Original article

Does Stone Culture Predict Systemic Inflammatory Response after Percutaneous Nephrolithotomy?

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Abstract

Introduction: Systemic inflammatory response syndrome (SIRS) is a common and important complication after percutaneous nephrolithotomy (PNL). This study was carried out with the objective of finding out the association between stone culture and PostPNL- SIRS.

Methods: A prospective study was done in the urology unit, Tribhuvan University Teaching Hospital from July 2009 to June 2011. Preoperative midstream urine, intraoperative pelvic urine and stone fragments were sent for culture in all patients undergoing PNL. The Primary outcome was SIRS on second postoperative day. Data analysis was done using Statistical Package for Social Sciences (SPSS) 17.0 version.

Results: Out of 47 patients 22 (46.8%) patients developed SIRS on second postoperative day. Stone and pelvic urine culture positivity rate was 8(17%) and 6(12.8%) respectively with *P. aeruginosa,* E. coli *and Proteus spp* being the common organisms isolated, most of which were sensitive to amikacin. Positive stone culture was the significant risk factor for SIRS (P= 0.018).

Conclusion: Positive stone culture is an important risk factor for SIRS after PNL. Routine stone culture is beneficial in patients undergoing PNL for the subsequent postoperative management.

Key Words: Percutaneous nephrolithotomy, Stone culture, Systemic Inflammatory Response Syndrome (SIRS)

Introduction

Percutaneous nephrolithotomy (PNL)was started by Fernstrom and Johansson and is one of the most common urological procedures for past 35 years.[1] The overall complication rate of PNL has been estimated at 20.5%.[2] .Fever and Systemic inflammatory response syndrome (SIRS) are still common complications after PNL. The incidence of PostPNL SIRS ranges from 11.2%-37% [3, 4] which is multifactorial in origin. It is presumed that in PNL patients a positive stone culture is associated with increased incidence of SIRS postoperatively.[5] However; routine stone culture is not practiced yet. This study was carried out with the objective of finding out the association between stone culture and PostPNL- SIRS.

Methods

This prospective study was conducted in the urology unit, department of surgery, Tribhuvan University Teaching Hospital from July 2009 to June 2011. Forty seven patients who had undergone PNL were eligible for the study. Culture proven urinary tract infection was treated preoperatively to make the urine sterile. Informed consent was taken from each patient. Ethical approval was taken from Institutional Review board of Institute of Medicine. Preoperative midstream urine culture (UC), pelvic urine culture (PC) and stone culture (SC) was obtained in all patients undergoing PNL. It is our protocol to administer one gram ceftriaxone intravenously half an hour prior to surgery and two more doses within 24 hours postoperatively

(Short Course antibiotics prophylaxis)[6]. All the patients had undergone standard PNL after fluoroscopy guided puncture.[7] All intraoperative parameters and postoperative fever, systemic inflammatory response syndrome (SIRS) were recorded. Outcome variables were defined as per the standard protocol. The primary outcome was SIRS on second postoperative day (POD2). The ACCP-SCCM (American Committee of Chest Physicians/Society of Critical Care Medicine) criterion was used to define SIRS8. Urosepsis was defined as presence of SIRS along with positive pelvic urine or stone culture[8]. The secondary outcomes were length of hospital stay and need to change antibiotics.

Data analysis was done using Statistical Package for Social Sciences (SPSS) 17.0 version 2009 (Chicago, Illinois). $P<0.05$ was considered significant. The data were divided according to presence or absence of SIRS .The association between different groups was assessed using Fisher exact test for dichotomous variables and Independent sample t-test for continuous variables. The sensitivity and specificity of UC, PC and SC to predict the postPNL-SIRS was assessed.

Results

A total of 47 patients were eligible for final data analysis out of which 31(66%) were male. The mean age of the patients was 36.6±13 years. Five (10.6%) patients had positive preoperative urine culture which was made sterile before operation based on results of culture and sensitivity**.** The mean duration of PNL procedure was 84.2±37.1 minutes.

Postoperatively 22 (46.8%) patients developed SIRS on second postoperative day. There was 91.5% stone clearance rate on 6 weeks follow up on X-ray KUB without any mortality. Stone and pelvic urine culture positivity rate was 8(17%) and 6(12.8%) respectively with *P. aeruginosa,* E. coli *and Proteus spp* being the common organisms, most of which were sensitive to amikacin.

Presence of positive stone culture was a significant risk factor for SIRS (P= 0.018). (Table1)**.**

Table 1. Comparison of patients with and without SIRS POD2

Variable		SIRS		P Value
		No (n=25)	Yes (n=22)	
Age (Years)	Mean± SD	36.4± 12.5	36.8± 13.9	.923
Preop Total count(/cmm)	Mean± SD	7950.8± 1896.5	8058.1± 1350.9	.826
Size of the stone(mm)	Mean± SD	24.6± 8.6	25.7±9.0	.680
Sex	Female	8(17.0)	8(17.0)	.768
	Male	17(36.1)	14(29.7)	
Type of stone	Primary	23(48.9)	18(38.2)	.398
	Recurrent	2(4.2)	4(8.5)	
Positive Preop urine culture	n(%)	2(8.0)	3(13.6)	.654
Duration of the procedure	Mean± SD	76.8±32.5	92.6± 40.9	.147
Pulse rate POD2	Mean± SD	81.8±6.4	96.6± 9.8	.0001*
Respiratory rate POD2	Mean± SD	19.8±2.5	22.9±3.6	.001*
TC POD2	Mean± SD	7795.2± 1785.1	11451.8± 4045.6	.0001*
Positive Pelvic Urine Culture	n(%)	1(4.0)	5(22.7)	.085
Positive stone culture	n(%)	1(4.0))	7(31.8)	.018**

Among the stone culture positive patients the need to change antibiotics and urinary tract infection was significantly higher with longer hospital stay. (P=0.0001, 0.026 and 0.0001 respectively) (Table 2).

Table 2. Outcomes based on Results of stone culture

Variable		Stone Culture		P Value
		Negative(39)	Positive(8)	
Need to change Antibiotics	n(%)	0(0)	6 (75)	0.0001*
Skin/Soft tissue Infection	n(%)	0(0)	1(12.5)	0.167
Urinary Tract Infection	n(%)	0(0)	2(25)	0.026
Length of Hospital stay (Days)	Mean±SD	3.23±1.4	6±3.3	0.0001**

*Fisher's Exact Test **Independent sample t-test

The sensitivity and specificity of stone, pelvic urine and preoperative midstream urine culture to predict SIRS was calculated out of which stone culture had the highest sensitivity and specificity (31.8% and 96% respectively) with positive predictive value of 87.5% and negative predictive value of 61.5%. **(Table 3)**

Table 3. Sensitivity and Specificity of different cultures to predict Post PCNL-SIRS

Test		SIRS		Sensitivity(%)	Specificity(%)	PPV(%)	NPV(%)
		Yes	No				
Preop Urine culture	Positive	3	2	13.6	92	60	54.7
	Negative	19	23				
Pelvic urine culture	Positive	5	1	22.7	96	83.3	58.5
	Negative	17	24				
Stone culture	Positive	7	1	31.8	96	87.5	61.5
	Negative	15	24				

Discussion

In this study we have attempted to establish the diagnostic ability of stone culture for PostPNL-SIRS. In our study the positivity rate of stone culture was 17%. The positivity rate of stone culture varies from 16% to 34%.[9, 10] In our study though the stone culture has low sensitivity (31.8%) to predict SIRS, it has a high specificity (96%) to predict SIRS. Similarly, stone culture has a positive predictive value of 87.5%. We have noted that when stone culture is positive, it is likely that SIRS will be positive, which may be helpful to immediately identify patients who are at risk of postoperative infectious complications. This corroborates with the findings of the study done by Eswara,Gonen and Kreydin.[11-13]They have also highlighted that positive stone culture is significantly associated with fever, the systemic inflammatory response syndrome (SIRS), and sepsis. SIRS is a biological response to infection and trauma. Infections are thought to be the most common causes of SIRS, mediated via macrophage-derived cytokines (IL -1, 2; TNF etc) which target end-organ receptors.[5] Bacterial dissemination during PNL involves two major components. The first is presence of stone colonizing bacteria and bacterial endotoxins, namely lipopolysaccharides (LPS)[14,15] that are released once the kidney stone is fragmented and continuously washed by the irrigant solution. The second is a readily available access to the blood provided by multiple small venous and lymphatic channels (pyelovenous and pyelolymphatic channels) opened during surgery. High concentrations of the LPS released into the systemic circulation during stone manipulation triggers a systemic inflammatory response. Prophylactic antibiotic alone may not be sufficient to prevent postPNL-SIRS because within the core of stone bacteria may be colonizing and antibiotics do not penetrate through the biofilms or stones.

There is no consensus guideline to define PostPNL SIRS. Some authors define SIRS as mere presence of fever after PNL[4]. Similarly, other authors use postPNL SIRS and urosepsis interchangeably[16]. Due to this reason there is under or overrating of true incidence of PostPNL SIRS. In our study, we have adhered to the SIRS defining criteria given by ACCP and SCCM. Before consensus guidelines

are made for this purpose, it is better to use the ACCP-SCCM criteria to define postPNL SIRS. Many studies have attempted to find risk factors for postPNL SIRS. Fever, SIRS and Urosepsis after stone manipulation during PNL may occur despite the presence of a sterile UC and a proper regimen of antibiotic prophylaxis. Urosepsis may cause significant morbidity; therefore, methods to reduce the risk of post-PNL SIRS are required. Study done by Draga et al [4] showed that in 35% of the patients fever was present after first postoperative day with SIRS in 11.2%. They have observed a significant association between fever after first postoperative day (POD1) and previous ipsilateral PNL. Similarly paraplegic patients had a higher risk of developing SIRS after PNL.

In the study incidence of SIRS on second postoperative day was 46.8%. We have taken into account of SIRS after first postoperative day (day 2 more specifically) only because the SIRS in the first postoperative day may be due to operative trauma itself. Positive stone culture (P=0.018) was the significant risk factor for SIRS. However there was no association of SIRS with the type of stone, duration of the procedure, positive urine culture and residual stones.

The incidence of SIRS in our series is higher than that in the series by Draga et al.[4] The reason behind this might be that our study is prospective one with strict adherence to protocol for SIRS defining criteria given by ACCP-SCCM. The study done by Draga et al was a retrospective study which was using only two parameters (Tachycardia and fever) as SIRS defining criteria. Margel et al [3] reported a stone culture positivity rate of 25% in patients with sterile UC. Seventeen patients (22%) had postoperative SIRS. In 13 of them, a change in antibiotic treatment was made according to the SC findings. The incidence of SIRS was not related to the length of the operation and stone-free rate as in our study. The relative risk of SIRS when the SC was positive was 3.6. [3]

Mariappan et al [16] reported preoperative midstream urine to be an inadequate tool for preoperative bacterial colonization assessment. In their series midstream urine culture was positive in 11.1% of cases, stone culture was positive in 35.2% and pelvic urine culture was positive in 20.4%. Of the patients 37% had SIRS and 3 experienced septic shock. Patients with infected stones or pelvic urine were found to be at a relative risk for SIRS that was at least 4 times greater (P = 0.0009). [24] In our study the sensitivity and specificity of stone culture to predict SIRS was 31.8% and 96% respectively. The study done by Mariappan et al16 showed the sensitivity and specificity of 73.7% and 81.8% .Our results significantly support the importance of obtaining an SC during PNL. In our study, 6 of the 22 patients who developed SIRS during hospitalization, the antibiotic regimen was altered as the patients did not respond to empirical antibiotic treatment. Those patients improved only after antibiotic adjustments were made according to the stone culture results.

Korets R et al[9] have prospectively determined the correlation between preoperative bladder urine cultures, intraoperative renal pelvic urine cultures and stone cultures in patients undergoing PNL. In their study 20 (9.8%) patients had evidence of SIRS postoperatively, including 6 (30%) requiring intensive care.

One of the limiting factors in using stone culture results obtained from samples collected during PNL is the time to get results. It usually takes 48 to 72 hours for the report to come. Sometimes we need to adjust the treatment regimen empirically before the reports are available. Lack of blood culture in patients with SIRS to document bacteremia and lack of anaerobic and fungal culture are limitations of our study.

Conclusion

Sterile preoperative bladder urine culture does not mean that pelvic urine or stone is sterile. Positive stone culture is an important risk factor for PostPNL-SIRS. Preoperative midstream urine culture is a poor predictor of SIRS after PNL. Routine stone culture is beneficial in patients undergoing PNL for the subsequent postoperative management.

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