

Original Research Article

Preoperative and intraoperative factors that influence development of systemic inflammatory response syndrome following percutaneous nephrolithotomy

Sandeep Reddy Donthiri¹, Jamal Shaik^{2*}, A. P. S. Guru Praveen², M. Laxmi Ramesh²,
P. Vedamurthy Reddy²

¹Department of Urology, Yashoda Hospitals, Somajiguda, Hyderabad, Telangana, India

²Department of Urology, Narayana Medical College and Hospitals, Nellore, Andhra Pradesh, India

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*Correspondence:

Dr. Jamal Shaik,

E-mail: jamalshaik39@gmail.com

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ABSTRACT

Background: Sepsis is one of the complications of PCNL. Various pre operative and intra operative factors are associated with its development. Sepsis initially starts with SIRS-Systemic Inflammatory Response Syndrome. Early diagnosis and treatment of SIRS also prevents the development of sepsis during the post operative period which markedly reduces the hospital stay and cost of care associated with the treatment and prevents mortality which can be attributed to septic shock. This study aimed to study the incidence of SIRS in the patients who underwent PCNL. Also, to study the pre operative and intra operative factors associated with development of SIRS in patients who underwent PCNL.

Methods: An observational study was conducted in the Department of Urology, Narayana Medical College and Hospitals, Nellore for 18 months from June 2021 to November 2022. A convenient sample of 100 were selected among the patients who underwent percutaneous nephrolithotomy procedure.

Results: 36% developed SIRS during the course of treatment. The association between development of SIRS and pelvic urine culture and sensitivity ($P=0.018$), stone culture and sensitivity ($P=0.0004$), requirement of blood transfusion ($P=0.03$) and operating time ($P=0.0001$) was statistically significant.

Conclusions: The patients with risk factors like positive pelvic urine culture and sensitivity, positive stone culture and sensitivity, requirement of blood transfusion and longer duration of surgery are to be carefully monitored and treated to prevent the development of SIRS.

Keywords: Intra operative and post operative factors, PCNL, SIRS

INTRODUCTION

Approximately 1% of emergency admissions result from renal colic and complications associated with renal calculi.¹ Kidney stones are prevalent globally, affecting approximately 12% of the population. Their prevalence in India mirrors the global prevalence, roughly 12%.² It is comparatively more prevalent in northern India, where it constitutes 15%.^{1,3} Soucie et al determined that the prevalence in males is 10% and in females is 4%.⁴

The etiology of kidney stones is deemed multifaceted, influenced by age, sex, familial history, dietary habits, concomitant conditions, environmental factors, genetic predisposition, and more variables.¹ There is a significant likelihood of kidney stone recurrence regardless of the medication administered. Approximately 98% of individuals are expected to develop another stone within 25 years of the initial event.¹ The calcium oxalate type of renal calculi is the most prevalent, accounting for 60% of all such stones.⁵

Unenhanced helical computed tomography is the optimal radiographic examination for detecting urolithiasis in patients experiencing acute flank pain.⁶ Intravenous urography was once the gold standard; however, new prospective trials indicate that computed tomography is the superior method for diagnosing ureteral calculi.⁷ If the symptoms are not attributable to urolithiasis, computed tomography can frequently ascertain the actual reason.¹ Most kidney stones are detectable with computed tomography, with the exception of those caused by specific medications, such as indinavir. Indications for immediate intervention encompass the presence of infection accompanied by urinary tract obstruction, urosepsis, intractable pain or vomiting, approaching acute renal failure, obstruction in a solitary or transplanted kidney, and bilateral obstructing stones.⁸

Per cutaneous nephro lithotomy (PCNL)

Percutaneous nephrolithotomy entails establishing an access pathway into the renal collecting system, facilitating nephroscopy. The nephroscope features a working canal for the introduction of an intracorporeal lithotripsy device, such as a lithotrite or laser. Stone shards are extracted by suction, graspers, or basket retrieval methods. This procedure facilitates the retrieval of stones for analysis, allowing for the complete removal of stone material, so preventing the patient from having to expel any fragments, as is typical with shock wave lithotripsy and ureteroscopy. Despite being considered more invasive

than alternative therapies, a comprehensive meta-analysis has shown that percutaneous nephrolithotomy is both safe and effective, especially for big, numerous, or complex stones.⁹ Nonetheless, it is a complex surgical procedure that may entail considerable problems, potentially undermining its effectiveness.

Advancements in technology have significantly reduced the mortality and morbidity associated with surgical procedures. Sepsis is a complication associated with surgical procedures that affects the duration of hospital stays. The onset of sepsis in a patient is contingent upon multiple circumstances.

Sepsis is one of the complications of PCNL also. Various pre operative and intra operative factors are associated with its development. Sepsis initially starts with SIRS. Early diagnosis and treatment of SIRS also prevents the development of sepsis during the post operative period which markedly reduces the hospital stay and cost of care associated with the treatment and prevents mortality which can be attributed to septic shock.

Criteria for SIRS

Temperature >38 degrees C or <36 degrees C (Yes = 1; No = 0), Heart rate >90 (Yes = 1; No = 0), Respiratory rate >20 or PaCO₂ <32 mmHg (Yes = 1; No = 0), WBC > 12,000/mm³ or < 4,000/mm³ or >10% bands (Yes = 1; No = 0).

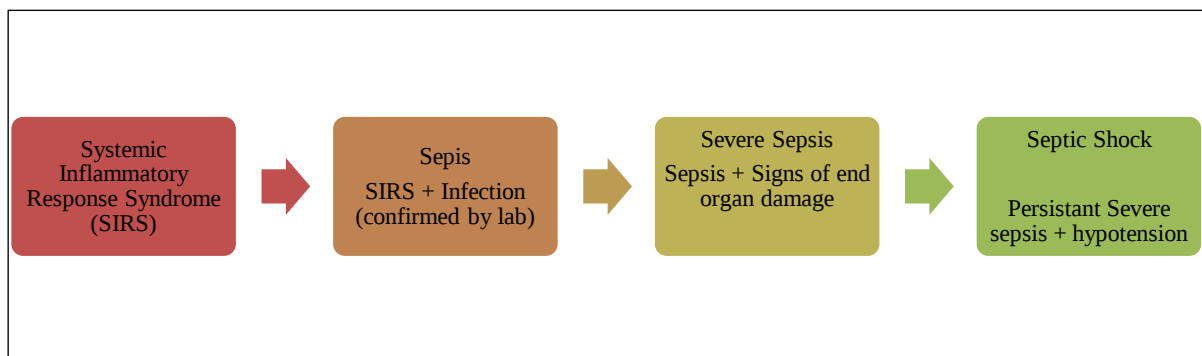


Figure 1: The progression of SIRS.

There is paucity of literature regarding the factors associated with SIRS in patients who underwent PCNL. Hence the present study was taken up to study the pre operative and intra operative factors that are associated with development of SIRS in patients who underwent PCNL. The aim of the study was to study the pre operative and intra operative factors that are associated with development of SIRS in patients who underwent PCNL. The objectives of the study were to estimate the incidence of SIRS in the patients who underwent PCNL, to study the pre operative factors and intra operative factors associated with development of SIRS in patients who underwent PCNL.

METHODS

An observational study was conducted in the Department of Urology, Narayana Medical College & Hospitals, Nellore for 18 months i.e., from June 2022 to November 2023.

Sample size was calculated using the formula Z^2pq/d^2

Taking the incidence of SIRS after PCNL as 24.16%, with 95% confidence interval, 80% power of the study, with 9% anticipated error, sample size was calculated.¹⁰

$N = Z^2pq/d^2$

Z=1.96

P=24.16%

Q=100-P=75.84

d=[absolute precision] =9

N = [1.96x1.96x24.16x75.84] /92

=86.9 + 10% attrition

=95.5 Rounded off to 100

A total of 100 the patients admitted in the inpatient department and who underwent percutaneous nephrolithotomy procedure by giving the informed consent were included in the study. Patients with ureteric stones, concomitant renal illness, infecting collecting system and who were not willing to give informed consent were excluded from the study.

The data was collected prospectively by direct observation in specially designed proforma containing patient details like registration number, age, gender and details of risk factors like diabetes. Other details which were noted were bladder urine culture, pelvic urine culture and stone culture details. All the patients were subjected to routine investigation like CBP, CUE, X-ray KUB and CT both plain and contrast.

All patients underwent PCNL under general anesthesia. Patients were placed in lithotomy position and a 5 Fr ureteric catheter was introduced. Contrast was used to identify the collecting system and to select the calyx for puncture. After prone positioning with adequate padding posterior calyceal puncture was done under fluoroscopic guidance. Level of puncture was decided as per location of stone to ensure complete clearance. Puncture was done using 18 G three part needle and guide wire was placed within the system. Guide rod was introduced and serial coaxial dilatation of tract done with Alkens metal dilator. Amplatz sheath was placed. Using 26 Fr Karl Storz nephroscope and Karl Storz pneumatic lithotripter stone fragmentation was done. After fragments were evacuated antegrade 4 Fr ureteric stent was placed. A 20 Fr nephrostomy tube was also placed.

Intraoperative parameters like operative time, no of access tracts used and need for blood transfusion were recorded. Pelvic urine collected on puncture and stone were sent for culture.

Patients were followed up in postop period with daily complete blood count including White blood cell count, serial pulse rate, temperature and respiratory rate monitoring. Post procedure check Xray KUB was taken before removing the nephrostomy tube in the first

postoperative day. Ureteric stent was removed after 14 days.

Systemic inflammatory response syndrome (SIRS)

The patients were followed up post operatively for any rise in temperature (fever), tachycardia, tachypnoea and rise in WBC count which indicate septicemia. Patients who developed systemic inflammatory response syndrome were identified and managed as per the SIRS protocol.

Criteria for SIRS

Temperature >38 degrees C or <36 degrees C (Yes = 1; No = 0), Heart rate >90 (Yes = 1; No = 0), Respiratory rate >20 or PaCO₂ <32 mmHg (Yes = 1; No = 0), WBC >12,000/mm³ or < 4,000/mm³ or >10% bands (Yes = 1; No = 0). If the score is 0 or 1, patient does not meet criteria for SIRS. If score is 2, 3 or 4 then patient meets SIRS criteria.

Data entry and analysis

The data was entered in Microsoft Excel 2010 version. Data was analyzed using Microsoft Excel 2010 and Epi Info 7.2.0. Descriptive and inferential statistical analysis were used in the present study. Results on continuous measurements were presented on Mean±SD [Min-Max] and results on categorical measurements were presented in Number [%]. Significance was assessed at 5% level of significance. ANOVA was used to compare inter group variation for continuous variables. Chi square test was used to compare categorical variables. A p value of <0.05 was considered as statistically significant.

Ethical clearance

Ethical clearance was obtained from the Institutional Ethical Committee, Narayana Medical College, Nellore.

RESULTS

The mean age was 43.76±18.87 years (4-81 years). The mean serum creatinine in mg/dl was 1.277±0.66 (0.44 - 3.95 mg/dl), with mean stone size was 1.824±0.8124 cms (0.5-4.5 cms). The mean tracts were 1.14±0.348 (1-2) with the mean operating time 84.22±24.57 minutes (50-150 minutes).

Table 1: The prevalence of SIRS in study population.

SIRS	Frequency	Percentage
Present	36	36
Absent	64	64
Total	100	100

Among the study population, 70% were males and 30% were females and 32% were diabetics. The urine culture and sensitivity results showed bacterial growth in 55%.

Pelvic urine culture and sensitivity results showed bacterial growth in 34%. Stone culture and sensitivity results showed bacterial growth in 44%. 14% required

blood transfusion during the course of treatment. 86% had single tract and 14% had two tracts.

Table 2: The association between gender and development of SIRS.

Parameter	Sub group	SIRS		Total	P value
		Present	Absent		
Gender	Female	8	22	30	X ² : 1.62
	Male	28	42	70	P value : 0.1
Diabetes	Present	12	20	32	X ² : 0.04
	Absent	24	44	68	P value : 0.415
Bladder urine C/S	Bacteria present	17	38	55	X ² : 1.37
	Normal	19	36	45	P value : 0.12
Pelvic urine C/S	Bacteria present	17	17	34	X ² : 4.38
	Normal	19	47	66	P value : 0.018**
Stone urine C/S	Bacteria present	22	22	44	X ² : 6.6
	Absent	14	42	56	P value : 0.0004**
Blood transfusion	Yes	8	6	14	X ² : 3.15
	No	28	58	86	P value : 0.03**
No. of tracts	One	32	54	86	X ² : 0.38
	Two	4	10	14	P value : 0.26

**Statistically significant p value

Table 3: Showing the association of SIRS with continuous study variables.

Study variable	SIRS	Mean ± Standard Deviation	ANOVA P value
Age	Present (n=36)	42.16±21.65	0.529
	Absent (n=64)	44.65±17.23	
Serum creatinine	Present (n=36)	1.27±0.74	0.97
	Absent (n=64)	1.27±0.61	
Operating time in minutes	Present (n=36)	97.02±26.03	<0.00001**
	Absent (n=64)	77.0156±20.063	
Stone size in cms	Present (n=36)	1.96±0.87	0.18
	Absent (n=64)	1.74±0.76	

**Statistically significant

Among the study population, 36% developed SIRS during the course of treatment.

1.19 with mean stone size was 2.89 cms. The mean tracts were 1.1, with the mean operating time 70.32 minutes.

DISCUSSION

A total of 100 patients who were satisfying the inclusion criteria enrolled into the study. The results of the study are discussed below:

Baseline study parameters

In the present study, among the study population, the mean age was 43.76±18.87 years. The mean serum creatinine in mg/ml was 1.277±0.66, with mean stone size was 1.824±0.8124 cms. The mean tracts were 1.14±0.348, with the mean operating time 84.22±24.57 minutes.

In a study done by Turk et al, the mean age was 46.5±26.7 years with mean operating time of 85.2 min.¹¹ In another study done by Ramaraju et al, the mean age was 42.18 years.¹⁰ The mean serum creatinine in mg/ml was

Gender

In the present study, among the study population, 70% were males and 30% were females. Males are more prone for stone formation due to their outdoor mobility which leads to dehydration. Similar findings were observed by Turk et al, and Ramaraju et al, were male preponderance was reported with 66.1% and 73% respectively.^{11,10}

Culture and sensitivity results

In the present study, among the study population, urine culture and sensitivity results showed bacterial growth in 55%. Pelvic urine culture and sensitivity results showed bacterial growth in 34%. Stone culture and sensitivity results showed bacterial growth in 44%. Turk et al, reported bacterial growth in 11.69% of urine cultures, 10.08% of pelvic urine cultures, and 50% in stone cultures.¹¹

No. of tracts

In the present study, among the study population, 86% had single tract and 14% had two tracts. Turk et al, reported single tracts in 89.91% and multiple tracts in 10.09%.¹¹

Incidence of SIRS

In the present study, among the study population, 36% developed SIRS during the course of treatment. In the study done by Turk et al, the incidence of SIRS was 14.5% which is similar to the study done by Akdeniz et al, which reported 12.7%.^{11,12} Studies done by Ramaraju et al,

Lojanapiwat et al, and Chen et al, reported incidence of SIRS as 24.16%, 28% and 23.14% respectively.^{10,13,14}

Factors which were not significantly associated with development of SIRS

In the present study, among the study population, the association between development of SIRS and age (P=0.5), gender (P= 0.1), diabetes (P=0.415), bladder urine culture and sensitivity (P= 0.12), no. of tracts (P=0.26), serum creatinine (P=0.97), stone size (P=0.18) was not statistically significant.

Table 4: Showing the comparison of various study parameters with published studies.

Author/ Parameter	Present study	Turk et al ¹¹	Akdeniz et al ¹²	Ramaraju et al ¹⁰	Lojanapiwat et al ¹³	Chen et al ¹⁴
Age	0.529	<0.0001*	Not significant	0.01*	Not significant	Not significant
Gender	0.1	<0.0001*	Not significant	0.829	Not calculated	Not significant
Diabetes	0.415	Not calculated	Not significant	0.06	Not calculated	Not significant
Sr. creatinine	0.97	Not calculated	Not significant	0.13	Not calculated	Not significant
Bladder urine culture	0.12	<0.0001*	Not significant	0.2	<0.05*	Not significant
Pelvic urine culture	0.01*	<0.0001*	Not significant	0.04*	<0.05*	Not significant
Stone urine culture	0.004*	<0.0001*	Not significant	0.03*	<0.05*	Not significant
No. of tracts	0.26	0.133	Not significant	0.001*	Not calculated	<0.05*
Stone size	0.18	Not calculated	0.023*	0.004*	Not significant	<0.05*
Operating time	0.0001*	0.23	0.04*	0.829	Not significant	Not significant
Blood transfusion	0.03*	Not calculated	0.002*	0.009*	Not calculated	<0.05*

*Statistically significant

Factors which were significantly associated with development of SIRS

In the present study, among the study population, the association between development of SIRS and pelvic urine culture and sensitivity (P=0.018), stone culture and sensitivity (P= 0.0004), requirement of blood transfusion (P=0.03) and operating time (P= 0.0001) was statistically significant.

The limitations of the study include small sample size and results are specific to the given study population and study place.

CONCLUSION

The prevalence of SIRS was 36%. The factors associated with development of SIRS were pelvic urine culture and sensitivity (P=0.018), stone culture and sensitivity (P= 0.0004), requirement of blood transfusion (P=0.03) and operating time (P= 0.0001). Hence the patients with above mentioned risk factors are to be carefully monitored and treated to prevent the development of SIRS.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee of Narayana Medical College, Nellore

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