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Analysis of Pathogens and Calculus Components in Patients with Urolithiasis Complicated with Urosepsis

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Abstract: *Objective*: The incidence of urolithiasis is high in Yingde Area, and the incidence of urolithiasis complicated with urinary tract infection (UTI), especially urosepsis, is also high, which poses great challenges to clinical treatment. In addition, the negative rate of pathogen detection for this disease is high, and the composition of pathogens and calculus components has not been reported yet. *Methods*: This study retrospectively analyzed 450 patients with urolithiasis complicated by urinary tract infection who were admitted to the People's Hospital of Yingde City between 2015 and 2024. The study population included 199 patients in the uncomplicated UTI group, 127 in the preoperative urosepsis group, 72 in the pyonephrosis group, and 31 in the non-infection group and 21 patients with postoperative urosepsis. Patient sex distribution, pathogen profiles from urine cultures, pathogen distribution associated with urinary nitrite positivity, stone composition, and pathogen distribution from blood cultures were systematically analyzed. *Results*: The distributions of sex, urinary pathogen profiles, urinary nitrite status, stone composition, and blood culture results across different patient groups are summarized in Tables 1–5. A female predominance was observed among patients with severe infections. In the pre-hospital urosepsis group, females accounted for 74.8% of the cases, while all patients in the postoperative urosepsis group were female. Urine culture results showed that the proportion of culture-negative cases decreased with increasing infection severity. The urine culture negative rate was 78.6% in the uncomplicated UTI group, 55.6% in the pyonephrosis group (60 of 72 patients underwent urine culture), 63.0% in the pre-hospital urosepsis group, and 38.1% in the postoperative urosepsis group. Among culture-positive urine samples, Escherichia coli was the most frequently identified pathogen across all groups. Blood culture analysis in patients with urosepsis revealed similar negative rates between the pre-hospital and postoperative groups (52.9% and 52.4%, respectively). Among culture-positive blood samples, *E. coli* was the predominant pathogen in both groups, while *Enterococcus faecium* was identified only in the postoperative urosepsis group. Urinary nitrite positivity increased with infection severity. The positive rates were 0% in the non-infection group, 8.5% in the uncomplicated UTI group, 29.2% in the pyonephrosis group, 24.4% in the pre-hospital urosepsis group, and 33.3% in the postoperative urosepsis group. Analysis of stone composition revealed that calcium oxalate–based calculi were the most common type in all groups. Calcium oxalate

monohydrate combined with calcium oxalate dihydrate was the predominant component in the non-infection group (58.1 %), uncomplicated UTI group (43.4%), pyonephrosis group (33.3%), and pre-hospital urosepsis group (33.1%). In both urosepsis groups, a subset of cases contained carbonate apatite (14.3% in the postoperative group and 12.6% in the pre-hospital group). Notably, L-cystine and pure calcium oxalate monohydrate were observed only in the pre-hospital urosepsis group (1.6% and 0.8%, respectively). *Conclusion*: *Escherichia coli* was the most frequently identified pathogen in patients with urolithiasis complicated by urosepsis. Notably, *Enterococcus faecium* was detected exclusively in patients with postoperative urosepsis, indicating that Gram-positive coccal infections in this population should not be overlooked. The predominant calculus components in both urosepsis groups were calcium oxalate–based stones, with a subset of cases containing carbonate apatite. In addition, struvite calculi were rarely observed, whereas carbonate apatite was present in a considerable proportion of cases, warranting clinical attention.
Keywords: Urolithiasis; Urinary tract infection; Urosepsis; Pathogens; Calculus components

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1. Introduction

Urinary tract infection (UTI) is one of the most common infectious diseases encountered in urology [1]. Urolithiasis, as an important risk factor for UTI, can significantly increase the incidence and progression of infection through mechanisms such as urinary tract obstruction, urinary stasis, and bacterial biofilm formation [2,3]. In some patients, the condition may rapidly progress to urosepsis, which represents a severe form of sepsis with distinct clinical phenotypes. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) redefined septic shock and identified distinct phenotypes, including vasoplegic shock and cryptic shock, which are excluded from the new definition but exhibit significant mortality differences [4]. This classification highlights the importance of early recognition and risk stratification in patients with severe infections. Urosepsis is associated with a severe clinical course and high mortality, posing a serious threat to patient survival [5].

In recent years, with the widespread application of endourological techniques, minimally invasive treatment of urinary calculi has achieved remarkable progress. However, stone-associated infection and perioperative urosepsis remain major challenges in urological practice [6]. Meanwhile, the extensive use of antibiotics has led to increasing antimicrobial resistance among pathogens, along with persistently high negative rates of blood and urine cultures, making the selection of empirical antimicrobial therapy more difficult [7,8].

The incidence of urolithiasis is relatively high in the Yingde region. Nevertheless, there is a lack of systematic studies on the pathogen spectrum, culture-negative rates, and stone composition in patients with urolithiasis complicated by UTI or urosepsis in this area. Therefore, this study retrospectively analyzed the clinical data of patients with UTI and stone-associated infection treated at the People's Hospital of Yingde City, aiming to summarize the distribution characteristics of pathogens and stone composition among different types of urosepsis, and to provide evidence to support clinical decision-making and the development of anti-infective treatment strategies.

2. Materials and methods

2.1. Study population

A retrospective analysis was conducted on patients diagnosed with urinary tract infection (UTI) and/or urolithiasis who were admitted to the Department of Urology, People's Hospital of Yingde City, between January 2015 and December 2024.

2.1.1. Inclusion criteria

(1) Urolithiasis confirmed by imaging examinations (ultrasonography, computed tomography, or X-ray) and laboratory tests

(2) Fulfillment of the diagnostic criteria for UTI, including uncomplicated UTI, pyonephrosis, and sepsis

(3) Age ≥ 18 years with complete clinical data available [9,10]

2.1.2. Exclusion criteria

(1) A history of renal or urinary tract malignancy

(2) Presence of severe immunodeficiency or systemic inflammatory diseases

(3) Incomplete clinical data or missing follow-up information [11]

2.2. Grouping method

Based on clinical manifestations, laboratory findings, and imaging results, patients were categorized into five groups:

(1) Non-infection group;

(2) Uncomplicated UTI group;

(3) Pyonephrosis group;

(4) Pre-hospital urosepsis group

(5) Postoperative urosepsis group.

2.3. Data collection

Data collected included demographic characteristics (sex and age), results of urine and blood cultures, urinary nitrite test results, and stone composition analysis [12].

2.4. Laboratory examinations

(1) Urine culture

Pathogen isolation and identification were performed using routine culture methods.

(2) Blood culture

An automated blood culture system was used, and the positive rate and pathogen distribution were recorded.

(3) Urinary nitrite test

Urinary nitrite was detected using dipstick testing or chemical methods and served as an auxiliary indicator for UTI.

(4) Stone composition analysis

Stone components were identified using infrared spectroscopy, including calcium oxalate, calcium oxalate monohydrate, calcium oxalate dihydrate, and carbonate apatite.

2.5. Statistical analysis

Statistical analyses were performed using SPSS version 26.0. Categorical variables were analyzed using the chi-square test or Fisher's exact test, while continuous variables were expressed as mean ± standard deviation. A two-sided p value < 0.05 was considered statistically significant.

2.6. Ethical statement

This study was approved by the Ethics Committee of the People's Hospital of Yingde City. All patient data were anonymized, and the study was conducted in accordance with the Declaration of Helsinki.

3. Results

A total of 450 patients with urolithiasis complicated by urinary tract infection were included in this study. Data on sex and urinary nitrite testing were complete for all patients, yielding a completion rate of 100.0%. Urine culture results were available for 304 patients (67.6%), while data were missing for 146 patients (32.4%). Stone composition analysis was completed in 449 patients (99.8%), with data missing in 1 patient (0.2%). Blood culture results were available for 140 patients (31.1%), whereas 310 patients (68.9%) did not undergo blood culture testing. See **Table 1**.

Table 1. Data completeness of study variables

Variable	Valid cases (n)	Percentage (%)
Sex	450	100.0
Urine culture	304	67.6
Urinary nitrite	450	100.0
Stone composition	449	99.8
Blood culture	140	31.1

3.1. Comparison of sex distribution among different groups

A total of 450 patients were included, comprising 167 males (37.1%) and 283 females (62.9%). Among them, 199 patients (44.2%) were classified into the uncomplicated UTI group, 127 patients (28.2%) into the preoperative urosepsis group, 72 patients (16.0%) into the pyonephrosis group, 31 patients (6.9%) into the non-infection group, and 21 patients (4.7%) into the postoperative urosepsis group following endourological lithotripsy.

Significant differences in sex distribution were observed among the groups. In the uncomplicated UTI group, the proportions of male and female patients were comparable (50.8% vs. 49.2%). In contrast, the pyonephrosis group and the pre-hospital urosepsis group were predominantly female, with females accounting for 76.4% and 74.8% of patients, respectively. Notably, all patients in the postoperative urosepsis group following endourological lithotripsy were female (100.0%) (**Table 2**, **Figure 1**).

Table 2. Comparison of sex distribution among different patient groups

Group	Male, n (%)	Female, n (%)	Total
Non-infection group	17 (54.8)	14 (45.2)	31
Uncomplicated UTI group	101 (50.8)	98 (49.2)	199
Pyonephrosis group	17 (23.6)	55 (76.4)	72
Pre-hospital urosepsis group	32 (25.2)	95 (74.8)	127
Postoperative urosepsis group	0 (0.0)	21 (100.0)	21
Total	167 (37.1)	283 (62.9)	450

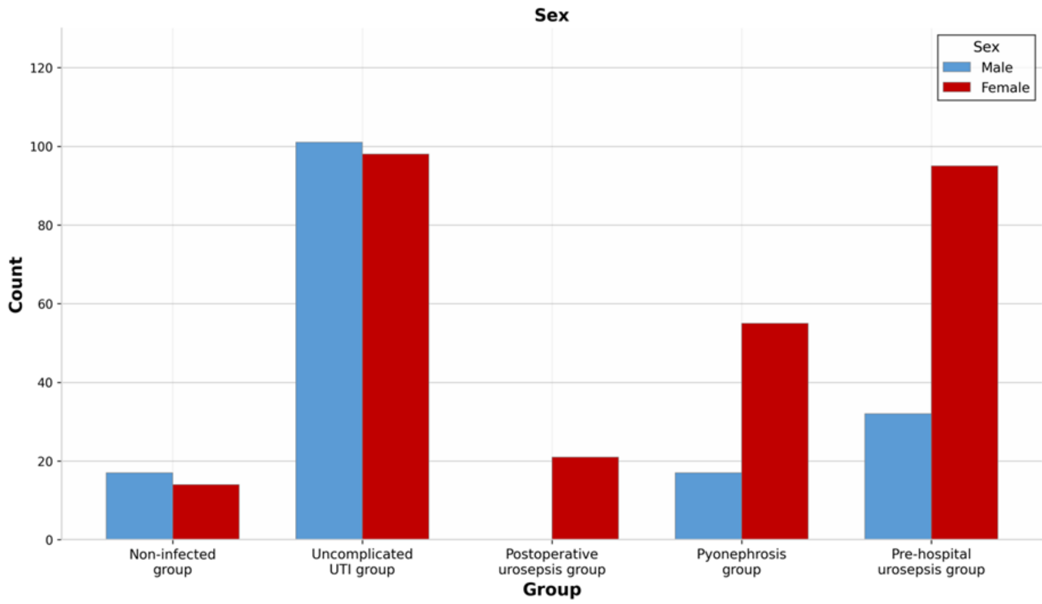

Figure 1. Comparison of sex distribution across different patient groups.

Sex distribution differed significantly among the groups ($\chi^2 = 45.783$, df = 4, $p < 0.001$). As shown in **Table 2**, the proportion of female patients in the sepsis group was significantly higher than that in the other groups.

3.2. Comparison of urinary pathogen distribution among different groups

A total of 304 patients underwent urine culture testing. Overall, no bacterial growth was detected in 194 cases (63.8%). Among culture-positive cases, *Escherichia coli* was the most common pathogen (66 cases, 21.7%). Other pathogens included the *Yersinia enterocolitica* group (2 cases, 0.7%), *Enterococcus faecalis* (3 cases, 1.0%), and *Citrobacter freundii* (3 cases, 1.0%).

Significant differences in urine culture results were observed among the different groups. The common urinary tract infection group showed the highest rate of negative urine cultures (78.6%), with *Escherichia coli* being the predominant pathogen among culture-positive cases (13.1%). The pyonephrosis group and the pre-hospital urosepsis group exhibited higher urine culture positivity rates than the common infection group, with Escherichia coli accounting for 25.0% and 22.8% of cases, respectively. The postoperative urosepsis group following endourological lithotripsy demonstrated a relatively high urine culture positivity rate (61.9%); in addition to *Escherichia coli* (38.1%), *Enterococcus faecalis* and *Citrobacter amalonaticus* were also detected (**Table 3**, **Figure 2**).

Table 3. Comparison of urinary pathogen distribution among patients in different groups

Group	No bacterial growth, n(%)	*Escherichia coli*, n(%)	Other pathogens, n(%)	Total
Uncomplicated UTI group	66 (78.6)	11 (13.1)	1 (1.2)	84
Pyonephrosis group	40 (55.6)	18 (25.0)	2 (2.8)	60
Pre-hospital urosepsis group	80 (63.0)	29 (22.8)	3 (2.4)	127
Postoperative urosepsis group	8 (38.1)	8 (38.1)	3 (14.3)	21
Total	194 (63.8)	66 (21.7)	11 (3.6)	304

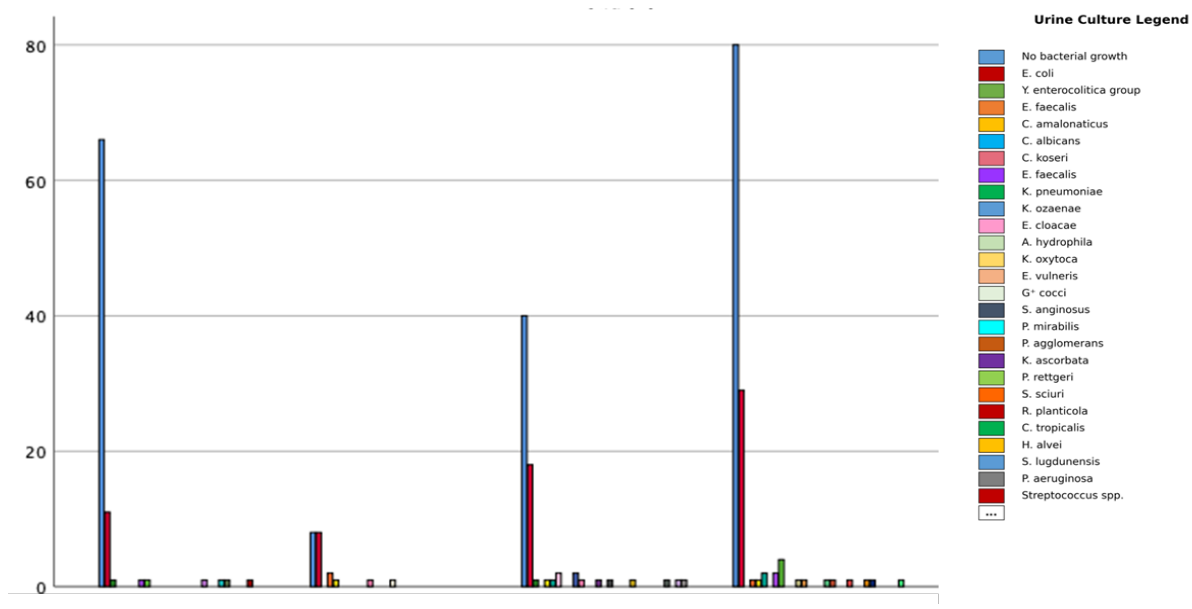

Figure 2. Comparison of urinary pathogen distribution among patients in different groups.

The distribution of urine culture results differed significantly among the groups (Pearson's χ^2 = 115.832, df = 87, p = 0.021). As shown in **Table 3**, *Escherichia coli* was the predominant pathogen. Higher urine culture positivity rates were observed in the postoperative urosepsis group and the pyonephrosis group.

3.3. Comparison of urinary nitrite distribution among patients in different groups

A total of 450 patients underwent urinary nitrite testing. Overall, urinary nitrite was positive in 76 cases (16.9%) and negative in 374 cases (83.1%). Significant differences in urinary nitrite positivity rates were observed among the different groups. Uncomplicated UTI group had 17 positive cases (8.5%), whereas higher positivity rates were found in the Postoperative urosepsis group (7 cases, 33.3%), the pyonephrosis group (21 cases, 29.2%), and the pre-hospital urosepsis group (31 cases, 24.4%). All patients in the non-infection group tested negative for urinary nitrite (100%). Overall, urinary nitrite positivity rates were markedly higher in the urosepsis groups and the pyonephrosis group than in the common urinary tract infection group and the non-infection group, indicating that urinary nitrite testing may, to some extent, reflect the severity of infection.

In both urosepsis groups, stone composition was predominantly composed of calcium oxalate monohydrate, calcium oxalate dihydrate, and carbonate apatite. The proportion of stones containing magnesium ammonium phosphate was relatively low, whereas carbonate apatite stones accounted for a relatively higher proportion (**Table 4**, **Figure 3**).

Table 4. Comparison of urinary nitrite distribution among patients in different groups

Group	Negative, n (%)	Positive, n (%)	Total
Non-infection group	31 (100.0)	0 (0.0)	31
Uncomplicated UTI group	182 (91.5)	17 (8.5)	199
Postoperative urosepsis group	14 (66.7)	7 (33.3)	21
Pyonephrosis group	51 (70.8)	21 (29.2)	72
Pre-hospital urosepsis group	96 (75.6)	31 (24.4)	127
Total	374 (83.1)	76 (16.9)	450

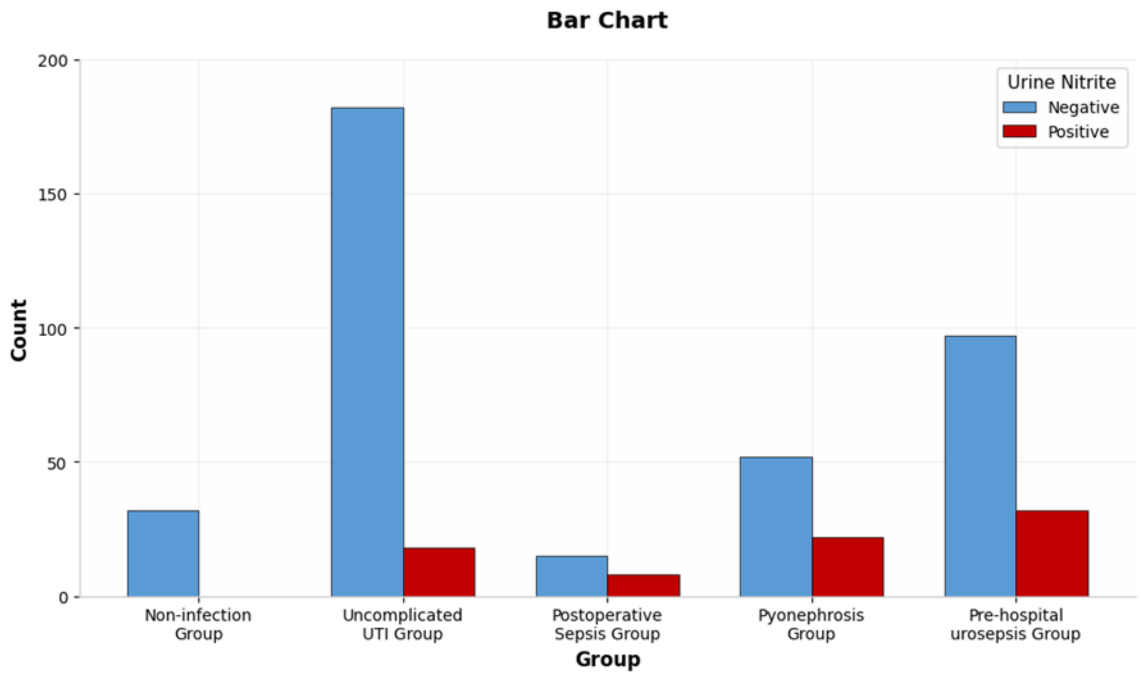

Figure 3. Distribution of urinary nitrite among patients in different groups.

Pearson's chi-square test showed a statistically significant difference in urinary nitrite distribution among the different groups ($\chi^2 = 33.071$, df = 4, $p < 0.001$). **Table 3** shows that urinary nitrite positivity rates were significantly higher in the urosepsis groups and the pyonephrosis group compared with uncomplicated UTI group and the non-infection group.

3.4. Comparison of stone composition distribution among patients in different groups

Among the 450 patients, stone composition was predominantly composed of calcium oxalate monohydrate, calcium oxalate dihydrate, and carbonate apatite, accounting for 178 cases (39.6%) and 72 cases (16.0%), respectively.

Differences in stone composition distribution were observed among the different groups. In the uncomplicated UTI group, stones were mainly composed of mixed calcium oxalate monohydrate and calcium oxalate dihydrate (43.4%), followed by mixed calcium oxalate monohydrate, calcium oxalate dihydrate, and carbonate apatite (19.7%). Similarly, stones in the pyonephrosis group and the pre-hospital urosepsis group were predominantly composed of calcium oxalate monohydrate and calcium oxalate dihydrate, accounting for 33.3% and 33.1% of cases, respectively. In the postoperative urosepsis group, stones were mainly composed of mixed calcium oxalate monohydrate and calcium oxalate dihydrate (38.1%), followed by mixed calcium oxalate monohydrate, calcium oxalate dihydrate, and carbonate apatite (14.3%). Stones composed of L-cystine, pure calcium oxalate monohydrate, and anhydrous uric acid were relatively uncommon (**Table 5**, **Figure 4**).

Table 5. Comparison of stone composition distribution among patients in different groups

Group	L-cystine, n (%)	Calcium oxalate monohydrate, n (%)	Calcium oxalate monohydrate + dihydrate, n (%)	Calcium oxalate monohydrate + anhydrous uric acid + dihydrate, n (%)	Calcium oxalate monohydrate + dihydrate + carbonate apatite, n (%)
Non-infection group	0 (0.0)	0 (0.0)	18 (58.1)	3 (9.7)	4 (12.9)
Uncomplicated UTI group	0 (0.0)	9 (4.5)	86 (43.4)	3 (1.5)	39 (19.7)
Postoperative urosepsis group	0 (0.0)	0 (0.0)	8 (38.1)	1 (4.8)	3 (14.3)
Pyonephrosis group	0 (0.0)	0 (0.0)	24 (33.3)	2 (2.8)	10 (13.9)
Pre-hospital urosepsis group	2 (1.6)	1 (0.8)	42 (33.1)	2 (1.6)	16 (12.6)
Total	2 (0.4)	10 (2.2)	178 (39.6)	11 (2.4)	72 (16.0)

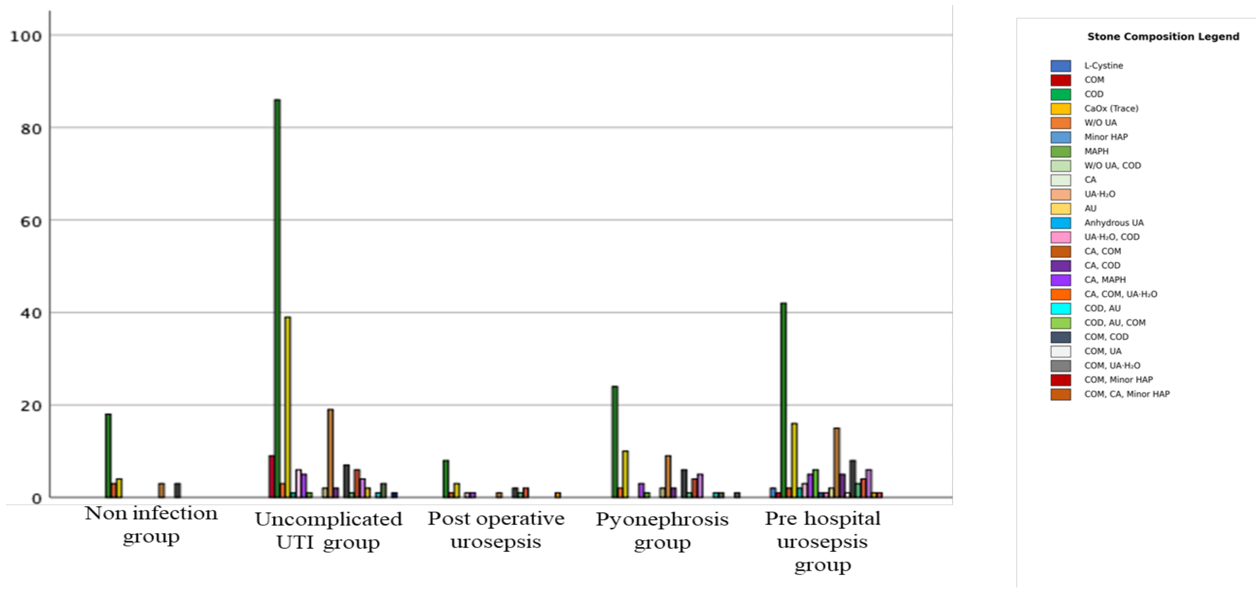

Figure 4. Comparison of stone composition distribution among patients in different groups. **Abbreviations:** COM, calcium oxalate monohydrate; COD, calcium oxalate dihydrate; CaOx, calcium oxalate; W/O UA, without uric acid; HAP, hydroxyapatite; MAPH, magnesium ammonium phosphate hexahydrate (struvite); CA, carbonate apatite; UA·H_2O, uric acid monohydrate; AU, ammonium urate; Anhydrous UA, anhydrous uric acid.

As shown in **Table 4**, no significant differences in stone composition distribution were observed among the groups (Pearson's χ^2 = 117.139, df = 100, p = 0.116). Across all groups, stones were predominantly composed of calcium oxalate monohydrate, calcium oxalate dihydrate, and carbonate apatite, whereas low-frequency stone types such as L-cystine and pure uric acid stones were rare.

3.5. Comparison of blood culture pathogen distribution among different groups

A total of 140 patients with sepsis underwent blood culture testing, including 127 patients in the Pre-hospital urosepsis group and 21 patients in the postoperative urosepsis group. Overall, the blood culture–negative rate was relatively high, with no pathogen isolated in 74 cases (52.9%). Among culture-positive cases, *Escherichia coli* was the most frequently identified pathogen (49 cases, 35.0%), followed by *Enterococcus faecium* (3 cases, 2.1%), *Yersinia enterocolitica* group (1 case, 0.7%), and *Candida albicans* (1 case, 0.7%).

Group-wise analysis showed that the blood culture–negative rate in the postoperative urosepsis group was 52.4%, with *Escherichia coli* accounting for 23.8% and *Enterococcus faecium* for 14.3% of isolates. In the Pre-hospital urosepsis group, the blood culture–negative rate was 52.9%, and *Escherichia coli* accounted for 37.0% of isolates, while other pathogens were detected at relatively low frequencies. These findings indicate that *Escherichia coli* remains the predominant pathogen in urosepsis; however, infections caused by Gram-positive cocci and occasional fungal pathogens should not be overlooked (**Table 6**, **Figure 5**).

Table 6. Comparison of blood culture pathogen distribution among different groups

Group	No growth n (%)	*E. coli* n (%)	*E. enterocolitica* group n (%)	*E. faecium* n (%)	*C. albicans* n (%)
Post operative urosepsis group	11 (52.4)	5 (23.8)	0 (0)	(14.3)	0 (0)
Pre-hospital urosepsis group	63 (52.9)	44 (37.0)	1 (0.8)	0 (0)	1 (0.8)
Total	74 (52.9)	49 (35.0)	1 (0.7)	3 (2.1)	1 (0.7)

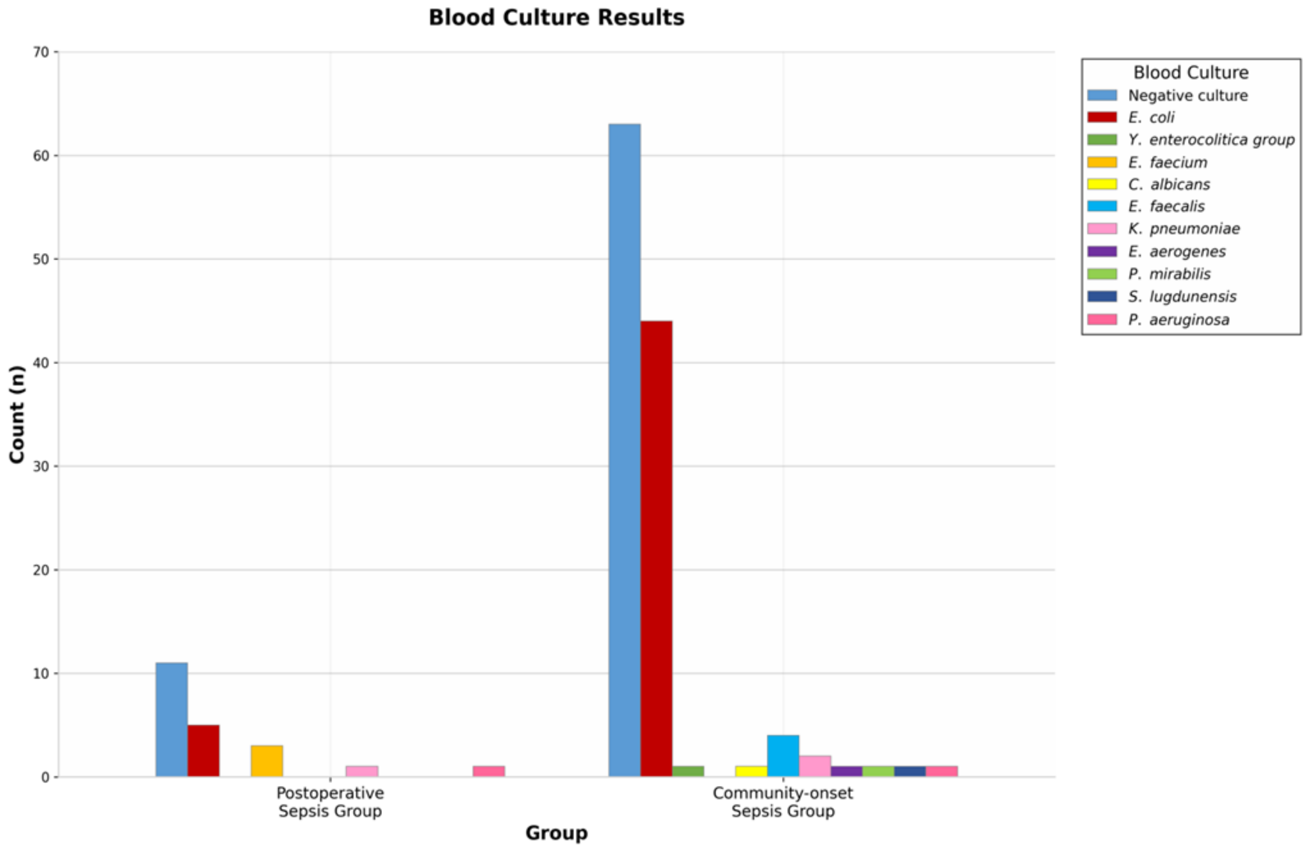

Figure 5. Blood culture pathogen distribution in different sepsis group.

Abbreviations: *E. coli, Escherichia coli; Y. enterocolitica, Yersinia enterocolitica; E. faecium, Enterococcus faecium; C. albicans, Candida albicans; E. faecalis, Enterococcus faecalis; K. pneumoniae, Klebsiella pneumoniae; E. aerogenes, Enterobacter aerogenes; P. mirabilis, Proteus mirabilis; S. lugdunensis, Staphylococcus lugdunensis; P. aeruginosa, Pseudomonas aeruginosa.*

The chi-square test demonstrated a statistically significant difference in the distribution of blood culture pathogens among patients with sepsis in different groups (Pearson $\chi^2 = 22.186$, df = 10, $p = 0.014$). As shown in **Table 5**, the detection rate of *Escherichia coli* was higher in the pre-hospital urosepsis groupthan in the postoperative urosepsis group, whereas the detection rate of *Enterococcus faecium* was higher in the postoperative urosepsis group.

4. Discussion

The present study investigated the clinical characteristics, pathogen profiles, and stone composition in patients with urolithiasis complicated by urinary tract infections (UTIs) of varying severity. Our findings revealed several important patterns that have significant implications for clinical practice.

4.1. Female predominance in severe infections

Consistent with previous studies, we observed a marked female predominance among patients with severe infections [2,7]. In the pre-hospital urosepsis group, females accounted for 74.8% of cases, while all patients in the postoperative urosepsis group were female. This gender disparity can be attributed to anatomical differences, with females having a shorter urethra and higher susceptibility to ascending infections [2,8]. Additionally, hormonal factors and pregnancy-related physiological changes may contribute to increased UTI severity in females [2]. The complete female predominance in the postoperative urosepsis group suggests that female patients undergoing urological procedures may be at particularly high risk for severe infectious complications, warranting enhanced perioperative monitoring and prophylactic measures.

4.2. Pathogen distribution and culture-negative infections

Our study revealed that the proportion of culture-negative cases decreased with increasing infection severity, from 78.6% in uncomplicated UTI to 38.1% in postoperative urosepsis. This trend suggests that severe infections are more likely to yield positive cultures, possibly due to higher bacterial loads and more extensive tissue invasion [7]. Among culture-positive samples, *Escherichia coli* was the most frequently identified pathogen across all groups, which aligns with the established literature identifying *E. coli* as the predominant uropathogen in both community-acquired and healthcare-associated UTIs [2,3,7,11].

Notably, blood culture analysis demonstrated similar negative rates between pre-hospital and postoperative urosepsis groups (52.9% and 52.4%, respectively). Among culture-positive blood samples, *E. coli* remained the predominant pathogen, while *Enterococcus faecium* was identified exclusively in the postoperative urosepsis group. This finding is clinically significant as *E. faecium* is inherently resistant to multiple antibiotic classes and associated with worse outcomes [2,11]. The exclusive detection of *E. faecium* in postoperative cases suggests that healthcare-associated factors, including antibiotic exposure and invasive procedures, may select for this resistant organism [6,11]. This underscores the importance of considering Gram-positive cocci, particularly enterococci, in the empirical antibiotic coverage for postoperative urosepsis.

4.3. Urinary nitrite as an infection severity marker

Our results demonstrated that urinary nitrite positivity increased with infection severity, with rates of 29.2% in pyonephrosis, 24.4% in pre-hospital urosepsis, and 33.3% in postoperative urosepsis. Nitrite is produced by Gram-negative bacteria that reduce nitrate, and its presence indicates significant bacteriuria [2]. The higher nitrite positivity in severe infections suggests greater bacterial loads and supports the utility of nitrite detection as a rapid screening tool for severe UTIs. However, the relatively low overall positivity rates (even in severe groups) indicate that nitrite testing alone has limited sensitivity, and negative results should not preclude further diagnostic workup in clinically suspected severe infections.

4.4. Stone composition and infection association

Analysis of stone composition revealed that calcium oxalate–based calculi were the most common type across all groups, consistent with global epidemiological patterns [12,13]. In both urosepsis groups, the predominant components were calcium oxalate monohydrate combined with calcium oxalate dihydrate, with a subset containing carbonate apatite. This finding aligns with previous studies demonstrating that calcium oxalate stones are frequently associated with UTIs, particularly when mixed with calcium phosphate components [4,12,13].

Interestingly, struvite calculi (magnesium ammonium phosphate hexahydrate) were rarely observed in our cohort, despite their well-established association with urease-producing bacteria such as *Proteus mirabilis* [4,10]. This may reflect regional differences in stone epidemiology or the effectiveness of modern antibiotic therapy in preventing infection-related stone formation. However, the presence of carbonate apatite in a considerable proportion of cases warrants clinical attention, as this component is often associated with infection and may indicate ongoing or previous UTIs [12,13]. The presence of L-cystine and pure calcium oxalate monohydrate exclusively in the pre-hospital urosepsis group suggests diverse metabolic backgrounds among patients presenting with community-onset severe infections.

4.5. Clinical implications and therapeutic considerations

Our findings have several important clinical implications. First, the predominance of *E. coli* across all infection severities supports the empirical use of antibiotics with reliable *E. coli* coverage, such as third-generation cephalosporins or fluoroquinolones, in initial therapy for urosepsis associated with urinary stones [6,7]. However, the exclusive detection of *E. faecium* in postoperative cases highlights the need for broader empirical coverage, including agents active against Gram-positive cocci such as vancomycin or linezolid, in postoperative patients with suspected urosepsis [2,11].

Second, the high proportion of culture-negative cases in uncomplicated UTI (78.6%) suggests that empirical antibiotic therapy guided by local resistance patterns may be appropriate in this population, whereas severe infections (pyonephrosis and urosepsis) warrant aggressive culture acquisition to guide targeted therapy. The similar blood culture negative rates in both urosepsis groups (approximately 52%) indicate that blood cultures remain essential for pathogen identification in severe cases, despite their limited yield.

Third, the predominance of calcium oxalate–based stones with carbonate apatite components in urosepsis patients suggests that metabolic evaluation and stone prevention strategies should be implemented alongside infection management. The presence of carbonate apatite may serve as a marker for infection-related metabolic alterations and should prompt thorough evaluation for underlying UTIs [12,13].

5. Limitations

This study has several limitations. First, the retrospective design may introduce selection bias and limit the ability to establish causal relationships. Second, the single-center nature of the study may restrict generalizability to other populations with different epidemiological characteristics. Third, the relatively small sample size in the postoperative urosepsis group (n = 21) may limit statistical power for subgroup analyses. Fourth, we did not perform extended culture techniques or molecular diagnostics for fastidious or slow-growing organisms, which may have contributed to the high culture-negative rates. Finally, the lack of longitudinal follow-up precludes assessment of long-term outcomes such as stone recurrence or chronic kidney disease progression.

6. Conclusion

In conclusion, this study demonstrates that *E. coli* remains the predominant pathogen in urolithiasis complicated by urosepsis, while *Enterococcus faecium* is exclusively associated with postoperative cases, highlighting the importance of Gram-positive coverage in this high-risk population. The predominance of calcium oxalate–based stones with carbonate apatite components underscores the complex interplay between metabolic and infectious factors in stone pathogenesis. These findings support the implementation of severity-stratified diagnostic and therapeutic approaches, with particular attention to resistant organisms in postoperative patients and comprehensive metabolic evaluation in all stone formers. Future prospective, multicenter studies incorporating advanced microbiological diagnostics are warranted to further elucidate the complex relationships between stone composition, infection severity, and clinical outcomes.

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Disclosure statement

The authors declare no conflict of interest.

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