Preoperative Bladder Urine Culture as a Predictor of Intraoperative Stone Culture Results: Clinical Implications and Relationship to Stone Composition

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Purpose: We examine the relationship between urine and stone cultures in a large cohort of patients undergoing percutaneous stone removal and compare the findings in infectious vs metabolic calculi.

Materials and Methods: A total of 776 patients treated with percutaneous nephrolithotomy who had preoperative urine cultures and intraoperative stone cultures were included in the study. Statistical analysis used chi-square or logistic fit analysis as appropriate.

Results: Preoperative urine culture was positive in 352 patients (45.4%) and stone cultures were positive in 300 patients (38.7%). There were 75 patients (9.7%) with negative preoperative cultures who had positive stone cultures, and in patients with both cultures positive the organisms differed in 103 (13.3%). Gram-positive organisms predominated in preoperative urine and stone cultures.

Conclusions: Preoperative urine cultures in patients undergoing percutaneous nephrolithotomy are unreliable as there is a discordance with intraoperative stone cultures in almost a quarter of cases. There has been a notable shift toward gram-positive organisms in this cohort of patients.

Key Words: kidney calculi; nephrolithiasis; urinary tract infections; nephrostomy, percutaneous

Abbreviations and Acronyms

CT = computerized tomography

PCNL = percutaneous nephrolithotomy

SIRS = systemic inflammatory response syndrome

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Renal calculi requiring percutaneous nephrolithotomy commonly harbor infectious organisms even when the stone is metabolic in origin.[1–3] Furthermore, a sterile voided urine does not preclude the presence of pathogens in the stone[4,5] or the development of postoperative bacteriuria.[6] Several recent studies have found that the risk of infectious complications after PCNL correlate better with stone cultures than preoperative voided or renal pelvic cultures.[7–9] These studies further noted a poor correlation between voided and stone cultures but are limited by small patient numbers.[7–10] Although these groups have recommended the routine collection of stone cultures during PCNL, this is not standard practice for most urologists and the AUA (American Urological Association) guidelines make no recommendations in this regard.[4] The European Association of Urology guidelines on urolithiasis state that

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intraoperative renal stone culture may help to select postoperative antibiotics.[11]

In this study we determine the ability of preoperative urine cultures to predict the presence of infection in kidney stones and identify the organism(s) present in the stone. Stone composition is analyzed in relation to urine and stone culture findings. We report a shift toward a predominance of gram-positive organisms associated with this complex cohort of patients requiring PCNL. Finally, we present our data regarding sepsis after PCNL, which is among the most significant complications after this procedure. To our knowledge this study represents the largest series of patients undergoing PCNL reported to date evaluating the correlation between preoperative urine culture and stone culture.

METHODS

An institutional review board approved prospectively collected database (IRB#101002243) has been maintained at our institution since April 1999 for all PCNL procedures. Informed consent was obtained from all patients entered in the database. We retrospectively identified 1,295 consecutive patients who underwent PCNL for renal stones at our institution between April 1999 and January 2014. Patients who met the study inclusion criteria had results for preoperative urine culture and intraoperative stone culture.

At our institution a preoperative bladder urine culture is obtained from all patients scheduled to undergo PCNL. All preliminary urine cultures reported as contaminated are requested to be fully speciated by the microbiology laboratory. Patients with a positive urine culture or a history of urosepsis or recurrent urinary tract infections are treated before PCNL for at least 2 weeks with culture specific antibiotics. Those with a negative urine culture are routinely treated for 1 week with oral antibiotics (usually a fluoroquinolone unless contraindicated by patient allergy). All patients receive a prophylactic antibiotic intravenously before the start of surgery.

At our institution PCNL is a single stage procedure. Initially a ureteral catheter is placed. With the patient in the prone position, access is established by the treating urologist under fluoroscopic guidance. The nephrostomy tract is balloon dilated and a 30Fr Amplatz sheath is placed in all instances. Stone material is fragmented using a combination of ultrasonic and pneumatic lithotripsy as indicated. Sterile graspers are used to retrieve stone fragments, which are immediately transferred to a sterile collection cup containing sterile saline. Care is taken with the stone to avoid skin contaminants. The stone fragments are crushed into powder using a sterile needle driver. The specimen is then sent for culture and sensitivity.

Flexible nephroscopy is performed in all cases. A nephrostomy tube, usually a 10Fr Cope loop (Cook Urological, Bloomington, Indiana) is placed at the conclusion of the PCNL procedure in all cases. Noncontrast CT is performed on postoperative day 1. If CT shows no residual stones, a nephrostogram is obtained. If adequate drainage is confirmed, the nephrostomy tube is removed and the patient is discharged from the hospital. If drainage is poor or absent, the patient is discharged home with the nephrostomy tube and scheduled for a repeat nephrostogram a few days later. When remaining stone fragments are identified on CT, second look nephroscopy is performed on postoperative day 2. Patients can generally be discharged home after the secondary procedure. Antibiotics are continued in the postoperative period for at least 1 week. If the results of the stone culture are positive, antibiotics are adjusted based on sensitivities and continued for 3 months after surgery.

In situations where a culture grew multiple organisms with only one being a urease producing organism, that case was grouped in the category of urea splitting organisms.[12] When a culture grew multiple organisms without a urease producing organism or had more than 1 urease producing organism, that case was grouped in multiple organisms. Multiple organisms were cultured in 6% of preoperative urine cultures and 8.3% of stone cultures (see figure). The identity of organisms cultured was missing for 1 patient in each of the preoperative urine culture and stone culture groups. Statistical analysis used chi-square or logistic fit analyses as appropriate. Calculations were done using JMP® software.

RESULTS

Of 1,295 consecutive patients 828 had results for intraoperative stone culture. Among these patients 776 also had results for preoperative urine culture and were included in the final analysis. Patient and stone demographics are summarized in table 1. Overall 352 (45.4%) patients had a positive preoperative urine culture while 300 (38.7%) had a positive stone culture. The figure illustrates the type and number/percentage of organisms identified in bladder urine (part *A*) and kidney stones (part *B*). Staphylococcus was the most common organism cultured from preoperative urine cultures (22.2%) and kidney stones (25.3%). Other common organisms found on preoperative urine culture were proteus species (15.3%), Escherichia coli (13.1%) and enterococcus (8.8%). Other common stone culture pathogens were enterococcus (13.7%), followed by proteus (13%) and candida (12.7%).

Both cultures were negative in 349 (45%) patients. Overall 127 (16.4%) patients with positive preoperative urine cultures had negative stone cultures. On the other hand, a positive stone culture in the presence of sterile urine was identified in 75 (9.7%) patients. There were 225 (29%) cases with positive preoperative urine and stone cultures. The same organisms were identified in both cultures in 122 (54.2%) patients. However, different organisms were isolated between cultures in 103 (45.8%) patients, 13.3% overall. For this analysis the cultures