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ANALYSIS OF VARIOUS URINE OR STONE SAMPLES AS PREDICTORS OF UROSEPSIS FOLLOWING PERCUTANEOUS NEPHROLITHOTOMY - A PROSPECTIVE CLINICAL STUDY

Urology

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ABSTRACT

Introduction: Percutaneous nephrolithotomy (PCNL) is the procedure of choice for the management of large and complex renal stones and is one of the most frequent renal procedures done at our institution. Urosepsis and bacteremia following PCNL can be devastating despite sterile preoperative urine and prophylactic antibiotics. Despite careful pre-operative evaluation and ensuring strict aseptic precautions during the procedure, patients still have this complication of a life threatening Urosepsis. The present investigation analyzed and studied the culture and sensitivity of the three samples namely the bladder urine, pelvic urine, and extracted stone during PCNL and compared them to ascertain as the better predictors of urosepsis following the procedure. **Material And Methods:** 68 patients who had symptomatic renal calculi who underwent PCNL during the period between December 2021 to February 2023. We excluded patients with a stent, nephrostomy tube or indwelling catheter, who are diabetic, with renal failure, with episodes of fever prior to surgery, previous manipulation/procedure, and presence of contralateral renal/ureteral stones. **Conclusions:** In our study, Upper urinary tract cultures have higher sensitivity and NPV for determining urosepsis post PCNL than bladder urine culture. The Profile of organism cultured in stone as well as pelvic urine has better agreement. Stone culture had highest positivity rate as compared to bladder urine. Pelvic urine had highest positive predictive value in predicting sepsis. Hence, routine upper urinary tract culture is highly recommended following PCNL. Whenever possible culture specific antibiotic regimen has to be followed and samples collected from the upper tract will be the best guide to therapeutic antibiotic use. Our study has helped us to define our department protocol, in sending pelvic urine and stone for culture sensitivity and following culture specific antibiotics in better management of postoperative fever following PCNL.

KEYWORDS

Percutaneous Nephrolithotomy, PCNL, Urosepsis, Septic Shock, Urine Culture, Stone Culture, Pelvic Culture

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is the procedure of choice for the management of large and complex renal stones and is one of the most frequent renal procedures done at our institution. Indications are larger stones (greater than 2 cm), stones not suitable for extracorporeal shock wave lithotripsy, and stones in kidneys with abnormal anatomy. Urosepsis and bacteremia following PCNL can be devastating despite sterile preoperative urine and prophylactic antibiotics. Despite careful pre-operative evaluation and ensuring strict aseptic precautions during the procedure, patients still have this complication of a life threatening Urosepsis. Infected stones, stone burden, hydronephrosis, prolonged manipulation, access difficulties, bleeding and comorbidity have been held responsible for Urosepsis, which often needs intensive care treatment that escalates the cost of treatment.

An infection during urologic surgery occurs when urinary bacteria enter the bloodstream via vascular, lymphatic, or cell disruption. Manipulation of infected urine or infection stones with an increase in renal collecting system pressure causes liberation of bacteria and its endotoxins. The mechanisms of systemic absorption are due to direct absorption, pyelovenous, pyelolymphatic or pyelotubular backflow, and calyceal forniceal rupture, which eventually trigger a systemic inflammatory response syndrome (SIRS) or septic shock. Escherichia coli remain the most common microbe responsible for clinical urinary tract infections. This is followed by Klebsiella and Proteus. Also there is increasing prevalence of Gram positive bacteria such as Enterococcus and Staphylococcus.

Risk factors associated with postoperative infections in genitourinary surgery

Patient related factors	Disease related factors	Procedure related
• Malignancy • Immunocompromised individuals • Steroid use • Diabetes mellitus • Autoimmune disease • Poor nutritional status • Severe renal failure • Severe liver dysfunction • older age • Female gender • coexistent infection • hospitalization for prolonged duration	• Hydronephrosis • Voiding dysfunction • Bacteriuria • Renal stone disease • Stents/Indwelling catheters • Endogenous material • Anomalous kidneys • Poor blood flow	• Incisional therapy • long duration • Genital tract involvement • Involvement of gastrointestinal tract • Prosthesis

Although PCNL has a low reported overall incidence of urosepsis (0.3–1%), there is a very high mortality rate of 66–80% following sepsis. It is widely accepted fact that the preoperative urine must be sterile before percutaneous renal surgery. Unfortunately, this is not always possible due to the colonization of the stones and the urinary tracts; hence the role of appropriate antibiotic therapy that should be started at least a week before the procedure. The urine culture reports from patients with stones are not predictive of stone bacteriology most of the times. Therefore, these patients should receive a broad-spectrum antibiotic course sensitive to the cultured bacteria. Pyelovenous or pyelolymphatic backflow occurs when the renal pelvic pressure is greater than 30mmHg. Other factors that lead to postoperative fever and bacteremia are higher Guy's stone score, longer operative time, larger stone burden, and larger volume of irrigating fluid. Manipulation and fragmentation of infected stones can cause urosepsis due to endotoxemia. It is also noted that bleeding and prolonged manipulations increased the chance of bacteria entering the systemic circulation leading to septicemia.

MATERIAL AND METHODS

AIMS AND OBJECTIVES

1. To determine the correlation of culture and sensitivity between various sites of urine sampling in the form of bladder urine, pelvic urine and extracted stone during PCNL procedure.
2. To monitor the Systemic Inflammatory Response Syndrome (SIRS) and Septic shock following PCNL procedure.
3. To determine the better predictors of Urosepsis following PCNL.

Study Design: Prospective study Duration: December 2021 to February 2023

Inclusion Criteria: Patients with renal calculi undergoing Percutaneous Nephrolithotomy

Exclusion Criteria: Diabetes mellitus, Pyrexia prior to procedure, Renal failure, Patients with a stent, nephrostomy tube or indwelling catheter, Contralateral renal and ureteric calculus, Any previous procedures or manipulations done

Our study included 68 patients who had symptomatic renal calculi who underwent PCNL during the period between December 2021 and February 2023. All patients had basic investigations, renal function

tests, X-ray KUB, Ultrasound KUB and CT urogram. Our standard protocol is to evaluate the patient with midstream bladder urine culture and sensitivity a week prior to the planned procedure and treat them with appropriate antibiotics according to the culture and sensitivity reports to make the urine sterile prior to PCNL. All patients received IV Cefotaxime prior to anesthesia induction as per our institutional protocol. Midstream bladder urine was collected a day prior to the surgery. Under general anesthesia, after strict asepsis preparation with betadine, a 5F ureteral catheter was inserted in a retrograde fashion into the ipsilateral ureter with standard cystoscope and retrograde pyelogram obtained. Patient is repositioned to prone position. Puncture was done into the appropriate calyx with 18 – gauge needle under C arm guidance using Triangulation technique/Bull's eye technique. The first aspirated urine following a successful puncture into the collecting system is collected and is labelled as Pelvic urine which is sent for culture and sensitivity. A 0.035-inch terumo guide wire was placed into the collecting system and coiled into the pelvis or negotiated into the ureter. It is followed by multiple serial dilatations using Amplatz dilator set from 8F to 28 F dilators under Fluoroscopic guidance. Then, a 28F dilator was passed and a 30F Amplatz sheath was advanced over it. Nephroscopy was done and the stones were identified. Lithotripsy was done with the help of pneumatic lithotripter under low pressure irrigation. The fragments were retrieved out. Nephrostomy tube was placed. The extracted stones were processed by Nemoy & Stamey Technique and sent for stone culture & sensitivity. Double J stent was placed for all cases.

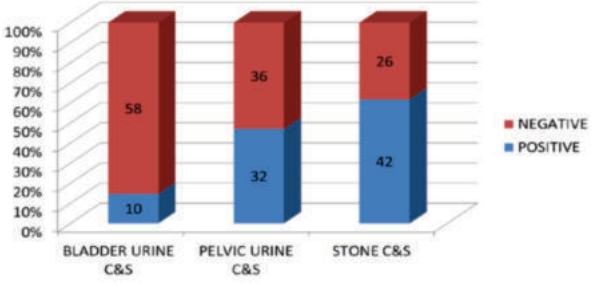
In the post-operative period patient was monitored for SIRS and sepsis by standard definitions. Patients temperature, pulse rate, respiratory rate, blood pressure, urine output were monitored. The development of hypotension below a systolic blood pressure of 90 mm Hg or 40 below baseline for the patient in the presence of SIRS was considered septic shock. Urosepsis in this study was defined as either the presence of SIRS or septic shock. Patients with manifestations of sepsis were investigated with Hemoglobin, Total Counts, Differential counts, Blood urea, Serum Creatinine, Serum Electrolytes, Urine culture and sensitivity. Blood culture was sent for those patients with septic shock. PCN was removed on the post-operative day 1 and Foley's catheter removed on the second post-operative day.mWe received the culture reports in second post-operative day and culture specific antibiotics given.

Statistical Analysis

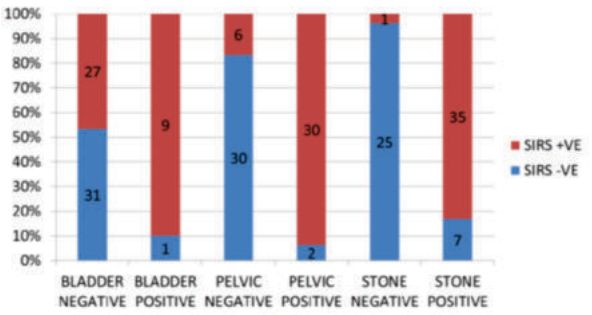
We used Fisher exact and Mantel-Haenszel chi-square tests to determine associations among the three groups. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) of the three methods was calculated.

RESULTS

There were equal numbers of male and female patients. The mean age of patients is 43 years and we dealt with stone sizes ranging between 25 to 40mm. The mean operative time was 88.4 minutes with almost all patients having a single puncture only. Of the three samples sent for culture and sensitivity, the most prevalent culture positive specimen is stone culture with 61.8% positivity when compared to other two specimens, with bladder culture being only 14.8% positive. The most common microbes cultured were Escherichia coli in all three samples. The other common microorganism that grew was Klebsiela, Proteus, Coagulase negative Staphylococcus, and Pseudomonas.



Most of the bladder urine culture was of mixed growth of organisms. Pelvic urine C&S and stone C&S grew identical microbes in 24 patients (82.8% of upper urinary tract culture positive). Infected bladder urine did not carry bacteria identical to that found in the Stone. Infected bladder urine and pelvic urine grew similar microbes in only 2 patients; hence the possibility of cross infection among samples was reduced. Since infections in stones were highly prevalent, we used bladder and pelvic urine to predict the infection in stones.



The sensitivity was only 19% compared to pelvic urine (69%) to predict infection in stones and hence sepsis. However both pelvic and bladder urine has almost similar specificity rate(92%) in predicting infection, which emphasis the role of preoperative culture sensitivity based treatment of bladder infection prior to PCNL and the need for prophylactic antibiotics prior to PCNL which is our standard protocol. Pelvic urine was the more accurate of the two specimens with a 3 fold risk of being associated with infection in the stone. All the 30 patients had at least 1 culture positive specimen. 30 patients (44.1%) showed features of SIRS. Septic shock developed In 6 patients (8.8 %). There was no mortality.

DISCUSSION

Urosepsis and shock following PCNL occurs in direct correlation with the duration of the procedure, urine microbes, severity of obstruction by stone and the infective microorganism in stones. In our study patients were carefully selected to ensure that other factors like diabetes, renal failure, prior fever, and prior intervention, indwelling stents and contra lateral stones that might cause SIRS were excluded. In our present study none of the patients has a positive blood culture although one of the three samples of bladder urine, pelvic urine and stone culture were positive in patients with postoperative SIRS. In our study, strict measures were taken to avoid cross contamination between samples collected. The stones were serially washed in five sterile test tubes before finally crushing them and sending it for culture and sensitivity as per Nemoy and Stamey technique of processing the stones for C&S. This ensured that cross contamination between the stone and pelvic urine is avoided. Pelvic urine C&S and stone C&S grew identical microbes in 24 patients (82.8%). Infected bladder urine did not carry bacteria identical to that found in the Stone culture. Moreover, infected bladder urine and pelvic urine grew similar microbes in only 2 patients.

We had 51.2% correlation between stone and pelvic urine cultures. Since stone culture positivity was high we used bladder and pelvic urine to predict culture positivity in them and found that pelvic urine had PPV of 0.94%whencompared to bladder urine. This further emphasized that there is a good correlation between pelvic urine and stone culture when compared to bladder urine. While the incidence of septic shock in our series is higher (8%), this probably reflects our tertiary referral practice, which deals with complex stones and poor socioeconomic status of our patients. In our study the sensitivity of bladder urine in predicting sepsis is only 25%, when compared to stone culture which is about 97%. Yet, it is also noted that the bladder urine had 97% specificity which emphasizes the role of prophylactic antibiotics prior to the procedure and make urine sterile before attempting PCNL. Pelvic urine has highest PPV of 0.94 in predicting sepsis, highlighting the importance of upper urinary tract culture sensitivity specific antibiotic course to overcome this catastrophic complication following PCNL. Because many patients with renal stones are being treated for recurrent urinary tract infections, the potential for antibiotic resistance becomes high. Irrational use of higher antibiotics only based in clinical features leads to increased incidence of antibiotic resistance, Upper urinary tract culture based antibiotic therapy will salvage the situation in most instances.

CONCLUSION

In our study, Upper urinary tract cultures have higher sensitivity and NPV for determining urosepsis post PCNL than bladder urine culture. The Profile of organism cultured in stone as well as pelvic urine has better agreement. Stone culture had highest positivity rate as compared to bladder urine. Pelvic urine had highest positive predictive value in

predicting sepsis. Hence, routine upper urinary tract culture is highly recommended following PCNL. Whenever possible culture specific antibiotic regimen has to be followed and samples collected from the upper tract will be the best guide to therapeutic antibiotic use. Our study has helped us to define our department protocol, in sending pelvic urine and stone for culture sensitivity and following culture specific antibiotics in better management of postoperative fever following PCNL.

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