Original Research Article

# Factors determining postoperative infectious complications of percutaneous nephrolithotomy: Experience from a single centre

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## Abstract

**Introduction**: PCNL is considered the standard treatment for staghorn and large-volume renal calculi, as well as upper tract calculi refractory to other modalities, difficult lower pole stones, cystine nephrolithiasis, and calculi in anatomically abnormal kidneys. PCNL is typically a very safe and well-tolerated procedure, but as with any surgical intervention, PCNL is associated with a specific set of complications. Complication rates for PCNL reportedly range from 20-83%. The true complication rates of PCNL are difficult to determine and compare because most contemporary reviews of PCNL outcomes report only rates of specific complications of the procedure. PCNL technique has a steep learning curve and has certain complications specific to it. These include hemorrhage requiring transfusion, fever, sepsis, extravasation, pleural injury and colonic injury which can cause serious morbidity and mortality.**Aims and objectives**: To analyze the infectious complications following percutaneous nephrolithotomy(PCNL) and to assess factors responsible for these complications.**Patients and methods**: It is a retrospective study done at Department of Urology, Nizams Institute of Medical Sciences, Hyderabad. Patients who underwent PCNL between September 2016 and December 2018 were included in the study.**Results:** Out of total 320 patients, 64 (20%) developed features of systemic inflammatory response syndrome, 6 patients developed haemorrhage, 2 patients had pleural injury and 2 patients had colonic injury in the postoperative period. In the study population of 320 patients 128(40%) were females and 192(60%) were males. Among the males 35 (18.2%) developed SIRS and 31 (23.5%) females developed SIRS. Among the study population the mean stone size in patients who developed fever/sirs was 4.47(SD=±0.81) and the mean stone size in patients who didn't have fever/SIRS was 3.78(SD=±0.94) On statistical analysis the difference in the mean size between both the groups for development of fever/SIRS is statistically significant ($p<0.001$). There was no statistically significance ($p= 0.043$) observed in patients between presence of growth in pre operative urine culture and sterile urine among patients who developed SIRS. It is observed that the chances of developing fever/SIRS is higher as the number of tracts increases and it is statistically significant ($p<0.001$). The proportion of patients developing fever/sirs appears to be high in patients with positive pelvic urine culture but it is not statistically insignificant ($p=0.205$).**Conclusion**: Statistical analysis showed significant association between stone size, number of calculi, pyelocaliectasis, number of access tracts, intra operative bleeding, intra operative time and post-operative blood transfusion for development of fever or SIRS. Diabetes mellitus, gender distribution, bladder urine culture showing growth, pelvic urine culture showing growth and stone culture showing growth are not significant predictors for development of SIRS.

**Keywords:** percutaneous nephrolithotomy, systemic inflammatory response syndrome, urine culture, stone culture, renal calculus, haemorrhage.



## Introduction

Known since ancient times, renal stone disease constitutes a major burden of urology work load. Estimated life time prevalence of the disease is 1- 15%. Males are affected two to three times more often than females[1]

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Treatment options available range from extra corporeal shockwave therapy (ESWL) and open surgery to minimally invasive surgery like precutaneousnephrolithotomy (PCNL). Since its first report in 1976[2]. PCNL has become standard of treatment for staghorn calculi, treatment failures of ESWL and difficult lower pole calculi.
PCNL is considered the standard treatment for staghorn and large-volume renal calculi, as well as upper tract calculi refractory to other modalities, difficult lower pole stones, cystine nephrolithiasis, and calculi in anatomically abnormal kidneys. PCNL is typically a very safe and well-tolerated procedure, but as with any surgical intervention, PCNL is associated with a specific set of complications. Complication rates for PCNL reportedly range from 20-83%. The true complication rates of PCNL are difficult to determine and

compare because most contemporary reviews of PCNL outcomes report only rates of specific complications of the procedure. PCNL is cost effective as it requires a shorter hospital stay and allows early return to work[3].The technique has a steep learning curve and has certain complications specific to it. These include hemorrhage requiring transfusion, fever, sepsis, extravasation, pleural injury and colonic injury which can cause serious morbidity and mortality[4].

**Aims and Objectives**

To analyze the infectious complications following percutaneous nephrolithotomy (PCNL) and to assess factors responsible for these complications.

**Methodology**

After institutional ethics committee approval , a retrospective observational study was done in patients who underwent PCNL at Nizams Institute Of Medical Sciences between September 2016 and December 2018 .All patients who presented to our Department with renal stone disease were evaluated with physical examination, urine analysis, urine culture and sensitivity , complete blood count , renal function test , X ray KUB. Based on the serum creatinine values and the density of opacification of stone on X ray KUB patients were subjected to Intra venous urogram, Plain CT of KUB and DTPA/EC renogram accordingly[5-7]

All patients were given 3 days of oral ofloxacin 200mg pre operatively and all the patients pre operative urine culture were ensured that they are negative and sensitive antibiotics were started in culture positive patients and made culture negative before taking up for surgery.

All patients received 1.5 gm cefaperazone and sulbactum combination one hour before procedure and continued for 2 days after. Culture specific antibiotics were given to patients based on pre operative urine culture and sensitivity report[8-10]

Patient factors like age, sex and presence or absence of diabetes were recorded. Preoperative factors like stone size, number of calculi, urine culture sensitivity, presence or absence of pyelocaliectasis, intraoperative parameters like operative time, number of access tracts used, intraoperative time, intraoperative bleeding, stone and pelvic urine culture sensitivity, need for blood transfusion were recorded.

Patients were followed up in postoperative period with complete blood count including haemoglobin, White blood cell count, serial pulse rate, temperature and respiratory rate monitoring[11-14]

**Results**

Out of total 320 patients 64 (20%) developed features of systemic inflammatory response syndrome, 6 patients developed haemorrhage, 2 patients had pleural injury and 2 patients had colonic injury in the postoperative period.In the study population of 320 patients 128(40%) were females and 192(60%) were males. Among the males 35 (18.2%) developed SIRS and 31 (23.5%) females developed SIRS .On statistical analysis it was found that gender distribution between those who developed and who did not develop SIRS was not statistically significant (p= 0.308) .In the study population the number of patients with diabetes mellitus was 68(21.2%) and 252 (78.8%) didn't have diabetes mellitus. Of the patients who developed SIRS 18 (26.4%) had diabetes mellitus and 47 (18.8%) didn't have diabetes mellitus .

18 out of 68 patients who had diabetes mellitus developed SIRS which seems to be a significant proportion when compared with non diabetics. But the difference between them was statistically insignificant (p=0.221) .

In the study population 256 (80%) patients had single calculus, 55 (17.2%) had two calculus and 9 (2.8%) had three or more than three calculus. 30 (11.5%), 30 (53.5%) and 7 (71.4%) patients with one, two and three or more than three calculus developed SIRS respectively.

Among the study population the mean stone size in patients who developed fever/SIRS was 4.47(SD=±0.81) and the mean stone size in patients who didn't have fever/sirs was 3.78(SD=±0.94)

On statistical analysis the difference in the mean size between both the groups for development of fever/sirs is statistically significant (p<0.001).

**Table 1: Bladder urine culture crosstab**

| Pre op Urineculture | Fever or SIRS | | Total | p value | Odds ratio(95% CI) |
|---|---|---|---|---|---|
| | No n (%) | Yes n (%) | | | |
| Growth | 77 (72.3) | 29 (27.7) | 106 | 0.043 | 0.525(0.280-0.986) |
| Nogrowth | 178 (83.2) | 36 (16.8) | 214 | | |
| Total | 255 | 65 | 320 | | |

Bladder urine culture and sensitivity done pre operatively showed growth in 106 (33.2%) patients and 214 (66.8%) patients had urine culture sterile. Of the patients whose pre operative urine culture showed presence of growth 29 (27.7%) developed SIRS and 36 (16.8%) patients with sterile urine developed SIRS .There was no statistically significance (p= 0.043) observed in patients between presence of growth in pre operative urine culture and sterile urine among patients who developed SIRS.

Among the study population 75 (23.5%) patients had preoperative pyelocaliectasis and 245 (76.8%) didn't have pyelocaliectasis. Among patients who had pyelocaliectasis 34 (44.8%) developed SIRS and 61 (25%) patients developed SIRS who didn't have pyelocaliectasis. On statistical analysis it is found that people who had pyelocaliectasis on pre operative imaging were found to have significant (p < 0.001) risk for development of SIRS.

**Table 2: Number of tracts cross tab**

| Intra op NOT | Fever or SIRS | | Total | p value |
|---|---|---|---|---|
| | No n (%) | Yes n (%) | | |
| 1 | 228 (87.7) | 32 (12.3) | 260 | <0.001 |
| 2 | 24(47.5) | 27 (52.5) | 51 | |
| 3 | 3 (28.6) | 6 (71.4) | 9 | |
| Total | 255 | 65 | 320 | |

In the study population there was single tract in 260 (81.2%) patients, two tracts in 51 (16%) and three or more tracts in 9 (2.8%) of patients. Among the patients with single tract, two tracts, three or more tracts 12.3%,52.5% and 71.4% of patients developed fever/SIRS respectively . From the above tabulation it is observed that the chances of developing fever/sirs is higher as the number of tracts increases and it is statistically significant(p<0.001)

**Table 3:Showing pelvic urine culture cross tab**

| Intra op PUC | Fever or SIRS | | Total | p value | Odds ratio(95% CI) |
|---|---|---|---|---|---|
| | Non (%) | Yesn (%) | | | |
| Growth | 72 (74.7) | 24 (25.3) | 96 | 0.205 | 0.660 (0.346-1.259) |
| No growth | 183 (81.7) | 41 (18.3) | 224 | | |
| Total | 255 | 65 | 320 | | |

In the study population growth of micro organisms was positive in 96(30%) patients and it was sterile in 224(70%) patients. Among the patients whose culture was positive 24(25.3%) patients developed fever/SIRS and among patients whose pelvic urine culture was sterile 41(18.3%) patients developed fever/SIRS . The proportion of patients developing fever/SIRS appears to be high in patients with positive pelvic urine culture but it is not statistically insignificant (p=0.205)

The proportion of patients developing fever/SIRS appears to be high in patients with positive pelvic urine culture but it is not statistically insignificant (p=0.205)[15]

Among the study population stone culture was positive in 86 (26.8%) patients and it was sterile in 234(73.2%) patients. 23.9% of patients developed fever/sirs among patients whose stone culture was positive and 19.1% of patients developed fever/SIRS whose stone culture was sterile [16-18]

On analysis it was found that development of SIRS in patients with positive stone growth is not significant (p=0.409) when compared with patients whose stone cultures were sterile.

Among the study population the mean intra operative time for patients with sirs was 60.51 (SD =±13.76) and for patients without SIRS was (SD=43.72±11.13). On statistical analysis the difference in mean between two groups was statistically significant for development of SIRS(p<0.001).

Among the study population supra coastal approach for stone clearance was there in 18(5.6%) patients and 302 (94.4%) patients didn't have supra coastal approach. Among patients with supra coastal approach 6 patients developed fever/SIRS and 52 patients with out supra coastal approach developed fever/SIRSFrom the above tabulation it is seen that supra coastal approach for stone clearance is not an independent risk factor for development of fever/SIRS. It is statistically insignificant (p=0.43500)

Among the study population 40(12.4%) patients required post operative blood transfusion and 280 (87.6%) patients didn't require blood transfusion. Among the patients who required blood transfusion 58.1% of patients developed fever/SIRS and among who didn't require blood transfusion 15.1% developed fever/SIRS . On analysis it was found that the association between the patients who had blood transfusion and developed SIRS in comparison to those who didn't receive transfusion was statistically significant (p<0.001).

**Discussion**

Percutaneous nephrolithotomy procedure is usually done after sterilizing the urine in patients with preoperative urine culture showing growth. Still 15 - 30 % of patients develop postoperative systemic inflammatory response syndrome of which 1-2% develop sepsis.

The likelihood of developing complications in patients undergoing percutaneous nephrolithotomy can be determined by identifying certain preoperative and intraoperative factors associated with the patients.

Our study comprising of 320 patients who underwent percutaneous nephrolithotomy showed that 64 (20%) of them developed fever/SIRS postoperatively.

**Table 4: Comparison of SIRS incidence**

| S. No | Study | SIRS (%) |
|---|---|---|
| 1 | Liang Chen et al (12) | 23.4% |
| 2 | Singh et al (13) | 17.6% |
| 3 | Korets et al (11) | 9.8% |
| 4 | DhinakarBabu et al (14) | 24.1% |
| 5 | Present Study | 20% |

From the above table the incidence ofpost operative SIRS / fever in the present study is 20% and it is the most common complication encountered after percutaneous nephrolithotomy.

The incidence of haemorrhage and pleural injury in the present study is 1.6% and 0.8%.

**Table 5: Haemorrhage and pleural injury incidence**

| S. No | Study | Haemorrhage | Pleural Injury |
|---|---|---|---|
| 1 | Mousavi et al (15) | 0.6% | 0.7% |
| 2 | Rana et al (16) | 1.49% | 0.14% |
| 3 | Present Study | 1.6% | 0.8% |

On analysis of data collected before, during and after surgery it showed certain factors associated significantly in developing SIRS.

Statistical analysis showed significant association between stone size, number of calculi, pyelocaliectasis, number of access tracts, intra operative bleeding, intra operative time and post-operative blood transfusion for development of fever or SIRS.With regard to gender distribution, diabetes mellitus, bladder urine culture showing growth, pelvic urine culture showing growth and stone culture showing growth the association was found to be statistically insignificant.

In our findings two patients who had pleural injury there was supra coastal access for stone clearance i.e. above 11th rib. So supra coastal access is definitely a risk factor for pleural injury leading to effusion or nephropleural fistula.

In our study six patients had haemorrhage out of which four patients had acute haemorrhage and two patients had delayed haemorrhage. All the patients with acute haemorrhage were successfully managed with absolute bed rest, blood transfusions and I.V antibiotics.

Both the patients with delayed haemorrhage had significant intra operative bleeding and both the patients had immediate post-operative blood transfusion. Both the patients developed delayed haemorrhage on post- operative day 5 which did not subside with conservative treatment. So both the patients were managed with super selective angioembolization.

To assess, patients with large multiple calculus with more number of access tracts and significant intra operative bleeding requiring blood transfusion are at increased risk for the development of haemorrhage.
Two out of 320 patients had colonic injury (0.8%) in the present study. One injury was identified intra operatively during nephrostogram. DJS was placed and the nephrostomy tube was pulled into the colon. Other injury was identified on the second postoperative day and the nephrostomy tube was gradually pulled.
Both the patients were managed conservatively nil by mouth for 3 days, I.V broad spectrum antibiotics, laxative rectal suppositories. On 6th post operative day lack of communication between both the systems and distal patency of colon was confirmed with contrast injection through the tube under fluoroscopy. Tube was clamped and removed on 7th post op day and was uneventful.
Haemorrhage, pleural injury and colon complication was seen in 1.6%, 0.8% & 0.8% respectively of study population. To assess the statistical significance between the risk factors and the complication the incidence is low and it should be in a significant population to analyse as chances of error are more with only few patients showing complications among 320 patients.

**Conclusion**

1. Significant association was found between stone sizes, number of calculi, presence of pyelocaliectasis, requirement of access tracts, increased intra operative time, intra operative bleeding and requirement of post-operative blood transfusion for development of SIRS.
2. Diabetes mellitus, gender distribution, bladder urine culture showing growth, pelvic urine culture showing growth and stone culture showing growth are not significant predictors for development of SIRS.
3. Intra operative cultures (pelvic urine and stone) are only therapy guided and takes time to achieve result. These culture sensitivity reports only help in choosing the sensitive antibiotic.
4. Pre-operative sterile urine culture did not decrease the incidence of post- operative fever/SIRS.
5. Hence patients with above identified risk factors for development of SIRS should be given appropriate sensitive antibiotics and closely monitored in a high dependency unit in order to prevent the occurrence of sepsis post operatively.

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