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Factors Affecting Urethral Catheter Placement Following Flexible Ureterorenoscopy: RIRSearch Study Group

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ABSTRACT

Purpose: To investigate the factors affecting UC placement following flexible ureterorenoscopy (fURS) and the effect of urethral catheter (UC) placement on patient quality of life.

Methods: The present study was performed in prospective manner from 1st January 2015 to 30th December 2023, and patients with renal stones smaller than two centimeters who underwent fURS were analyzed for study inclusion. Patients' demographic characteristics, operative parameters, success of procedure, complications, and VAS score were recorded. Patients were categorized into two groups according to UC placement or not.

Results: In total, 324 patients were enrolled into the study. In the patient group with UC placement, ratio of male patients (p= 0.002), ratio of anticoagulant use (p= 0.002), preoperative creatinine level (p=0.001), stone size (p= 0.001), stone burden (p= 0.001), and ratio of multiple stones (p= 0.001) were significantly higher. Operation time was significantly longer (p= 0.003) and intraoperative complications (p= 0.045) were significantly higher in patients with UC insertion. Need for additional analgesia and VAS score was significantly lower in patients without UC placement (p= 0.004 vs. p= 0.001). Multivariate analysis revealed that male gender, higher preoperative creatinine level, higher stone size and stone burden, and longer operation time were predictive factors for UC placement following fURS (p= 0.008, p= 0.001, p= 0.001, p= 0.010, and p= 0.001, respectively).

Conclusion: Our study demonstrated that male gender, higher preoperative creatinine level, higher stone size and stone volume, and longer operation time resulted in UC insertion after fURS.

Keywords: flexible ureterorenoscopy, fURS, kidney stone, urethral catheter

ÖZET

Amaç: Fleksibl üreterorenoskopi (fURS) sonrası üretral katater (ÜK) yerleştirilmesini etkileyen faktörleri ve ÜK yerleştirilmesinin hastanın yaşam kalitesi üzerindeki etkisini araştırmak.

Yöntemler: Bu çalışma 1 Ocak 2015 ile 30 Aralık 2023 tarihleri arasında prospektif olarak gerçekleştirildi ve iki santimetreden küçük böbrek taşı olan ve fURS uygulanan hastalar çalışmaya dahil edilmek üzere analiz edildi. Hastaların demografik özellikleri, ameliyat parametreleri, işlem başarısı, komplikasyonlar ve VAS skoru kaydedildi. Hastalar ÜK yerleştirilip yerleştirilmemesine göre iki gruba ayrıldı.

Sonuçlar: Toplam 324 hasta çalışmaya dahil edildi. ÜK yerleştirilen hasta grubunda erkek hasta oranı (p= 0.002), antikoagülan kullanım oranı (p= 0.002), ameliyat öncesi kreatinin düzeyi (p=0.001), taş boyutu (p= 0.001), taş yükü (p= 0.001) ve çoklu taş oranı (p= 0.001) anlamlı olarak daha yüksekti. ÜK yerleştirilen hastalarda operasyon süresi anlamlı olarak daha uzundu (p= 0.003) ve intraoperatif komplikasyonlar (p= 0.045) anlamlı olarak daha yüksekti. Ek analjezi ihtiyacı ve VAS skoru ÜK yerleştirilmeyen hastalarda anlamlı olarak daha düşüktü (p= 0.004 vs. p= 0.001). Çok değişkenli analiz, erkek cinsiyet, ameliyat öncesi yüksek kreatinin düzeyi, daha yüksek taş boyutu ve taş yükü ve daha uzun ameliyat süresinin fURS sonrası ÜK yerleştirilmesi için öngörücü faktörler olduğunu ortaya koydu (sırasıyla p= 0.008, p= 0.001, p= 0.001, p= 0.010 ve p= 0.001).

Sonuçlar: Çalışmamız erkek cinsiyet, yüksek preoperatif kreatinin düzeyi, daha yüksek taş boyutu ve taş hacmi ve daha uzun operasyon süresinin fURS sonrası ÜK yerleştirilmesine neden olduğunu göstermiştir.

Anahtar Kelimeler: fleksibl üreterorenoskopi, fURS, böbrek taşı, üretral katater

Flexible ureterorenoscopy (fURS) is a procedure using natural orifices for diagnosis and treatment of upper urinary system pathologies, including ureteral strictures, ureteral and renal tumors, ureteral stone(s) and kidney stone(s), etc. Renal stone surgery is the most common area where fURS is performed (1). According to European Urology Association and America Urology Association guidelines, fURS is recommended as a first-line treatment option for kidney stones smaller than two centimeters in diameter (2). Chen and colleagues (3) analyzed data from 108 patients with renal stones, and the authors found 98.6% stone-free rate for renal stone located in the upper-middle calyx, and 85.7% success rate for lower calyx renal stones after one session. In a meta-analysis by De Coninck et al., (4) the authors emphasized that although complication rates after fURS vary between 1-37%, major complications such as ureteral avulsion, bleeding or sepsis are very rare. The factors affecting the patient's comfort after fURS are still under investigation.

Urethral catheter (UC) placement following fURS an issue that has not yet been fully explored. Some urologists insert UC after fURS to monitor the patient's urine volume more accurately and to avoid the risk of acute urinary retention. In addition, some authors claimed that the presence of UC following fURS may have a potential role in reducing infectious complications (5). On the other hand, the presence of UC is associated with pain and patient discomfort, and increases the risk of urethral stricture during long-term follow-up. Also, the catheter itself has a cost, and removal of the catheter after the procedure increases the workload of healthcare professionals (6).

Although previous studies about fURS mostly focused on success and complications of the procedure, a limited number of studies aimed to clarify the effect of UC following fURS on pain of patients. In this study, we aimed to investigate the factors affecting UC placement following fURS and the effect of UC placement on pain of patients.

Material and Methods

This multicentric study was performed in prospective manner from 1st January 2015 to 30th December 2023, and patients with renal stones smaller than two centimeters who underwent fURS were analyzed for study inclusion. Patients' demographic characteristics including age (years), sex, body mass index (BMI) (kg/m^2), presence of comorbidities, anticoagulant use, preoperative creatinine level (mg/dl), presence of preoperative JJ stent, stone size (millimeter), stone burden (centimeter square), number of stones (single or multiple), stone localization (ureter or kidney), Hounsfield unit, and presence of hydronephrosis were recorded. Patients with concomitant kidney and ureter stones, with nephrostomy tube, with neurologic and psychiatric disease, who were illiterate, and with drug addiction were excluded from the study.

In addition, side of operation, operation time (minutes), perioperative complications and postoperative complications, success or failure of the procedure, requirements for additional anesthesia in the postoperative period, and Visual Analogue Scale (VAS) score at postoperative 6th hour were noted.

Flexible Ureteroscopy Procedure

In lithotomy position, cystoscopy was done to identify any bladder pathology and the ureteral orifice of the operation side. Then to identify any ureteral pathology and achieve passive dilatation of the ureter, semi rigid ureterorenoscopy was performed. A ureteral access sheath (UAS) was placed two or three cm below the ureteropelvic junction under fluoroscopic guidance. Then, a flexible ureterorenoscope was inserted through the UAS, and the stone was detected by direct vision. In cases where the UAS did not pass, the procedure was performed without using the UAS. During stone fragmentation, Holmium laser with 273 microfiber was used, and stone fragments larger than 3 mm were extracted with nitinol baskets. Stone fragments smaller than 3 cm were left to spontaneously pass. Stone-free status of patients was defined by visual evaluation of all calyces and by fluoroscopy-guided evaluation. At the end of the procedure, JJ stent was inserted routinely. The decision about UC placement was made according to surgeon preference after the operation.

To clarify the factors affecting UC placement at the end of procedure and the effect of UC placement on patient quality of life, patients were categorized into two groups according to UC placement or not. These groups were compared according to preoperative parameters, intraoperative data, complications, success and VAS at postoperative 6th hour.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS IBM Corp., Armonk, NY, USA) version 27 was used. Distribution of the variables was assessed with the Shapiro-Wilk test. Independent student t-test was done for comparison of the variables. Descriptive data are summarized as mean

± standard deviation for continuous variables. Categorical variables were compared using the χ2 test. Logistic regression analysis was performed to evaluate the parameters that predicted UC insertion. The data were analyzed at 95% confidence level, and a p value of less than 0.05 was accepted as statistically significant.

Results

In total, 324 patients were enrolled into the study. UC was inserted in 170 patients following fURS and was not inserted to 154 patients. Age, BMI, preoperative JJ stent rate, stone location, Hounsfield unite, and presence of hydronephrosis were similar between the groups (p= 0.946, p= 0.319, p= 0.194, p= 0.195, p= 0.277, and p= 0.721, respectively). The ratio of male patients was significantly higher in patients with UC inserted (p= 0.002). Additionally, in the patient group with UC placement, ratio of anticoagulant use (8.2% vs. 1.9%, p= 0.002), preoperative creatinine level (1.1 mg/dl vs. 0.8 mg/dl, p=0.001), stone size (23.8 mm vs. 19.6 mm, p= 0.001), and stone burden (3.7 cm^2 vs. 30 cm^2, p= 0.001) were significantly higher. Ratio of multiple stones was significantly higher in patients with UC placement (34.1% vs. 13.6%, p= 0.001) (Table 1).

Table 1: Comparison of patient demographic data and stone characteristics according to urethral catheterization status

	Urethral Catheterization		P value
	Yes (n : 170)	No (n : 154)	
Age (years)*	42.2 ± 12.6	42.0 ± 13.0	0.946
Gender, n (%) Female Male	 78 (45.9%) 92 (54.1%)	 97 (63.0%) 57 (37.0%)	***0.002***
Body mass index (kg/m^2)*	27.2 ± 3.1	27.6 ± 3.4	0.319
Comorbidities, n (%) Hypertension Diabetes mellitus Coronary artery disease Chronic kidney disease	 32 (18.8%) 21 (12.4%) 17 (10.0%) 12 (7.1%)	 22 (14.3%) 18 (11.7%) 9 (5.8%) 1 (0.6%)	 0.274 0.854 0.169 ***0.003***
Anticoagulant use, n (%)	14 (8.2%)	3 (1.9%)	***0.011***
Preoperative creatinine (mg/dl)*	1.1 ± 0.5	0.8 ± 0.2	***0.001***
Preoperative JJ stent, n (%)	10 (5.9%)	15 (9.7%)	0.194
Stone size (mm)*	23.8 ± 7.3	19.6 ± 7.9	***0.001***
Stone burden (cm^2)*	3.7 ± 1.6	3.0 ± 1.5	***0.001***
Number of stone, n (%) Single Multiple	 112 (65.9%) 58 (34.1%)	 133 (86.4%) 21 (13.6%)	***0.001***
Stone localization, n (%) Ureter Kidney	 31 (18.2%) 139 (81.8%)	 20 (13.0%) 134 (87.0%)	0.195
Hounsfield unit*	782.0 ± 262.7	812.1 ± 231.4	0.277
Hydronephrosis, n (%) Yes No	 132 (77.6%) 38 (22.4%)	 117 (76.0%) 37 (24.0%)	0.721
**Mean ± standard deviation*			

Side, postoperative complications, and success rate were comparable between the groups (p= 0.855, p= 0.714, and p= 0.854, respectively). Operation time was significantly longer (55.0 min vs. 46.4 min, p= 0.003) and intraoperative complications (4.1% vs. 0.6%, p= 0.045) were significantly higher in patients with UC insertion. Moreover, need for additional analgesia and VAS score was significantly lower in patients without UC placement (p= 0.004 vs. p= 0.001).

Table 2: Comparison of operation features according to urethral catheterization status

	Urethral Catheterization		P value
	Yes (n : 170)	No (n : 154)	
Side, n (%) Left Right	79 (46.5%) 91 (53.5%)	70 (45.5%) 84 (54.5%)	0.855
Operation time (min)*	55.0 ± 29.9	46.4 ± 18.7	***0.003***
Perioperative complications, n (%)	7 (4.1%)	1 (0.6%)	***0.045***
Postoperative complications, n (%)	21 (12.3%)	17 (11.0%)	0.714
Success, n (%)	149 (87.6%)	136 (88.3%)	0.854
Need for additional analgesia, n (%)	42 (24.7%)	19 (12.3%)	***0.004***
VAS score*	4.2 ± 1.9	2.7 ± 1.1	***0.001***

**Mean ± standard deviation*
VAS: Visual Analog Scale

Multivariate analysis revealed that male gender and higher preoperative creatinine level were predictive factors for UC placement following fURS (p= 0.008 and p= 0.001). In contrast, anticoagulant use and presence of perioperative complication did not significantly affect UC insertion (p= 0.397 vs. p= 0.932). Moreover, higher stone size and stone burden, and longer operation time significantly increased the rate of UC insertion following fURS (p= 0.001, p= 0.010, and p= 0.001, respectively).

Table 3: Multivariate analysis evaluating risk factors for urethral catheter placement

	Odds ratio	95% CI	P value
Gender	2.078	1.213 – 3.560	***0.008***
Anticoagulant use	2.117	0.374 – 11.996	0.397
Preoperative creatinine (mg/dl)	4.835	2.051 – 11.396	***0.001***
Stone size	1.074	1.038 – 1.111	***0.001***
Number of stones	2.399	1.235 – 4.660	***0.010***
Operation time	1.019	1.008 – 1.030	***0.001***
Perioperative complications	1.125	0.076 – 16.653	0.932

Discussion

Flexible ureterorenoscopy is a common surgical procedure for proximal ureteral stone(s) and kidney stone(s). While possible factors that increase success and reduce complication rates have been extensively investigated, the number of studies identifying factors affecting quality of life after fURS is limited (7, 8). It is well known that UC placement after surgical procedures is related with pain and deterioration of quality of life. Thus, we conducted a study to identify the effect of UC on patient quality of life after fURS, and to analyze the factors affecting UC placement following fURS. Our findings revealed that male gender, higher preoperative creatinine level, higher stone size and stone volume, and longer operation time were predictive factors for UC placement following fURS.

Acute urinary retention (AUR) is simply defined as the inability to urinate, and previous reports emphasized that the risk was 13 times higher in men in comparison with women (9). In addition, due to anatomical properties,

urethral length is much longer in men which increases the risk of damage from surgical manipulations through the urethra. Hori and colleagues (10) analyzed UC placement rates after endoscopic ureteral stone surgery, and the authors concluded that being male was a predictive factor for UC insertion. Also, some male patients with fURS may have benign prostatic hyperplasia, and manipulations in this area may cause edema and bleeding that results in AUR. In the present study, we found significantly higher UC placement rate in males.

Stone size and stone volume are important parameters when selecting the type of kidney stone surgery. Majdalany and colleagues analyzed the factors affecting operation time for the fURS procedure. The authors stated that stone size was a predictive factor for prolonged operation time, not stone density (11). In another study, Akman et al. (12) analyzed safety and proficiency of fURS for kidney stone management, and concluded that with increasing stone size, requirements for second session-fURS and additional procedures increased. Also, as the size of kidney stones increases, the number of stone fragments may increase. While these stones are expelled by spontaneous passage, fragments may hit the urethra mucosa, causing pain or obstructing the urethra. We believe that due to these concerns, there were significant correlations of higher stone size and stone volume with UC placement.

Longer operation time could increase surgical morbidity and mortality. Previous studies about fURS demonstrated that longer operation time resulted in higher pelvicalyceal pressure during fURS (13). Moreover, Ozgor and colleagues (14) investigated factors affecting infectious complications after fURS. The authors stated that operation time longer than 60 minutes increased infectious complications. Also, some authors claimed that prolonged pressure on the ureteral wall significantly increased the risk of ureteral stricture (15). Similarly, prolonged pressure on the urethra or prolonged manipulation of the urethra may increase postoperative pain or cause urination difficulties. In the present study, prolonged operation time was a predictive factor for UC placement.

Although this study is one of the rare studies analyzing UC placement after fURS, the present study has some limitations. First of all, all patients with UC placement in a single group; however, we did not analyze the effect of the size of UC on the patients' quality of life. Secondly, due to the multi-centric nature of the study, operations were performed by different surgeons, so surgeon motivation to insert UC may have affected the results. In addition, we evaluated postoperative pain with a single VAS score; however, the length of hospital stay after fURS is short and frequent requests to provide VAS scores after the operation might disturb the patient. We also did not evaluate different types of urethral catheters (foley, silicon, etc.). Lastly, we did not focus on a cost analysis of UC placement.

Conclusion

The present study demonstrated that UC placement following fURS was associated with increased analgesia requirements and more pain. Moreover, our study demonstrated that male gender, higher preoperative creatinine level, higher stone size and stone volume, and longer operation time resulted in UC insertion after fURS.

Declarations

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There is no funding in this study

Conflicts of Interest/Competing Interests

There is no conflicts of interesst in this study for all authors

Ethics Approval

Ethics committee approval was issued by Acıbadem University Ethics Committee Committee with decision number 3/102.

Availability of Data and Material

Appropriate

Authors' Contributions:

Hakan Cakir: Substantial contributions to the conception or design of the work, analysis, interpretation of data for the work, drafting the work or revising it critically for important intellectual content, approved the final version of manuscript..

Onder Cinar: Collected the data, approved the final version of manuscript.

Murat Akgül: Collected the data, approved the final version of manuscript.

Oktay Özman: Collected the data, performed the analysis, approved the final version of manuscript.

Cem Başataç: Contributed data or analysis tools, approved the final version of manuscript.

Muhammed Fatih Şimşekoğlu: Contributed data or analysis tools, approved the final version of manuscript.

Kerem Teke: Performed the analysis, approved the final version of manuscript.

Eyüp Burak Sancak: Collected the data, performed the analysis, approved the final version of manuscript.

Cenk Murat Yazici: Performed the analysis, approved the final version of manuscript.

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