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CORRELATION BETWEEN PREOPERATIVE VARIABLES OF T HE PATIENTS AND MANAGEMENT OUTCOME AFTER PCNL SURGERY- AN OBSERVATIONAL STUDY

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ABSTRACT

Background: Urolithiasis is one of the most common diseases of trouble in our society and kidneys are the most common affected organ compared to ureter and bladder. It has various etiology such as imbalanced nutrition with excess oxalates, calcium in diet, inadequate urinary drainage, predisposed to heat exposure and urinary tract infection. Percutaneous nephrolithotomy (PCNL) is the treatment of choice for stones larger than 2 cm and lower pole stones larger than 1 cm and in patients. The true complications or successful outcome of PCNL surgery are difficult to determine and compare. Therefore, we have attempted to standardize the complications and outcome of PCNL by utilizing the modified Clavien complication grading system and correlated pre-op variables of the patients with the management outcome following PCNL surgery. **Methodology:** The study was conducted on 50 patients with urolithiasis posted for PCNL surgery and performed by senior Urologist with experience of >50 PCNL surgery at tertiary care service hospital, India.Various pre-op variables (Age, sex, BMI, comorbidity, positive urine culture, GSS and hydronephrosis) were correlated with management outcome based on modified Clavien complication grading system like complete/incomplete stone clearance, post-op fever, peri-op bleeding and other major complications following PCNL surgery. **Result:** PCNL surgery was performed by a senior urologist on 50 patients with renal calculi. The most common complications occurred to our patients after PCNL surgeries were incomplete stone clearance, post-op fever and peri-op bleeding. A total of 43 (86%) patients had complete clearance of stone while 7 (14%) patients had residual calculi. Post-op fever was developed in 13 (26%) patients, 10 patients (20%) developed peri-op bleeding and out of them, 5 patients required blood transfusion. Pre-op variables (comorbidity, Guy stone score) were significantly associated with stone clearance. While, only comorbidity of patients (a pre-op variable) was significantly associated with post-op fever > 38.5^{O}C and with respect to peri-op bleeding, positive urine culture report, Guy stone score, hydronephrosis (pre-op variables) were statistically associated. None of the patients had major complications like loss of renal function, pneumothorax, visceral injury, urinoma, urosepsis or death. **Conclusion:** Stone clearance is significantly associated with comorbidity and increasing GSS. It is not statistically associated with age, sex, BMI, positive urine culture report and hydronephrosis. Post-op fever >38.5^{O}C is significantly associated with comorbidity and not associated with other elaborated pre-op variables of the patient. Peri-op bleeding is significantly associated with preoperative urine culture, increasing GSS and hydronephrosis. Further studies with larger patient numbers and longer follow up would be needed to accurately study the profile and management outcomes of patients undergoing PCNL for the treatment of renal calculi.

BACKGROUND

Urinary stone disease is one of the most common diseases to afflict mankind and is two to three times more common in adult males than in females. Stone disease not only affects the patient, but also the national economy, because the disease is prevalent in the productive age group.[1] Urolithiasis is the formation of calculi (urinary stones), which are located anywhere in the urinary system. Kidneys are most commonly affected as compared to ureter and bladder.[2]

Urinary stones tend to occur more often in people living in a hot, arid and dry climate. Lower urine volume has an important role in urolithiasis in hot areas.[3] The incidence of urolithiasis is fairly high in South East Asia including several regions of India. Renal calculi that are >10mm in diameter will not pass on their own as compared to those that are <5mm. Calculi between 5–10 mm have variable outcomes and will either pass on their own or require further interventional management.[4]

There are various management options for kidney calculi such as open and laparoscopic surgery, extracorporeal shock wave lithotripsy (ESWL), Retrograde Intra Renal Surgery (RIRS), Percutaneous nephrolithotomy (PCNL) and its various modifications. Most patients harboring

uncomplicated stones located in the kidney and upper ureter, with aggregate stone size less than 20 mm and anatomy of the involved kidney is normal[5] can be treated satisfactorily with SWL. The European Association of Urology recommended Percutaneous nephrolithotomy (PCNL) as the treatment of choice for stones larger than 2 cm and lower pole stones larger than 1 cm and in patients with unfavorable factors for ESWL. It is also second line modality in pelvic, upper or middle calyceal stones from 1-2 cm and third line in stones smaller than 1 cm.[6] Its modification minimally invasive PCNL (Mini PCNL) can be applied on the pediatric population. Overall, Mini PCNL appears to have the best utility in the pediatric population and stone burden limited to 2 cm but it is being increasingly being applied to the adult population too.[7]

The true complications rates of PCNL are difficult to determine and compare because most contemporary reviews of PCNL outcome reports only rates of specific complications of the procedure. Various authors have attempted to standardize the complications of PCNL by utilizing the modified Clavien complication grading system, or by assigning Clavien grading system scores to the complications commonly associated with PCNL.[8,9] Complication rates for PCNL reportedly range from 20-83%.[8] An international multi-center study conducted by the Clinical Research of the Endourological Society (CROES) reported an overall complication rate of 21.5%. The majority of complications were minor, with rates of 16.4%. The most common minor complications included nephrostomy tube leakage (15%) and transient fever (10-30%). Major complications which include injury to adjacent organs, violation of the pleural space, bleeding or infection rate are 4.6%.[10] Hemorrhage is the most significant complication of PCNL, with transfusion rates reported to be from less than 1% to 10%.[11]

Stone location, size, and hydronephrosis were significant factors affecting outcomes of surgery in many studies.[11,12,13] The goal is to achieve stone-free status. To assess the stone free status various modalities are used such as plain X-Ray and NCCT KUB. Residual stone fragments after PCNL confers increased risk of future stone events.[14] Even when a stone-free status is achieved, the underlying metabolic abnormalities remain.[15] Comprehensive metabolic evaluation and aggressive medical management can control active stone formation and growth in patients with or without residual stone fragments after PCNL. Kang *et al*. found that selective medical therapy significantly decreased stone formation in stone-free and residual fragment groups after PCNL. Hence, they recommended medical management following PCNL without regard to stone-free status.[16]

Renal calculus disease is a fairly common disease in population, has got multiple etiology and following management by PCNL has outcomes different in nature from stone frees status and symptomatic to various complication laden post-operative course.[17] It is important to know the clinical profile of the patients of renal stone disease as it is useful in advising people for taking preventive measures for reducing the risk of recurrence and also helps in predicting the outcomes and possible complications in patients undergoing PCNL.[18] With this background, this study was conducted in a tertiary care hospital to assess the correlation between preoperative variables and management outcome after PCNL surgery.

MATERIALS AND METHODS

This prospective observational study was conducted on 50 consecutive patients of ASA (American Association of Anaesthesiologist) physical status 1 & 2 who underwent Percutaneous Nephrolithotomy at Base Hospital Delhi Cantt. over a period of one-year wef Apr 2018 to Mar 2019. All the surgeries were performed using a standard PCNL instrument and conducted by senior Urologist who had an experience of more than 50 PCNL surgeries.

Inclusion criteria

1. Renal calculi>2 cm in diameter
2. Calculi located in lower pole calyces or calyceal diverticula
3. Staghorn renal calculi
4. Stones associated with distal obstruction
5. Cystine stone
6. All age groups with ASA I and ASA II

Exclusion criteria

1. Patients treated conservatively
2. Patient who were suitable for ESWL
3. Those having contraindications for Endourological intervention due to co-morbidities or associated conditions
4. Patients who underwent PCN placement for other indications.
5. Patient refused to give consent.
6. Patients belonging to ASA grade 3 and grade 4.

Preoperative variables included in study were as mentioned below and compared with postoperative outcome-

Age
Sex of the patient
BMI
Comorbidities
Urine culture report
Hydronephrosis
Guy stone score

The modified Clavien grading system was used for evaluating perioperative and postoperative complications of PCNL like clearance of stone (complete, incomplete), postop fever ≥38.5°C, sepsis, visceral injury, pleural injury, loss of renal function, urinoma, metabolic derangement, surgical, endoscopic or radiological

intervention and peri-op bleeding requiring blood transfusion.

Table 1: Classification of surgical complications according to the modified Clavien system.[19]

Grades	Complication
Grade 1	Any deviation from the normal postoperative course without the need for pharmacologic treatment or surgical, endoscopic, and radiologic interventions. Allowed therapeutic regimens are drugs such as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade 2	Complications requiring pharmacologic treatment with drugs other than such allowed for grade 1 complication. Blood transfusions and total parenteral nutrition are also included.
Grade 3	Complications requiring surgical, endoscopic, or radiologic intervention.
Grade 4	Life-threatening complications (including central nervous system complications) requiring intensive care unit stay. Grade 4a: Single organ dysfunction (including dialysis) Grade 4b: Multiorgan dysfunction
Grade 5	Death of the patient

Table 2: Guy's stone score. (GSS)

Grade	Categorization
I	A solitary stone in the mid/lower pole, or renal pelvis with simple anatomy
II	A solitary stone in the upper pole with simple anatomy, multiple stones in a patient with simple anatomy, or any solitary stone in a patient with abnormal anatomy
III	Multiple stones in a patient with abnormal anatomy, stones in a calyceal diverticulum, or partial staghorn calculus
IV	Staghorn calculus or any stone in a patient with spina bifida or spinal injury

Statistical Analysis

All the data was collected, tabulated and analyzed using SPSS (Statistical Package for Social Sciences) package version 20.0. Qualitative data variable was expressed by using frequency and percentage. The Chi-Square test and Fischer extract test used to find association between various clinical profiles of the patient and outcomes as fever, post-operative bleeding, residual and recurrent calculi and post op symptom relief. A p value of < 0.05 was considered statistically significant.

RESULTS

In our study, we included a total of 50 patients of renal calculi who underwent PCNL by senior urologist after thorough preoperative evaluation and workup. Following PCNL surgery, management outcome was analyzed based on modified Clavien grading system in form of stone clearance, perioperative bleeding, post-op fever, sepsis, pneumothorax, visceral injury, metabolic derangement, loss of renal function, surgical or radiological intervention, death and outcome was correlated with preoperative variables of the patients. The most common complications occurred to our patients after PCNL surgeries were incomplete stone clearance, post-op fever and peri-op bleeding. None of the patients had complications like loss of renal function, pneumothorax, visceral injury, urinoma, metabolic derangement, urosepsis, collecting system injury, radiological or surgical intervention and death. We have classified adverse outcomes according to increased grade of severity in our study according to Modified Clavien-Dindo score. The total number of complications occurred in our study population were 18. Out of these complications, Grade 1 complication rate was 13(72%) and 5 (28%) had Grade 2 complications as shown in below table.

Table 3: Modified Clavien Dindo score in our study.

Grades	Complications	Frequency(n)	Percentage (%)
1	Post-op fever	13	72
2	Peri-op bleed required blood transfusion	5	28
	Total	18	100

Table 4- comparison between pre-op variables and stone clearance.

S NO	Preoperative variables		Stone clearance		Total	Pearson Chi-Square	p- value
			Complete	Incomplete			
1.	Age	21-30 Yrs	11	0	11	7.097[a]	0.131
		31-40 Yrs	12	1	13		
		41-50 Yrs	6	3	9		
		51-60 Yrs	10	1	11		
		61-70 Yrs	4	2	6		
2.	SEX	Male	26	6	32	1.666[a]	0.197
		Female	17	1	18		
3.	BMI	19- 24.9	17	3	20	4.299[a]	0.117
		25-29.9	20	1	21		
		>30	6	3	9		
4.	Comorbidities	NIL	36	4	40	8.333[a]	0.04
		DM2	3	1	4		
		HTN	1	2	3		
		DM2 & HTN	3	0	3		
5.	Urine culture	E coli	6	4	10	7.170[a]	0.067
		Proteus	1	0	1		
		Pseudomonas	2	0	2		
		Sterile	34	3	37		
6.	Guy`s Stone Score	1	31	3	34	13.254[a]	0.004
		2	8	1	9		
		3	4	1	5		
		4	0	2	2		
7.	Hydronephrosis	Yes	23	5	28	0.786[a]	0.375
		No	20	2	22		

Post-op outcome of patients following PCNL surgery mentioned below-

(a) Stone clearance

Out of 50 Patients, 43 (86%) patients had complete clearance of stone while 7 (14%) patients had residual calculi, for which they underwent ancillary procedure like 2nd and 3rd stage PCNL/ESWL. In our study, different age groups, gender, BMI, urine culture, hydronephrosis were correlated with the post-operative stone clearance and observed that stone clearance was not significantly associated with them. However, out of 7 patients with incomplete clearance, 3 were with comorbidities and decreased clearance was significantly associated with co morbid condition (p value 0.04). Similarly, it was also observed that with increasing complexity of stone with respect to position and location as assessed by Guy stone score, there was decreasing clearance and statistically significant (p value 0.004). [table 4]

(b) Post-op Fever > 38.5

In our study, out of 50 Patients, 13 (26%) patients developed fever during post-op period and we found that different age groups, sex, BMI, urine culture, hydronephrosis, Guy stone score were not significantly associated with post-operative fever. But, out of 11 patients who had comorbidities, 6 patients developed post-operative fever and which was statistically significant. (p value 0.027). [Table 5]

(c) Perioperative bleeding

In our study, a total of 10 patients (20%) developed peri-op bleeding and out of them, 5 patients required blood transfusion. A total of 13 patients who had preoperative positive urine culture report, 7 patients developed perioperative bleeding which was statistically significant with p value 0.003. We also observed, that there was strong association of increasing complexity of stone and Perioperative bleeding with p value 0.001. Similarly, out of 28 patients who had preoperative hydronephrosis, 9 patients had significant perioperative bleeding which was also statistically significant with p value 0.015. However, perioperative bleeding was not associated with increasing age, sex, BMI and comorbidities. [table 6]

Table 5 - comparison between pre-op variables and post-op fever.

S NO	Preoperative variables		Post-op fever ≥38.5°C		Total	Pearson Chi-Square	p- value
			Yes	No			
1.	Age	21-30 Yrs	0	11	11	6.506[a]	0.164
		31-40 Yrs	3	10	13		
		41-50 Yrs	3	6	9		
		51-60 Yrs	5	6	11		
		61-70 Yrs	2	4	6		
2.	SEX	Male	10	22	32	1.273[a]	0.259
		Female	3	15	18		
3.	BMI	19- 24.9	6	14	20	0.285[a]	0.867
		25-29.9	5	16	21		
		>30	2	7	9		
4.	Comorbidities	NIL	7	33	40	9.156[a]	0.027
		DM2	3	1	4		
		HTN	2	1	3		
		DM2 & HTN	1	2	3		
5.	Urine culture	E coli	4	6	10	2.127[a]	0.547
		Proteus	0	1	1		
		Pseudomonas	0	2	2		
		Sterile	9	28	37		
6.	Guy's Stone Score (GSS) grade	1	9	25	34	2.149[a]	0.542
		2	1	8	9		
		3	2	3	5		
		4	1	1	2		
7.	Hydronephrosis	Yes	10	18	28	3.121[a]	0.077
		No	3	19	22		

Table 6- Comparison between pre-op variables and peri-op bleeding.

S NO	Preoperative variables		Peri-op bleeding		Total	Pearson Chi-Square	p- value
			Yes	No			
1.	Age	21-30 Yrs	2	9	11	4.417[a]	0.353
		31-40 Yrs	2	11	13		
		41-50 Yrs	4	5	9		
		51-60 Yrs	1	10	11		
		61-70 Yrs	1	5	6		
2.	Sex	Male	6	26	32	0.087[a]	0.768
		Female	4	14	18		
3.	BMI	19- 24.9	5	15	20	0.769[a]	0.681
		25-29.9	3	18	21		
		>30	2	7	9		
4.	Comorbidities	NIL	8	32	40	5.833[a]	0.12
		DM2	0	4	4		
		HTN	2	1	3		
		DM2 & HTN	0	3	3		
5.	Urine culture	E coli	5	5	10	14.020[a]	0.003
		Proteus	1	0	1		
		Pseudomonas	1	1	2		
		Sterile	3	34	37		
6.	Guy`s Stone Score	1	3	31	34	15.682[a]	0.001
		2	2	7	9		
		3	3	2	5		
		4	2	0	2		
7.	Hydronephrosis	Yes	9	19	28	5.864[a]	0.015

DISCUSSION

Renal stone disease is a common disease in all societies and its incidence is fairly high. It is important to know the clinical profile and environmental factors of the patients of renal stone disease as it is useful in advising people for taking preventive measures for reducing the risk of disease as well as in treatment of the patient.[20] Percutaneous Nephrolithotomy is established and commonly practised treatment modalities for renal calculi. Stone location, size, and hydronephrosis are among significant factors affecting PCNL surgery outcomes. Although, percutaneous nephrolithotomy (PCNL) has been accepted as a standard method for the management of large renal stones, the incidence of complications is relatively high.[21] Therefore, correlation of pre-op variables with outcome of the PCNL surgery is an important consideration to assess better surgical outcome.

Stone clearance and pre-op patient profile

In our study of 50 patients with age range 23 to 68 years, 44 (88%) patients were less than 60 years of age and 6(12%) were more than 60 years of age. Out of which, 7 patients had incomplete clearance of stone. The association between clearance and age was not statistically significant (p value 0.131) which is similar to Morganstern et al study where they found no statistically significant difference between elderly (>65 years) and less in accomplishing stone free status.[22] Even CROES study also found similar results with respect to stone clearance and age.[23]

There were 20 patients with BMI (19-24.9 kg/m2), out of which 17(85%) had complete clearance and 3(15%) had residual stones. There were 21 patients with (BMI 25-29.9 kg/m2) among which, incomplete stone clearance was found in 1 patient and 9 patients were obese with BMI more than 30kg/m2, out of them, incomplete stone clearance was found in 3(33%) patients. The relation between clearance and BMI was not statistically significant (p-0.117) which is similar to Shohab et al. study where they showed no statistically significant difference with respect to mean stone clearance in normal, obese and overweight patients undergoing PCNL.[24] However Fuller et al. in a retrospective analysis of 5803 patients found an inferior stone-free rate in overweight and obese persons as compared with normal BMI patients.[25]

We also observed that, co-morbidities was significantly associated with stone clearance with p- value 0.04. Out of 10 patients who had Comorbidity in form of DM2 or Hypertension, 3(30%) patients had incomplete stone clearance. This is in contrast to studies by Dudevani et al.[26] and Nakamon et al.[27]

In our study it was observed that, with increasing complexity of stone with respect to position and location as assessed by Guy stone score, there was decreasing clearance and it is statistically significant (p value 0.004). The Guy`s stone score (GSS) includes stone number, location, presence of staghorn stones and abnormal anatomy to determine different grades, and it was reported that the Stone Free Status (SFS) declined with increasing grades of complexity. This was in accordance with a study by Ricchiuti et al[28] where they elucidated that as stone size increases, stone free rates decline from 87.5% (in 2–3 cm stone size) to 40% in size greater than 4 cm.[28] In a recent study by Sinha et al found that the GSS is highly associated with stone free clearance and can be used to predict the clearance rate.[29]

Fever and pre-op variables

In our study, it was observed the association of age of patient and post op fever is not significant p (p value 0.164) which is similar to study by Benson et al. where he found elderly patients with renal calculus who underwent PCNL did not have fevers, SIRS, sepsis or overall complications, in comparison to younger age group patients.[30] However, Krambeck et al. reported as age increases, PCNL for nephrolithiasis in the elderly was more likely have post-op fevers.[31]

Out of 32 male patients, 10 (32%) patients developed fever >38.5^{O}C in post-op period, whereas 3 patients out of 18 female patients developed fever. However, gender (p value 0.259) was not significantly associated with post-op fever in patients undergoing PCNL which is in concurrence with study by Yang et al. who showed no association between gender and Post op fever in patients undergoing PCNL (p-0.761).[32] Guatirez et al also had similar findings (p-0.971)[33] whereas, Sharifi et al found in his study that, post op fever is more common in female patients undergoing PCNL (p-0.01).[34]

In our study population, 6 patients had post-op fever with BMI (19- 24.9 kg/m2). Among overweight person (BMI 25-29.9 kg/m2) 5 (21%) patients developed post-op fever. Two obese persons with BMI more than 30kg/m2 had post-op fever. However, this did not show statistically correlation between Post-op fever and BMI. This observation is similar to the study by Sergeyev et al. who found no significant correlation between incidence of postoperative fever and BMI in patients undergoing PCNL.[35] Shin et al also found there is no significant association between BMI and post op fever (p value 0.85).[36]

Out of 10 patients with comorbidities, 6(60%) patients developed post-operative fever which was statistically significant (p value 0.027). This is similar to study by CROES group.[8] Ronald et al also found Diabetic patients undergoing PCNL were at a significantly greater risk of developing urinary tract infections and fever during the postoperative period (p value 0.023).[37]

We observed 13 patients who had preoperative positive urine culture report, 4 patients developed post-op fever. Although, this observation was not statistically significant (p value-0.547) and similar to finding of

Etemadian et al study.[38] However, most studies with higher number of patients found a positive correlation between preoperative urine culture and post op fever. During PCNL, the bacteria and endotoxin may be released from manipulation of stone or obstructed system, which may cause SIRS and fever. In our study probably because of effective pre-operative antibiotics the incidence of post-op fever was less and moreover the incidence of staghorn calculus in our study is low (1%) as compared with study by Guitierrez et al where incidence of staghorn calculi was more than 4%.[39]

In our study, hydronephrosis was not significantly associated with post op fever (p- value 0.077) which was most probably due to good pre-op antibiotics cover. However, hydronephrosis has been proposed to be associated with increased risk of postoperative infectious complications by Chen et al.[40] Hydronephrosis is a manifestation of poor drainage of the renal collecting system; therefore, it is possible to assume that kidney with impaired drainage is more likely to be infected.

Bleeding and pre-op variables

In our study, we did not find statistically significant relation between age (p- value 0.353), gender (p- value 0.768) and BMI (p- value 0.681) with bleeding during PCNL. Similar result also found by Morganstern et al,[41] Bagrodia et al.[42] and Shakhawan et al[43] studies. Similarly, we also found that patients with diabetes and hypertension were not significantly prone for post op hemorrhage p- value (0.120) which was in agreement with Stoller et al.[44] and Lee et al.[45] studies who had reported that the rate of transfusion similar in patients with Diabetes and without it. However, this finding was in contrast to study by Pardalidis et al. who observed diabetic patients are prone to increased blood loss due to associated arteriosclerosis and thickened basement membranes which makes such patients more prone to bleeding after the initial trauma of tract formation.[46] Anil Kumar et al. also had similar finding, they showed diabetes and hypertension had significant association with Post PCNL massive hematuria (p value < 0.05).[47]

In our study, we found 13 patients had preoperative positive urine culture among which 7 patients had perioperative bleeding which was statistically significant with p value 0.003. This was in accord with study by Huang et al who preoperative positive urine culture as a risk factor for massive hematuria post PCNL.[48] Similarly, we also observed that there was strong association of increasing complexity of stone and perioperative bleeding with p value 0.001 which was similar to study by Hueng et al (p value< 0.001) [48]. The occurrence of intraoperative pelvicalyceal perforations and complex stones are recognized risk factors for post-PCNL bleeding. Turna et al.[49] and Zehri et al.[50] who reported that partial (GSS grade 3) and complete staghorn (GSS grade 4) stones are more prone for bleeding due to more need of maneuvers to completely clear of the calyces from stone fragments, hence increasing the chance of more parenchymal and pelvicalyceal injury, which can lead to bleeding. However, Stroler et al. did not find any association with the postoperative bleeding rate and shape, position, composition, stone size, location of nephrostomy, and methods of nephrostomy dilatation.[51] Similarly, out of the 28 patients who had preoperative hydronephrosis, 9 patients had significant perioperative bleeding which was statistically significant with p value 0.015 which is in contrast to study by Shrivastav et al. who found no association with hydronephrosis and post op bleeding (p value-056).[52] Lee et al. found absence of hydronephrosis were significantly associated with the risk of severe bleeding during PCNL (p value 0.004). [53] The reason for peri-op bleeding following PCNL surgery in case of hydronephrosis could be due to abnormal vessels passing through hydronephrosis system.

CONCLUSION

In this study, we correlated pre-op variables of the patients with post-op outcome after PCNL surgery and found that most common outcomes following PCNL surgery were complete/incomplete stone clearance, post-op fever and peri-op bleeding. None of the patients had major complications like loss of renal function, pneumothorax, visceral injury, urinoma, urosepsis or death. The conclusion drawn from this study are as under-

1. Stone clearance is significantly associated with comorbidity and increasing GSS. It is not statistically associated with age, sex, BMI, positive urine culture report and hydronephrosis.
2. Post-op fever >38.5^{O}C is significantly associated with comorbidity and not associated with other elaborated pre-op variables of the patient.
3. Peri-op bleeding is significantly associated with preoperative urine culture, increasing GSS and hydronephrosis.
4. PCNL has a good success rate in terms of stone free status. However, it may lead to minor complications like peri-op bleeding requiring blood transfusion which can be managed non-operatively.
5. The Modified Clavien Grading System is useful for comparison and reporting of the complications following percutaneous nephrolithotomy.

Limitations

1. The patients included were those who underwent surgery for renal calculi represented a very small subset of population.
2. It was a single institution based observational study conducted in a limited time frame.

Recommendation

1. PCNL is a safe and effective procedure for the treatment of renal calculi.
2. Further studies with larger patient numbers and longer follow up is needed to accurately study the profile and management outcomes of patients undergoing PCNL for the treatment of renal calculi.

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