INFECTIVE OUTCOMES OF SEMI-RIGID URETEROSCOPY IN PATIENTS WITH POSITIVE PREOPERATIVE LEUCOCYTE ESTERASE: A RETROSPECTIVE ANALYSIS

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ABSTRACT:

Background: Ureteroscopy (URS) is the standard treatment for ureteral pathologies such as urolithiasis, but it carries a risk of postoperative infectious complications.[1,2] Screening for urinary tract infection (UTI) using leucocyte esterase (LE) on urine dipstick is routinely performed; however, LE may yield false-positive results in the presence of stone-related inflammation.[2,3]

Methods: This retrospective cohort study analyzed 231 patients who underwent semi-rigid URS at Sultan Ahmad Shah Medical Centre between December 2018 and December 2023. All patients had positive preoperative LE but negative nitrite and no clinical signs of infection. Surgical timing was determined by dipstick findings rather than awaiting C&S results, with culture data reviewed retrospectively.

Results: Postoperative urinary tract infection occurred in 16 patients (6.9%). Only 18 patients had positive urine cultures upon retrospective review, indicating a 92.2% discrepancy rate between LE positivity and true bacteriuria. Multivariate logistic regression identified positive urine culture and prior history of UTI as the independent predictors of postoperative infection.

Conclusion: Semi-rigid URS can be performed safely in patients with positive preoperative LE when clinical assessment and negative nitrite do not indicate active infection. The substantial discrepancy between LE and C&S supports a pragmatic approach of not delaying surgery for LE positivity alone, while retrospective C&S data are effective for postoperative risk stratification.

Keywords: ureteroscopy; leucocyte esterase; urinary tract infection

INTRODUCTION

The global burden of urolithiasis continues to rise, with documented increasing prevalence across Asia and other regions.[4] In Malaysia, the incidence has climbed steadily since early reports in the 1990s, with recent local studies confirming a significant prevalence of stone disease within the population.[5] The management of ureteric calculi has evolved significantly, with ureteroscopy establishing itself as the preferred modality due to its superior stone-free rates compared to extracorporeal shockwave lithotripsy.[6,7]

Despite its efficacy, URS is associated with complications, notably fever, urinary tract infection, and sepsis.[1,2] The Clinical Research Office of Endourological Society Global Study reported an overall complication rate of 7.4%, with postoperative fever and UTI accounting for a substantial proportion of adverse events.[1] While rare, urosepsis remains a potentially life-threatening sequelae of endourological intervention.[2] Consequently, preoperative screening for bacteriuria is mandatory before proceeding with URS.

The diagnostic gold standard for UTI is urine culture and sensitivity. However, the processing time for C&S inherently delays clinical decision-making, often necessitating a waiting period of 48 to 72 hours.[3] In contrast, urinalysis provides immediate results but lacks the specificity of culture.[3] The presence of leucocyte esterase on dipstick testing, while a sensitive marker for pyuria, is notoriously non-specific in the context of urolithiasis. Foreign bodies, including calculi, induce localized inflammation that can generate LE positivity in the absence of active bacterial infection.[2,3] This diagnostic uncertainty poses a clinical dilemma: delaying definitive stone management for all patients with positive LE risks prolonging morbidity due to obstruction, while proceeding without definitive exclusion of infection risks precipitating severe postoperative complications.

Furthermore, physiological parameters during URS, specifically intrarenal pressure, play a role in infectious pathogenesis. Systematic reviews have demonstrated that while semi-rigid URS typically generates lower intrarenal pressure compared to flexible URS with access sheaths, pressures can still exceed thresholds associated with pyelovenous reflux and systemic bacterial absorption.[8,9] This creates a theoretical risk that any bacterium present during the procedure could migrate systemically.[8,9]

In clinical settings, surgeons must balance the urgency of stone relief against the requirement for a negative culture. At our institution, we adopted a protocol where patients with positive LE but negative nitrite and no clinical signs of infection proceed to surgery without awaiting C&S results. The culture results are then reviewed retrospectively. This study evaluated outcomes in patients undergoing semi-rigid URS under this protocol. We hypothesized that a positive LE test in the absence of clinical symptoms does not indicate a high level of infection, and that the procedure is safe even with unknown culture results.

MATERIALS AND METHODS

Study Design and Setting

We conducted a retrospective cohort study at Sultan Ahmad Shah Medical Centre, a tertiary urological referral centre in Kuantan, Malaysia. The study period spanned from December 2018 to December 2023.

Participants

Consecutive patients aged 18 years and older who underwent semi-rigid URS and had positive preoperative LE on urine dipstick were included. Patients with diagnosed symptomatic UTI or incomplete medical records were excluded. The cohort comprised 231 patients.

Institutional Protocol

According to our institutional standard operating procedure, all patients admitted for ureteric stones undergo a urine dipstick test and a urine C&S sample. Patients were proceeded for semi-rigid

URS if they exhibited negative nitrite, absence of fever, dysuria, or flank pain suggesting active infection, regardless of the LE result. This refers to a patient who does not exhibit signs or symptoms of a urinary tract infection (UTI), such as dysuria, urinary frequency, or a sensation of incomplete voiding that was not previously present, and notably without fever. On examination, there was no suprapubic tenderness, and no urinary abnormalities, such as pyuria, were identified. Pertinent investigations, including UFEME, white blood cell count, and C-reactive protein levels, will be considered in the overall assessment.[18,19]

Preoperative prophylactic antibiotics were administered in accordance with institutional protocol. The choice of antibiotic was guided by the local antibiogram, with a single dose given one hour prior to surgery. Cefuroxime was the most used agent. Others, such as amoxicillin-clavulanic acid or ampicillin-sulbactam, will be considered if the patient has had exposure to cefuroxime before.[6,20,21]. C&S results were reviewed retrospectively after the procedure for the purpose of this study; they did not guide the timing of the index surgery.

Data Collection and Variables

Demographic data including age, gender, ethnicity, and body mass index were extracted using a standardized proforma. Clinical variables included a history of prior UTI, Charlson Comorbidity Index, and indication for surgery. Imaging characteristics, specifically the presence of hydronephrosis and stone location, were recorded. Surgical parameters such as operative duration, stone fragmentation, and operator status were documented. The primary outcome was postoperative UTI, defined as the presence of clinical symptoms requiring antibiotic therapy post-intervention. Secondary outcomes included length of stay and stone-free rate.

Statistical Analysis

Statistical analysis was performed using SPSS Version 25. Continuous variables were reported as mean ± standard deviation. Categorical variables were compared using the Chi-square test or Fisher's exact test where appropriate. Logistic regression was used to identify predictors of postoperative infection; variables with $p < 0.05$ in univariate analysis were entered into the multivariate model. Statistical significance was set at $p < 0.05$.

RESULT

A total of 231 patients with positive preoperative LE underwent semi-rigid URS. The cohort was predominantly male and of Malay ethnicity, with a mean age of 57.2 ± 13.6 years.

Discrepancy Between Leucocyte Esterase and Urine Culture

Despite 100% of the cohort having positive LE, retrospective review of C&S results revealed that only 18 patients had positive urine cultures. This indicates that over 92% of the patients had sterile urine despite the positive dipstick finding.

Infection Rates

Postoperative urinary tract infection developed in 16 patients, yielding an overall infection rate of 6.9%. No cases of urosepsis or mortality were recorded. Patients who developed postoperative UTI had a significantly longer length of stay compared to those who did not.

Baseline Characteristics by Outcome

Table 1 compares the socio-demographic and clinical characteristics of patients who developed postoperative UTI versus those who did not. Variables significantly associated with postoperative infection included a prior history of UTI, retrospectively positive urine culture, the presence of hydronephrosis, and longer operative time.

Predictors of Postoperative Infection

Multivariate logistic regression analysis identified retrospectively positive urine C&S and a history of prior UTI as independent predictors of postoperative infection. Hydronephrosis and operative time were significant on univariate analysis but did not retain statistical independence in the adjusted model.

DISCUSSION

This study provides valuable insight into the management of patients with positive preoperative LE undergoing ureteroscopic stone removal. Our data suggest that proceeding with surgery based on clinical judgment and negative nitrite, rather than awaiting culture results, is a safe clinical pathway in this specific population. The overall postoperative infection rate of 6.9% is comparable to global benchmarks, supporting the efficacy of this approach.[1]

The central finding of this work is that patients with positive LE can safely undergo semi-rigid URS without waiting for C&S confirmation, provided nitrite is negative and systemic signs of infection are absent. This is crucial given the inherent delay in culture processing.[2,3] Grüne et al highlighted the questionable necessity of mandatory preoperative culture in preventing infectious complications when dipstick and clinical findings are reassuring.[17]

Our infection rate of 6.9% aligns with the CROES Global Study findings, which reported an overall complication rate of 7.4%.[1] Notably, our cohort consisted entirely of patients who would typically be flagged as "high risk" by virtue of a positive LE dipstick. The fact that their outcomes mirrored general population data suggests that the inflammatory response to the stone itself, rather than active infection, was the driver of LE positivity in the vast majority of cases. This supports a pragmatic approach to patient selection where the urgency of stone decompression outweighs the theoretical risk of delayed antibiotic therapy.

Predictive Value of Retrospective C&S and Leucocyte Esterase Discordance

We observed a striking discordance: despite 100% LE positivity, only 7.8% of cultures were positive. This is consistent with literature demonstrating the poor positive predictive value of LE in stone patients.[10,11] Paydaş Hataysal et al reported positive predictive values for LE ranging from 48% to 52% in general populations,[11] while Bafna et al re-evaluated dipstick accuracy using Bayesian analysis and found substantial limitations.[10] Our lower rate of 6.9% likely reflects the specific pathology of ureteric stones causing sterile inflammation.

Moreover, retrospectively positive C&S was the strongest independent predictor of postoperative UTI. This corroborates findings from multiple systematic reviews.[2,12,13,14] Dybowski et al[12] identified presurgical urinary tract infections as key predictors of complications in retrograde intrarenal surgery. Carobbio et al[14] similarly found that positive culture results were significant determinants of postoperative morbidity. Although the C&S data in our study was retrospective, identifying these patients postoperatively allows for targeted surveillance and may justify extended prophylaxis or closer monitoring in future cases with similar profiles.

Significance of Prior UTI History

A history of prior UTI emerged as another independent risk factor. This aligns with emerging evidence suggesting that alterations in the urinary microbiome or previous recurrent infections predispose patients to sequelae following instrumentation.[2] Patients with a documented history of UTI may harbour subclinical reservoirs of bacteria or possess urothelium that is more susceptible to bacteremia during endoscopic manipulation. This data point reinforces the need for detailed history-taking during preoperative assessment, categorizing these individuals for optimized postoperative care pathways.

Operative Time and Intrarenal Pressure Considerations

On univariate analysis, operative time was associated with postoperative infection. Studies by Lane et al[15] have established a correlation between prolonged operative duration and adverse outcomes in ureteroscopy. Mechanistically, this is supported by data on intrarenal pressure. Systematic reviews indicate that while semi-rigid

URS generates lower pressures than flexible URS, continuous irrigation can still exceed physiological thresholds, potentially facilitating pyelovenous backflow.[8,9] Bai et al[8] demonstrated via fiber-optic sensors that pressures can fluctuate significantly during flexible procedures, and MRI studies by Lildal et al[16] have visualized backflow occurring at increasing pressure loads.

In our cohort, however, operative time did not retain significance in multivariate analysis. This suggests that the biological presence of bacteria and host factors like prior UTI history may be more critical determinants of infection than the duration of procedure alone, at least within the timeframes typical for semi-rigid URS.

Limitations

The retrospective nature of this study is its primary limitation. While we meticulously recorded data, we cannot exclude the possibility of unobserved confounders or minor inconsistencies in clinical documentation. Additionally, the single-centre design may limit the generalizability of our findings to other institutions with different bacterial resistance profiles or resource availability. The diagnosis of postoperative UTI was based on clinical criteria rather than uniform postoperative culture, which may have underestimated the rate of asymptomatic bacteriuria. Nonetheless, this reflects real-world practice where routine postoperative cultures are not universally performed in asymptomatic patients.

CONCLUSION

Positive preoperative leucocyte esterase should not be viewed as an absolute contraindication to semi-rigid ureteroscopy when combined with negative nitrite and the absence of clinical infection signs. The "retrospective culture" protocol—where surgery proceeds based on dipstick findings and culture results guide postoperative management—is a safe and efficient strategy that yields infection rates comparable to international standards. The high discrepancy rate between LE positivity and true bacteriuria underscores the necessity of interpreting dipstick results cautiously to avoid unnecessary surgical delays. Retrospective culture positivity and a prior history of UTI serve as valuable markers for identifying patients who warrant closer postoperative surveillance.

ETHICS APPROVAL

Ethical approval was obtained from the International Islamic University Malaysia Research Ethics Committee before study commencement. All procedures were performed in accordance with the Declaration of Helsinki and applicable institutional guidelines for research involving human subjects.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the conduct of this study or the preparation of this manuscript.

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TABLE LEGENDS:

Table 1. Characteristics of Patients Stratified by Postoperative UTI Status

Variable	Post-op UTI Yes (n=16)	Post-op UTI No (n=215)	P value
Malay ethnicity	15	198	0.72
Age, mean ± SD	60.4 ± 12.1	56.8 ± 13.9	0.31
Male gender	11	140	0.65
BMI, mean ± SD	28.1 ± 4.6	27.3 ± 5.1	0.48
Charlson Comorbidity Index	1.2 ± 0.8	1.1 ± 0.7	0.62
Therapeutic indication	14	197	0.56
History of UTI	9	51	0.004
Positive urine C&S*	7	11	<0.001
Hydronephrosis	10	82	0.048
Operative time (min)	69.5 ± 18.3	57.2 ± 16.9	0.006
Length of stay (days)	3.6 ± 1.1	2.4 ± 0.9	<0.001
Stone-free rate	13	184	0.63

*Urine culture obtained on admission and reviewed retrospectively.

Table 2. Univariate Logistic Regression for Postoperative UTI

Variable	OR	95% CI	P value
Positive urine C&S*	14.8	5.0–43.5	<0.001
History of UTI	4.2	1.6–10.9	0.004
Hydronephrosis	2.7	1.0–7.1	0.048
Operative time	1.03	1.01–1.06	0.006

*Urine culture obtained on admission and reviewed retrospectively.

Table 3. Multivariate Logistic Regression for Postoperative UTI

Variable	Adjusted OR	95% CI	P value
Positive urine C&S*	11.2	3.4–36.8	<0.001
History of UTI	3.6	1.3–9.8	0.01

*Urine culture obtained on admission and reviewed retrospectively.