International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 4(L); April 2018; Page No. 12085-12088
DOI: http://dx.doi.org/10.24327/ijcar.2018.12088.2118

Research Article

RENAL STONE CULTURE AND SENSITIVITY IS A BETTER PREDICTOR OF POST PCNL UROSEPSIS THAN PELVIC OR MIDSTREAM URINE CULTURE AND SENSITIVITY – OUR INSTITUTIONAL EXPERIENCE

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A R T I C L E I N F O

Article History:

Received 11th January, 2018
Received in revised form 6th February, 2018 Accepted 18th March, 2018
Published online 28th April, 2018

Key words:

Midstream urine, pelvic urine, percutaneous nephrolithotomy, renal stone culture and sensitivity, urosepsis

A B S T R A C T

Background and Aim: Urosepsis is a serious complication following percutaneous nephrolithotomy (PCNL) and can occur in spite of preoperative sterile urine culture and prophylactic antibiotics. The aim of the study was to analyze the utility of cultures of midstream urine (MSU), renal pelvic urine, and crushed stones for prediction of post operative urosepsis following PCNL

Materials and Methods: We performed a prospective clinical study in consecutive patients undergoing PCNL between October 2016 and March 2018. The samples collected for culture and sensitivity (C and S) were (1) Mid stream urine one day before surgery, (2) Urine from pelvicaliceal system during percutaneous puncture, and (3) Stone fragments collected during the procedure. All the patients were monitored during the postoperative period for symptoms and signs of urosepsis. The data collected were divided into 3 main groups, i.e., MSU C and S, pelvic urine C and S, and stone C and S, and were analyzed to determine association with urosepsis.

Results: A total of 83 patients were included. The MSU C and S was positive in 10.8%, pelvic C and S in 13.7%, and stone C and S in 30.1% patients. Twenty patients had systemic inflammatory response syndrome (SIRS) and 3 patients had septic shock. Out of the 20 with SIRS, 17 cases were stone C and S positive, 6 were pelvic urine C and S positive, and 2 patients had positive MSU C and S.

Conclusion: Stone C and S is a better predictor of potential urosepsis than pelvic urine and MSU C and S, which often fail to grow stone colonizing bacteria. We recommend routine collection of stone for C and S for the diagnosis and management of urosepsis after PCNL.

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is a minimally invasive treatment for renal stone disease. Indications for PCNL are large stones (>2 cm), multiple stones, failed extracorporeal shock wave lithotripsy, and <2 cm stones in lower calyx with narrow infundibulopelvic angle. PCNL is generally safe but may be associated with complications such as injury to adjacent organs, pneumothorax, extravasation, and urosepsis.[1] Urosepsis and shock occur in direct proportion to the duration of procedure, bacterial load in urine, severity of obstruction by stone, and presence of infection in stone.[2] Preoperative midstream urine (MSU) samples have been shown not to represent the infection in the upper tracts.[3,4] Septicemia following PCNL can occur despite adequate treatment with prophylactic antibiotics and sterile preoperative urine.[1,5-8]

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Most centres worldwide use antibiotic prophylaxis in accordance with the Infectious Diseases Society of America and European Society of Clinical Microbiology and Infectious Disease Guidelines.[6] The inability to reduce the infection within stones despite systemic antibiotics may be attributed to the impenetrability of the stones, presence of endotoxins in the stone matrix, and possibility of patients' noncompliance with the preoperative antibiotic regimen. We hypothesized that culture of harvested renal stones and urine collected directly from the renal pelvis may predict the risk of sepsis better than the MSU culture. This study was planned to study the utility of various culture specimens such as MSU, renal pelvic urine, and crushed stones in the prediction of urosepsis.

MATERIALS AND METHODS

We performed a prospective clinical study in 83 patients, duration October 2016 to march 2018. Patients with multiple or large renal stones, failed Extracorporeal shock wave lithotripsy (ESWL), and inferior calyceal stones were included. The exclusion criteria included patients on anticoagulants, bilateral obstruction, H/O previous renal

surgery, concomitant ureteral and bladder stones, morbid obesity (body mass index >30), abnormal urinary tract anatomy (horse shoe kidney), severe cardiorespiratory disease, and hepatic dysfunction. All patients had their urine tested 1 week before the scheduled surgery and received appropriate antibiotics. A repeat MSU was sent for culture and sensitivity (C and S) testing 1 day prior to the surgery. On the day of the surgery, antibiotic prophylaxis included Inj cefaperazone sulbactum 1.5 g intravenously (IV) after establishing IV access.

After induction of general anesthesia, a standard cystoscope with working channel was introduced into the bladder. The corresponding ureterovesical opening was cannulated with a sterile 0.0035‑inch guide wire and a sterile 5Fr ureteral catheter threaded over it. The proximal tip of the ureteral catheter was confirmed to be in the renal pelvis with C‑arm guidance. The patient was then turned prone, and under strict aseptic precautions, percutaneous access into the ipsilateral pelvicaliceal system was achieved under image intensification using a fine Needle-18Gauze Two part needle. Urine from the pelvicaliceal system, which was first aspirated after the puncture, was labeled as pelvic urine and sent for C and S. The tract was then dilated using Amplatz dilators until a 30Fr Amplatz sheath could be placed. Nephroscopy and pneumatic lithotripsy were performed under low pressure irrigation with normal saline, and stone fragments were collected to be processed for C and S. The collected stones were washed in 5 sequential bottles containing sterile saline and then crushed into fragments in the 5th bottle. The contents of the 5th bottle were sent for C and S. The nephrostomy tube was left *in situ* for 24 h (longer if signs of infection developed) before it was clamped and removed. Patients were monitored meticulously in the postoperative period for signs of systemic inflammatory response syndrome (SIRS), defined as development of two of the following four criteria: Fever (>38°C) or hypothermia (<36°C), tachycardia (heart rate >100 beats/min), tachypnea (respiratory rate >20 breaths/ min), and abnormal white blood cell count (>12000 mm3 or <4000 mm3). Septic shock was defined as systolic blood pressure (SBP) of less than 90 mmHg or a decrease in SBP of 30% below the baseline for the patients in the presence of SIRS. Presence of SIRS or septic shock was categorized as urosepsis. The data collected were divided in to three main groups, i.e., MSU C and S, pelvic urine C and S, and stone C and S.

Statistical analysis of the data was done using the Statistical Package for the Social Sciences version 17 software (SPSS Inc. Released 2008, Chicago). Fischer exact test and Chi‑square tests were performed to determine associations among various groups. *P* value of <0.05 was considered significant.The sensitivity, specificity, positive and negative predictive values of MSU, pelvic urine and stone culture, and sensitivity were calculated.

RESULTS

A total of 83 patients were included in the study. The details of patients and stone demographics are presented in Table 1. Nine patients required more than one percutaneous track to clear the stones, and no patient required allogeneic blood transfusion. Five patients required a second operation within the same hospitalization for complete removal of the stone. There was no mortality in the study population. The most prevalent culture positive specimen was stone C and S, which was significantly higher than pelvic and midstream urine samples (*P* = 0.0252). MSU C and S was positive in 9/83 (10.8%) patients, pelvic urine C and S was positive in 10/83 (13.7%) patients, and stone C and S was positive in 25/83 (30.1%) patients [Figure 1]. All three cultures were positive in two cases. Though stone C and S was positive in 25 cases, only 4 (16%) cases of these were concordant with MSU C and S. Twenty (24.1%) patients had SIRS and 3 (3.61%) patients experienced septic shock. Only 1 patient with shock had positive blood culture (*Escherichia coli*). The most common bacteria isolated in the stone culture was *E. coli* (14/25), followed by *Pseudomonas* (3/25), *Enterococci* (3/25), *E. cloacae* (3/25), and *Klebsiella* (2/25). Out of the 25 cases of stone culture positive patients, 17 patients developed SIRS. However, only 2 patients with MSU C and S positivity and 6 with positive results in pelvic urine C and S developed SIRS. Table 2 lists the sensitivity, specificity, and positive and negative predictive values for SIRS among the different C and S. Stone culture had better sensitivity and was more predictive than MSU and pelvic urine C and S in the diagnosis of SIRS after PCNL.

DISCUSSION

Majority of complications after PCNL are minor, the most frequent of which are fever and bleeding.[1,9] In a systematic review, Michel *et al*. reported an incidence of fever ranging 21–32% whereas septicemia was seen in 0.3–4.7% of patients after PCNL.[1] To decrease the infectious complications careful preparation of patients is essential. The preoperative workup at our institute includes performance of urine C and S and treatment with full course of appropriate antibiotics.

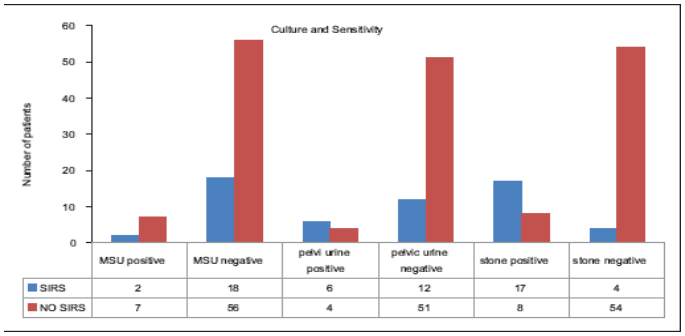

Figure 1 The correlation between SIRS and the presence of infection in the MSU, pelvic urine and stone culture and sensitivity

In some patients, preoperative drainage of obstructed pelvicalyceal system with a percutaneous nephrostomy is done before the definitive surgery. In spite of all these precautions, patients may still develop fulminant urosepsis. The inability to reduce the infection within stones despite systemic antibiotics was attributed to the impenetrability of the stones, presence of endotoxins in the stone matrix, and possibility of patients' noncompliance with the preoperative antibiotic regimen. The factors identified with an increased risk of sepsis include infected urinary stones, prolonged duration of surgery, female, use of nephrostomy tube, renal insufficiency, obstructed tract, and amount of irrigation fluid used.[5,10‑12] Presence of infection was traditionally diagnosed with MSU C and S. However, several authors have reported a poor correlation between infection in the stone and bladder urine specimens.[13] In one series, stone culture was positive in

77% of the patients whereas a simultaneous bladder urine sample was positive in only 12.5% of the patients.[14] Mariappan *et al*. reported that MSU C and S was positive in 11.2% whereas stone culture was positive in 35.2%.[3] The findings of the present study were similar with stone culture positive in 30.1% and MSU positive in 10.8% of the patients. Even pelvic urine sample culture which was considered better at predicting infectious complications after PCNL was not efficient in identifying SIRS in the present study.[3,15] A significant cause for failure of MSU C and S in prediction of SIRS may be because stones could be a source of endotoxins release rather than bacteremia

Table 1 The Details of Patient And Stone Demographics

Demographics	Number of cases
Age (years)	
<40	39
40-60	24
>60	20
Duration of surgery (min)	
<60	33
60-90	27
>90	23
Gender	
Male	45
Female	38
Stone size in (mm) (mean±SD)	43±8
ASA status	
I	31
II	47
III	5
No. of percutaneous tracks	
1	55
2	28

ASA = American Society of Anesthesiologists

Table 2 Sensitivity, Specificity, And Positive and Negative Predictive Values of Msu, Pelvic Urine, and Stone Culture and Sensitivity

	Midstream urine C and S	Pelvic urine C and S	Stone C and S
Sensitivity (%)	10.00	33.33	80.95
Specificity (%)	88.89	92.73	87.10
Positive predictive value (%)	22.22	60.00	68.00
Negative predictive value (%)	75.68	80.95	93.10

C and S = Culture and sensitivity

Overt bacteremia was found only in 50% of patients with sepsis.[16] In the present study, blood culture also could not accurately guide management because only 1 patient out of 2 who developed sepsis had bacterial growth on blood C and S. Whether measurement of endotoxins during PCNL is helpful is not known, and literature evaluating the relation between stone C and S and endotoxin levels is not available. With the poor predictive value of MSU, pelvic, and blood culture, stone culture appears to be the best guide for antibiotic therapy. Though available only after surgery, it may be most useful in case postoperative sepsis develops. Patients with staghorn or multiple calculi who may require repeat surgery for the removal of residual stone may be treated with appropriate antibiotics based on the results of stone C and S. This may significantly reduce the morbidity and mortality after repeat PCNL.

CONCLUSION

In conclusion, stone C and S is a better predictor of potential urosepsis than pelvic urine and MSU C and S, which often fail to grow stone colonizing bacteria. Stone culture may be the best guide for antibiotic therapy in case sepsis develops. It may be particularly useful in patients requiring repeat surgery for residual stones. We recommend routine collection of stone for C and S for the diagnosis and management of urosepsis after PCNL

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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How to cite this article:

Senthilvel Arumugam *et al* (2018) 'Renal Stone Culture And Sensitivity Is A Better Predictor of Post Pcnl Urosepsis Than Pelvic Or Midstream Urine Culture And Sensitivity-Our Institutional Experience', *International Journal of Current Advanced Research,* 07(4), pp. 12085-12088. DOI: http://dx.doi.org/10.24327/ijcar.2018.12088.2118

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