Original Article

Complications of ureteroscopy with intracorporeal lithotripsy in patients with urinary tract infection

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Keywords:
Ureteric calculi, ureteroscopy, lithotripsy, urosepsis, SIRS, complications

Abstract

Objective: To study the risk of complications associated with ureteroscopy with intracorporeal lithotripsy in patients with urinary tract infection.

Materials and Methods: 420 patients who underwent ureteroscopy with lithotripsy from March 2022 to March 2024 in Sisaket Hospital were enrolled onto this study. Data pertinent to baseline characteristics, perioperative variables, successful outcome and associated complications were collected retrospectively. The efficacy of the procedure, including complications, length of hospital stay, and pain score, was analyzed and comparisons were made between patients with and without sepsis.

Results: 89 patients were categorized as being in the sepsis group, and 331 patients in the non-sepsis group. The average age in the sepsis group was 51.2 years and patients in the non-sepsis group were slightly older at 55.56 years. 58.43% of the sepsis group had no underlying disease, and 56.19% of the non-sepsis group ($p = 0.706$). There was no significant difference betweentotal complications in the sepsis and non-sepsis group at 24.72% and 18.73% respectively ($p = 0.221$). The most common complication was post-operative fever. There were no serious complication in the sepsis group. The mean hospital stay in the sepsis group was 3.99 days, which is significantly higher than in the non-sepsis or controlgroup, which was 2.94 days ($p = 0.002$). The pain score in the sepsis was significantly higher than in the controls.

Conclusion: Our study demonstrated that the postoperative complications of URSL in a non-sepsis group are comparable to the sepsis group. But sepsis increased the length of hospital stay and resulted in higher postoperative pain. The definitive treatment with URSL is safe for ureteric stone in mild sepsis patients. However, further large comparative studies with adequate follow-up stone clearance are recommended to support our results.

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Introduction

Ureteric calculi are a form of urinary calculi, which are one of the most prevalent urinary problems worldwide with a rate of 1-5% in Asia and 16.90% in the northeast region of Thailand. This is widely believed to be the country is located in a tropical area, resulting in an increased rate of the condition. The calculi found in patients in the northeast region of Thailand are calcium-containing stones (whewellite, dahllite, and weddellite).[1-3]

The presence of ureteric calculi can have consequences at multiple levels of severity and can involve pain, infection, urinary obstruction leading to renal failure or being a cause of death. The current treatment according to European Association of Urology Guidelines is ureteroscopy, a standard treatment for ureteral stone patients with a low rate of spontaneous passage, pain with optimal pain medication or urinary obstruction and renal failure. Ureterscopy can remove all stones with one operation, despite the potential for complications and longer admission time.

The most common postoperative complications are fever and urinary tract infection, which increase the mortality rate of patients. Current evidence suggests that among patients undergoing ureteroscopy (URS) for treatment of stone disease, the risk of postoperative urosepsis is 5.00%.[4] Increased infection rate can be found in elderly patients or patients with a Sequential Organ Failure Assessment (SOFA) score of at least 2, and patients with upper urinary tract stones.[5] At present, there is no specific study regarding post-ureteroscopic infection prevention. The sole recommendation at present is preprocedural treatment to limit or eliminate the potential for infection in patients who will undergo a surgical procedure for stone removal by upper tract urinary diversion (with a ureteral stent or percutaneous nephrostomy tube). Patients face an elevated risk of complications in association with stent placement hence, the procedure is avoided in patients with untreated urinary tract infections (UTI). There is no clear criteria to assess the level of severity or any definition for the mentioned UTI evaluation.[6] However, in a study by Mohamed Bakr, in emergency treatment of URS in patients with mild sepsis, no difference in outcome, complications, or admission time was found, in comparing preop-procedures associated with double-J ureteral stent insertion with definitive URS management of ureteral stone after resolution of sepsis.[7]

The definition of sepsis as described in the third international consensus on sepsis and septic shock (sepsis-3) is "life-threatening organ dysfunction due to a dysregulated host response to infection".[8] A study by Eamon and colleagues found that in a study involving 184,875 patients, urinary tract infection was found as the second most common cause of sepsis, following pulmonary infection. Sepsis was shown to be an important cause of increasing the mortality rate of patients to 20.00% regarding severity level of infection. Currently many criteria can be applied in the evaluation of infection, although Sepsis-3 provides recommendations in the quick Sequential Organ Failure Assessment (qSOFA) for patient assessment. From a review of pertinentliterature, the qSOFA has a high specificity rating, however has the lowest sensitivity in comparison to Systemic Inflammatory Response Syndrome (SIRS) and National Early Warning Score (NEWS). Consequently, the guidelines in 2021 still recommended SIRS and NEWS for patient assessment. This study used SIRS because it has the highest level of sensitivity.[9-11] Any complications associated with the surgery were classified and collected by using the Clavien-Dindo Classification (Table 1).

The objective of this study is to study the safety of ureteroscopy with intracorporeal lithotripsy in patients with sepsis. Is there a significant difference in complications of ureteroscopy with intracorporeal lithotripsy between patients with and without sepsis?

Materials and Methods

Study design

This retrospective study was approved by the institutional review board (COA no.010/2024). Data concerning 420 patients were retrospectively reviewed. Patients who met the inclusion criteria and underwent ureteroscopy with lithotripsy in Sisaket Hospital between March 2022 and March 2024 were enrolled onto this study. Exclusion criteria were patients with multi-organ failure, incomplete data records, dying due to non-operative causes, or refusing treatment. The patients were divided into two groups: the group with urinary tract infection (sepsis) which included patients with a SIRS score of at least 2 with symptoms of UTI (dysuria, frequency, urgency,

Table 1. The complications associated with surgery using The Clavien-Dindo Classification.

Grade	Definition
I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, or radiological interventions.
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. *Blood transfusions and total parenteral nutrition are also included.
III	Requiring surgical, endoscopic, or radiological intervention.
IIIa	Intervention not under general anaesthesia.
IIIb	Intervention under general anaesthesia.
IV	Life-threatening complications requiring intermediate care/intensive care unit management. *Includes central nervous system complications.
IVa	Single-organ dysfunction. *Includes dialysis.
IVb	Multiple-organ dysfunction.
V	Death of the patient.

suprapubic pain, chills, fever, and flank pain) and the group that had no clinical urinary tract infection (control / non-sepsis). Sepsis identification criteria in the study were aSIRS of at least 2 with an infection (body temperature more than 38° C or less than 36° C, a heart rate more than 90 / minute, a respiratory rate more than 20 /minute or a $paCO_2$ less than 32 mmHg and a white blood cell count of more than 12,000 /cubic millimeter or less than 4,000 /cubic millimeter or band form more than 10.00%. Primary outcome was complications associated with surgery (Clavien-Dindo classification) and the secondary outcome was length of hospital stay.

Baseline characteristics were recorded, including age, gender, body mass index (BMI), comorbidity, duration of symptoms, need for antibiotics and timing of antibiotics before operation, urine culture, stone location, extent and degree of hydronephrosis. Data related to surgery were recorded, including time of operation, postoperative stenting, stone fragmentation, surgeon and anesthesia. Postoperative data were recorded for analysis of outcome, including perioperative and postoperative complications and length of hospital stay, also postoperative pain score.

Surgical procedure

The URSL procedure involved the placing of the patients in the lithotomy position, and the insertion of an 8/9.8 Fr semi-rigid ureteroscope (Richard Wolf, Germany)approach the stone. The stone was then fragmented with pneumatic intracorporeal lithotripsy (Swiss LithoClast-EMS Medical, Switzerland) or holmium YAG laser (Richard Wolf, Germany) and stone forceps were used to extract the fragments of the stone. After the operation was done, a 4.8 Fr, 26 cm Double-J ureteral, open-end Ureteral catheter stent or no postoperative stent was inserted, as directed by the surgeons.

Data analysis

Descriptive statistics are reported as number, percentage, mean and standard deviation. Inferential statistics were used to compare complications using the Chi square test and exact probability test. Length of hospital stay was compared using an independent t-test or Mann Whitney U test, depending on data distribution.

Results

A total of 420 cases were included in the study, the sepsis group = 89, the non-sepsis or control group = 331. The demographic data and clinical characteristics of both groups are shown in Table 2.

The average age of the sepsis group was 51.2 years and the control group was 55.56 years. 58.40% of the sepsis patients were male, average BMI was 23.3 kg/m^2. Duration of symptoms is significantly different between the groups. in the sepsis group average duration was shorter than control group (11.5 and 38.3 days, respectively, $p < 0.001$). No statistical difference was found between the duration of the antibiotic use with sepsis group being 24.3 hours, and the control group 19.6 hours.

58.43% of the sepsis group had no underlying disease, and 56.19% of the controls ($p = 0.706$).

Table 2. The demographic data and clinical characteristics (N= 420)

	Sepsis group (n=89)	Normal group (n=331)	P-value
Gender n (%)			0.520
Malen	52 (58.43)	181 (54.68)	
Female	37 (41.57)	150 (45.32)	
Age (years), mean (SD)	51.24 (14.79)	55.56 (11.96)	0.004
BMI (kg/m^2), mean (SD)	23.3 (4.33)	24.08 (4.42)	0.137
Comorbidity, n (%)			0.706
None	52 (58.43)	186 (56.19)	
Diabetes melitus	14 (37.84)	37 (25.52)	
Cardiovascular disease	0 (0.00)	5 (3.45)	
Chronic kidney disease	9 (24.32)	35 (24.14)	
Immunosuppressive	1 (2.70)	1 (0.69)	
Hypertension	7 (18.92)	39 (26.90)	
Orthers	6 (16.22)	29 (19.31)	
Duration of symptoms (mean, day)	11.56 (21.32)	38.32 (50.04)	< 0.001
Duration of antimicrobial (mean, hour)	24.31 (32.05)	19.63 (13.48)	0.039
Urine culture, n (%)			0.280
Negative	72 (80.90)	283 (85.50)	
E. Coli	17 (19.10)	48 (14.50)	
Klebsiella pneumoniae	5 (29.41)	5 (54.17)	
Proteus mirabilis	3 (17.65)	4 (8.33)	
Enterococcus faecalis	2 (11.76)	3 (6.25)	
Enterobacter	1 (5.88)	3 (6.25)	
Acinetobacter baumannii	2 (11.76)	1 (2.08)	
Staphylococcus spp.	0 (0.00)	4 (8.33)	
Maximum stone diameter (cm), mean (SD)	1.12 (0.75)	0.85 (0.44)	0.001
Location of stone, n (%)			0.002
Proximal ureter	20 (2.47)	121 (36.56)	
Mid ureter	9 (10.11)	32 (9.67)	
Distal ureter	42 (47.19)	152 (45.92)	
Ureterovesical junction	18 (20.22)	26 (7.85)	
Degree of hydronephrosis, n (%)			0.071
None	0 (0.00)	16 (4.83)	
Mild	43 (48.31)	170 (51.36)	
Moderate	43 (48.31)	126 (38.07)	
Severe	3 (3.37)	19 (5.74)	

SD = standard deviation, BMI = body mass index

In both groups, the most common comorbidity was diabetes mellitus 25.52% and 24.32% in the sepsis and controlgroups, respectively (p = 0.434). The second most common in the control group was hypertension, 26.90% and in the sepsis group was chronic kidney disease, 24.32%.

In most common locations of stone in both groups were distal followed by proximal, and the most common degree of hydronephrosis was mild. Positive urine culture in the sepsis group and control group were 14.50% and 19.10% respectively, these results showed no statistically significant difference (p = 0.287). *E.coli* was the most common pathogen in both groups.

Patients in the sepsis group had not received previous treatment 87.64%, a higher number than the control group 66.16% (p = 0.002). The operative treatment in the non-sepsis group was DJ stent insertion(14.20%), ESWL (8.16%) and URS (5.44%). Whereas, in the sepsis group was URS (5.62%), DJ stent (3.37%) and PCN insertion (2.25%). The mean operative time in the sepsis group was 22.11 minutes (SD = 14.12) and in the non-sepsis group was 23.98 minutes (SD = 16.50)

(p = 0.329), showing no significant difference. After surgery a DJ stent was most frequently inserted in the sepsis group 51.69% , and a ureteric catheter in 33.71% of cases; in the non-sepsis group DJ stent was used in 43.20% of cases and ureteric catheter 32.93%. Stone fragmentation was almost always done using pneumatic lithotripsy in both groups.

Outcome

Total complications in the sepsis and non-sepsis groups were 24.72% and 18.73% respectively (p = 0.221), showing no significant difference. In the non-sepsis group, intraoperative and postoperative complications were classified using to the Clavien-Dindo system: Grade I complications occurred in 43 patients, including postoperative fever in 42 patients and hematuria in 1 patient. Grade II 10 patients (postoperative UTI 6, AUR 1 and hematuria 3), grade III 7 patients (ureteric perforation 1, mucosal injury 2 and stone retropulsion to kidney 3, bleeding intraoperation 1 all cases were managed by Double-J ureteral stent insertion) and grade IVa 2 patients, both patients having septic shock with acute respiratory failure and required transfer to ICU. Meanwhile, in the sepsis group, Grade I complications were observed in 18 patients. (postop fever 18), and Grade II 4 patients (postop UTI 1, Hematuria with clot retention 3 which was managed by retained Foley catheter with continued bladder irrigation.) There were no serious complication in the sepsis group. The mean hospital stay in the sepsis patients was 3.99, higher than the control groups which was 2.94 days (p = 0.002). Thepain score in sepsis patients was significantly higher than the non-sepsis group (1.17 and 0.77, respectively, p = 0.007). No patients in the sepsis group returned to the hospital but 3 patients in the non-sepsis group revisited the hospital within 30 days postoperative.The cause of the revisit was hematuria in 2 cases and urinary tract infection in 1 case.

Discussion

In this study, we aimed to evaluate the ability to definitively treat with URSL and compare postoperative complications to patients with no sepsis. Current standard guidelines according to EAU state that although most small ureteric calculi can be spontaneously passed, some patients develop complications (infection, refractory pain, deterioration of renal function) and need a stone removal procedure. Indications for removal of ureteral stones are stones with a low likelihood of spontaneous passage, persistent pain despite adequate analgesic medication, persistent obstruction and renal insufficiency (renal failure, bilateral obstruction, or single kidney). But if a patient develops a clinically significant infection and obstruction, guidelines suggest to treat infection with subsequent drainage for several days before starting stone removal. However, in a study by Mohamed Bakr, for ureterolithotomy in patients with mild sepsis, no differences with regard to safety and complications, or length of admission, were found, in comparison to preop-procedure Double-J ureteral stent insertion with definitive URS management.[6,7] A systematic review showed that older age, comorbidities such as diabetes mellitus and ischemic heart disease, preoperative stent placement, positive urine culture, and longer procedure time were independently associated with increased postoperative urosepsis risk.[4] Also, Laih et al found that age, operative time, hydronephrosis, proximal location, SOFA and qSOFA scores were significantly associated with postoperative sepsis with SOFA score being the highest predictor of sepsis.[12]

Our results showed that baseline characteristics, degree of hydronephrosis and stone position in both groups were not significantly different, with the exception of the average age of the non-sepsis group being higher than the sepsis group. The most common organism causing urinary tract infection in Sisaket hospital is *E.coli.* Susceptibility to antibiotics from previous data collected in our hospital showed susceptibility to cephalosporins as 60%, carbapenem 85% and quinolones as about 32%. Therefore, the antibiotics that were mostly used in this study were from the cephalosporin groups consistent with the previous recommendations by the AUA that did not recommend quinolones due to higher drug resistance. The duration of preoperative and postoperative antibiotic prophylaxis is unclear, given the paucity of research for high-risk patients.[13] In this study the the duration of antibiotics before the procedure is not significantly different in the two groups. In the sepsis group, we started antimicrobial drugs as soon as possible and wait for the availability of the operating room and team.

In the non-sepsis group, we started antimicrobial drugs when patients were admitted the night before surgery. National and regional antibiotic resistance patterns can differ significantly; the choice of antibiotic prophylaxis should be tailored to institutional or regional antimicrobial susceptibility. Despite the duration of symptoms and previous procedures, other perioperative parameters were comparable. The operative data from both groups did not differ significantly i.e. operative time, postoperative ureteral stent, stone fragmentation and anesthesia.

However, patients in the emergent URS group had a significantly longer operative time, which increased the risk of perioperative urinary tract infection in the previous study. But in this study, the incidence of postoperative urosepsis was not significantly different in the two groups. Although the sepsis group had a higher rate of postoperative fever, they have the same rate of septicemia as the non-sepsis group and no need of any further procedure with the exception of empirical broad-spectrum antibiotics. New techniques and higher-quality equipment may help to decrease urosepsis. At our institution, we do not currently measure intrarenal backflow, a factor that may contribute to higher infection rates.[13] Potential increases in intrarenal pressure are related to infectious and hemorrhagic complications, as well as kidney damage.[14] This is an area where modern technology and methods offer significant advantages. Consequently, URS under appropriate antimicrobial coverage and with skilful surgeons appears to be a feasible and safe option for the treatment of infected hydronephrosis.[7] Our subgroup analysis revealed no statistically significant differences in postoperative complications across patient ages, gender or comorbidities. The advantages of emergency ureteroscopy from a meta-analysis by Picozzi et al. showed significant advantages regarding immediate ureteroscopy for ureteral stone colic and presents as being a safe treatment with a high success rate, more rapid stone clearance, relief from colic pain and a reduction in follow-up visits, radiation exposure and ultimately the costs.[15]

The results showed that definitive URSL in the sepsis group increased the length of hospital stay. When reviewing medical records regarding the cause of increased hospitalization, it was found that patients were admitted longer, waiting 2-5 days for hemoculture and urine culture results. Some patients also required treatment for comorbidities, such as anemia in chronic disease requiring transfusion. It was also found that operative pain scores were slightly higher in the sepsis group than in the non-sepsis group with average pain scores of 1.17 and 0.77, respectively.

Conclusions

URSL without pre-procedure urinary tract diversion appears to be a safe and effective alternative to temporary ureteral stenting in carefully chosen cases of urinary tract infection. There were no significant operative complications with regard to differences in subsequent management, However, increased length of hospital stay and slightly higher postoperative pain were factors associated with sepsis. The definitive treatment with URSL is safe for ureteric stone in UTI without multi-organ failure patients. Risk of selection bias and lack of information regarding postoperative imaging are potential limitations. Further large comparative studies with adequate follow-up in relation to stone clearance are recommended to support our results.

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Conflict of Interest

The author declares no conflicts of interest.

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