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# Comparison of Preoperative Urine Culture and Intraoperative Renal Pelvis Culture in Patients Who Underwent Flexible Ureterorenoscopy

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**What's known on the subject? and What does the study add?**

Urine culture was recommended before any type of stone surgeries. The urine culture generally collected from bladder and infectious complications could occurs even the bladder urine culture was negative. The studies suggested that bladder urine culture do not correlate with pelvic urine culture and pelvic urine culture were better predictors for infectious complications and sepsis. However, the pelvic urine culture could not collect routinely.

Our study demonstrated that preoperative bladder urine culture may not shows pelvic urine culture colonization and in patients with preoperative hydronephrosis and low tomographic pelvic urine density prone to positive pelvic urine culture. Our study suggest that preoperative antibiotic prophylaxis could be administered to patients who had preoperative hydronephrosis and low pelvic urine density.

## Abstract

**Objective:** There is no correlation between the preoperative bladder urine culture (PBUC) sensitivity test and the results of the renal pelvic urine culture (RPUC) test.

**Materials and Methods:** A total of 129 patients who underwent f-URS included the study. Preoperatively, PBUC was collected in all cases, and RPUC was taken when starting the surgery.

**Results:** In PBUC, there was growth in 25 (19.4%) patients and in RPUC, there were only in 35 (27.1%) cases. Preoperative tomographic urine density at the renal pelvis [odds ratio (OR): 0.848, p<0.001], grade ≥2 hydronephrosis (OR: 18.970, p=0.001), and lower calyceal stone location (OR: 0.033, p=0.017) were determined as independent predictive factors for RPUC growth. The ability of tomographic urine density to foresee positive RPUC positivity was determined to be 0.858 (0.780-0.936). The tomographic urine density threshold for RPUC positivity prediction was 4.5, with 80% sensitivity and 77.7% specificity.

**Conclusion:** PBUCs do not necessarily mean accurate colonization. Obtaining renal pelvis urine samples is important for managing postoperative infectious complications. Patients that have preoperative hydronephrosis and nominal tomographic urine density could develop RPUC even if the preoperative bladder urine samples are negative.

**Keywords:** Bladder urine culture, Renal pelvic urine culture, RIRS

## Introduction

The preoperative bladder urine culture (PBUC) test is a part of the generally applied procedure before any type of stone operation. Previous studies have shown that a positive PBUC indicates an increased possibility of postoperative infectious complication development (1). However, infectious complications can occur even in the presence of prophylactic antibiotics and a negative PBUCs (2,3).

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The results of the PBUC susceptibility test and pelvic urine culture (RPUC) analysis do not correlate well with each other (4). Growth in RPUC has been shown to be a significant signal of infection development following endoscopic operations (5). Despite antibiotic treatment or preoperative antibiotic prophylaxis (PAP), growth may occur in cultures taken intraoperatively, or postoperative urinary tract infection may develop depending on factors such as obstruction and antimicrobial resistance in the urinary system (6,7). If the type of the bacteria in the upper urinary system can be predicted before the operation using any method, patients can be treated with a more appropriate antibiotic or appropriate prophylaxis before the intervention/operation. While the American Urological Association (AUA) guidelines suggest that PAP should be applied to all patients to reduce urosepsis after flexible ureterorenoscopy (f-URS), the European Association of Urology (EAU) recommends that it should only be given to patients with a high risk of infection (8-10). The role of cultures taken during f-URS has not yet been fully revealed. Sepsis is the most terrifying infectious complication of f-URS that may result in intensive care unit hospitalization and even mortality. In case of post-operative fever and/or sepsis, a positive culture which was obtained from the renal pelvis is critical for arranging proper antibiotherapy.

In this study, we evaluated the disagreement between preoperative PBUC analysis and RPUC obtained at the outset of the f-URS operation and determined the predictability of a positive RPUC based on associated preoperative markers.

## Materials and Methods

After obtaining the approval of the ethics committee (01.04.2021.01), a retrospective analysis was conducted based on a database that was prospectively collected from 129 patients who received f-URS on renal and proximal ureteral stones in two different medical facilities from 2017 to 2020. All the patients were evaluated preoperatively using 64-detector non-contrast computed tomography (NCCT). The renal pelvis urine density [hounsfield units (HU)] of the patients with hydronephrosis was measured using the technique described by Basmaci and Sefik (11). Wall thickness at the location of the stones in the proximal ureter and pelvis was measured and recorded as defined by Sarica et al. (12). Stone parameters evaluated consisted of number, size (measured as the longest diameter of the stone in NCCT in axial or reconstructed coronal planes), and CT attenuation value. Patient data obtained included age, gender, body mass index, history, physical examination findings, and specific comorbidities. PBUC and RPUC were performed using 5% sheep blood agar and eosin-methylene blue agar and incubated at 37 °C for 18-24 h. The results are evaluated (13,14). The bacterial growth of ≥105 cfu/mL was determined as positive.

PBUC was obtained from the patients, and if negative, intravenous cefazolin was administered as PAP with the induction of anesthesia according to the EAU guidelines (9). In the case of a positive PBUC, the operation was not performed until a negative PBUC was achieved with appropriate antibiotherapy. Patients with a previous history of urological operation, urinary system catheterization, or congenital urinary system anomalies, patients using corticosteroid drugs, and cases in which a Double-J (DJ) stent was placed for passive dilation were excluded from the study.

All operations were performed by experienced surgeons in the lithotomy position under general anesthesia. First, ureteroscopy was performed using a semirigid ureteroscope (8 Fr; Karl Storz, Tuttlingen, Germany) to provide active dilatation and place a guidewire. At this stage, approximately 10 cc of available urine sample was taken from the renal pelvis for the RPUC analysis. Cultures were obtained with a semi-rigid ureterorenoscopy for proximal ureter stones either after the stone was slightly broken or pushed into the pelvis. In other cases, cultures were obtained using a flexible ureterorenescope after it reached the pelvis. If the stone did not allow the progression of ureteroscopy or guide wire through the ureter, these patients were excluded from the study. Also, if the stone was only slightly broken, or if the stone could be pushed into the pelvis then, the culture was taken at that stage. Afterwards, according to the surgeon's preference for all procedures, a ureteral access sheath (UAS) (Flexor 9.5/11.5Fr or 12/14Fr, Cook Medical Bloomington, IL, USA, Navigator 11/13Fr, Boston Scientific, Natik, MA, USA) was placed over the guidewire under fluoroscopic control. However, we prefer not use UAS mostly. Also, in cases where UAS could not be placed, the flexible scope was back-loaded over a guidewire and procedure was performed. If the flexible ureteroscope could not reach the kidney, a DJ stent was placed and the procedure was postponed by 2 weeks. In all patients, f-URS was performed using a flexible ureteroscope (Flex-X2, Karl Storz Endoscope, Tuttligen, Germany) and a 200/273-micron Holmium laser lithotriptor. The procedure was terminated after stone-free status was confirmed by both ureteroscopic inspection and fluoroscopy (leaving only ungraspable gravel or fragments <2 mm), in cases of bleeding, or if deemed necessary by the surgeon. To minimize perioperative complications, the operation was stopped if 120 min. elapsed. At the end of the operation, a DJ stent or a ureteral catheter was placed according to the surgeon's preference. On the first postoperative day, the patients were discharged if there was no hematuria or fever.

### Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 23 for Windows. Categorical data are presented as numbers and percentages. The compliance of continuous data with a normal distribution was evaluated with the Shapiro-Wilk test. Continuous data conforming to non-normal distribution was presented as median and interquartile range (IQR) values. Pearson's chi-square or the exact test was used in the comparison of categorical data. The Mann-Whitney U test was used in the comparison of continuous variables. Univariate regression analysis was performed to evaluate the factors associated with a positive pelvis urine culture, and the parameters that were found to be significant at this stage were further examined using the multivariate analysis. A value of $p<0.05$ was considered statistically significant.

## Results

### Demographic Data

The characteristics of the patients and stones are shown in Table 1. The median age of the patients was 69 years, and the female/male ratio was 61 (47.3%)/68 (52.7%). The median stone size and median stone density (HU) were 90 $mm^2$ and 1,039, respectively. The most frequent primary location of the stones was the pelvis (35.7%) stones. The median operation time was 65 minutes. While postoperative stents were placed in 77.5% of the patients, a ureteral catheter was required in 9.3%. The stone-free rate was 69.7%. Seven (5.4%) patients had postoperative fever, and one (0.7%) developed sepsis.

### Group Comparisons

The frequencies and rates of microorganisms grown in urine cultures are presented in Table 2. The PBUC analysis revealed positivity in 25 (19.4%) patients, and the most common microorganism was identified as *Escherichia coli* (9.3%). According to the perioperative RPUC, 35 (27.1%) patients had growth. *Pseudomonas aeruginosa* (10.1%) was the most common organism identified in the RPUC analysis. When the bacteriological analysis results of RPUC and PBUC were compared, it was observed that the same organism was isolated only from seven patients (14.3%). Growth was detected in both the pelvic and urinary cultures of 12 (24.5%) patients.

Table 3 presents a comparison of the factors associated with a positive RPUC. A higher rate of growth was seen in the RPUC of patients with preoperative hydronephrosis ($p<0.001$). The ureteral wall was found to be thicker in RPUC-positive patients ($p<0.001$). The presence or absence of growth was evaluated according to stone location, and the subgroup analysis revealed less growth in lower, middle and upper pole stones while multicalyceal stones had significantly greater growth ($p=0.011$). Increased stone size and decreased preoperative tomographic urine density (HU) were associated with a positive RPUC ($p<0.001$ for both).

The multivariate analysis of factors associated with a positive RPUC and postoperative fever is shown in Table 4. Multivariate logistic regression was used to evaluate potential signals for predicting a positive RPUC. Preoperative tomographic urine density [odds ratio (OR): 0.848, $p<0.001$], grade ≥2 hydronephrosis (OR: 18.970, $p=0.001$) and lower calyceal location (OR: 0.033, $p=0.017$) were found to be independent predictive markers for a positive RPUC. Receiver operating

**Table 1. Demographic parameters**

| | | Value |
|---|---|---|
| **Age[a]** | | 69.0 (66.0-72.0) |
| **BMI[a]** | | 25.4 (23.5-27.6) |
| **Gender[b]** | **Female** | 61 (47.3%) |
| | **Male** | 68 (52.7%) |
| **History of ESWL[b]** | **Absent** | 100 (77.5%) |
| | **Present** | 29 (22.5%) |
| **Metabolic syndrome[b]** | **Absent** | 88 (68.2%) |
| | **Present** | 41 (31.8%) |
| **Stone location[b]** | **Lower pole** | 20 (15.5%) |
| | **Middle pole** | 5 (3.9%) |
| | **Upper pole** | 5 (3.9%) |
| | **Pelvis** | 46 (35.7%) |
| | **Proximal ureter** | 26 (20.1%) |
| | **Multiple calyxes** | 27 (20.9%) |
| **Preoperative Hydronephrosis[b]** | **None** | 45 (34.9%) |
| | **Grade 1** | 59 (45.7%) |
| | **Grade 2** | 22 (17.1%) |
| | **Grade 3** | 3 (2.3%) |
| **Ureteral wall thickness[a] (mm)** | | 1.90 (1.7-2.4) |
| **Preoperative tomographic urine density[a] (HU)** | | 6.0 (-4.0-9.0) |
| **Stone density[a] (HU)** | | 1039.0 (751.0-1223.0) |
| **Stone size[a] ($mm^2$)** | | 90.0 (80.0-130.0) |
| **Postoperative stent[b]** | **None** | 17 (13.2%) |
| | **Ureteral catheter** | 12 (9.3%) |
| | **Double-J stent** | 100 (77.5%) |
| **Postoperative complication[b]** | **None** | 121 (93.7%) |
| | **Fever** | 7 (5.4%) |
| | **Perforation** | 0 |
| | **Sepsis** | 1 (0.7%) |
| | **Death** | 0 |
| **Operation time[a] (min)** | | 65.0 (50.0-70.0) |
| **Hospitalization date[a] (day)** | | 2.0 (2.0-3.0) |
| **Residual fragment[b]** | **Absent** | 90 (69.7%) |
| | **Present** | 14 (10.8%) |
| | **CIRF** | 25 (18.6%) |

[a]Data expressed as median and interquartile range.
[b]Data expressed as count and frequency, BMI: Body mass index, ESWL: Extracorporeal shock wave lithotripsy, HU: Hounsfield unit, CIRF: Clinically insignificant residual fragment, min: Minute

characteristic analysis was used to evaluate the predictive ability of tomographic urine density for determining positive RPUC. The threshold for tomographic urine density in predicting RPUC positivity was determined to be 4.5 with a sensitivity of 80%, specificity of 77.7% and an area under the curve of 0.858 (0.780-0.936) (Figure 1).

Additionally, in univariate analysis; increased age, prolonged operation time, decreased preoperative tomographic urine density in CT, increased hydronephrosis grade and stone size, multicalyxial stone location, positive RPUC and UAS usage were statistically significantly associated with postoperative fever. There was no significant correlation between PBUC and postoperative fever. In the multivariate analysis, only the operation time was found as an independent prediction factor (OR: 1.149, p=0.037).

## Discussion

PBUC analysis is a standard procedure performed before any stone surgery and is very important for selecting patients undergoing f-URS to receive prophylaxis and for predicting the risk of postoperative infection complications (1,5). In a previous meta-analysis, a single preoperative antibiotic dose was shown to reduce postoperative pyuria and bacteriuria, but it did not statistically significantly reduce postoperative urinary tract infections (15). Theoretically, the effect of PAP is considered to prevent the spread of bacteria during the stone operation; however, the actual efficacy of this application remains uncertain. In our study, PBUC growth was present in 19.4% of the patients. Although there was no growth in the post-treatment control cultures of these patients, it was observed that bacteriuria persisted in RPUC in 27.1%. Considering this information, it has been deemed necessary to establish proper prophylaxis and treatment strategies in patients with a positive PBUC to prevent infectious complications. The AUA guidelines recommend PAP to all patients to reduce urosepsis after f-URS while EAU states that PAP is indicated only for those with a high risk of infection (8-10).

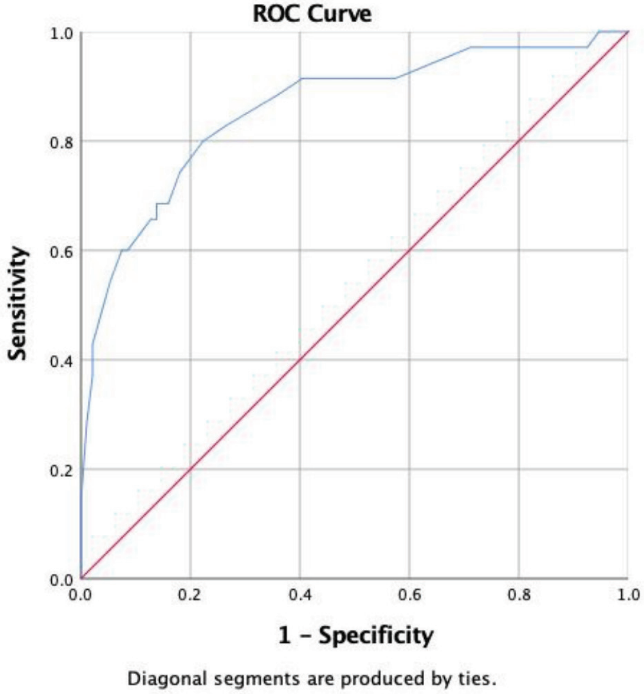


**Figure 1.** Receiver operating characteristic (ROC) curve plot of pelvis urine density in predicting pelvis culture positivity (AUC: 0.858)

In another previous study, the efficacy of PAP and preoperative antimicrobial treatment were compared using the cultures taken intraoperatively, and growth was found in intraoperative cultures in only 3.2% of the patients who were negative for PBUC and were administered PAP. In the same study, 43.3% of the cultures taken intraoperatively from patients with a positive PBUC had growth despite appropriate antibiotherapy; i.e., an existing or different microorganism managed to survive. That study demonstrated the efficacy of preoperative antimicrobial therapy to be 71.6% (16). In our study, we found that growth in pelvic urine culture in some patients is different from bladder urine culture. Previous studies, the reason for this is not fully explained. We think that the growth of different microbial cultures can be caused by urinary obstruction, biofilm, or antimicrobial resistance, inadequate or inappropriate antimicrobial and prophylaxis usage. Even though we sterilized our reusable f-URS before each operation, we believe that it is still possible that there can still be residual microorganisms that remain in the device and that may be the source of positive RPUC cultures that we examined in some patients.

| Table 2. Bacteriological analysis of culture | | |
|---|---|---|
| Preoperative bladder urine culture[b] | None | 104 (80.6%) |
| | *Escherichia coli* | 12 (9.3%) |
| | *Pseudomonas aeruginosa* | 6 (4.7%) |
| | *Staphylococcus aureus* | 1 (0.8%) |
| | *Enterecocus* | 4 (3.1%) |
| | *Proteus mirabilis* | 0 |
| | *Klebsiella* | 1 (0.8%) |
| | *Candida albicans* | 1 (0.8%) |
| Perioperative pelvis urine culture[b] | *None* | 94 (72.9%) |
| | *Escherichia Coli* | 6 (4.7%) |
| | *Pseudomonas aeruginosa* | 13 (10.1%) |
| | *Staphylococcus aureus* | 4 (3.1%) |
| | *Enterecocus* | 9 (7.0%) |
| | *Proteus mirabilis* | 1 (0.8%) |
| | *Klebsiella* | 2 (1.6%) |

**Table 3. Comparison of the patients with and without a positive pelvis urine culture**

| | | Pelvis urine (Negative) | Pelvis urine (Positive) | p-value |
|---|---|---|---|---|
| **Agea (years)** | | 69.0 (66.0-71.0) | 69.0 (65.0-74.0) | 0.686# |
| **BMI**[a] | | 25.4 (23.1-27.5) | 25.8 (23.9-29.0) | 0.176# |
| **Gender**[b] | **Female** | 48 (51.1%) | 13 (37.1%) | 0.159* |
| | **Male** | 46 (48.9%) | 22 (62.9%) | |
| **History of ESWL**[b] | **Absent** | 72 (76.6%) | 28 (80.0%) | 0.680* |
| | **Present** | 22 (23.4%) | 7 (20.0%) | |
| **Metabolic syndrome**[b] | **Absent** | 66 (70.2%) | 22 (62.9%) | 0.425* |
| | **Present** | 28 (29.8%) | 13 (37.1%) | |
| **Stone location**[b] | **Lower pole** | 19 (20.2%)[a] | 1 (2.8%)[b] | **0.010^** |
| | **Middle pole** | 5 (5.3%)[a] | 0[a] | |
| | **Upper pole** | 5 (5.3%)[a] | 0[a] | |
| | **Pelvis** | 33 (35.1%)[a] | 13 (37.1%)[a] | |
| | **Proximal ureter** | 18 (19.1%)[a] | 8 (22.8%)[a] | |
| | **Multiple calyxes** | 14 (14.8%)[a] | 13 (37.1%)[b] | |
| **UAS usage** | **No** | 79 (84.0%) | 25 (71.4%) | 0.107* |
| | **Yes** | 15 (16.0%) | 10 (28.6%) | |
| **Preoperative bladder urine culture**[b] | **None** | 80 (85.1%)[a] | 24 (68.6%)[b] | **0.026^** |
| | *Escherichia coli* | 9 (9.6%)[a] | 3 (8.6%)[a] | |
| | *Pseudomonas aeruginosa* | 3 (3.2%)[a] | 3 (8.6%)[a] | |
| | *Staphylococcus aureus* | 0[a] | 1 (2.9%)[a] | |
| | *Enterecocus* | 1 (1.1%)[a] | 3 (8.6%)[b] | |
| | *Proteus mirabilis* | 0[a] | 0[a] | |
| | *Klebsiella* | 0[a] | 1 (2.9%)[a] | |
| | *Candida albicans* | 1 (1.1%)[a] | 0[a] | |
| **Preoperative hydronephrosis**[b] | **None** | 43 (95.5%) | 2 (4.5%) | **<0.001*** |
| | **Grade 1** | 45 (76.3%) | 14 (23.7%) | |
| | **>Grade 2** | 6 (24.0%) | 19 (76.0%) | |
| **Preoperative tomographic urine density**[a] **(HU)** | | 8.0 (6.0-11.0) | -7.0 (-10.0-3.0) | **<0.001#** |
| **Stone densitya (HU)** | | 1092.0 (800.0-1250.0) | 950.0 (728.0-1150.0) | 0.078# |
| **Stone size**[a] **(mm²)** | | 90.0 (80.0-110.0) | 110.0 (90.0-190.0) | **<0.001#** |
| **Postoperative complication**[b] | **None** | 92 (97.8%) | 29 (89.2%) | **0.006^** |
| | **Fever** | 2 (2.2%) | 5 (14.3%) | |
| | **Perforation** | 0 | 0 | |
| | **Sepsis** | 0 | 1 (2.9%) | |
| | **Death** | 0 | 0 | |
| **Preoperative white blood cell count**[a] **($10^3$/µL)** | | 8.0 (6.7-9.8) | 7.9 (6.3-9.0) | 0.401# |
| **Preoperative neutrophil count**[a] **($10^3$/µL)** | | 4.3 (3.6-6.1) | 4.2 (3.8-5.8) | 0.824# |
| **Operation time**[a] **(min)** | | 60.0 (45.0-70.0) | 70.0 (60.0-75.0) | **0.003#** |
| **Hospitalization date**[a] **(day)** | | 2.0 (2.0-3.0) | 2.0 (2.0-4.0) | 0.379# |
| **Residual fragment**[b] | **Absent** | 68 (72.3%) | 22 (62.9%) | 0.352* |
| | **Present** | 8 (9.0%) | 6 (17.1%) | |
| | **CIRF** | 18 (19.1%) | 7 (20.0%) | |

[a]Data expressed as median and interquartile range.
[b]Data expressed as count and frequency, *Pearson chi-square test, # Mann-Whitney U test.
^Fisher's exact test, Bold values indicate statistical significance, BMI: Body mass index, CIRF: Clinic insignificant residual fragment, HU: Hounsfield unit

He et al. (17) administered cefuroxime PAP for three days preoperatively to patients without preoperative urine culture growth and observed reduced growth in RPUC. The authors emphasized that preoperative antibiotic administration should be adjusted according to the risk level and suggested that RPUC showed bacterial colonization more effectively. In our study, we determined that even if the patients with a positive PBUC were treated, some had growth RPUC. However, PBUC positivity is not an independent predictive factor for the possibility of growth in RPUC. The efficacy of PAP or antimicrobial treatment before surgery was limited against bacteria that we could not detect preoperatively. Therefore, we consider that even if PBUC is negative in patients scheduled to undergo f-URS, we should be prepared for the possibility of a positive RPUC in some patients to ensure that appropriate antibiotherapy is started promptly to prevent alarming complications, such as sepsis.

The literature shows that there is significant growth in intraoperative cultures in patients with renal stones and a history of obstructive pyelonephritis (16). In our study, a statistically significant relationship was found between stone location and the presence of hydronephrosis and RPUC positivity. If a stone is in a location that can cause hydronephrosis (e.g., pelvis and/or proximal ureter), it can explain a higher rate of growth in RPUC. In patients with urinary system obstruction, infection or bacterial colonization in the upper urinary tract may continue even in the presence of

**Table 4. Factors affecting renal pelvis urine culture positivity and postoperative fever**

| [a]Renal pelvis urine culture positivity | OR | 95% CI | | p |
|---|---|---|---|---|
| | | Lower | Upper | |
| **PBUC** | 2.191 | 0.532 | 9.026 | 0.278 |
| **Stone size, mm²** | 1.003 | 0.994 | 1.014 | 0.494 |
| **Stone density, HU** | 0.999 | 0.997 | 1.001 | 0.425 |
| **Preoperative tomographic urine density, HU** | 0.848 | 0.782 | 0.919 | **<0.001** |
| **Stone location** | | | | |
| **Other** | Ref | | | |
| **Lower calyx** | 0.033 | 0.002 | 0.543 | **0.017** |
| **Multiple calyxes** | 1.823 | 0.401 | 8.286 | 0.437 |
| **Preoperative hydronephrosis** | | | | |
| **Grade 0** | Ref | | | |
| **Grade I** | 0.624 | 0.148 | 2.629 | 0.660 |
| **Grade II** | 18.970 | 3.406 | 105.657 | **0.001** |
| **[b]Postoperative fever** | | | | |
| **Age, years** | 1.031 | 0.886 | 1.200 | 0.692 |
| **Preoperative tomographic urine density, HU** | 0.920 | 0.770 | 1.100 | 0.362 |
| **Preoperative hydronephrosis** | | | | |
| **Grade 0** | Ref | | | |
| **Grade I** | 0.122 | 0.001 | 10.204 | 0.352 |
| **Grade II** | 0.408 | 0.019 | 8.535 | 0.563 |
| **Stone size, mm²** | 1.011 | 0.984 | 1.039 | 0.429 |
| **Stone location** | | | | |
| **Other** | Ref | | | |
| **Multiple calyxes** | 1.205 | 0.064 | 22.526 | 0.901 |
| **Operation time, min** | 1.149 | 1.008 | 1.309 | **0.037** |
| **PBUC** | 0.168 | 0.004 | 6.609 | 0.341 |
| **RPUC** | 10.188 | 0.145 | 713.392 | 0.284 |
| **UAS usage** | 0.397 | 0.021 | 7.624 | 0.540 |

[a]: Variable(s) entered on step for Renal pelvis urine culture positivity: Preoperative urine culture, Stone size, Stone density, Preoperative pelvis urine density, Stone localization, Preoperative hydronephrosis , [b]: Variable(s) entered on step for Postoperative fever: Age, Preoperative tomographic urine density, Preoperative hydronephrosis, Stone size, Stone location, Preoperative urine culture, Renal pelvis urine culture, OR: Odds ratio, CI: Confidence interval, HU: Hounsfield unit, RBUC: Preoperative bladder urine culture, RPUC: Renal pelvic urine culture, UAS: Ureteral access sheath

J Urol Surg,
2022;9(3):172-179

a negative PBUC. Other studies have revealed that in addition to the degree of hydronephrosis, the thickness of the ureteral wall surrounding the stone may also increase. A significant association between ureteral wall thickness (UWT) and degree of obstruction has been demonstrated, and a possible predictive value has been presented (18,19). Sarica et al. (12) found the cut-off value of UWT to 3.35 mm and they were not unable to place a DJ stent in patients with a value over this threshold. The authors considered that if the guidewire required for the DJ insertion could not reach the proximal of the stone, the urine sample obtained preoperatively would also not be sufficient for the culture analysis. Impacted stones have indirect NCCT findings, including changes in UWT, degree of hydronephrosis, and fluid collection around the kidney (20). Another study revealed that the thickness of the wall immediately surrounding the stone depends on the time elapsed and the degree of inflammatory reactions that occur (21). In our study, the wall tissue thickness at the proximal ureter and/or pelvis was higher in patients with RPUC growth. However, due to being a confounding factor in the multivariate analysis, it was excluded in the model.

The literature demonstrates that 10.1% of the patients with a negative PBUC were positive for RPUC, but these patients also did not show any signs of infection (4). Basmaci and Sefik (11) reported that at a cut-off value of 0, renal pelvis HU had 100% sensitivity and 96% specificity for a positive RPUC. In our study, the HU value was found to be lower in the RPUC group. We certainly do not claim that it is possible to definitively determine the presence of RPUC growth by examining HU. However, we consider that in patients examined for stone disease and planned to undergo f-URS, pelvis HU can predict RPUC growth, and thus help identify those that require wider-spectrum PAP and a closer follow-up in the postoperative period. We think that a low HU value in patients with RPUC growth may be due to bacterial burden colonizing in that location, fragmented urine, and/or increased urine density.

In previous studies, the percentage of patients with fever and sepsis was reported as 4.4% and 0.7%, respectively, after f-URS (3,22). We observed postoperative fever in 7 patients (5.4%) and sepsis in 1 patient (0.7%) during the study. In the literature, high stone burden, long operation time, positive preoperative culture, presence of diabetes mellitus, presence of renal abnormalities were identified to influence the infection risk following f-URS (5,22,23). In our study, we found that the operation time was the only predictive factor for postoperative fever. Günseren et al. (23) showed that f-URS operations can be held safely for as long as 83 minutes. We think that as the operation time increases, intrarenal pressure protective mechanisms (pyelo-tubular, pyelo-venous, pyelo-sineous, and pyelo-lymphatic) might become less effective and give way to infections. However, it might be inaccurate to claim that the operation length is the only reason for infection. In our study, we only obtained RPUC perioperatively. We didn't find any correlation between that and fever in our multivariate analysis. However, we think that if we obtained stone cultures perioperatively, we might have found it to be a significant predictor of infection. Thatis because we think that there might be microorganisms colonized inside the stones, which might have spread after the fragmentation and caused an infection.

### Study Limitations

This study has certain limitations. First, it was a retrospective study and had few patients. Another important limitation of our study is that we didn't compare intraoperative urine cultures with postoperative samples. The main goal of our study was to demonstrate that urine cultures obtained from obstructed upper urinary system obstruction cases may not always reflect an accurate picture. Therefore, we excluded postoperative urine cultures in our study. Second, the chemical analysis of the stones was not undertaken. Third, this study was not conducted with a single-use f-URS. The reason for PBUC and RBUC to show different microbial growth can be device contamination despite sterilization procedures. Fourth, stone cultures were excluded from the study. Although the effect of PAP and preoperative antimicrobial treatment remains uncertain, it is essential to identify high-risk patients, take an intraoperative culture and perform infection control more carefully according to the results to prevent serious infection complications. Therefore, well-designed prospective studies with larger case series must confirm the results of the current study.

## Conclusion

Preoperative PBUC may not represent true colonization; therefore, preoperative PAP administration should be adjusted according to the individual risks of PBUC-negative patients. Obtaining renal pelvis urine culture is important for managing postoperative infectious complications. Even if PBUC is negative, it should be kept in mind that there may be growth in RPUC in cases where preoperative hydronephrosis and low tomographic urine density were present.

### Ethics

**Ethics Committee Approval:** This study was conducted with the approval from the Ethics Committee of the Mustafa Kemal University (01.04.2021.01).

**Informed Consent:** An informed consent was obtained from all patients.

**Peer-review:** Externally peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: F.G., Ö.K., S.P., M.Ş., A.E., D.B., İ.H.B., Concept: F.G., Ö.K., S.P., M.Ş., A.E., D.B., İ.H.B., Design: F.G., Ö.K., S.P., M.Ş., A.E., D.B., İ.H.B., Data Collection or Processing: F.G., Ö.K., S.P., M.Ş., A.E., D.B., İ.H.B., Analysis or Interpretation: F.G., Ö.K., S.P., M.Ş., A.E., D.B., İ.H.B., Literature Search: F.G., Ö.K., S.P., M.Ş., A.E., D.B., İ.H.B., Writing: F.G., Ö.K., S.P., M.Ş., A.E., D.B., İ.H.B.

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