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Original Research Article

Risk Factors for Infectious Complications of Ureteroscopy Following Obstructive Acute Pyelonephritis

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Abstract:

Background and Aim: Kidney stone disease is a frequently seen condition in urologic practice. Urinary tract infection (UTI) is often linked to KSD, both as a cause (such as struvite and carbonate apatite stones) and as a potential complication (like obstructive pyelonephritis and post-operative UTI). It is worth noting that a considerable amount of the financial strain caused by KSD is primarily focused on stones that are linked to infection. Our study sought to investigate the results of URS following OAPN in a significant patient population. Additionally, we aimed to evaluate potential risk factors such as RIRS and the time interval between OAPN and URS. The ultimate goal was to improve the management of patients who undergo stone removal after OAPN.

Material and Methods: The study was conducted at a Department of General Surgery in a Tertiary Care Teaching Institute in India for duration of 1 year. An analysis was conducted on the data of patients who were referred to Study hospital and diagnosed with OAPN secondary to urinary calculi. The study focused on those who underwent emergency drainage over the past three years. Patient records were examined to gather important information on various factors that could contribute to postoperative complications. These factors included age, sex, body mass index (BMI), presence of diabetes mellitus, leucocyte counts and C-reactive protein at presentation of OAPN, type of preoperative drainage, days from drainage to surgery, operative time, and stone factors.

Results: 12 cases underwent auxiliary shockwave lithotripsy. There were no deaths during the perioperative period. Several factors were found to be potential risk factors associated with postoperative UTI, including the presence of diabetes mellitus, duration from drainage to surgery of over one month, a high stone burden, simultaneous RIRS, and an operation time exceeding 75 minutes. These findings were statistically significant with a p value of less than 0.05.

Conclusion: Individuals who had previous OAPN faced a higher likelihood of experiencing postoperative infectious complications. Several factors were found to be significant predictors of postoperative UTI, including diabetes mellitus, duration of more than one month from drainage to surgery, and undergoing simultaneous RIRS. Our findings indicated that there is a potential correlation between.

Keywords: Acute Pyelonephritis, Body Mass Index, Diabetes Mellitus, Ureteroscopy.

Introduction

Statistics show that a significant portion of adults will experience kidney stone disease at some point in their lives. The likelihood of developing a stone can differ based on factors such as age, gender, race, and where a person lives. [1]

For individuals experiencing symptoms from ureteral or renal stones, the usual approach involves providing pain relief, administering medical expulsive therapy, and regularly monitoring the stone's location and checking for hydronephrosis. However, if individuals experience on-going complications such as pain, nausea, and renal insufficiency, it may be necessary to pursue definitive treatment for the stones. There are various surgical options for treating stone disease, such as ureteroscopy (URS), shockwave lithotripsy, and percutaneous nephrolithotomy. The choice of treatment is primarily influenced by the patient's preferences, symptoms, and the size and location of the stone.

Obstructive acute pyelonephritis (OAPN) caused by ureteral stones is a serious urologic condition

that demands immediate attention. It is crucial to promptly drain the urinary collecting system through stenting or percutaneous nephrostomy (PNS). OAPN can be a serious condition, with a potential risk of progressing to sepsis. It is important to note that reported mortality rates are around 2%, highlighting the potential life-threatening nature of this condition. [2,3] Managing OAPN has become increasingly crucial due to the growing number of OAPN cases and the sepsis it can cause. [4] Patients who have recovered from OAPN need to have obstructive stones removed. Nevertheless, the on-going issue of infection recurring after the surgical procedure has raised concerns. Patients with a history of OAPN face a higher risk of postoperative complications, but the best approach to managing these patients is still unclear. [5-7]

In recent research, the results of URS with previous OAPN have been examined. [8-10] several risk factors for postoperative complications were identified in these studies. According to a study, it is crucial to completely remove the stone in order to prevent the recurrence of OAPN. Nevertheless, the safety of retrograde intrarenal surgery (RIRS) for the removal of concomitant renal stones remains uncertain.

In addition, a brief period between OAPN and surgery could potentially lead to more complications, while leaving the drainage tube in place for a longer time has been linked to a higher risk of postoperative infection. There is still a lack of clarity regarding the treatment of infected stones, leaving many questions unanswered. In this study, we sought to investigate the results of URS following OAPN in a significant number of patients. Additionally, we examined potential risk factors such as RIRS and the time interval between OAPN and URS. Our goal was to improve the management of patients who undergo stone removal after OAPN.

Material and Methods

The study was conducted at a prestigious Department of General Surgery in India over a period of one year. An analysis was conducted on the data of patients who were referred to Study hospital, diagnosed with OAPN secondary to urinary calculi, and underwent emergency drainage over the past three years. One of the criteria for OPN is the presence of obvious obstructive stones. If the body temperature exceeds 38°C or if there are symptoms that strongly indicate systemic inflammation, it is important to take immediate action. Excluded from the study were patients who did not receive definitive treatment or underwent a different treatment than URS.

The drainage of OAPN was primarily achieved through the use of ureteral stenting. A 6-Fr ureteral stent was placed retrograde, while the patient was under transurethral anaesthesia, with or without sacral spinal anaesthesia. A PNS procedure was carried out under local anaesthesia using a 7-Fr pigtail stent when retrograde placement was not feasible. The infection was effectively treated with the appropriate antibiotics, as determined by the urine culture. The stone removal procedure using URS was successfully carried out after the completion of the prescribed antibiotics. Preoperative administration of first-generation cephalosporins or other antibiotics that are susceptible according to urine culture was carried out. The ureter was thoroughly examined during URS using semi-rigid ureteroscopy to detect any stones or strictures. During the procedure, a ureteral access sheath was inserted. A 200-mm Holmium laser fibre was utilised for renal calculi fragmentation using flexible ureteroscopy. A double-J stent was inserted after the surgery and left in place for a few days. Antibiotics were also given for a short period of time after the surgery.

The main focus was on postoperative infectious complications, which were evaluated using strict criteria derived from the existing literature.[11] An infection that requires antibiotic administration beyond the prophylactic dose is considered a postoperative urinary tract infection (UTI). In order to diagnose sepsis, medical professionals look for certain criteria. These include abnormal body temperature, elevated heart rate, rapid breathing, and abnormal white blood cell count. These indicators help identify the presence of a urinary tract infection along with a systemic inflammatory response. Sepsis with organ dysfunction is classified as severe sepsis.

Patient records were used to collect basic patient characteristics and previously reported risk factors for postoperative complications. These included age, sex, body mass index (BMI), Eastern Cooperative Oncology Group performance status (ECOG-PS), presence of diabetes mellitus, leucocyte counts and C-reactive protein at presentation of OAPN, admission in the intensive care unit, type of preoperative drainage, days from drainage to surgery, operative time, and stone factors.

The factors that were considered included the size of the stone, the amount of stone present, where the stone was located, whether the patient was stone-free after surgery, and the composition of the stone. Urine culture results were not included in the analysis since it is expected that all patients with OAPN would have bacteriuria.

Statistical analysis

The data was compiled and entered into a spread sheet computer programme (Microsoft Excel 2007) and then exported to the data editor page of SPSS

version 15 (SPSS Inc., Chicago, Illinois, USA). The quantitative variables were reported using either means and standard deviations or median and interquartile range, depending on their distribution. The data was presented in the form of counts and percentages, highlighting the qualitative variables. Confidence level and level of significance were set at 95% and 5% respectively for all tests.

Results

In total, 378 patients were referred to our hospital due to OAPN caused by urinary calculi and received emergency drainage. Following the exclusion process, a total of 200 patients were included in this study.

The patient characteristics are provided in Table 1. The patients had an average age of 70.12 years, and 124 (62%) of them were females. A total of 38 patients (19%) in this study had diabetes mellitus, while 80 patients (40%) had an ECOG-PS score of 2 or higher. The median levels of C-reactive protein and leucocyte counts were measured at 11.3 mg/dL and 11100 /mL, respectively. A total of 24 patients, or 12.0% of the total, needed to be hospitalised in the intensive care unit.

Emergency drainage was performed using a ureteral stent in 188 patients (94%) and percutaneous nephrostomy tube in 12 patients (6%). Out of all the patients, 26 individuals (13% of the total) experienced a waiting time exceeding one month. On average, the duration from drainage to URS was 21 days. The average maximum stone size and stone burden were 12.3 and 21.9 mm, respectively. During surgery, 58 (29%) stones were located at the ureter, 28 (14%) at the kidneys, and 114 (57%) at both the ureter and kidneys. Among the 200 patients with renal stones, 168 (84%) underwent RIRS. Of the 58 patients with ureteral stone alone, 28 (48.2%) needed RIRS for fragments that were pushed up during surgery.

Accordingly, the mean operative time was 62.1 min, while 168 (84%) patients achieved stone-free status after a single session. Auxiliary shockwave lithotripsy was performed in 12 cases. No perioperative mortality was observed. Out of the total number of patients, 32 individuals (16%) were diagnosed with UTI. Among these patients, 16 (8%) developed sepsis, while 6 (3%) experienced severe sepsis. Three patients needed to have their drainage tubes replaced.

Several factors were found to be potential risk factors associated with postoperative UTI. These include the presence of diabetes mellitus, a duration from drainage to surgery of more than one month, stone burden, simultaneous RIRS, and an operation time of more than 75 minutes. These findings were determined through univariate analysis and were found to have a significant p value of less than 0.05. Meanwhile, a multivariable analysis revealed that the highest AIC values were associated with a combination of diabetes mellitus, duration of more than one month from drainage to surgery, and the presence of RIRS.

Table 1: Characteristics of the study population

Variables	Number
Age, years	70.12 ± 14.12
Gender, female	124 (62%)
BMI, kg/m2	21.7 ± 4.2
Diabetes mellitus	38 (19%)
ECOG-PS ≥ 2	80 (40%)
C-reactive protein, mg/dL	11.3 (5.6–20.6)
Leukocyte counts, 103 /mL	11.7 (8.3–15.1)
Type of drainage	
Stent	188 (94%)
PNS	12 (6)
Drainage to op >1 month, yes	26 (13)
Stone location at surgery	
Ureter	58 (29)
kidney	28 (14)
ureter + kidney	114 (57)

Table 2: Surgical outcomes of ureteroscopy

Variables	Number
Operation time, min	62.1 ± 34.2
Stone-free status	168 (84%)
Infection stone	64 (32%)
Auxillary treatment	12 (6%)
Postoperative complications	36 (18%)

UTI	32 (16%)
Sepsis	16 (8%)
Severe sepsis	6 (3%)
Infection other than UTI	2 (1%)
Cardiovascular	1 (0.5%)
Perirenal hemorrhage	1 (0.5%)

Discussion

Identifying risk factors for urosepsis after URS would provide valuable information to patients, physicians, and health care policy makers, given the significant clinical and economic burden associated with this complication. While some have discussed the factors that contribute to generalised infectious complications. [12,13]

The study analyzed the outcomes of 200 patients following OAPN. The rate of patients without stones was 84%, with 16% experiencing complications, primarily UTIs. Several factors were found to be significant predictors of postoperative UTI, including diabetes mellitus, a duration of more than one month from drainage to surgery, and RIRS.

According to our findings, the incidence of urinary tract infections (UTIs) following ureteroscopy (URS) in patients with a history of obstructive acute pyelonephritis (OAPN) was found to be 16%. In addition to the current study, numerous studies have investigated the results of URS in patients who have undergone OAPN. [14-16]

In a recent study, 82 URS procedures were examined, revealing a complication rate of 4%. Additionally, a retrospective study analyzed 115 URS providers after OAPN and found a postoperative UTI rate of 27.8%. [17] The varying complication rates suggest that the differences in patient characteristics or procedures performed in these studies have a significant influence on postoperative morbidity.

According to the latest research, there is a significant link between RIRS and postoperative UTI. There have been reports of high intrarenal pressure during renal stone treatment causing the absorption of irrigation fluid that contains bacteria. This absorption can potentially lead to urinary tract infections (UTIs). A specific study found that intrarenal pressures were higher during RIRS compared to PCNL. [18,19] There is a range of infectious complications that can occur, including fever, urinary tract infection, pyelonephritis, systemic inflammatory response syndrome, and urosepsis. It is important to customise antibiotics based on local resistance profiles in order to lower infection and urosepsis rates. [20]

According to Baboudjian et al., implementing strategies such as minimising operative times and addressing pre-operative UTIs can potentially result in lower rates of postoperative infections. [21] Patients who have undergone surgery without previous OAPN have not considered RIRS as a risk factor for infectious complications. Even with a full course of antibiotics for OAPN, the presence of biofilms on the stent can still contribute to bacterial growth. It is worth considering that infected kidneys could potentially be more susceptible to intra-renal pressure. Patients with previous OAPN should undergo careful preparation before undergoing RIRS. Considering that the stone-free rate did not have a significant impact, patients with both ureter and renal stones may want to consider a two-stage surgery. However, additional investigation is needed to ensure the safety of the staged surgery.

In this study, it was discovered that when the time between drainage and URS exceeded one month, there was a significant correlation with postoperative UTI. Studies have indicated that when a stent remains in place for more than 1 month, there is an increased risk of developing post-URS sepsis. Our findings revealed that there was no correlation between being female and experiencing infectious complications, even though numerous recent systematic reviews have highlighted it as a major risk factor. [22,23] Female patients may be more susceptible to bacterial invasion due to the anatomical differences in their urethra. Given that all patients with OAPN had infected urine, it appears that the influence of sex is relatively insignificant.

It is important to recognise the limitations of the current study when interpreting the results. Given the retrospective design and long study period, there was a lack of standardization in surgical and perioperative management.

Conclusion

Individuals who had previous OAPN faced a higher likelihood of experiencing postoperative infectious complications. Several factors were found to be significant predictors of postoperative UTI, including diabetes mellitus, duration of drainage to surgery exceeding one month, and undergoing simultaneous RIRS. It is important to carefully plan simultaneous RIRS, particularly for patients with diabetes mellitus or long waiting times for URS, according to our study findings.

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