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Predictive factors of infectious complications following Percutaneous Nephrolithitomy-An Institutional Study

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Abstract:
Objective: *To determine the predictors of infectious complications following percutaneous nephrolithotomy (PCNL) in a prospective study.*
Materials and Methods: *A total of 120 patients with renal or upper ureteric calculi who underwent PCNL between January 2016 and December 2017 were included in the study. Infectious complications included febrile urinary tract infection and septicemia. The patients were divided into Group A and B depending on whether they developed or did not develop infectious complications. Patient, stone, renal, and procedure‐related factors were compared between the two groups.*
Results: *There was no significant (P > 0.05) difference among age (39.5±18.3vs 40.76±19.4) and sex between both the groups. The patients in Group A were found to have significantly higher incidence of renal failure (37.5% vs 6.73%, P = 0.00022), diabetes mellitus ([5 (31.52%) vs. 12 (11.53%), P = 0.035]), previous PCN tube placement (4 [25%] vs. 6 [5.8%] P = 0.0096), mean number of punctures (1.88 ± 0.7 vs. 1.4 ± 0.38, P = 0.0001), and mean duration of surgery (101.56±21.02 vs. 87±18.76, P = 0.0052) than Group B. The multivariate binary logistic regression analysis revealed that patients with renal failure (serum creatinine >1.4 mg/dl), staghorn stone, higher number of puncture, and longer duration of surgery were found to be significant factors associated with infectious complications*
Conclusion: *Post‐PCNL infectious complications were found to be more common in patients with renal failure, diabetes mellitus, preoperative PCN placement, staghorn calculi, severe HDN, multiple punctures, and prolonged duration of surgery.*
Key Words: *Diabetes mellitus, febrile urinary tract infection, hydronephrosis, percutaneous nephrolithotomy, Septicaemia*

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I. Introduction

Percutaneous nephrolithotomy (PCNL) is the treatment of choice for large, complex multiple, and lower calyceal stones.[1. literature on the predictors of its complications are very limited.

complications of PCNL vary according to the complexity of stone disease as well as patient and procedure-related factors. Liretature quotes complications range from 3% to 83%.[2,3] Postoperative fever is the most common of them with rates between 15% and 30%.[4,5,6,7] [8]

Duration of procedure,urinary bacterial load and severity of obstruction affect the incidence of febrile urinary tract infection (UTI) and/or urosepsis.[9,10]. Accurate prediction of post operative infection is not always possible[9] therefore a thorough evaluation of stone, patient and procedure related factors is needed. our study is therefore aimed to determine predictive factors of complications following percutaneous nephrolithitomy.

II. Materials And Methods

After ethical clearance, patients with renal or upper ureteric calculi undergoing PCNL between January 2016 and December 2017 at Government Stanley medical college, Chennai were included in study. Written informed consent was obtained from all patients. Patients who underwent simultaneous bilateral PCNLand second look PCNL were excluded from study.

In patients' demographics, a detailed clinical history including past renal surgery, percutaneous nephrostomy (PCN) tube placement were recorded; blood investigations including complete blood count, renal function test, and blood sugar were done in all patients. X-ray, kidney-ureter-bladder (KUB), ultrasound KUB, intravenous urogram, and/or computed tomography with or without contrast were done to evaluate anatomical and functional status of kidney as well as stone parameters.

Temperature >38°C on 2 consecutive postoperative days or >39°C on any one postoperative day was defined as febrile UTI.[11] clinically evident severe urinary infection with features consistent with systemic inflammatory response syndrome was defined as urosepsis.[12]

Ultrasoung KUB was used to assess the degree of hydronephrosis[HN]. Mild HN was defined as calyceal enlargement with preservation of the renal papillae; moderate HN was defined calyceal rounding with obliteration of the renal papillae; and severe HN was defined as ballooning of calyces with thinned out renal cortex.[13]

Sterile urine was confirmed through urine culture sensitivity test before the procedure and appropriate antibiotics were prescribed in needed cases.Prophylactic antibiotics [second generation cephalosporins or culture specific antibiotics]were given at the induction of anesthesia to all patients.

Technique of percutaneous nephrolithotomy

Under general anesthesia, in lithotomy position,ureteric catheter was inserted in a retrograde manner on the ipsilateral side. Patient was turned prone, and percutaneous access was obtained under fluoroscopic guidance by the operating surgeon using a diamond tip 18-G puncture needle. A hydrophilic guide wire was passed, over which tract dilatations were done using Alken metal dilators and a Amplatz sheath was placed into system. Stones were fragmented using pneumatic lithoclast and removed. Intraoperative stone clearance was accessed using fluoroscopy. A double J stent/ureteric catheter and nephrostomy tube was placed in most of the cases.

Patients were divided into two groups: Group A includes patients who developed febrile UTI and Group B includes patients who did not develop febrile UTI.

Statistical analysis

The results are presented in mean ± standard deviation and percentage. The categorical variables were compared using Chi-square test. The unpaired t-test was used to compare the continuous variables between the groups. The multivariate binary logistic regression was carried out to find the significant factors associated with different outcomes. The $P < 0.05$ was considered significant. All the analysis was carried out using SPSS software.

III. Results

A total of 120 patients were included in this study. The basic characteristics of the patients are presented in Table 1.Complications were seen in 34 (28.33%) patients. Many patients had more than one complication; thus, overall 51 complications were seen [Table 2].Comparisons of the patient, stone, renal, and procedure-related characteristics of both groups are shown in Table 3.

There was no significant ($P > 0.05$) difference among age (39.5±18.3vs 40.76±19.4) and sex between both the groups. The patients in Group A were found to have significantly higher incidence of renal failure (37.5% vs 6.73%, $P = 0.00022$), diabetes mellitus ([5 (31.52%) vs. 12 (11.53%), $P = 0.035$]), previous PCN tube placement (4 [25%] vs. 6 [5.8%] $P = 0.0096$), mean number of punctures (1.88 ± 0.7 vs. 1.4 ± 0.38, $P = 0.0001$), and mean duration of surgery (101.56±21.02 vs. 87±18.76, $P = 0.0052$) than Group B. A significantly longer hospital stay was observed in Group A patients which signifies morbidity of febrile UTI. The multivariate binary logistic regression analysis revealed that patients with renal failure (serum creatinine >1.4 mg/dl), staghorn stone, higher number of puncture, and longer duration of surgery were found to be significant factors associated with infectious complications [Table 4].

IV. Tables

TABLE 1: BASIC CHARESTERISTICS OF PATIENTS

PARAMETER	**NUMBER(120)**
Age(mean±SD) (range)	40.13±18.8
Right/Left	66/54
Male/Female	68/52
Mean puncture tracts(range)	1.25±0.48(1-4)
Mean hospital stay (days)	5.12±2.93
Mean duration of surgery (min)	75.32±28.76

SD- Standard Deviation, BMI-Body Mass Index

TABLE-2: CLASSIFICATION OF COMPLICATIONS OF PCNL

GRADE/COMPLICATIONS	**NUMBER**	**PERCENTAGE OF PATIENTS**
GRADE I		
Fever	7	5.8
Decreased urine output (<30ml/hr requiring diuretics)	0	0
Hydropneumothorax managed by watchful waiting	0	0

GRADE II		
Blood transfusion	20	16.67
Urine leakage <12hr	4	3.33
Wound infection	2	1.6
Febrile urinary tract infection	14	11.7
GRADE IIIa		
Double-J stent replacement for urine leakage >24hr	1	0.83
Stent migration needed reposition	1	0.83
Hydropneumothorax needed chest tube	0	0
GRADE IIIb		
Arterio-venous fistula requiring angioembolisation	0	0
Uncontrolled bleeding due to A-V fistula requiring nephrectomy	0	0
GRADE IVa		
Neighbouring organ injury	0	0
Myocardial infarction	0	0
Creatinine elevation with dyselectrolytemia requiring dialysis	0	0
GRADE IV b		
Urosepsis	2	1.6
GRADE V		
Death	0	0

TABLE 3: FACTORS ASSOCIATED WITH INFECTIOUS COMPLICATIONS (FEBRILE UTI AND UROSEPSIS)

PARAMETERS	Patients with post-PCNL febrile UTI AND Urosepsis (Group A)	Patient without febrile UTI and urosepsis (Group B)	P value
Age in years	39.5±18.3	40.76±19.4	0.80
Male/Female	10/6	58/46	0.61
Patients with serum creatinine>1.4mg/dl	6(37.5)	7(6.73)	0.00022
Patients with diabetes(%)	5(31.2)	12(11.53)	0.035
Previous PCN(%)	4(25)	6(5.8)	0.0096
Mean preoperative hemoglobin	10.9	11.2	0.153
Previous renal operative history	2(12.5)	9(8.6)	0.617
Stone characteristics(%) Staghorn Multiple Pelvic/single calyceal/ upper ureteric	 8 5 3	 19 40 45	 0.0046 0.58 0.062
Mean number of punctures	1.88±0.7	1.4±0.38	0.0001
Duration of surgery(min)	101.56±21.02	87±18.76	0.0052
Hospital stay (days)	7.85±3.17	6.14±1.9	0.0009

TABLE 4: SIGNIFICANT FACTORS ASSOCIATED WITH FEBRILE UTI-MULTIVARIATE LOGISTIC REGRESSION ANALYSIS

PARAMETERS	P value
Previous PCN(%)	0.0096
Patients with serum creatinine>1.4mg/dl	0.00022
Patients with diabetes(%)	0.035
Staghorn calculi	0.0046
Mean number of punctures	0.0001
Duration of surgery(min)	0.0052
Hospital stay(days)	0.0009

V. Discussion

Owing to improved perioperative care,modern instruments and technical expertise, complication rates of PCNL have drastically reduced.[8]

Septicemia may be due to an infection introduced during access to the kidney or during manipulation of infected stones. Post PCNL fever is most commonly associated with infected stones (struvite or staghorn stones compared to those with sterile stones.[15] Post PCNL urosepsis had been attributed to systemic release of endotoxins released during manipulation of stones resulting in systemic inflammatory response. This process is even more exaggerated in obstructed system due to pyelolymphatic and pyelovenous backflow channels.[9]

In our study, infectious complications were seen in 16 patients (13.33%). Among these, febrile UTI (managed by antibiotics, Clavien grade 2) was seen in 14 (11.4%) of patients, and urosepsis (managed by intensive care monitoring, Clavien grade 4) was seen in 2 (1.6%) patients. Others also found the incidence of fever following PCNL in the range of 21–32.1% of the cases[7,16] and septicemia in 0.9–4.7% of the cases.[8]

Urosepsis is a medical emergency with very high mortality rate (60–80%).[17,18] Therefore, determination of factors affecting infectious complications and risk stratification are critical to avoid serious postoperative events.

In our study, most common organism isolated from urine culture was Escherichia coli as in the previous reports.[19,20] However,Pseudomonas aeruginosa was most commonly associated in patients who developed sepsis.

The presence of pus or cloudy urine on initial puncture was considered to be high-risk for the development of postoperative sepsis.[20,21] In these cases, we placed nephrostomy tube and deferred the surgery until urine culture was rendered sterile.

We observed that patients who had PCN tube in situ were associated with higher incidence of febrile UTI (4(25%) as compared to Group B (6(5.8%)] P = 0.0096). it may be either due to infected stone which initially lead to pyonephrosis or the biofilm formation and subsequent dissemination of bacteria during PCNL.

Patients with renal failure (37.5% in Group A vs. 6.73% in Group B, P = 0.00022) as well as diabetes mellitus (5 [31.2%] vs. 12 [11.53%], P = 0.035) had significant higher incidence of febrile UTI, probably due to low immunity. Renal insufficiency and diabetes mellitus as a risk factor for postoperative fever and sepsis have been observed in other studies also.[8]

Staghorn calculus may disseminate during manipulation causing infection and ultimately lead to postoperative fever and sepsis. In our study, staghorn calculus was associated with infective complications which was similar to findings with Mariappan et al.,[22].

Duration of surgery was significantly (P = 0.0052) longer in Group A (101.56±21.02) as compared to Group B (87±18.76). Longer operative time implies greater quantities of irrigation fluid used as well as greater maneuvering which increases the chances of sepsis. The risk of infection is directly proportional to the duration of surgery and amount of irrigation fluid used [6]

Multiple punctures increase the probability of introducing more infective organism into system increase the probability of septic complications. Mean number of puncture was higher in those who developed febrile complication (1.88±0.7 in Group A vs. 1.4±0.38 in Group B, P = 0.0001). Instrumentation of the urinary tract is not uncommon to cause bacteremia.[23]

Intestinal and colonic injuries could result in septic complications such as peritonitis or severe UTI. Previous bowel surgery predisposes to duodenum or colonic injury, and a urologist should proceed with special care.[24] Colonic perforation has been observed in <1% of PCNLs.[8] In current study, we did not encountered any bowel injury.

Limitations of our is small sample size.We did not assess the intrapelvic pressure directly. PCNL through 28 French Amplatz and 24 French nephroscope is a low pressure system, and it was probably not a significant factor in the current study. Tube PCNL and tubeless PCNl cases were not studied separately in our study.

The strengths of our study include a prospective design, use of standard criteria defined, especially to identify the infection-related events and evaluation of considerably a high number of variables.

VI. Conclusion

Infectious complications following PCNL were found more common in patients with diabetes mellitus,renal failure, staghorn calculi, preoperative PCN placement, multiple puncture, severe hydronephrosis and prolong duration of surgery. This was not related to age, sex, preoperative hemoglobin, and previous operative history.

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