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Predictive Value of Intraoperative Urine Culture for Postoperative Urinary Tract Infections in Endourological Surgery: A Prospective Observational Study

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Abstract

Background

Postoperative urinary tract infections (UTIs) remain a significant complication following endourological procedures. While preoperative urine culture (UC) is standard practice, its predictive accuracy for postoperative infectious complications is often limited. This study evaluates the diagnostic performance of intraoperative urine culture (IOUC) in predicting postoperative UTIs.

Methods

A prospective observational study was conducted at the Hassan II Military Hospital of Laayoune (March–August 2026). Patients undergoing endourological interventions (ureteroscopy, transurethral resection, cystoscopy) with negative preoperative UC were included. IOUC was collected during surgery. Patients were monitored for 30 days for symptomatic and culture-confirmed postoperative UTIs. Sensitivity, specificity, and risk factors were analyzed using Jamovi software.

Results

A total of 82 patients were included (mean age 58.4 ± 12.3 years). IOUC was positive in 18 patients (21.9%). Postoperative UTI occurred in 12 patients (14.6%). IOUC demonstrated a sensitivity of 83.3% and a specificity of 88.6% for predicting postoperative infection. Escherichia coli (41.6%) and Klebsiella pneumoniae (25%) were the most common isolates. Multivariable analysis identified operative duration > 60 minutes (OR 3.2, 95% CI 1.1–9.4) and diabetes mellitus (OR 2.5, 95% CI 1.0–6.3) as independent risk factors.

Conclusion

Intraoperative urine culture is a highly sensitive and specific predictor of postoperative UTIs in endourology. Its systematic use could guide early targeted antibiotic therapy and reduce empirical overconsumption.

Introduction

Urinary tract infections (UTIs) are among the most frequent healthcare-associated infections, particularly following urological surgery. Endourological interventions, such as operative cystoscopy, ureteroscopy, or transurethral resection (TUR), expose patients to a non-negligible risk of postoperative infection. These complications can lead to prolonged hospitalization, increased morbidity, and severe outcomes like urosepsis.

Current guidelines recommend a preoperative urine culture (UC) to detect pre-existing infections and tailor antibiotic prophylaxis [1]. However, preoperative results do not always accurately reflect the microbiological environment at the time of surgery, especially when stones or biofilms are manipulated

[2]. Several studies have suggested that intraoperative urine culture (IOUC) might provide a more representative microbiological profile [3, 4].

Despite this, the clinical utility of IOUC remains under-investigated in local settings. There is a lack of data regarding its capacity to predict postoperative UTIs and its impact on reducing empirical antibiotic use. This study aims to evaluate the sensitivity and specificity of IOUC in predicting postoperative UTIs and to identify associated risk factors in a cohort of endourological patients.

Materials and Methods

Study Design and Population

We conducted a prospective observational study at the Department of Urology and the Laboratory of Medical Biology at Hassan II Military Hospital, Laayoune, from March 1 to August 30, 2026. The study included adult patients (≥ 18 years) undergoing endourological procedures (ureteroscopy, TUR, cystoscopy, lithotripsy). Exclusion criteria were: known/treated UTI at the time of intervention, long-term urinary catheterization, antibiotic treatment within 72 hours prior to surgery, and incomplete follow-up. All participants provided written informed consent.

Data Collection

Clinical data (age, sex, comorbidities, type and duration of intervention) were recorded using a standardized collection sheet.

- Preoperative: UC was performed 48–72 hours before surgery. Only patients with negative UC or successfully treated infections were included.
- Intraoperative: Urine samples were collected during the procedure (direct aspiration via cystoscope or renal pelvis/ureteral fluid aspiration).
- Postoperative: Patients were monitored for clinical signs of UTI (fever ≥ 38°C, chills, dysuria, flank pain). In case of clinical suspicion, a postoperative UC was performed.

Laboratory Procedures

UC was performed by semi-quantitative seeding on CLED agar and direct microscopic examination. Plates were incubated at 37°C for 18–24 hours. Germ identification followed standard biochemical methods, and antimicrobial susceptibility testing was performed according to EUCAST 2025 guidelines [5]. A positive IOUC was defined as bacterial growth above a predefined threshold or isolation of a recognized pathogen.

Statistical Analysis

Descriptive statistics (means, standard deviations, and percentages) were used to summarize patient characteristics. The performance of IOUC was assessed using a 2×2 contingency table to calculate sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Chi-square tests were used for associations, and multivariable logistic regression was applied to identify independent risk factors for postoperative UTI. All analyses were performed using Jamovi software.

Results

Patient Characteristics

A total of 82 patients were analyzed. The mean age was 58.4 ± 12.3 years, with a male predominance (79.3%). The most common procedures were transurethral resection of the prostate (TURP, 36.6%) and ureteroscopy (30.5%). The mean operative duration was 52.8 ± 15.4 minutes.

Microbiological Findings

Preoperative UC was negative in all included patients. IOUC was positive in 18 patients (21.9%). The most frequently isolated organisms in IOUC were Escherichia coli (n = 8, 44.4%), Klebsiella pneumoniae (n = 4, 22.2%), and Pseudomonas aeruginosa (n = 3, 16.7%).

Predictive Performance

Postoperative UTI occurred in 12 patients (14.6%) within 30 days. Among these 12 cases, 10 had a positive IOUC, reflecting a high concordance. The diagnostic performance of IOUC is summarized in Table 1.

Table 1
Diagnostic Performance of IOUC in Predicting Postoperative UTI

Parameter	Value (%)	95% Confidence Interval
Sensitivity	83.3%	51.6% – 97.9%
Specificity	88.6%	78.7% – 94.9%
Positive Predictive Value (PPV)	55.6%	30.8% – 78.5%
Negative Predictive Value (NPV)	96.9%	89.1% – 99.6%

Risk Factor Analysis

Multivariable logistic regression (Table 2) showed that operative time exceeding 60 minutes was associated with a 3.2-fold increase in UTI risk. Diabetes mellitus was also a significant predictor (OR 2.5).

Table 2
Multivariable Logistic Regression for Risk Factors of Postoperative UTI

Variable	Odds Ratio (OR)	95% CI	p-value
Age (> 65 years)	1.4	0.5–3.8	0.52
Male Sex	1.1	0.3–4.2	0.89
Diabetes Mellitus	2.5	1.0–6.3	0.04
Operative Duration > 60 min	3.2	1.1–9.4	0.03
Positive IOUC	15.4	3.8–62.5	< 0.001

Discussion

This study highlights the clinical relevance of intraoperative urine culture in endourological practice. Our finding of 14.6% postoperative UTI rate is consistent with existing literature for endourological procedures. More importantly, the high sensitivity (83.3%) and negative predictive value (96.9%) of IOUC suggest that it is a powerful tool for ruling out potential infectious complications.

The discrepancy between preoperative UC and IOUC can be explained by the presence of bacteria within kidney stones or biofilms that are released only during surgical manipulation. In our cohort, 18 patients had positive IOUCs despite sterile preoperative urine, confirming that preoperative screening may miss latent bacterial colonization.

The high specificity (88.6%) indicates that a positive IOUC is a strong indicator for initiating targeted therapy rather than relying on empirical antibiotics. Identifying E. coli and K. pneumoniae as primary pathogens aligns with global trends in urological infections, though the presence of P. aeruginosa underscores the need for vigilance against resistant strains.

Our analysis of risk factors confirms that prolonged operative time and metabolic comorbidities like diabetes significantly predispose patients to infections. These findings suggest that patients with these risk factors should be prioritized for IOUC screening and closer postoperative monitoring.

Limitations

The sample size of 80–82 patients, while sufficient for a pilot assessment, may limit the generalizability of the multivariable model. Future multi-center studies with larger cohorts are needed to validate these findings across different surgical techniques and patient populations.

Conclusion

Intraoperative urine culture (IOUC) is an effective diagnostic tool for predicting postoperative urinary tract infections following endourological surgery. Given its high sensitivity and NPV, IOUC can guide

clinicians in the early management of infectious risks, facilitating targeted antibiotic treatment and supporting antimicrobial stewardship programs.

Declarations

Author Contribution

Z.L. conceived and designed the study, collected and analyzed the data, performed the statistical analysis, interpreted the results, and drafted the manuscript. M.T. contributed to the study design, data interpretation, and critically revised the manuscript for important intellectual content. A.B. supervised the research, contributed to the interpretation of the findings, and critically reviewed the manuscript. H.A. participated in the study supervision, validated the methodology, and critically revised the manuscript. All authors reviewed and approved the final version of the manuscript.

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