Effect of standard antibiotic prophylaxis versus enhanced prophylactic measures on rate of urinary tract infection after flexible ureteroscopy: A randomized clinical study

El-Sayed I. El-Agamy
  Al-Azhar University Faculty of Medicine

Mohamed A. Elhelaly.
  Al-Azhar University Faculty of Medicine

Tamer A. Abouelgreed (dr_tamer_ali@yahoo.com)
  Al-Azhar University, Faculty of Medicine, Department of urology  https://orcid.org/0000-0003-2640-3425

Abdrabuh M. Abdrabuh
  Al-Azhar University Faculty of Medicine

Mohamed F. Elebiary
  Al-Azhar University Faculty of Medicine

Mohamed A. Abdelaal
  Al-Azhar University Faculty of Medicine

Research article

Keywords: Antimicrobial, flexible ureteroscopy, prophylaxis, urinary tract infection

DOI: https://doi.org/10.21203/rs.3.rs-215192/v1

License: ☒  Ⓢ This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

Background

Prevention of urinary tract infections (UTIs) after flexible ureteroscopy (fURS) remains controversial. The present study aimed to compare the rate of post-procedural UTI in patients subjected to the standard antibiotic prophylaxis alone versus enhanced prophylactic measures.

Methods

from August 2018 to September 2020, a total of 100 patients subjected to fURS for management of ureteral and/or renal stones were included in this study. Patients were equally and randomly divided to two treatment groups using randomly computer-generated allocation tables and concealed envelope technique. Treatment groups included standard antibiotic prophylaxis group and enhanced prophylaxis group. Patients in the standard antibiotic prophylaxis group IV, fluoroquinolone 1 hour preoperatively and oral antibiotics were used for 24h postoperatively. In the enhanced prophylaxis group, patients had urine culture 10 days before the procedure. In addition to the antibiotic prophylaxis, hydrophilic-coated ureteral access sheaths were systematically used.

Results

Comparison between the baseline and operative characteristics of the studied groups revealed no statistically significant differences. Postoperatively, 8 patients (16.0%) in the standard prophylaxis group were diagnosed with UTI in comparison to 2 patients (4.0%) in the enhanced prophylaxis group expressing a statistically significant difference (p = 0.046). Using binary logistic regression analysis, female patients' sex [OR (95% CI): 0.09 (0.018–0.46), operative time [OR (95%CI): 0.97 (0.94–0.99)] were significant predictors of postoperative UTI in univariate analysis. However, only female sex remained significant in multivariate analysis [OR (95% CI): 0.09 (0.017–0.49)].

Conclusions

Urinary tract infection after fURS can be significantly reduced by using the suggested enhanced prophylactic approach.

Background

Thanks to the continuous technological developments, flexible ureteroscopy (fURS) has become one of the most reliable tools in upper urinary tract endourology. Weaponed by creative ancillary instruments such as graspers and baskets, effective energy sources and digital and robotic enhancements, fURS could expand its diagnostic and therapeutic applications to many upper urinary tract pathologies beyond their common use in management of renal stones [1]. (fURS can be used as a conservative treatment for urothelial tumors of the upper urinary tract (UTUC) and can serve as follow up aid after radical treatment of UTUC [2]. However, use of fURS isn't without drawbacks. Significant complications including urinary
tract infection (UTI) and ureteric trauma are frequently reported [3]. In one study, febrile UTI was reported in 14.1% of patients submitted to flexible ureteroscopic lithotripsy [4]. Unfortunately, prevention of postoperative UTI after fURS remains a debatable issue with current practice lacks well-established clinical evidence based on randomized clinical studies and is mostly based on retrospective studies [5]. In an effort to standardize the periprocedural systemic antimicrobial administration, the American Urological Association best practice policy statement was developed [6]. However, real-world practice is widely variable and observational studies show relatively low compliance with these recommendations [5]. To guard against postprocedural infection, the most common practice is single dose antibiotic prophylaxis [7]. On the other hand, some centers use more enhanced precautions including centralized collection and examination of preoperative urine cultures, standardized antibiotic prophylaxis and use of ureteral access sheath. Even with these precautions, postoperative UTI was encountered in 6.7% of patients [8]. The present randomized study aimed to compare the rate of post-procedural UTI in patients subjected to the standard antibiotic prophylaxis alone versus enhanced prophylactic measures.

Methods

The present randomized study was conducted at department of Urology, Armed forced Hospital, Alhada, KSA in the period from August 2018 to September 2020. The study protocol was approved by the local ethical committee of the author’s institute and informed written consent was obtained from all patients before enrollment. The study is registered at clinicaltrials.gov (NCT04731090). The study included all patients subjected to fURS for management of ureteral and/or renal stones. Exclusion criteria were symptomatic UTI, use of rigid ureteroscope and antegrade ureteroscopy. Preoperatively, all patients were subjected to careful history taking, thorough clinical examination and non-contrast computed tomography scan to evaluate the stone characteristics. Patients were equally and randomly allocated into one of the two treatment groups using randomly computer-generated allocation tables and concealed envelope technique. Randomization and patients allocation were supervised by an independent researcher. Treatment groups included standard antibiotic prophylaxis group and enhanced prophylaxis group. Patients in the standard antibiotic prophylaxis group IV fluoroquinolone 1 hour preoperatively and oral antibiotics were used for 24h postoperatively. In the enhanced prophylaxis group, patients had urine culture 10 days before the procedure. Patients with sterile culture received standard antibiotic prophylaxis while patients with polymicrobial preoperative urine culture (defined by a urine culture isolating at least three microorganisms, of which none is predominant) were treated by ceftriaxone 48 h before the intervention which was continued until 1 day after surgery. Those having positive urine culture were contacted by the urologist to assess if they had symptoms of UTI. In asymptomatic cases, according to the specific pathogens identified, a full course of antibiotics was started 5 days prior to surgery until 48 h after the intervention. For those having clinically significant infection, intervention was deferred. In addition to the antibiotic prophylaxis, hydrophilic-coated ureteral access sheaths were systematically used. The primary outcome in the present study is occurrence of postoperative UTI withing 30 days postoperative. Postoperative UTI was defined as the occurrence of a temperature higher than 38°C associated with pyuria and/or bacteriuria without any other focal infectious sites.
Data obtained from the present study were presented as number and percent or mean and standard deviation (SD). Numerical data were compared using t test while categorical data were compared using chi-square test. Logistic regression was used to identify predictors of outcome. All statistical operations were computed using SPSS 25 (IBM, USA) and p value less than 0.05 was considered statistically significant.

**Results**

The present study comprised 100 patients submitted to FURS. They were simply and equally randomized into two groups according to the used prophylaxis protocol against postoperative UTI. The standard prophylaxis group (n = 50) received standard antibiotic prophylaxis while the enhanced prophylaxis group (n = 50) had preoperative culture and coated ureteral access sheaths in addition to the antibiotic prophylaxis. Comparison between the baseline and operative characteristics of the studied groups revealed no statistically significant differences (Table-1). Postoperatively, 8 patients (16.0 %) in the standard prophylaxis group were diagnosed with UTI in comparison to 2 patients (4.0 %) in the enhanced prophylaxis group expressing a statistically significant difference (p = 0.046) (Table-1). Using binary logistic regression analysis, female patients’ sex [OR (95% CI): 0.09 (0.018–0.46), operative time [OR (95%CI): 0.97 (0.94–0.99)] were significant predictors of postoperative UTI in univariate analysis. However, only female sex remained significant in multivariate analysis [OR (95% CI): 0.09 (0.017–0.49)] (Table-2).

**Discussion**

Urinary tract infections after fURS are commonly seen in clinical practice. Even in the absence of microbial invasion, the surgical procedure itself elicits significant systemic inflammatory response which is related to the duration of the procedure and can predispose to infectious complications [9]. The present randomized study assessed the value of standard antibiotic prophylaxis versus enhanced prophylaxis in prevention of UTI after fURS. Postoperative UTI was diagnosed in 8 patients (16.0 %) in the standard prophylaxis group versus 2 patients (4.0 %) in the enhanced prophylaxis group (p = 0.046). Clearly, the beneficial effects of enhanced prophylaxis are attributed to additional measures included in the protocol namely the preoperative culture and treatment of identified infections and coated ureteral access sheaths. The relation between positive preoperative culture and postoperative UTI in patients submitted to fURS was discussed by the study of Senocak et al., [10] In their work, positive preoperative urine culture with multidrug resistance isolates was recognized as an independent risk factor of postoperative UTI. Of note, none of our patients had such isolates. Also, in the study of Alezra et al., [11] positive day-1 culture was a significant predictor of severe UTI. In addition, the study of Auge BK et al., [12] highlighted the value of ureteral access sheath (UAS) in reduction of postoperative UTI after fURS. Similar conclusions were reported by the randomized study of Özkaya et al., [13] who noted that use of UAS in impacted mid-upper ureteral stones is related to fewer infectious complications. The UAS serve to reduce the irrigation pressures transmitted to the renal pelvis and parenchyma [12]. Moreover, appropriate UAS selection is
important to optimize the renal blood flow during fURS. Adequate renal blood flow is essential to maintain local immune defensive mechanisms [14]. In our study, logistic regression analysis identified female sex as an independent risk factor of postoperative UTI. This finding is in conformity with the study of Baboudjian et al., [8]. In their study, they also added preoperative polymicrobial urine culture and increased operative time as predictors of postoperative UTI. Our conclusions are also supported by the recent meta-analysis of Ma et al. [15]. In contrast, the study of Baseskioglu et al., [16] recognized preoperative infection history, comorbidity score and residual fragments as significant predictors of UTI after fURS while the relevant risk factors in the study of Ozgor et al., [17] were longer operation time, presence of renal abnormality and age ≤ 40 years.

Conclusion

The present study concluded that UTI after fURS can be significantly reduced by using the suggested enhanced prophylactic approach.

Abbreviations

(fURS)
flexible ureteroscopy
(UTIs)
urinary tract infections
(UTUC)
uurothelial tumors of the upper urinary tract
(UAS)
ureteral access sheath

Declarations

1. Competing interests: The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

2. Funding: The authors received no financial support for the research, authorship and/or publication of this article.

3. Informed consent for participation and publish: Informed written consent was obtained from all patients before the study for participation and publish.

4. Ethical approval

All procedures performed in this study were in accordance with the ethical standards of the Institution and/or National Research Committee and the 1964 Declaration of Helsinki and its later amendments or
comparable ethical standards. The protocol and written informed consent were approved by the local ethical committee of Armed forced Hospital, Alhada, KSA. Rec No: 536).

5. Guarantor: None

6. Authors’ Contributions:

All listed authors (EI., MA., TA., AM., MF. and MAA.) have performed all four points specified below:

A. Made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data.

B. Involved in drafting the manuscript or revising it critically for important intellectual content.

C. Provided final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content.

D. Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

All authors read and approved the final manuscript.

7. Acknowledgements: None.

8. Availability of data and materials: The data that support the findings of this study are available from the corresponding author upon request.

References

1. Alenezi H, Denstedt JD. Flexible ureteroscopy: Technological advancements, current indications and outcomes in the treatment of urolithiasis. Asian J Urol. 2015;2(3):133-141.

2. Cho SY. Current status of flexible ureteroscopy in urology. Korean J Urol. 2015;56(10):680-688. doi:10.4111/kju.2015.56.10.680

3. Osther PJS. Risks of flexible ureterorenoscopy: pathophysiology and prevention. Urolithiasis. 2018;46(1):59-67.

4. Kim JW, Lee YJ, Chung JW, et al. Clinical characteristics of postoperative febrile urinary tract infections after ureteroscopic lithotripsy. Investig Clin Urol. 2018;59(5):335-341. doi:10.4111/icu.2018.59.5.335

5. Greene DJ, Gill BC, Hinck B, et al. American Urological Association Antibiotic Best Practice Statement and Ureteroscopy: Does Antibiotic Stewardship Help? J Endourol. 2018;32(4):283-288. doi:10.1089/end.2017.0796

6. Wolf JS Jr, Bennett CJ, Dmochowski RR, et al. Best practice policy statement on urologic surgery antimicrobial prophylaxis [published correction appears in J Urol. 2008 Nov;180(5):2262-3]. J Urol.
7. Pietropaolo A, Bres-Niewada E, Skolarikos A, et al. Worldwide survey of flexible ureteroscopy practice: a survey from European Association of Urology sections of young academic urologists and uro-technology groups. Cent European J Urol. 2019;72(4):393-397.

8. Baboudjian M, Gondran-Tellier B, Abdallah R, et al. Predictive risk factors of urinary tract infection following flexible ureteroscopy despite preoperative precautions to avoid infectious complications. World J Urol. 2020;38(5):1253-1259. doi:10.1007/s00345-019-02891-8

9. Zhong W, Leto G, Wang L, Zeng G. Systemic inflammatory response syndrome after flexible ureteroscopic lithotripsy: a study of risk factors. J Endourol. 2015;29(1):25-28. doi:10.1089/end.2014.0409

10. Cagri Senocak, Cihat Ozcan, Tolga Sahin, Gulden Yilmaz, et al. Risk Factors of Infectious Complications after Flexible Uretero-renoscopy with Laser Lithotripsy. Journal urology 2018;15(4):158-163. doi: 10.22037/uj.v0i0.3967

11. Alezra E, Lasselin J, Forzini T, François T, Viart L, Saint F. [Prognostic factors for severe infection after flexible ureteroscopy: Clinical interest of urine culture the day before surgery?]. Prog Urol. 2016;26(1):65-71. doi:10.1016/j.purol.2015.09.008

12. Auge BK, Pietrow PK, Lallas CD, Raj GV, Santa-Cruz RW, Preminger GM. Ureteral access sheath provides protection against elevated renal pressures during routine flexible ureteroscopic stone manipulation. J Endourol. 2004;18(1):33-36. doi:10.1089/089277904322836631

13. Özkaya F, Sertkaya Z, Karabulut İ, Aksoy Y. The effect of using ureteral access sheath for treatment of impacted ureteral stones at mid-upper part with flexible ureterorenoscopy: a randomized prospective study. Minerva Urol Nefrol. 2019;71(4):413-420. doi:10.23736/S0393-2249.19.03356-3.

14. Sener TE, Tanidir Y, Bin Hamri S, et al. Effects of flexible ureteroscopy on renal blood flow: a prospective evaluation. Scand J Urol.2018;52(3):213-218. doi:10.1080/21681805.2018.1437770

15. Ma YC, Jian ZY, Yuan C, Li H, Wang KJ. Risk Factors of Infectious Complications after Ureteroscopy: A Systematic Review and Meta-Analysis Based on Adjusted Effect Estimate [published online ahead of print, 2020 Apr 15]. Surg Infect (Larchmt). 2020;10.1089/sur.2020.013. doi:10.1089/sur.2020.013

16. Baseskioglu B. The Prevalence of Urinary Tract Infection Following Flexible Ureteroscopy and the Associated Risk Factors. Urol J. 2019;16(5):439-442. Published 2019 Oct 21. doi:10.22037/uj.v0i0.4340

17. Ozgor F, Sahman M, Cubuk A, Ortac M, Ayranci A, Sarilar O. Factors affecting infectious complications following flexible ureterorenoscopy. Urolithiasis. 2019;47(5):481-486.

**Tables**

**Table 1:** Comparison between the studied groups regarding the preoperative, operative and postoperative data
|                     | Standard Prophylaxis | Enhanced Prophylaxis | P value |
|---------------------|----------------------|----------------------|---------|
| Age (years) mean ± SD| 48.7 ± 13.5          | 45.0 ± 16.5          | 0.22    |
| Male/female n       | 33/17                | 35/15                | 0.67    |
| BMI (Kg/m²) mean ± SD| 30.1 ± 4.6           | 28.1 ± 4.0           | 0.13    |
| Associated morbidities n (%) |                     |                      |         |
| Hypertension        | 16 (32.0)            | 15 (30.0)            | 0.83    |
| Diabetes mellitus   | 25 (50.0)            | 21 (42)              | 0.42    |
| Previous stone operation n (%) | 23 (46.0)          | 27 (54.0)            | 0.42    |
| Preoperative ureteral stent n (%) | 14 (28.0)          | 13 (26.0)            | 0.82    |
| Preoperative hydronephrosis n (%) |                   |                      |         |
| None                | 13 (26.0)            | 15 (30.0)            | 0.58    |
| Mild                | 28 (56.0)            | 24 (48.0)            |         |
| Moderate            | 8 (16.0)             | 11 (22.0)            |         |
| Stone location n (%)|                      |                      |         |
| Kidney              | 18 (36.0)            | 20 (40.0)            | 0.7     |
| Ureter              | 20 (40.0)            | 16 (32.0)            |         |
| Combined            | 12 (24.0)            | 14 ()                |         |
| Stones number mean ± SD | 2.3 ± 1.4        | 2.2 ± 1.3            | 0.66    |
| Largest stone size (cm³) mean ± SD | 2.1 ± 1.2        | 2.4 ± 1.5            | 0.34    |
| Operative time (min.) mean ± SD | 115.2 ± 25.5    | 111.9 ± 26.8         | 0.52    |
| Postoperative UTI n (%) | 8 (16.0)           | 2 (4.0)              | 0.046   |

Table2: Predictors of postoperative UTI in the studied groups
|                  | Univariate analysis | Multivariate analysis |
|------------------|---------------------|-----------------------|
|                  | OR      | 95% CI   | P value | OR      | 95% CI   | P value |
| Age              | 0.99    | 0.94-1.03| 0.54    | -       | -        | -       |
| Sex              | 0.09    | 0.018-0.46| 0.004   | 0.09    | 0.017-0.49| 0.005   |
| Diabetes         | 0.53    | 0.14-2.02| 0.36    | -       | -        | -       |
| Stone size       | 0.82    | 0.55-1.24| 0.35    | -       | -        | -       |
| Operative time   | 0.97    | 0.94-0.99| 0.032   | 0.97    | 0.95-1.01| 0.063   |
| Type of prophylaxis | 0.22  | 0.044-1.09| 0.063   | 0.19    | 0.033-1.14| 0.069   |