A comparative study of midstream urine culture and stone culture in patients undergoing ureteroscopic stone removal

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Research Article

Keywords: Kidney stone, Urine culture, Stone culture, Ureteroscopy

Posted Date: August 24th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1941276/v1

Abstract

Background

The purpose of this study was to see the correlation between urine and stone cultures in individuals who had ureteroscopic stone removal.

Methods

This is a prospective comparative observational study of patients who had ureteroscopic stone removal from September 2019 to March 2021. A total of 50 patients were included in our study. Midstream urine sample was collected 7 days before surgery and sent for culture, stone collected during surgery were also sent for culture. The association between preoperative urine culture and intraoperative stone culture, as well as the bacterial flora in both cultures, was investigated.

Results

64% of patients were males, and 36% were females.16% of patients had positive urine culture compared to 42% positive stone culture.12% of patients were positive for both stone and urine culture. Only 4% of the time, the bacteriological investigation revealed the same pathogen. E. coli was the most common pathogen in urine culture, while enterobacter was the commonest organism in stone culture. The sensitivity, specificity, PPV, NPV, and diagnostic accuracy of urine culture versus stone culture were calculated to be 28.57 percent, 93.10 percent, 75 percent, 64.28 percent, and 66 percent, respectively.

Conclusions

Pre-operative urine cultures have a low predictive value and diagnostic accuracy for infective organisms in ureteric stones. As a result, stone culture should be incorporated into standard procedures for stone removal during endourological surgery.

Background

Urosepsis is a potentially life-threatening systemic response to a urogenital tract infection. It usually occurs due to urinary tract obstruction caused by urolithiasis, tumors, or strictures. It can also happen after urinary tract manipulation, such as ureteroscopy (1).

The most often used procedure for ureteral stone therapy is ureteroscopic lithotripsy (URSL) (2). One of the most expected consequences of the operation is a postoperative urine infection.

An obstructed ureter with stagnant urine is an infective source (3). Generally, sterile urine is a prerequisite for ureteroscopic stone removal. Whenever there is infected urine, patients are treated with antibiotics, either empirically or based on culture and sensitivity (C&S). However, after stone fragmentation, it is not uncommon for individuals with a sterile pre-operative urine culture to suffer post-operative sepsis, probably due to the release of germs into the bloodstream (4, 5).

Urinary calculi are widely known for acting as bacterial nidus. According to a study by Larsen et al. (6), in patients with preoperative bacteriuria, stone cultures revealed bacteria in 77% of the calculi. Sterile urine does not rule out the possibility of bacteriuria after surgery. The bacterial ecology of the stone could thus be employed as a predictor of post-operative indicators of urosepsis.

Stone culture is not common in endourologic surgeries, and pre-operative urine cultures have been relied on to treat post-operative infections and sepsis (7).

Methods

A Prospective comparative observational study of patients who had ureteroscopic stone removal was carried out from September 2019 to March 2021. A total of 50 patients were included in our Study. A Midstream urine sample was collected 7 days before surgery and sent for culture and sensitivity. For those patients whose culture was positive, 5 days of antibiotics were given, and a repeat culture was done. Once the culture became sterile, a third-generation cephalosporin was given 30 minutes before surgery.

A conventional cystoscope with a working channel is placed into the bladder under saline infusion after antiseptic preparation with chlorhexidine. The lithotripsy procedure is carried out using normal low-pressure irrigation. The stone fragments are collected, rinsed in 5 bottles of sterile 0.9 percent normal saline, and then crushed in the 5th bottle.

Inclusion criteria:

Male and female of 18 years and above with ureteric calculus without prior treatment.

Exclusion criteria:

1. Patients with positive urine culture
2. Patients taking a broad-spectrum antibiotic
3. Urine tract anatomical anomalies
4. Patients having urinary stents

Urine culture

After a thorough cleansing of the external genital organs, a mid-stream urine sample was taken in a sterile container a week prior to surgery. Samples were inoculated on MacConkey agar and incubated for

24 hours at 37 degrees Celsius. Samples were declared sterile if there was no growth after 24 hours. Disc diffusion was used to assess antibiotic sensitivity.

Stone Culture

During the operation, calculi were collected in a sterile container. The surface contaminates were rinsed off using the standardized Stamey procedure after a sample of shattered stones was obtained (8). Crushed stones were cultivated on MacConkey's agar, thiosulfate citrate bile salt sucrose, and incubated at 37°C for 48 hours. The disc diffusion method was also used to test the antibiotic sensitivity of bacterial isolates.

The study was conducted according to institutional and national policies. Consent forms were obtained from patients prior to using their clinical data. Patient records were obtained and included anonymously. All stages of the project were approved by the Institutional Ethics Committee of (Dr. S N Medical College, Jodhpur, India), (Code: F.NO/16/SNMC/IEC/2019/7840).

For data entry and analysis, IBM Statistical Package for Social Science (SPSS) for Windows version 23 (IBM Corp., Armonk, NY) was utilized. Percentages, medians, means, and standard deviations were used to represent the data. The significance of the results was determined using the Chi-square test or the Student's T-test. Statistical significance was defined as a p-value of less than 0.05.

Results

General characteristic

A total of 50 patients were included in the study. The median age was 55 years, ranging from 18–78 years. Out of 50 patients, 32 were males (64%), and 18 were females (36%), with M:F ratio of 1.78:1.

Type of microorganism

In patients with positive urine culture most common organism was E. Coli (37.5%). In patients with positive stone culture, the most common isolate was Enterobacter (23.8%). (Table 1).

Table 1
Type of bacteria isolated

Type of organism	Urine culture-positive patients (n = 8)	Stone culture-positive patients (n = 21)
E.Coli	3 (37.5%)	4 (19%)
Pseudomonas	1 (12.5%)	3 (14.3%)
Enterobacter	2 (25%)	5 (23.8%)
Enterococcus	1 (12.5%)	3 (14.3%)
Coagulase positive Staph	0	2 (9.5%)
Coagulase-negative Staph	0	1 (4.7%)
Klebsiella	0	2 (9.5%)
Proteus	1 (12.5%)	1 (4.7%)

Bacteriological analysis of stone and urine culture

Out of 50 patients, 8(16%) had positive urine culture compared to 21(42%) had positive stone culture (Table 2), (Fig. 1).

Table 2
Bacteriological analysis of stone and urine culture

Stone Culture	Urine culture	Number of patients
Positive	Positive	6(12%)
Positive	Negative	15(30%)
Negative	Positive	2(4%)
Negative	Negative	27(54%)

When comparing the results of the bacteriological investigation of stone and urine culture, it was discovered that only 6 (12%) patients were positive for both stone and urine culture, with just two patients having the same organism isolated (4 percent). Thus, bacterial concordance was 4%. Additionally, 2 patients (4%) had a positive urine culture but a negative stone culture, whereas 15 patients (30%) had a positive stone culture but a negative urine culture.

When overall urine cultures were cross-tabulated with stone cultures, a significant association was found between the two based on Chi-square analysis ($p = 0.039$) (Table 3).

Table 3
Comparison of Stone culture with urine culture

	Stone Culture Positive	Stone Culture negative
Urine culture positive	6(a)	2(b)
Urine culture negative	15(c)	27(d)
Chi-square = 4.2576, p = 0.039(Significant)		

The sensitivity (a/a+c), specificity (d/b+d), PPV (a/a+b), NPV (d/c+d), and diagnostic accuracy ([a+d]/a+b+c+d) of urine culture versus stone culture were calculated to be 28.57 percent, 93.10 percent, 75 percent, 64.28 percent, and 66 percent, respectively, using these data.

In addition, urine and stone culture negative (n=27) and urine and stone culture positive (culture with same organism growth) (n=2) results were observed in 58% of cases (29/50). In comparison, different results (i.e., growth only in one culture or both positive with different organism growth) were observed in 42% of cases (21/50). As a result, urine culture cannot accurately establish the bacteriology of stone.

Discussion

In every patient who undergoes elective ureteroscopic procedures of the urinary tract, midstream urine is analyzed by culture and sensitivity. This is done 1week before the elective procedure. In cases of culture-proven infection, antibiotics are given, and a repeat culture is done 3–5 days after antibiotics. Despite this meticulous preoperative preparation, patients nevertheless suffer septicemia and septicemic shock in direct proportion to the length of the surgery, the bacterial load in the urine, the severity of the obstruction caused by the stone, and the presence of infection in the stone (9). After ureteroscopy, mortality from septicemia was as high as 66% in a study of 9 patients by O'Keeffe et al. (10).

According to Stamey et al. (3), ureteral catheterization and urine collection from within the ureter can detect infection in the upper urinary system that would otherwise go undetected by a regular bladder urinalysis. Infections of the upper urinary tract that persist must be treated with the appropriate drugs, which Urine Culture cannot determine (9).

Gram-negative bacterial infections are the most common in stone and urine microbiology, with gram-positive infections being less common (10). This was also seen in our study, with E. coli and enterobacter being the most common bacteria in urine culture and stone culture-positive patients.

Stones are more likely to harbor bacteria than urine, and a negative urine culture does not rule out infection within the stone. The microbiological environment of the stone differs significantly from that of urine. As a result, stones are still one of the most common causes of sepsis after surgery.

Stone cultures can be collected quickly and at a low cost at the time of operation. This will minimize not only the length of stay in the hospital but also the overall expense of treating a case of sepsis.

Conclusions

The findings of this study reveal that stone cultures correlate better with bacterial profiles than urine cultures. When urine culture is negative, a positive stone culture might help clinicians decide which antibiotics to use, especially if the patient develops post-operative life-threatening urosepsis.

Limitations

Patients with diabetes, hypertension, and other comorbidities were included in this study. These patients are already prone to develop infections in the post-operative period irrespective of urine or stone cultures reports. We did not follow up with patients for the presence of urosepsis in this study. Stone size and composition were also not taken into consideration.

Declarations

Ethics approval and consent to participation: This study was conducted in accordance with the declaration of Helsinki. It is also approved by the Institutional Ethics Committee of Dr. S N Medical College (Jodhpur, India), (Code: F.NO/16/SNMC/IEC/2019/7840).

Consent for publication: Not applicable.

Availability of data and materials: The datasets generated and/or analyzed during the current study are not publicly available due to the policies of research team. But they might be available from the corresponding author on reasonable request.

Competing interests: The authors declare no conflict of interest

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

Authors' contributions: All authors have read and approved the manuscript. SG: Involved in patient management, data sampling and wrote the manuscript. MAM: Reviewed results and revised the manuscript. AK: Involved in patient management, did background research, and reviewed results.

Acknowledgements: Not applicable.

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Figures

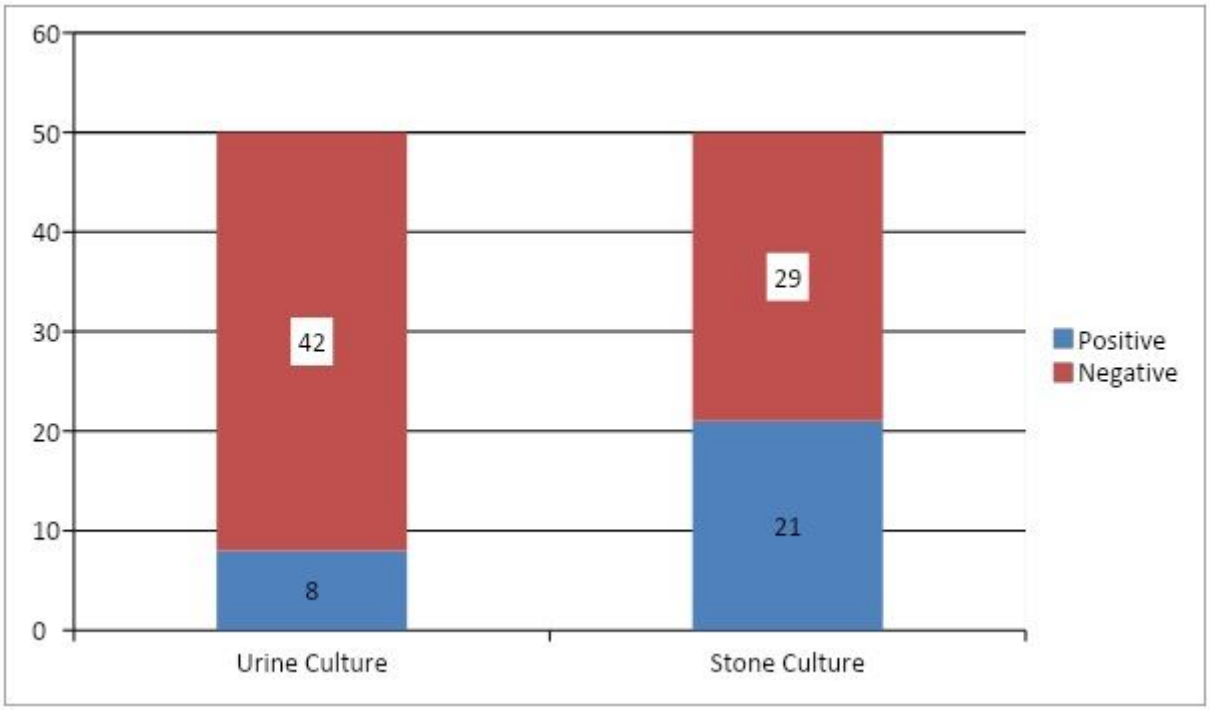

Figure 1

Patients having positive urine and stone culture