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Influence of Ureteric Orifice Configuration on Effective Insertion of Ureteral Access Sheath during Flexible Ureteroscopy

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ABSTRACT

Introduction

Retrograde Intrarenal surgeries are facilitated by the use of ureteral access sheaths (UAS) but it is not always possible to insert the sheath on the first attempt. The aim of the study was to determine the possible predictive factors enabling insertion of UAS during flexible ureteroscopy (fURS).

Methods

All consecutive patients undergoing fURS/RIRS who were not pre-stented were studied and data collected. The study parameters were the demographics of the patients, characteristics of the stones, and perioperative data, including the ureteric orifice (UO) configuration over introductory guidewire. Multivariate logistic regression analysis was used to detect the possible predictors of successful UAS insertion.

Results

In total, 78 patients who underwent primary fURS were included, with a mean age of 38.9±14.68 years and a male: female ratio of 2.25:1 with an average stone burden of 11.4 mm. There was successful primary insertion of UAS in 47(60.26%) patients. Out of them, 44 of the patients had rounded configuration of the ureteric orifice with a successful primary insertion of UAS in 17 (38%) patients whereas 30 (88%) patients had successful insertion in those with tented configuration of the ureteric orifice over a guidewire with a significant p value (<0.001). In multivariate regression analysis, a tent-shaped UO after guidewire insertion was the only significant predictor (OR:13.70 95% CI:3.76-50.10 with p-value<0.0001) for primary successful UAS insertion into virgin ureters.

Conclusion

Patients with tent-shaped UOs after insertion of a guidewire were more likely to have an UAS insertion on the first attempt in a virgin ureter.

Keywords

Flexible ureteroscopy; ureteric access sheath; ureteric orifice configuration; virgin ureters

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INTRODUCTION

The Ureteric Access Sheath (UAS) has become a valuable tool in Retrograde Intrarenal Surgery (RIRS) and flexible ureteroscopy for the management of stones. Its widespread use attributes advantages like easier access to the collecting system, facilitation of repeated scope entries, reduced intrarenal pressure, and improved outflow. These contribute not only to the protection of the instrument but also reduced risk of ureteral trauma. [1,2] On the contrary, reperfusion upon sheath removal might induce oxidative stress, damaging the ureteral lining in addition to overdistension of ureter caused by UAS placement. [3,4] Despite these concerns, use of UAS in flexible ureteroscopy is currently the preferred approach for managing renal and ureteral stones smaller than 2 cm.[5,6]

First introduced in 1974,[7] the UAS has undergone substantial improvements. While European Association of Urology guidelines do not clearly endorse routine UAS use during ureteroscopy, American Urological Association (AUA) recommends its application in complex or large renal stone.[5,6]

Some studies have shown higher Stone-Free Rates (SFR) with UAS use prior to flexible ureteroscopy[8,9] others have emphasized a notable insertion failure rate ranging between 8.6% and 22%. Predictors for successful UAS insertion include prior ipsilateral ureteroscopy and preoperative stenting[10–12] However, no definitive predictors are currently available for virgin ureters.[13]

This study focuses on assessing whether configuration of the orifice (Fig.1 and Fig.2) observed during guidewire passage can predict UAS insertion success and influence outcomes. Such information may improve counselling and support surgical planning.

METHODS

Study design

It was prospective cross-sectional study carried out for all the consecutive patients undergoing flexible Ureteroscopic surgery for the management of Pelviureteric junction/Proximal ureteric and renal stones at Maharajgunj Medical Campus, Tribhuwan University Teaching Hospital from December 2024. Ethical approval was obtained from IRC of IOM.

All the surgeries were performed by experienced Urologists. All the patients over the age of 18 years were included in the study and written informed consent were obtained. Exclusion criteria included those with ureteric stent in situ, prior history of ureteric instrumentation and those on alpha blockers.

Pre operative evaluation with complete urine analysis and culture and sensitivity, complete blood count, renal function tests, blood sugar and other investigations for the evaluation of comorbidities and fitness for anaesthesia was carried out. Computed tomography evaluation was done preoperatively on all the patients.

Data collection

The Demographic data of the participants were collected. These included age, sex, body mass index (BMI), concomitant preoperative use of α-adrenergic blockers, history of previous ipsilateral URS or ureteral stenting, laterality of the stone, the size of the stone (the largest stone diameter calculated on CT), number of stones, and stone location were collected. Perioperative parameters included, shape of the ureteral orifice (UO) over an introductory guidewire and ureteric injury related to the insertion of the UAS.A proforma was made which included all these parameters and used as a tool for the collection of data.

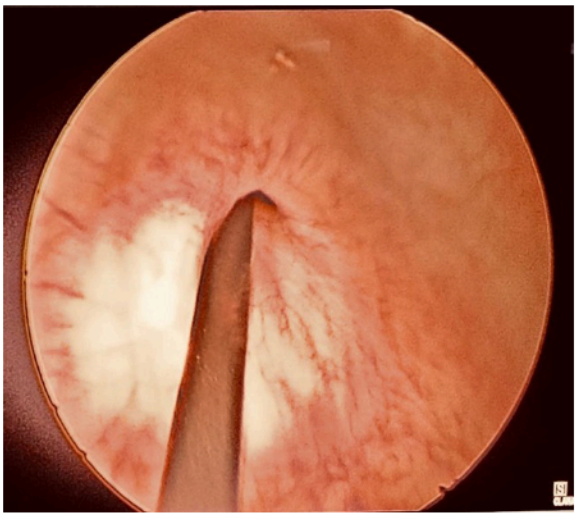

Figure 1. *Round ureteric orifice configuration*

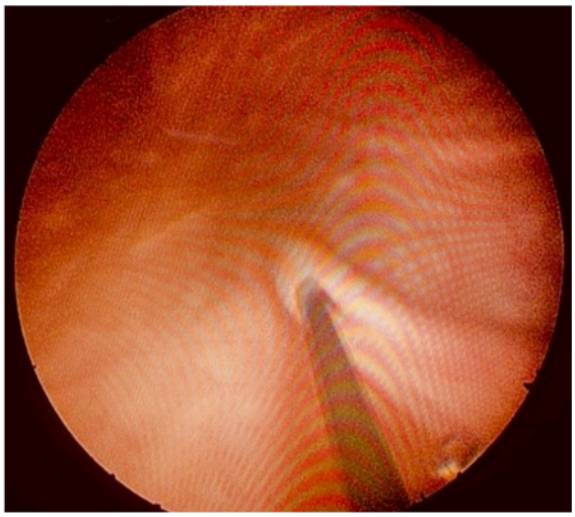

Figure 2. *Tented ureteric orifice configuration*

Operative procedure

Urine culture was obtained and made sure that the culture showed no growth. Pre-operatively antibiotics was given in all the cases. All the surgeries were done under General Anaesthesia. All the patients were kept in standard lithotomy position, preliminary rigid cystoscopy was done in every case with 17 Fr sheath and 30° scope (Karl Storz, Tutllingen, Germany) and the findings were noted. A 0.035-inch straight tip Terumo hydrophilic guidewire (Terumo Medical Corporation, Somerset, NJ, USA) was inserted in the desired ureteric orifice and the configuration of the ureteric orifice over the guidewire was noted. The appropriate position of the guidewire was confirmed fluoroscopically. A ureteric access sheath 9.5/11.5 Fr (U-FLEX, Allwin Medical Devices) was then inserted over the guidewire under fluoroscopic control. A 35 cm long UAS was used for females whereas the length of UAS used for male was of 45cm.The insertion of the UAS was aborted if the operating surgeon experienced difficulty negotiation of the sheath beyond the VUJ. Undue forceful negotiation was discouraged. A DJ stent was kept in these patients and the definitive procedure was carried out at a later date.

The procedure was continued in cases where there was successful insertion of the UAS over the guidewire. Visual inspection of the ureter was done on completion of the procedure among them with successful insertion of UAS and the injury was graded as per the classification proposed by Traxer and Thomas.

Data analysis

Data were collected and tabulated using the Statistical Package for the Social Sciences software, version 26. Descriptive parameters were presented in terms of frequency, percentage, means, and standard deviations. Fisher's exact test was used for categorical variables and Student's t-test for continuous variables. Multivariate logistic regression was done to detect possible predictors of successful UAS insertion. The multivariate model included all the clinically important variables that would potentially influence the outcome. Two-tailed p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 78 patients were evaluated for the study. As illustrated in Table 1, the mean age of the study population was 38.96±14.68 years and the male: female ratio was 2.25:1. The average BMI of the patients was 26.14kg/m^2.

There was successful insertion of Ureteric access sheath in a virgin ureter in 47 patients. The configuration of the ureteric orifice over an introductory guidewire was tented in 34 (43.59%) patients whereas 44 (56.41%) patients had round ureteric orifice over the guidewire. Among those with tented configuration of Ureteric Orifice 30 out of 34 (88.24%) patients had successful primary insertion of the UAS whereas only 17 out of 44 (38.64%) patients with round configuration of ureteric orifice had successful primary insertion and this particular finding was statistically significant (p<0.001) as shown in Table 2.

Table 1. Characteristics of the study population

Characteristics	Number (%)
Age (years)	38.96(14.68)
Sex	54
Male	24
Female	
BMI (kg/m^2)	26.14(2.884)
Comorbidities	
Diabetes	8
Hypertension	19
Others	3
Stone burden (mm)	11.4 (3.03)
Laterality (Rt/Lt)	38/40
Stone multiplicity	
Single	53
Multiple	25
Shape of UO	
Round	44
Tented	34

Grade 1 ureteric injury was observed in 6 patients among those with successful insertion of UAS as illustrated in Table 4 with no patient experiencing higher grade ureteric injury.

A multivariate analysis of different factors (Table 3) for the prediction of successful insertion of UAS in virgin ureter, showed the ureteric orifice configuration over an introductory guidewire as an independent predictor (OR:13.70; 95% CI:3.76-50.10) with statistically significant p-value <0.0001.

Complications were classified according to the classification proposed by Traxer and Thomas.[14]

DISCUSSION

The proven advantages of UAS have been an improvement in operative vision and irrigation fluid, decrease in the intrarenal pressure, and easy repeated passage of the ureteroscope. [1,2,15,16] These have been the reasons why there have been studies regarding parameters that would

Table 2. Successful primary insertion of the ureteric access sheath vs failed attempt

Characteristics	Successful(n=47)	Failure(n=27)	p value
Age(years)	38.98±14.89	38.94±14.59	0.99
Sex			
Male	33	21	1.00
Female	14	10	
BMI (kg/m²)	25.94±2.49	26.47±3.28	0.42
Stone burden			
>15mm	7	4	0.91
10-15mm	22	16	
<10mm	18	11	
Laterality			
R	22	16	0.82
L	25	15	
Stone multiplicity			
Single	32	21	1.00
Multiple	15	10	
Shape of UO over the guidewire			
Round	17	27	<0.001
Tent shaped	30	4	

Table 3. predictors of successful insertion of UAS in virgin ureter

Parameters	OR (95% CI)	Lower 95% CI	Upper 95% CI	p value
Age	1.010	0.97	1.05	0.68
BMI	0.941	0.76	1.16	0.57
Sex	1.610	0.49	5.25	0.43
Stone size	1.08	0.90	1.31	0.77
Ureteric orifice configuration	13.70	3.76	50.10	<0.001

Table 4. Complications in those with successful UAS insertion

Injury grade		Endoscopic findings	N (%)
Low grade	G0	No lesion found or only mucosal petechiae	41 (87.24%)
	G1	Ureteral mucosal erosion without smooth muscle injury	6 (12.76%)
High grade	G2	Ureteral wall injury, including mucosa and smooth muscle, with adventitial preservation	0
	G3	Ureteral wall injury, including mucosa and smooth muscle, with adventitial perforation (periureteral fat seen)	0
	G4	Total ureteral avulsion	0

enable effective insertion of UAS. Despite multiple studies there has been just a single study published showing a relation between the configuration of ureteric orifice over an introductory guidewire and successful UAS insertion.[17] Forzini et. al[18] in his study found a failure rate of 8.6% whereas 10.7% failure rate as per study by Alkhamees M. et. al[13] and 15.4% in a study by Morgan et al.[11] This study

though showed a higher failure rate of 39% which can be attributed to the fact that ureteral dilatation was not done in any of the cases and those cases with unsuccessful attempt at primary insertion of the UAS were stented and the definitive surgery was postponed for a later date.

A study done by Senel et al[19] found younger age, prior urinary tract infection and female gender as independent factors for difficult ureter and unsuccessful insertion of UAS. Our study showed no significant association between the age and gender of the patient on the insertion of UAS. The impact of the stone location was significant in a study done by Fuller et al [20] where proximal stones had higher failure rate but the location of the stone did not predict successful insertion in our study as well as the study by Azhar et al.[21]

Azhar et al found that patients with normal BMIs had a better chance for primary UAS insertion with or without UO dilatation. However, Senel et al concluded that the procedures are independent of the BMI[19] and these findings were similar to the results of our study which had no statistical significance of successful UAS insertion as per the BMI of the patient. The preoperative tent-shaped UO over a guidewire was a significant predictor of the successful insertion of UAS into virgin ureters as per the study by Azhar et al which was validated by this study as well with tented configuration of UO being the only significant predictor.

Traxer and Thomas, in 2013, observed superficial mucosal ureteral wall lesions in almost half of the patients following the insertion of a 12/14 Fr UAS, and also 15% extending into the smooth muscle layer following removal of UASs from 359 patients and thus presented a classification system to address these complications.[14] Azhar et al found no adventitial ureteral perforations or ureteral avulsions in any of the 110 patients who underwent successful UAS insertion. Nine patients (8.2%) had ureteral adverse events,6.4% patients had grade 1 ureteric injury and 2 patients had grade 2 ureteric injury. In this study though 6 patients (12.76%) out of 47 successful UAS insertion has grade 1 ureteric injury and no patients with any higher grade of injury. The possible explanation could be the change in tissue dynamics, such as resistance and elasticity, influenced by potential injury.[14,22]

Limitations

This was a single centre study and the surgeries were performed by different experienced and endourology trained urologists. The duration of the study was short and the sample size was small as well. Dilatation of the ureteric orifice was not done when UAS was not successfully inserted and rather a DJ stent was kept and the surgery was rescheduled at a later date.

CONCLUSION

This study concludes that the tented configuration of ureteric orifice over an introductory guidewire being the only significant predictor of successful insertion of UAS in a virgin ureter, can help cost effective management of cases as well as avoid undue ureteric injury.

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CONFLICT OF INTEREST

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