, URS was then conducted with ICLT, when indicated. A postoperative ureteral stent was placed at the end of the procedure. Systematic visual assessment of the entire ureter was performed with digital fURS at the end of the procedure or during removal of the UAS to recognize and grade ureteral injury.

Primary and secondary endpoints

Patients were stratified according to the results into three groups: effective passage of the UAS without a need for UO dilation, effective passage of the UAS after sequential UO dilation, and failure to pass the UAS with or without dilatation. The primary endpoint was to determine the possible predictors for effective insertion of a UAS into virgin ureters. The secondary endpoints were to assess UAS-related postoperative ureteral wall injury, the SFR, and associated ureteral injuries, which were evaluated according to Traxer and Thomas, 2013.[13]

Followup data

Patients were evaluated one and three months postoperatively with NECT to evaluate the stone-free status, defined as complete absence of stone fragments or the presence of a single residual non-obstructing fragment less than 4 mm. Hospital stays after the procedures were not considered serious adverse events unless the hospital admissions occurred because of complications from the performed procedure.

Data analysis

Data were collected and tabulated using the commercially available Statistical Package for the Social Sciences software (SPSS Inc., Chicago, IL, U.S.), version 22. Descriptive statistics were presented in terms of frequency, percentage, means, and standard deviations. Differences between groups were compared with Fisher's exact test for categorical variables and Student's t-test for continuous variables. The interplay of more than two variables was analyzed using multivariate logistic regression to detect possible predictors of successful UAS insertion. The multivariate model included all the clinically important variables that would potentially influence the outcome of interest, irrespective of their statistical significance in the univariate model. Two-tailed p-values of less than 0.05 were set for statistical significance.

Results

A total of 128 patients who underwent primary fURS were included, with a mean age of 43.3±12.3 years and a stone burden of 12.3±6.9 mm. Ninety-five (74.2%) patients were males. The shape of the UO over the introductory guidewire was documented in 92 patients (71.9%), including 56 (60.9%) round UOs and 36 (39.1%) tent-shaped orifices. Baseline demographic and stone characteristics of the study population are presented in Table 1.

One hundred and ten patients (85.9%) had successful ureteral access insertion, including 81 (63.3%) without ureteral dilatation and 35 with dilation, of which 29 (22.7%) had a successful UAS afterward, while six failed. The procedure was aborted in 12 patients (9.4%) after insertion of double-J ureteral stents.

Patients who underwent successful UAS placement in virgin ureters were significantly older, had a lower BMI, and had significantly right-sided stones (Table 2). Compared to round UOs, tent-shaped orifices over the guidewires facilitated successful insertion of UAS, even without ureteral dilatation (94.4 vs. 71.4, p=0.007). Patient sex, previous history of stone passage, stone burden, stone multiplicity, and concomitant use of α-adrenergic blockers did not influence the successful insertion of the primary UAS (Table 2).

Table 1. Overall characteristics of the study population

Variable (n=128)	Mean (SD)/n (%)
Age/years	43.3± 2.3
Sex (males)	95 (74.2%)
BMI (kg/m²)	30.0±6.9
Comorbidities	
Diabetes	26 (20.3)
HTN	23 (18.0)
CVD	10 (7.8)
Others	31 (24.2)
Stone burden (mm)	12.3±5.4
Laterality (left-side)	80 (62.5)
Current use of alpha-blockers	49 (38.3)
History of spontaneous passage of stones	16 (12.5)
Stone multiplicity	
Single kidney stones	57 (44.5)
Multiple kidney stones	71 (55.5)
Shape of the UO (n=92)	
Round	56 (60.9)
Tent-shaped	36 (39.1)

BMI: body mass index; CVD: cardiovascular disease; HTN: hypertension; SD: standard deviation; UO: ureteral orifice.

UAS successfully passed without dilatation in older patients with lower BMI who had a tent-shaped UO, compared to those who underwent ureteral dilatation (Table 3). Otherwise, successful insertion of the UAS was not influenced by other patient or stone characteristics. The overall SFR after the primary single URS was 78.2%, which was comparable between patients with primary UAS insertion and those without primary UAS insertion (79.0% vs. 75.8%, p=0.79).

Table 2. Successful primary insertion of the UAS into virgin ureters or after ureteral dilatation vs. a failed or aborted procedure

Parameter	Successful (n=110)	Failure (n=18)	p
Mean age/years	48.3±8.2	41.1±6.3	<0.001
Male sex	76 (69.1)	14 (77.8)	0.58
Mean BMI (kg/m²)	27.2±4.6	33.6±6.4	<0.001
Mean stone burden (mm)	12.3±3.2	10.8±1.8	0.06
Laterality (left-side)	57 (51.8)	14 (77.8)	0.04
Stone passage	14 (12.7)	2 (11.1)	1.00
Use of alpha-blockers	43 (39.1)	7 (38.9)	0.98
Stone multiplicity			
Single	52 (47.3)	7 (38.9)	0.61
Multiple	58 (52.7)	11 (61.1)	
Shape of the UO over the guidewire (n=92)			
Round (n=56)	40 (71.4)	16 (28.6)	0.007
Tent-shaped (n=36)	34 (94.4)	2 (5.6)	
UO dilatation	29 (26.4)	6 (33.3)	0.57

Results are expressed as means ± standard deviations or as numbers (%). BMI: body mass index; UAS: ureteral access sheath; UO: ureteral orifice

Table 3. Successful primary insertion of the UAS into virgin ureters vs. those that needed ureteral dilatation

Parameter	Success in virgin ureters (n=81)	Success after UO dilation (n=29)	p
Mean age/years	47.4±6.5	43.2±7.6	0.005
Male sex	56 (69.1)	24 (82.5)	0.22
Mean BMI (kg/m^2)	28.8 ± 5.9	32.6±4.2	0.002
Mean stone burden (mm)	11.8±4.1	10.5±1.6	0.10
Laterality (left-side)	42 (51.9)	15 (51.7)	1.00
Stone passage	10 (12.3)	4 (13.8)	0.98
Use of alpha-blockers	32 (39.5)	11 (37.9)	0.99
Stone multiplicity			
Single	38 (46.9)	14 (48.3)	1.00
Multiple	43 (53.1)	15 (51.7)	
Shape of the UO over the guidewire (n=74)			
Round (n=40)	20 (35.7)	20 (69.0)	<0.001
Tent-shaped (n=34)	32 (88.9)	2 (6.9)	
Stone-free rate	64 (79.0)	22 (75.8)	0.79

Results are expressed as means ± standard deviations or as numbers (%). BMI: body mass index; UAS: ureteral access sheath; UO: ureteral orifice

The multivariate model included patient age, gender, BMI, history of spontaneous passage of stones, preoperative use of α-adrenergic blockers, and shape of UO over the introductory guidewire. In the multivariate regression analysis, cases with BMIs of <30 kg/m^2 (odds ratio [OR] 1.89, 95% confidence interval [CI] 1.28–7.03) and those with a tent-shaped UO over the introductory guidewire (OR 6.60, 95% CI 3.8–7.2) maintained their significance to predict successful UAS insertion in virgin ureters (Table 4). Of 110 patients, intraoperative adverse events were recorded in nine (8.2%), among whom seven (6.4%) patients had ureteral mucosal erosion without smooth muscle injury (grade 1) and two (1.8%) patients had mucosal and smooth muscle injuries with preserved adventitia (grade 2). No adventitial perforation or ureteral avulsion was detected (Table 5).

Discussion

Stone-free status is the primary goal in the management of patients with urolithiasis. The usefulness of a UAS during ureteroscopic stone removal is still debatable. Evidence from a meta-analysis did not support the use of UAS during URS, as it did not improve the operative outcomes but was possibly associated with higher postoperative complications;[6] however, only two randomized controlled studies were included in the analysis.

Nevertheless, a UAS may improve operative vision and irrigation fluid, decrease intrarenal pressure, and enable repeated passage of the ureteroscope while minimizing damage to the ureter.[1-4] These concepts encourage researchers to look for possible parameters that may enable effective insertion of a UAS.

Table 4. Multivariate regression analysis of predictors of UAS insertion into virgin ureters before flexible ureteroscopy

Parameter	OR (95% CI)	p
Age of patients >50 years	1.01 (0.84–1.04)	0.589
Male sex	1.45 (0.92–1.63)	0.067
BMI <30 kg/m^2	1.89 (1.28–7.03)	0.043
Spontaneous stone passage	1.26 (0.98–1.56)	0.081
Tent-shaped UO over the guidewire	6.60 (3.8–7.2)	0.004

BMI: body mass; CI: confidence interval; OR: odds ratio; UO: ureteral orifice.

The current study included patients with virgin ureters precluding preoperative ureteral stenting or a history of previous ipsilateral URS, which were significantly associated with successful UAS placement.[10,11] The American Urological Association (AUA) and European Association of Urology (EAU) guidelines do not recommend routine preoperative stenting before URS; however, preoperative stenting may enhance successful UAS insertions and prevent associated ureteral wall injuries.[11,13,14] Traxer and Thomas found that the absence of preoperative stenting was the most significant predictor for severe injuries associated with UAS placement (by seven-fold).[13] Similarly, Breda and colleagues reported that pre-stented status was the only independent predictor for successful UAS insertion (98.5% vs. 82%).[15] Yuk and colleagues found that preoperative ureteral stenting seems to increase the success rate of UAS placement during RIRS, with a tendency to use a larger sheath.[7] However, this does not affect operative time, perioperative complications, or SFR.

Fuller and colleagues reported a 7.7% failure rate for accessing the unstented ureter, even after ureteral dilatation.[16] This failure rate is comparable to our figure after the exclusion of patients with aborted procedures. Unsuccessful ureteroscopic access in the former study was significantly lower in younger females (34 vs. 52 years). Compared to renal stones,

Table 5. Complications of UAS insertion (n=110)

Injury grade	Endoscopic findings	n (%)
Low-grade		
G0	No lesion found or only mucosal petechiae	101 (91.8)
G1	Ureteral mucosal erosion without smooth muscle injury	7 (6.4)
High-grade		
G2	Ureteral wall injury, including mucosa and smooth muscle, with adventitial preservation (periureteral fat not seen)	2 (1.8)
G3	Ureteral wall injury, including mucosa and smooth muscle, with adventitial perforation (periureteral fat seen)	0 (0%)
G4	Total ureteral avulsion	0 (0%)

UAS: ureteral access sheath.

proximal ureteral stones had a significantly higher failure rate for UAS (18.3%) and remained the only significant predictor of access failure in the multivariable regression model compared with distal ureteral stones.[16] It was not clear why the authors may have needed UAS insertion in cases with distal ureteral stones. Our results support successful UAS insertion in elderly patients, which did not maintain its significance in the multivariate model, as previously reported.

In a recent study, authors did not identify any patient demographics or stone characteristics that might influence the failure of UAS placement in virgin ureters[12] and were unable to decide whether to proceed with URS, preoperative ureteral stenting, or abortion of the procedure. The study missed important factors that may influence UAS placement in a virgin ureter, such as the shape of the UO over the guidewire and concurrent use of α-adrenergic antagonists. Preoperative α-adrenergic blockers may inhibit peristalsis, with a subsequent reduction in ureteral pressure and maximal UAS insertion forces.[17] Of interest, non-stented patients who received preoperative α-adrenergic antagonists for seven days had a significant reduction in UAS insertion forces and were comparable to pre-stented patients who did not receive these medications.[17] Therefore, these medications seem to improve UAS-associated injuries, but it is still unknown whether UAS insertion force reductions are dose-dependent. This finding was not supported in our study, which may be because of the small number of patients who were on concomitant α-adrenergic antagonists and failed UAS insertion, precluding any statistically significant differences.

In a multi-institutional prospective study, 1494 (67%) patients were treated with a UAS, and 745 (33%) were not. Although the difference was statistically comparable, SFRs were lower in the UAS group (73.9 vs. 82.8%). Therefore, the UAS should not be primarily placed to increase the SFR.[18] However, these results may be biased because UAS placement depends solely on the discretion of endourologists. Similarly, Berquet et al[9] and Kourambas et al[3] showed no significant differences in SFRs (86% UAS vs. no 87% UAS and 79% UAS vs. 86% no UAS, respectively).

Our results indicated that patients with normal BMIs seem to have a better chance for primary UAS insertion with or without UO dilatation. Hypothetically, URS can pose a challenge in obese patients due to difficulties in positioning and restriction of the surgeon's dexterity within the collecting system. However, Chew et al concluded that the procedures are equally efficacious for obese and non-obese patients, and that UAS placement in obese patients does not affect SFRs.[19] Of interest, the preoperative tent-shaped UO over a guidewire significantly predicts the successful insertion of UAS into virgin ureters by 6–7 times, as detected in the multivariate model. To our knowledge, this variable was not assessed in previous similar studies and confirms our observations during surgical interventions.

Experimental studies showed that UAS placement would compress the ureter, resulting in decreased blood, ureteral ischemia, and necrosis, with subsequent ureteral thickening and stricture.[20,21] The UAS may also increase the outer diameter of the ureter by approximately two-fold, resulting in severe overstretching of the ureteral tissue[22] and a significant increase in the expression of the pro-inflammatory markers TNFa and COX-2.[23] In 2013, Traxer and Thomas presented a reliable classification system to address intraoperative complications resulting from UAS placement. Following removal of UASs from 359 patients, the authors prospectively found superficial mucosal ureteral wall lesions in almost half of the patients following the insertion of a 12/14 Fr UAS, including 15% extending into the smooth muscle layer.[13] They did not detect complete ureteral avulsionIn our study, no adventitial ureteral perforations or ureteral avulsions were detected in any of the 110 patients who underwent successful UAS insertion. Nine patients (8.2%) had ureteral adverse events, most of them (6.4%) had ureteral mucosal erosions without smooth muscle injury (grade 1), and only two patients had mucosal and smooth muscle injuries with a preserved adventitia (grade 2). It seems that tissue dynamics, such as resistance and elasticity, are influenced by potential injury rather than the physical narrowness of the ureter.[11,13]

Limitations

This study is limited by its retrospective nature, as well as possible selection bias dependent solely on the discretion of endourologists. The limited subgroup analyses may preclude possible significant differences in some variables — history of spontaneous stone passage and concurrent use of α-adrenergic blockers — which may be assumed to increase successful UAS insertion. However, all the procedures were performed in tertiary care centers by many endourologists with different experience levels; hence, the results can be generalizable.

To our knowledge, this is the first study to assess the influence of the shape of the UO over the introductory guidewire on successful UAS insertion. Notably, different commercially available UASs have different mechanical properties, which may influence the outcomes.[24]

Conclusions

UAS insertion into virgin ureters seems to be influenced by BMI and the shape of the UO over the introductory wire. Patients with a normal BMI and a tent-shaped UO over the guidewire are more likely to achieve primary UAS insertion without the need for ureteral dilation. Surgeons should consider ureteral dilatation (rather than abortion of the procedure) and insertion of ureteral stents in patients with virgin ureteral orifices that seem to be inaccessible.

Competing interests: The authors do not report any competing personal or financial interests related to this work.

This paper has been peer-reviewed.

References

1. Stern JM, Yiee J, Park S. Safety and efficacy of ureteral access sheaths. *J Endourol* 2007;21:119-23. https://doi.org/10.1089/end.2007.9997
2. Rehman J, Monga M, Landman J, et al. Characterization of intrapelvic pressure during ureteropyeloscopy with ureteral access sheaths. *Urology* 2003;61:713-8. https://doi.org/10.1016/S0090-4295(02)02440-8
3. Kourambas J, Byrne RR, Preminger GM. Does a ureteral access sheath facilitate ureteroscopy? *J Urol* 2001;165:789-93. https://doi.org/10.1016/S0022-5347(05)66527-5
4. Auge BK, Pietrow PK, Lallas CD, et al. Ureteral access sheath provides protection against elevated renal pressures during routine flexible ureteroscopic stone manipulation. *J Endourol* 2004;18:33-6. https://doi.org/10.1089/089277904322836631
5. Monga M, Bhayani S, Landman J, et al. Ureteral access for upper urinary tract disease: The access sheath. *J Endourol* 2001;15:831-4. https://doi.org/10.1089/089277901753205843
6. Huang J, Zhao Z, AlSmadi JK, et al. Use of the ureteral access sheath during ureteroscopy: A systematic review and metaanalysis. *PLoS ONE* 2018;13:e0193600. https://doi.org/10.1371/journal.pone.0193600
7. Yuk HD, Park J, Cho SY. The effect of preoperative ureteral stenting in retrograde intrarenal surgery: multicenter, propensity score-matched study. *BMC Urology* 2020;20:147-53. https://doi.org/10.1186/s12894-020-00715-1
8. L'Esperance JO, Ekeruo WO, Scales CD Jr, et al. Effect of ureteral access sheath on stone-free rates in patients undergoing ureteroscopic management of renal calculi. *Urology* 2005; 66:252-5. https://doi.org/10.1016/j.urology.2005.03.019
9. Berquet G, Prunel P, Verhoest G, et al. The use of a ureteral access sheath does not improve stone-free rate after ureteroscopy for upper urinary tract stones. *World J Urol* 2014;32:229-32. https://doi.org/10.1007/s00345-013-1181-5
10. Forzini T, Lecuelle D, Alezra E, et al. Predictive factors of insertion failure of ureteral access sheath for flexible ureteroscopy: A study about 594 procedures. *Eur Urol Suppl* 2017;16;e385. https://doi.org/10.1016/S1569-9056(17)30287-7
11. Mogilevkin Y, Sofer M, Margel D, et al. Predicting an effective ureteral access sheath insertion: a bicenter prospective study. *J Endourol* 2014; 24:1414-7. https://doi.org/10.1089/end.2014.0215
12. Alkhamees M, Aljuhayman A, Abdulmalik AA, et al. Failure of ureteral access sheath insertion in virgin ureters: A retrospective tertiary care center study. *Urology Annals* 2020;12:331-4. https://doi.org/10.4103/UA.UA_94_20
13. Traxer O, Thomas A. Prospective evaluation and classification of ureteral wall injuries resulting from insertion of a ureteral access sheath during retrograde intrarenal surgery. *J Urol* 2013;189:580-4. https://doi.org/10.1016/j.juro.2012.08.197
14. Astroza G, Catalan M, Consigliere L, et al. Is a ureteral stent required after use of ureteral access sheath in presented patients who undergo flexible ureteroscopy? *Cent European J Urol* 2017;70:88-92. https://doi.org/10.5173/ceju.2016.919
15. Breda A, Emiliani E, Millan F, et al. The new concept of ureteral access sheath with guidewire disengagement: one wire does it all. *World J Urol* 2016;34:603-6. https://doi.org/10.1007/s00345-015-1638-9
16. Fuller TW, Rycyna KJ, Ayyash OM, et al. Defining the rate of primary ureteroscopic failure in unstented patients: A multi-institutional study. *J Endourol* 2016;30:970-4. https://doi.org/10.1089/end.2016.0304
17. Koo KC, Yoon JH, Park NC, et al. The impact of preoperative α-adrenergic antagonists on ureteral access sheath insertion force and the upper limit of force required to avoid ureteral mucosal injury: a randomized controlled study. *J Urol* 2018;199:1622-30. https://doi.org/10.1016/j.juro.2017.09.173
18. Traxer O, Wendt-Nordahl G, Sodha H, et al. Differences in renal stone treatment and outcomes for patients treated either with or without the support of a ureteral access sheath: the Clinical Research Office of the Endourological Society Ureteroscopy Global Study. *World J Urol* 2015;33:2137-44. https://doi.org/10.1007/s00345-015-1582-8
19. Chew BH, Zavaglia B, Paterson RF, et al. A multicenter comparison of the safety and effectiveness of ureteroscopic laser lithotripsy in obese and normal weight patients. *J Endourol* 2013;27:710-4. https://doi.org/10.1089/end.2012.0605
20. Lildal SK, Sorensen FB, Andreassen KH, et al. Histopathological correlations to ureteral lesions visualized during ureteroscopy. *World J Urol* 2017; 35:1489-96. https://doi.org/10.1007/s00345-017-2035-3
21. Dinlenc CZ, Liatsikos EN, Smith AD. Ureteral ischemia model: an explanation of ureteral dysfunction after chronic obstruction. *J Endourol* 2002;16:47-50. https://doi.org/10.1089/089277902753483727
22. Zelenko N, Coll D, Rosenfeld AT, et al. Normal ureter size on unenhanced helical CT. *AJR Am J Roentgenol* 2004;182:1039-41. https://doi.org/10.2214/ajr.182.4.1821039
23. Lildal SK, Nørregaard R, Andreassen KH, et al. Ureteral access sheath influence on the ureteral wall evaluated by cyclooxygenase-2 and tumor necrosis factor-α in a porcine model. *J Endourol* 2017;31:307-13. https://doi.org/10.1089/end.2016.0773
24. Patel N, Monga M. Ureteral access sheaths: a comprehensive comparison of physical and mechanical properties. *Int Braz J Urol* 2018; 44:524-35. https://doi.org/10.1590/s1677-5538.ibju.2017.0575

Correspondence: Dr. Raed A. Azhar, Department of Urology, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia; raedazhar@gmail.com