Should renal pelvic urine culture be obtained routinely in flexible ureterorenoscopy?

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Abstract

Background: Preoperative bladder urine culture (PBUC) analysis has become a standard application before any stone surgery. When growth is detected in PBUC, it is contraindicated to perform flexible ureterorenoscopy (f-URS). The results of the PBUC susceptibility test do not correlate well with those of the renal pelvic urine culture (RPUC) analysis. Previous studies have demonstrated the positivity of RPUC as an important marker for the development of infections after endoscopic operations. In the current study, we aimed to evaluate the consistency between PBUC and RPUC and to identify preoperative markers associated with a positive RPUC. Methods: Data from 129 patients who underwent f-URS on renal and proximal ureteral stones in two centers between 2015 and 2020 were prospectively recorded in a database and retrospectively analyzed. PBUC was obtained from all the patients preoperatively, and RPUC was taken at the beginning of the f-URS operation. The results of the two cultures were compared. Results: There was growth in PBUC in 25 (19.4%) patients and RPUC in 35 (27.1%) patients. Possible predictive markers in predicting a positive RPUC were evaluated using multivariate logistic regression analysis. Preoperative 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 localization (OR:0.033,p=0.017) were determined as independent predictive factors for a positive RPUC. The ability of pelvis urine density to predict positive RPUC positivity was evaluated using the receiver operating characteristic analysis, in which the area under the curve value was determined to be 0.858 (0.780-0.936). The cut-off value of pelvis urine density in the prediction of RPUC positivity was 4.5, at which it had 80% sensitivity and 77.7% specificity. Conclusions: PBUC may not represent true colonization. Although bladder urine culture is negative before the operation, patients with preoperative hydronephrosis and low pelvis urine density may have RPUC growth.

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Methods: 129 patients who underwent f-URS on renal and proximal ureteral stones in two centers between 2015 and 2020 were prospectively recorded in a database and retrospectively analyzed. PBUC was obtained from all the patients preoperatively, and RPUC was taken at the beginning of the f-URS operation. The results of the two cultures were compared.

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Conclusions: PBUC may not represent true colonization. Although bladder urine culture is negative before the operation, patients with preoperative hydronephrosis and low pelvis urine density may have RPUC growth.

Keywords: Flexible ureterorenoscopy, urine culture, Urinary tract infection, pelvis urine culture

What's already known about this topic?

Infectious complications can often occur after surgery performed for the treatment of upper urinary tract stones. Previous studies have shown that a positive preoperative bladder urine culture (PBUC) indicates an increased possibility of postoperative infectious complication development. However, infectious complications can occur even in the presence of prophylactic antibiotics and a negative PBUC. The results of the PBUC susceptibility test do not correlate well with the results of renal pelvic urine culture (RPUC) analysis. It has been demonstrated that growth in RPUC is an important marker for infection development after endoscopic operations.

What does this article add?

Preoperative PBUC may not represent true colonization; therefore, preoperative perioperative antimicrobial prophylaxis (PAP) administration should be adjusted according to the individual risks of PBUC-positive patients. Even if PBUC is negative, it should be kept in mind that there may be growth in RPUC in patients with preoperative hydronephrosis and low pelvis urine density.

Introduction

Infectious complications can often occur after surgery performed for the treatment of upper urinary tract stones. Preoperative bladder urine culture (PBUC) analysis has become a standard application before any stone surgery. Previous studies have shown that a positive PBUC indicates an increased possibility of postoperative infectious complication development [1].It is contraindicated to perform flexible ureterorenoscopy (f-URS) in the presence of a positive PBUC. However, infectious complications can occur even in the presence of prophylactic antibiotics and a negative PBUC [2]. It has been reported that although perioperative antimicrobial prophylaxis (PAP) is given after stone surgery, fever may develop in 4.4% and sepsis in 0.7% of patients [3]. In addition, infectious complications are among the most feared complications after f-URS. Despite the application of prophylactic antibiotherapy suitable for PBUC, infectious complications after f-URS cannot be completely prevented.

The results of the PBUC susceptibility test do not correlate well with the results of renal pelvic urine culture (RPUC) analysis [4]. It has been demonstrated that growth in RPUC is an important marker for infection development after endoscopic operations [5]. Despite antibiotic treatment or 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]. In addition, antibiotherapy applied as a result of obstruction in the upper urinary system that can cause hydronephrosis may lead to the incomplete destruction of bacteria and increase bacterial resistance due to its insufficient efficacy [7]. If there is a bacterial focus in the upper urinary system and if this 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 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].However, PBUC may not fully reflect the microbiological state in cases of upper urinary tract obstruction [11]. Even if PBUC is negative, RPUC can be positive, especially in the presence of upper urinary tract obstruction. It has been shown that in patients undergoing percutaneous nephrolithotomy, RPUC and stone culture taken during surgery can provide additional information for treatment planning in those that develop an infection in the postoperative period [12,13]. However, the role of cultures taken during f-URS has not yet been fully revealed.

In this study, we evaluated the consistency between the results of PBUC taken preoperatively and RPUC taken at the beginning of the f-URS operation and to determine the predictability of a positive RPUC based on associated preoperative markers.

Methods

After obtaining the approval of the ethics committee (01/04/2021.05-25), the data of 129 patients who underwent f-URS on renal and proximal ureteral stones in two centers between 2015 and 2020 were prospectively recorded in a database and retrospectively analyzed. All the patients were evaluated preoperatively using 64-detector non-contrast computed tomography (NCCT). The renal pelvis Hounsfield units (HU) of the patients with hydronephrosis were measured and recorded using the technique described by Basmacı et al. [14]. Wall thickness at the location of the stones in the proximal ureter and pelvis was measured and recorded as defined by Sarica et al. [15]. 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 (BMI), 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 were quantitatively evaluated [16,17]. The bacterial growth of [?] 10 ^{5}cfu/ml was determined as positive.

PBUC was taken from all the patients preoperatively, and if negative, intravenous cefazolin was administered as PAP with the induction of anesthesia according to the EAU guidelines [9]. In case of a positive PBUC before f-URS, 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, cases in which a double-J stent was placed for passive dilation at the time of the first operation and the operation was delayed, steroid users, and pregnant women were not included in the study.

All operations were performed with the patients in the lithotomy position under general anesthesia. First, ureteroscopy was performed with 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. Then, according to the surgeon's preference, 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 under fluoroscopic inspection over the guidewire. If UAS could not be placed, the operation was performed without a sheath. In all patients, f-URS was performed using flexible ureteroscopes (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 <2mm), in cases of bleeding, or if deemed necessary by the surgeon. At the end of the operation, a double-J 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 were presented as numbers and percentages. The compliance of continuous data with normal distribution was evaluated with the Shapiro-Wilk test. Continuous data conforming to non-normal distribution were presented as median and interquartile range values. Pearson's chi-square or the Pearson exact test was used in the comparison of categorical data. The Mann-Whitney U test was used in the comparison of continuous variables. The 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%). While the median stone size was 90 mm, the median stone density (HU) was found to be 1,039. The most frequent primary location of the stones was the pelvis (35.6%), followed by multiple calyceal (20.9%), proximal ureteral (20.1%) and lower calyceal (15.5%) stones.

The median operation time was 65 minutes. UAS was used in 17.8% of the patients. While postoperative stents were placed in 77.5% of the patients, a ureteral catheter was required in 9.3%. After the operation, residual fragments were detected in 10.8% of the patients and not present in 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 pelvic and urinary cultures of 12 (24.5%) patients. In addition, although the urine culture of 23 (46.9%) patients was negative, growth was detected in the pelvis culture (Figure 1). Even after adequate antibiotic administration, RPUC was positive for the same organism in 26.9% of the patients.

Table 3 presents the 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 localization, and the subgroup analysis revealed less growth in lower, middle and upper pole stones while multicalyceal stones had significantly more growth ($p = 0.011$). Increased stone size and decreased preoperative pelvic urine density (HU) were found to be associated with a positive RPUC (p < 0.001 for both).

The multivariate analysis of factors associated with a positive RPUC is given in Table 4. Possible predictive markers in predicting a positive RPUC were evaluated using the multivariate logistic regression analysis. Preoperative renal pelvis urine density (OR): 0.848, $p < 0.001$) , grade [?] 2 hydronephrosis (OR:18.970, $p = 0.001$) lower calyceal localization (OR: 0.033, $p = 0.017$) were determined to be independent predictive factors fora positive RPUC. However, stone size, stone density, and a positive PBUC were not independent markers for RPUC positivity. The ability of pelvis urine density to predict positive RPUC positivity was evaluated with the receiver operating characteristics analysis, in which the area under the curve value was determined to be 0.858 (0.780-0.936). The cut-off value of pelvis urine density in predicting RPUC positivity was 4.5, at which it had 80% sensitivity and 77.7% specificity (Figure 2).

Discussion

PBUC analysis is a standard procedure before any stone surgery. PBUC 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 [18]. 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%. In light of this information, it is necessary to establish a proper prophylaxis and treatment strategy 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].

In another previous study, the efficacy of PAP and preoperative antimicrobial treatment was 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 given PAP. In the same study, 43.3% of the cultures taken intraoperatively from patients with a positive PBUC had growth despite appropriate antibiotherapy. That study demonstrated the efficacy of preoperative antimicrobial therapy to be 71.6% [19]. In other words, despite preoperative antimicrobial therapy, 43.3% of the patients had growth in any of the intraoperative cultures taken during surgery; i.e., an existing or different microorganism managed to survive [19].

He et al. 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 better bacterial colonization [20]. In our study, we determined that even if the patients with a positive PBUC before the operation were treated, some had growth in 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 is limited against bacteria that we were not able to 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.

In the literature, it has been reported that there is significant growth in intraoperative cultures in patients with renal stones and a history of obstructive pyelonephritis [19]. In our study, a statistically significant relationship was found between stone localization and presence of hydronephrosis and RPUC positivity. If a stone is in a location that can cause hydronephrosis (e.g., pelvis and 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 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 [21,22]. Sarica et al. found the cut-off value of UWT as 3.35 mm and they were not able to place a double-J stent in patients with a value over this threshold [15]. The authors considered that if the guidewire required for the double-J 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 [23]. Another study revealed that the thickness of the wall immediately surrounding the stone depends on the elapsed time and the degree of inflammatory reactions that occur [24].In our study, the wall tissue thickness at the proximal ureter and pelvis was higher in patients with RPUC growth. However, due to being a confounding factor in the multivariate analysis, it was not included in the model.

In the literature, it was shown 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]. Preoperative NCCT findings are important for this patient group. It has been previously emphasized that RPUC can be predicted using certain non-specific findings, such as the thickening of the renal pelvis and stranding of perirenal fat renal in pyelonephritis [25]. Basmacı et al. reported that at a cut-off value of 0, renal pelvis HU had 100% sensitivity and 96% specificity for a positive RPUC[14]. 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 more close follow-up in the postoperative period. 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.

Limitations

This study has certain limitations. First, it was a retrospective study and had a small number of patients. Second, the chemical analysis of the stones was not undertaken. Third, stone cultures were not included in 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 in order to prevent serious infection complications. Therefore, well designed prospective studies with larger case series are required to confirm the results of the current study.

Conclusions

Preoperative PBUC may not represent true colonization; therefore, preoperative PAP administration should be adjusted according to the individual risks of PBUC-positive patients.

Even if PBUC is negative, it should be kept in mind that there may be growth in RPUC in patients with preoperative hydronephrosis and low pelvis urine density.

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Table 1. Demographic parameters

		Value
Age[a]	**Age[a]**	69. 0 (66.0-72.0)
BMI[a]	**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 Localization[b]	**Lower pole**	20 (15.5%)
	Middle pole	5 (3.8%)
	Upper pole	5 (3.8%)
	Pelvis	46 (35.6%)
	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)	**Ureteral Wall Thickness[a] (mm)**	1.90 (1.7-2.4)
Preoperative Pelvis Urine Density[a] (HU)	**Preoperative Pelvis Urine Density[a] (HU)**	7.0 (-4.0-9.0)
Stone Density[a] (HU)	**Stone Density[a] (HU)**	1039. 0 (751.0-1223.0)
Stone Size[a] (mm)	**Stone Size[a] (mm)**	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%)
	Fewer	7 (5.4%)
	Perforation	0
	Sepsis	1 (0.7%)
	Death	0
Operation Time[a] (min)	**Operation Time[a] (min)**	65. 0 (50.0-70.0)
Hospitalization Date[a](day)	**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*

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
Age[a](years)	**Age[a](years)**	69.0 (66.0-71.0)	69.0 (65.0-74.0)	0.686
BMI[a]	**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%)	0.113
	Male	46 (48.9%)	22 (62.9%)	
History of ESWL[b]	**Absent**	72 (76.6%)	28 (80.0%)	0.439
	Present	22 (23.4%)	7 (20.0%)	
Metabolic Syndrome[b]	**Absent**	66 (70.2%)	22 (62.9%)	0.277
	Present	28 (29.8%)	13 (37.1%)	
Stone Localization[b]	**Lower pole**	19 (20.2%)[a]	1 (2.8%) [b]	**0.011***
	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]	
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 (27.3%)	16 (72.7%)	
	Grade 3	0	3 (100%)	
Preoperative Pelvis Urine Density[a] (HU)	**Preoperative Pelvis Urine Density[a] (HU)**	8.0(6.0-11.0)	-7.0 (-10.0-3.0)	<**0.001**#
Stone Density[a] (HU)	**Stone Density[a] (HU)**	1092.0 (800.0-1250.0)	950.0 (728.0-1150.0)	0.078
Stone Size[a] (mm)	**Stone Size[a] (mm)**	90.0 (80.0-110.0)	110.0 (90.0-190.0)	<**0.001**#
Postoperative Complication[b]	**None**	92 (97.8%)	29 (89.2%)	**0.007**
	Fewer	2 (2.2%)	5 (14.3%)	
	Perforation	0	0	
	Sepsis	0	1 (2.9%)	
	Death	0	0	
Πρεοπερατιε Ω- ηιτε Βλοοδ ἓλλ ὂυντ[α](10^3/μΛ)	**Πρεοπερατιε Ω- ηιτε Βλοοδ ἓλλ ὂυντ[α](10^3/μΛ)**	8.0 (6.7-9.8)	7.9 (6.3-9.0)	0.401
Πρεοπερατιε Νευτροπηιλ ὂυντ[α](10^3/μΛ)	**Πρεοπερατιε Νευτροπηιλ ὂυντ[α](10^3/μΛ)**	4.3 (3.6-6.1)	4.2 (3.8-5.8)	0.824
Operation Time[a] (min)	**Operation Time[a] (min)**	60.0 (45.0-70.0)	70.0 (60.0-75.0)	**0.003**#
Hospitalization Date[a](day)	**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%)	0.409
	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

Bold values indicate statistical significance

BMI: Body mass index, CIRF: Clinic insignificant residual fragment, HU: Hounsfield unit

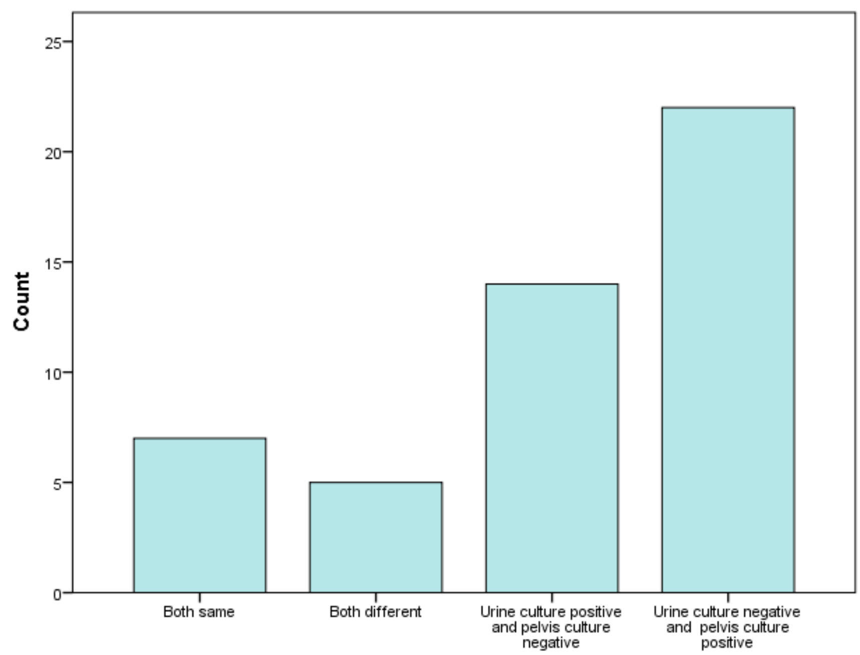
Table 4. Factors affecting renal pelvis urine culture positivity

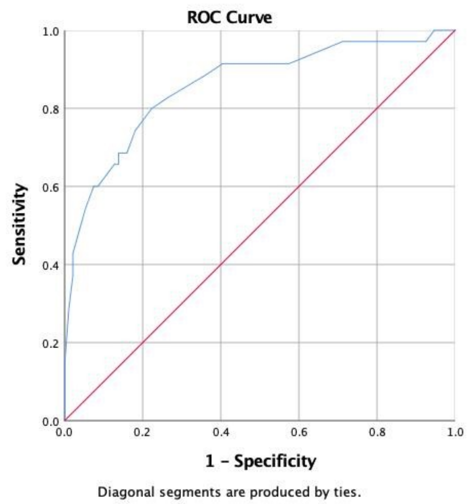
		OR	95% C.I. Lower	95% C.I Upper
Preoperative urine culture	2.191	2.191	0.532	9.026
Stone burden, mm^2	1.003	1.003	0.994	1.014
Stone density, HU	0.999	0.999	0.997	1.001
Preoperative pelvis urine density	0.848	0.848	0.782	0.919
Stone localization Other Lower calyx Multiple calyxes	Ref 0.033 1.823	Ref 0.033 1.823	0.002 0.401	0.543 8.2
Preoperative hydronephrosis				
Grade 0	Ref	Ref		
Grade I	0.624	0.624	0.148	2.629
Grade II	18.970	18.970	3.406	105.657

[a]. Variable(s) entered on step: Preoperative urine culture, Stone burden, Stone density, Preoperative pelvis urine density, Stone localization, Preoperative hydronephrosis

Figure 1. Bacteriological analysis of preoperative urine and intraoperative pelvis culture

Figure 2: Receiver operating characteristic (ROC) curve plot of pelvis urine density in predicting pelvis culture positivity (AUC: 0.858)




ROC Curve
Sensitivity
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1 - Specificity
Diagonal segments are produced by ties.