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Effectiveness of prophylactic ceftriaxone in postoperative cystoscopy urinary tract infection control; a prospective case-control study

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ABSTRACT

Introduction: Cystoscopy is a urological procedure that, despite its minimally invasive nature, carries a risk of postoperative urinary tract infection (UTI), and preventing such infections is clinically important. Ceftriaxone, a broad-spectrum third-generation cephalosporin, is commonly used in surgical prophylaxis, yet its effectiveness in reducing post-cystoscopy UTI has not been clearly established.

Objectives: This study aimed to evaluate whether a single preoperative dose of ceftriaxone reduces the incidence of postoperative UTI in patients who received ceftriaxone compared to those who did not.

Patients and Methods: This prospective case-control study was conducted at Al-Diwaniyha Teaching hospital in Iraq between April 2022 and April 2024, enrolling 200 patients undergoing flexible cystoscopy who were divided into two equal groups; one received a single preoperative dose of one gram of ceftriaxone, while the other had no antibiotic prophylaxis. Baseline demographic data were collected, and urine cultures were obtained within 24 hours before cystoscopy and again 5–7 days postoperatively. Outcomes assessed included postoperative urine culture results, occurrence of symptomatic UTI, and UTI requiring treatment, allowing comparison of infection rates between the ceftriaxone and control groups.

Results: The results showed that non-use of prophylactic ceftriaxone was not significantly associated with higher rates of post-operative infection outcomes. For post-operative urine culture positivity, symptomatic UTI, and UTI requiring treatment, the odds ratios were 1.51, 1.34, and 1.70 in the unadjusted model and 1.33, 1.17, and 1.49 in the adjusted model (adjusted for age and gender as a confounder), respectively; however, all analyses were non-significant ($P > 0.05$).

Conclusion: Omitting prophylactic ceftriaxone during flexible cystoscopy was not linked to increased post-procedural UTI, indicating that routine use may be unnecessary, requiring more judicious antibiotic therapy management

Implication for health policy/practice/research/medical education:
The absence of a significant association between withholding prophylactic ceftriaxone and the development of post-flexible cystoscopy urinary tract infections (UTIs) suggests that routine antibiotic prophylaxis may not be required in this context. Clinicians can therefore consider omitting ceftriaxone in standard practice, reserving its use for patients with specific risk factors or comorbidities that predispose them to infection.

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Introduction

Cystoscopy is a common procedure that enables urologists to visualize and inspect the interior lining of the bladder, which is super useful for both diagnosing issues and providing treatment (1,2). Although cystoscopy remains an essential tool in urological practice for the evaluation of hematuria, evaluating bladder tumors, and spotting any structural problems (3,4), one of its principal disadvantages is the risk of urinary tract infection (UTI) (5). The rates of UTIs after cystoscopy can vary quite a bit based on the patient group and what the procedure involves, making it a notable complication that folks need to be aware of (1,6-8). Current consensus guidelines from the European Association of Urology and the American Urological Association acknowledge this infection risk but do not universally recommend routine antibiotic prophylaxis

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for all patients undergoing cystoscopy, particularly those without established risk factors (5).

The role of prophylactic antimicrobials in preventing UTI following cystoscopy remains debatable. A meta-analysis study with 7,400 participants found that prophylactic antimicrobials may reduce the risk of UTI with a risk ratio of 0.49 (9); however, the quality of evidence was rated as low, and prophylactic antimicrobials indicated little effect on the occurrence of UTI compared to the control group (1). Moreover, evidence demonstrated that prophylactic antimicrobials may result in adverse events, including concerns regarding antimicrobial resistance (1, 2). Despite these results, evidence indicated that in clinical practice, over 90% of urologists and approximately 60% of practitioners continue to administer antibiotics routinely, regardless of risk profile (5).

Ceftriaxone, as a broad-spectrum third-generation cephalosporin against bacteria, was assessed for preventing various surgical infections as a prophylactic agent (10). It has demonstrated in vitro efficacy for the most uropathogenic *Escherichia coli*, and showed a prophylactic effect due to its bactericidal activity and favorable pharmacokinetic properties (11). Although cephalosporins have demonstrated their effectiveness as prophylactic agents for surgical procedures (10), there is a lack of evidence for approving the prophylactic effect of ceftriaxone following cystoscopy.

Objectives

The objective of this study is to evaluate whether a single prophylactic dose of ceftriaxone administered before cystoscopy reduces the incidence of postoperative UTI compared to those who do not use prophylactic antibiotics.

Patients and Methods

Study design and participant

This prospective case-control study included 200 patients who underwent flexible cystoscopy in the urology department of Al-Diwaniyha teaching hospital in Iraq from April 2022 to April 2024. Patients were classified into two groups; 100 patients received a single dose of one gram of ceftriaxone compared to 100 patients who did not receive prophylaxis antibiotics preoperatively.

Inclusion and exclusion criteria

Inclusion criteria included adult participants aged 18-75 years who were candidates for flexible cystoscopy by a single urologist, provided written informed consent, and had a negative urine culture. Participants also required the absence of symptoms of UTI and no fever at the time of the procedure. Exclusion criteria were the presence of allergy or hypersensitivity to ceftriaxone, receiving other antibiotics alongside ceftriaxone, and participants' unwillingness or uncooperative nature to complete the study follow-up period.

Data collection

At the beginning of the study, informed written consent was obtained from all participants who were going to undergo flexible cystoscopy by a single urologist. Data were collected prospectively, including baseline data, such as demographic characteristics of age and gender. All patients had a urine sample obtained within 24 hours before cystoscopy for urine culture by the hospital microbiology laboratory using routine methods. Patients who received prophylactic ceftriaxone before the cystoscopy were classified as a case group, and those who did not were allocated to the control group. And another urine sample was collected 5-7 days postoperatively and assessed for urine culture. The presence of symptomatic UTI and UTI requiring treatment was also assessed at this time. Data were collected and compared between the two groups.

Outcome measurement

The primary outcome includes comparing the results of post-operative urine culture (positive/negative), presence of post-operative symptomatic UTI (yes/no), and presence of post-operative UTI requiring treatment, during 5-7 days after cystoscopy, between the two groups of patients who received 1 gram of ceftriaxone and those who did not. The secondary outcome was assessing the effectiveness of using ceftriaxone as a prophylactic agent for the prevention of UTI following cystoscopy.

Statistical analysis

Data were analyzed using SPSS version 17 (SPSS IBM Corp; USA). Continuous variables (age) were reported as mean ± standard deviation (SD) and compared between groups using independent-samples t-tests after assessing normality by Shapiro–Wilk. Categorical variables (gender, postoperative urine culture positivity, symptomatic UTI, and UTI requiring treatment) were reported as numbers and percentages and compared between groups using chi-square tests. Multivariable binary logistic regression models were conducted to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the association between non-use of prophylactic ceftriaxone and each infection outcome (positive culture, symptomatic UTI, treatment-requiring UTI), with adjusted models controlling for age and gender. A $P < 0.05$ was considered statistically significant for all analyses.

Results

The study population consisted of a nearly balanced mix of male and female participants, with a mean age of 60.04 ± 6.22 years, who were equally distributed between two groups: patients who received ceftriaxone and those who did not. All participants had negative preoperative urine cultures, while postoperative cultures remained mostly negative with a small minority showing positivity, and

postoperative symptomatic UTI were uncommon, with an even smaller proportion requiring treatment (Table 1).

The two patient groups were similar in terms of demographic characteristics and clinical findings. The gender distribution was balanced across the groups, and there was no statistically significant difference in gender frequency distribution. The mean age was comparable between groups, and there were no statistically significant differences between patients who received prophylactic ceftriaxone and those who did not. In terms of infection parameters, in both groups, the postoperative urine cultures were predominantly negative, symptomatic UTI after surgery were uncommon, and a small proportion required treatment for postoperative UTI, and no statistically significant difference was observed between the two groups (Table 2).

The logistic regression analysis indicated that the relationship between the non-use of prophylactic ceftriaxone and the occurrence of post-operative UTI was not statistically significant. In both unadjusted and adjusted models (in terms of age and gender), none of the outcomes, including positive urine cultures, symptomatic UTI, and UTI requiring treatment, showed statistically significant associations with the absence of prophylactic ceftriaxone. Overall, the findings suggest that withholding prophylactic ceftriaxone was not independently associated with higher occurrences of post-operative UTIs (Table 3).

Discussion

The finding aligns with previous evidence. An assessment of prophylactic antibiotics involving 200 patients with sterile baseline urine undergoing diagnostic cystoscopy demonstrated minimal benefit, with only 1% positive urine cultures in the prophylaxis group (receiving cefoperazone) compared to 2% in the non-prophylaxis group, a difference that was not statistically significant (12). More recently, a randomized controlled trial examining 225 patients undergoing diagnostic rigid cystoscopy found that pre-procedural single-dose intravenous cefuroxime prophylaxis did not decrease the incidence of

Table 1. Total demographic and clinical findings of participating patients

Variable	Sub-variable	N	%
Gender	Male	102	51
	Female	98	49
Pre-operative urine culture	Negative	200	100
	Positive	0	0
Post-operative urine culture	Negative	195	97.5
	Positive	5	2.5
Post-operative symptomatic UTI	Negative	193	96.5
	Positive	7	3.5
Post-operative UTI required treatment	No	192	96
	Yes	8	4
Group classification	No antibiotic	100	50
	Ceftriaxone	100	50

Variable	Mean	SD	Minimum	Maximum
Age (year)	60.04	6.22	45	74

UTI: Urinary tract infection; SD: Standard deviation.

Table 2. The distribution of participants' demographic and clinical data between two groups of patients who received prophylactic ceftriaxone and those who did not

Demographic-clinical data		Group classification						*P* value*
		No antibiotic (n = 100)		Ceftriaxone (n = 100)		Total (N = 200)		
		No.	%	No.	%	N		
Gender	Male	47	46.1	55	53.9	102		0.258
	Female	53	54.1	45	45.9	98		
Post-operative urine culture	Negative	97	49.7	98	50.3	195		0.651
	Positive	3	60	2	40	5		
Post-operative symptomatic UTI	Negative	96	49.7	97	50.3	193		0.700
	Positive	4	57.1	3	42.9	7		
Post-operative UTI required treatment	No	95	49.5	97	50.5	192		0.470
	Yes	5	62.5	3	37.5	8		
Variable		**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	***P* value****
Age (year)		60.43	6.17	59.65	6.28	60.04	6.22	0.732

UTI: Urinary tract infection; SD: Standard deviation. *Chi-square, **Independent T-test.

Table 3. Assessing the occurrences of UTI related to non-use of prophylactic ceftriaxone by using logistic regression

Variable		Occurrences of infection related to non-use of ceftriaxone							
		Un-adjusted				Adjusted			
		P value	OR	95% CI		*P* value	OR	95% CI	
				Lower	Upper			Lower	Upper
Post-operative urine culture	Negative				Ref (1)				
	Positive	0.635	1.51	0.24	9.27	0.757	1.33	0.21	8.29
Post-operative symptomatic UTI	Negative				Ref (1)				
	Positive	0.701	1.34	0.29	6.18	0.834	1.17	0.25	5.51
Post-operative UTI required treatment	No				Ref (1)				
	Yes	0.457	1.70	0.39	7.32	0.593	1.49	0.90	1.14

UTI: Urinary tract infection; OR: Odds ratio; CI: Confidence interval; Ref: Reference.

post-cystoscopy positive urinary culture (8.7% without prophylaxis versus 3.6% with prophylaxis, $P=0.167$) or symptomatic UTI (6.1% without prophylaxis versus 1.8% with prophylaxis, $P=0.102$) (13). In a randomized controlled trial study by Slopnick et al on 216 women undergoing cystoscopy, the results indicated that the use of prophylactic antibiotics did not affect the incidence of postoperative UTI (14). The Cochrane systematic review analyzing antimicrobial agents for preventing UTIs in adults undergoing cystoscopy, which included 20 randomized and quasi-randomized trials, similarly concluded that prophylactic antibiotic administration showed low-quality evidence suggesting no reduction in systemic UTI incidence compared with placebo or no treatment, with significant heterogeneity noted across study populations and designs (1). Notably, subgroup analysis revealed differential effects based on cystoscopy type: prophylactic antibiotics might be effective for rigid cystoscopy (risk ratio 0.42, 95% confidence interval 0.19–0.91), whereas they did not appear effective for flexible cystoscopy (risk ratio 0.59, 95% confidence interval 0.31–1.10) (9). Vidovic et al, in a study on patients with pyeloplasty, stated that prophylactic antibiotics were not correlated with a lower incidence of post-pyeloplasty UTI (15). The absolute risk of symptomatic UTI following diagnostic cystoscopy in patients with sterile urine remains relatively low across contemporary studies, which raises important questions regarding the clinical significance and cost-effectiveness of routine antibiotic prophylaxis (16,17). However, in a study by Khichy et al, the use of short-term prophylactic antibiotics (three doses of ceftriaxone) was suggested to prevent postoperative wound infection (18).

Overall, current evidence does not support routine antibiotic prophylaxis before diagnostic cystoscopy as a standard of care for patients with sterile preoperative urine, and abandoning this practice aligns with principles of antimicrobial stewardship while reducing unnecessary antibiotic exposure, healthcare costs, and the risk of antimicrobial resistance selection. Future investigations should focus on identifying high-risk patient subgroups who may benefit from selective prophylaxis, optimizing procedural technique to minimize infectious complications, and exploring non-antibiotic preventive strategies in patients undergoing cystoscopy, while supporting the transition from universal to risk-stratified prophylaxis approaches in diagnostic urological procedures.

Conclusion

The findings of this study indicate that the omission of prophylactic ceftriaxone during flexible cystoscopy was not associated with an increased risk of post-procedural UTIs. These results suggest that routine administration of ceftriaxone may not be necessary in this setting, supporting a more judicious use of antibiotics to reduce unnecessary exposure and potential antibiotic resistance. This approach not only minimizes unnecessary antibiotic exposure but also supports antimicrobial stewardship efforts by reducing the risk of resistance development, lowering healthcare costs, and decreasing the potential for adverse drug reactions.

Limitations of the study

Conducted at a single center and small sample size, which may limit the generalizability of the findings, the short follow-up period, which potentially underestimates late-onset UTIs after cystoscopy, and not stratifying patients by comorbidities, prior UTI history, or procedural complexity that could influence infection risk are the most common limitations that should be considered.

Authors' contribution

Conceptualization: Ahmed Abdul Ameer Alwan.
Data curation: All authors.
Formal analysis: All authors.
Investigation: All authors.
Methodology: Ahmed Ali Obaid.
Supervision: All authors.
Validation: Ahmed Abdul Ameer Alwan.
Writing–original draft: All authors.
Writing–review and editing: All authors.

Conflicts of interest

The authors declare no conflict of interest.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical issues

The research was conducted in accordance with the Declaration of Helsinki. Informed written consent was obtained from all participants. The study resulted from a research project that was conducted at Al-Diwaniyha teaching hospital in Iraq and was approved by the College of Medicine, University of Al-Qadisiyah, Iraq (No. 1984). Besides, the authors have ultimately observed ethical issues (including plagiarism, data fabrication, and double publication).

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