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A comparative study between a single dose pre-induction antibiotic versus continuous antibiotics to prevent urinary tract infection during ureteroscopy

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Abstract

Background and objective: This study aimed to evaluate the effect of adding postoperative antibiotics in reducing the incidence of symptomatic urinary tract infections following ureteroscopic stone treatment beyond the recommended preoperative dose.

Methods: This prospective comparative study was conducted between March and November 2017. A total of 80 patients with preoperative negative urine cultures who underwent ureteroscopy were randomly allocated. All the patients received a single dose antibiotic before the induction of anesthesia, and a group of them also received postoperative antibiotics. The rate of symptomatic urinary tract infection was compared between the patients who received only preoperative antibiotics (group 1) and those who received pre- and postoperative antibiotics (group 2).

Results: Eighty patients underwent ureteroscopy for stone treatment. The time to follow up was 4±2 weeks from ureteroscopy. Eleven (13.8%) patients in total developed urinary tract infections postoperatively, including five (12.5%) from group 1 and six (15%) from group 2, *P* = 0.74. In group 1, four patients presented with cystitis and one with sepsis; those patients with infections in group 2 presented with pyelonephritis (n=2) and cystitis (n=4). Risk factors such as preoperative stenting, nephrostomy tubes, and Foleys catheters did not differ between groups.

Conclusion: The postoperative symptomatic urinary tract infection rate in this study (13.8%) is in agreement with previous reports. This study suggests that a single preoperative dose of antibiotics is sufficient, and additional postoperative antibiotics do not decrease infection rates after ureteroscopic stone treatment.

Keywords: Antibiotics; Infection; Prophylaxis; Stones; Ureteroscopy.

Introduction

Ureteroscopic lithotripsy is a common urological treatment for ureteric stones. This procedure poses a risk of postoperative urinary tract infection (UTI) of up to 25% in patients without prophylactic antibiotics.[1,2] This is primarily attributed to the introduction of bacteria into the urinary tract upon the insertion of surgical instruments. Any intravasation of bacteria or endotoxins into the blood stream may lead to urosepsis, a potentially lethal complication. These infections carry significant morbidity and increased healthcare expenditures.[3,4] Stone intervention should not be underestimated. All patients should be evaluated with a complete medical history, proper physical examination, and laboratory tests, including midstream urine (MSU) culture and sensitivity. A full preoperative evaluation will identify high-risk patients with the potential for infectious complications including Immunosuppression, Diabetes mellitus, female gender, anatomic anomalies, voiding dysfunction, urinary diversion, urinary tract obstruction and presence of indwelling tubes (stent, catheter, nephrostomy).[5-7] To decrease the risk for

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infection following ureteroscopy, optimizing modifiable risk factors is ideal. Furthermore, antimicrobial prophylaxis is recommended by the American Urology Association (AUA) Best Practice Guidelines to decrease the further risk of postoperative infection in patients undergoing ureteroscopy. Preoperative prophylactic antibiotics play an important role in reducing postoperative infections. AUA guidelines recommend a single dose of antibiotics covering both positive and negative uropathogens on all patients taking ureteroscopic lithotripsy.[8] This study aimed to evaluate the effect of adding postoperative antibiotics on reducing urinary tract infections (UTIs) following ureteroscopic stone treatment beyond the recommended preoperative dose.

Methods

This prospective comparative study was conducted in Rizgary Teaching Hospital, Erbil, Kurdistan region-Iraq, from March to November 2017. A total of 80 patients with ureteric stones and sterile urine were scheduled to be subjected to ureteroscopic lithotripsy. All the patients have received a single dose of intravenous gentamicin (80mg), ceftriaxone (1g), or Ciprofloxacin (400mg) before starting the induction of anesthesia. A group of patients received only preoperative antibiotics (group 1), while in addition, a subset of patients also received postoperative antibiotics (gentamicin, ciprofloxacin, or cefixime) (group 2). The preoperative patient evaluation included a thorough history taking, physical examinations, blood chemistry tests, urine analysis, and urine culture. Exclusion criteria were: age <18 years, preoperative positive urine cultures, and abnormal renal function. All the procedures were done under general anesthesia by using semirigid ureteroscope 9.5Fr., pneumatic Lithoclast was used as an intracorporial lithotripter, and Dormia basket was used for extraction of stone fragments. A DJ stent was inserted at the end of the procedure, according to the surgeon's discretion. Our primary endpoint was symptomatic UTI. If any symptoms of UTI (pain, urgency, frequency, dysuria, fever) were developed during the follow up, urine culture was repeated. A specially designed questionnaire was used for collecting data. The data were collected and then analyzed by the statistical package for the social sciences (version 22). The results were compared between patients with different variables, with a statistical significance level of <0.05. The results were presented as rates, ratios, frequencies, percentages in tables and figures, and analyzed using the t-test and Chi-square test. The study was approved by the scientific and the ethics committees at the Kurdistan Board for Medical Specialties.

Results

Over the period of the study, 80 patients underwent ureteroscopic lithotripsy at our institution, the median age was 41.8 years (range: 23–74), and the male to female ratio was 43:37. Mean BMI was comparable between the two groups; group 1 had a BMI of 25.83 (standard deviation [SD]=4.107), and group 2 had a BMI of 27.75 (SD=5.113). Both groups were similar in terms of basic demographics (Table 1). The preoperative antibiotic selection was predominantly gentamicin in 47 (58.8%) patients, followed by ciprofloxacin in 17 (21.3%) patients and ceftriaxone in 16(20%) patients (Figure 1). Ciprofloxacin was most commonly used in 57% of patients, followed by gentamicin in 22.50% patients and cefixime in 20%. Overall, eleven patients had a clinical UTI postoperatively or a positive urine culture (Figure 2).

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Table 1: Demographic characteristics of the participants.

Variable	Groups		Mean	(±S.D)	*P* value
Age	Group 1	N = 40	41.08	(±12.85)	
	Group 2	N = 40	41.88	(±11.79)	0.770
BMI	Group 1	N = 40	25.83	(±4.10)	0.060
	Group 2	N = 40	27.75	(±5.11)	
Gender	Group 1	Male	21	52.5%	0.820
		Female	19	47.5%	
	Group 2	Male	22	55%	
		Female	18	45%	

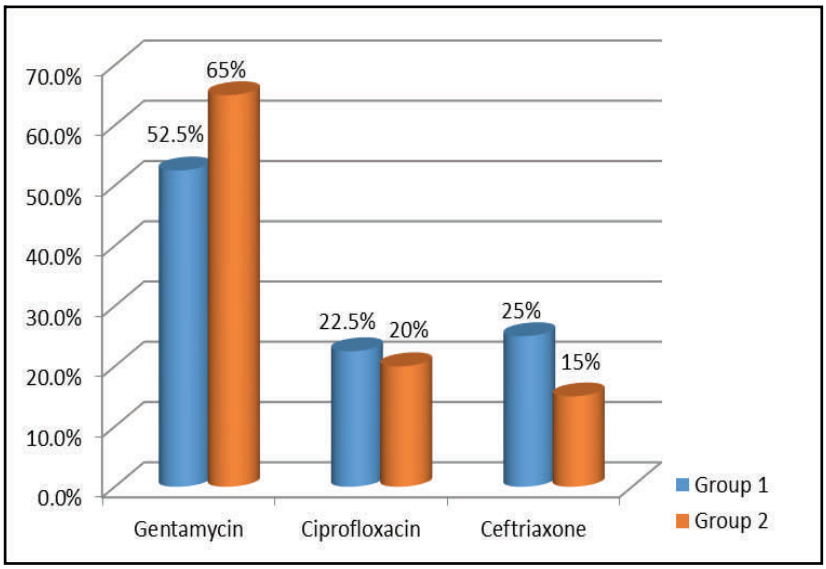

Figure 1: Preoperative antibiotic use for Group 1 and Group 2 patients.

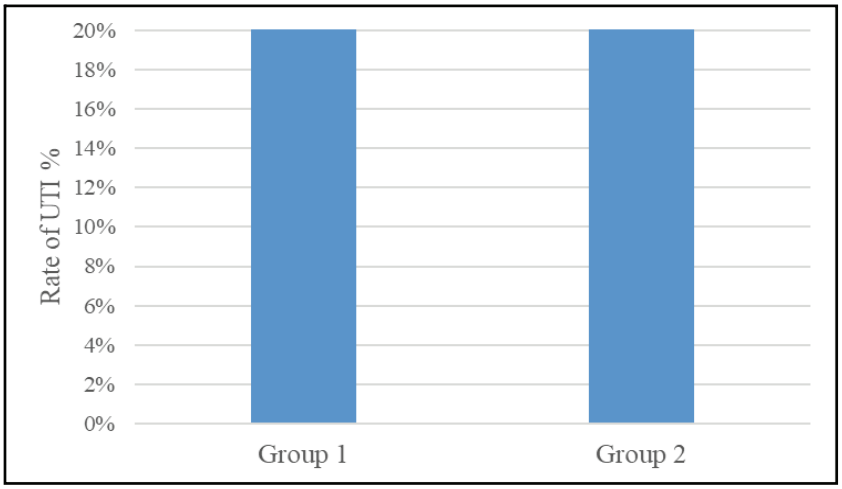

Figure 2: Post-operative UTI of both Groups.
P = 074

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Five (12.5%) of these patients were in group 1. One of these patients presented with urosepsis and the other four with cystitis. The patient with sepsis had a positive culture for *Klebsiella*. In the other three patients, *E. coli* was the cause. Only in one patient, *Pseudomonas aeruginosa* was the cause. Six (15%) patients in group 2 clinically demonstrated signs of UTI; two of them presented with pyelonephritis, one of them urine culture was positive for *E. coli,* the other had negative urine culture. The other four patients presented with cystitis; in two of them urine culture was positive for *E. coli*, urine culture for one of the other two patients was positive for Enterococcus and the other one had negative culture. All were treated effectively. Surgical factors and risk factors for infections were also assessed, as demonstrated in (Table 2). No associations with infection could be made here.

Discussion

Retrograde ureteroscopy as a method of treatment for ureteral calculi can lead to infectious complications.[2] In this study, 11 (13.8%) patients were treated for cystitis, pyelonephritis, or urosepsis. This is comparable with the historical rate of UTI after ureteroscopic management for the stone disease in the distal, middle, and upper ureter, which is around 4%, 2%, and 4%, respectively.[9,10,11] Among studies with less stringent exclusion criteria or inclusion of stenting, the rate of UTI or fever is comparable at 9% to 10%, and 33%, respectively.[12,13] This elevated rate of infection may be attributable to the inclusion of patients with risk factors for postoperative infections described in Table 2. Among preoperatively stented patients, three out of twelve (25%) presented with postoperative infection. Mechanistically, this could occur as a result of a biofilm

Table 2: Surgical factors and infection risk factors compared among patients receiving only preoperative antibiotics (Group 1) to those receiving Pre- and postoperative antibiotics (Group 2).

Variable	Categories	Study samples				*P* value
		Group 1		Group 2		
		No.	(%)	No.	(%)	
Postoperative Foley's catheter	Yes	1	(2.5)	2	(5.0)	0.55
	No	39	(97.5)	38	(95.0)	
Pre-operative stent	Yes	8	(20.0)	4	(10.0)	0.21
	No	32	(80.0)	36	(90.0)	
Postoperative stent	Yes	32	(80.0)	34	(85.0)	0.55
	No	8	(20.0)	6	(15.0)	
Diabetes mellitus	Yes	1	(2.5)	0	(0.0)	0.31
	No	39	(97.5)	40	(100.0)	
Ureteroscopy side	Right	19	(47.5)	21	(52.5)	0.65
	Left	21	(52.5)	19	(47.5)	
Stone location	Upper ureter	8	(20.0)	12	(30.0)	0.17
	Mid ureter	4	(10.0)	8	(20.0)	
	Lower ureter	28	(70.0)	20	(50.0)	
Total		40	(100.0)	40	(100.0)	

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being present on the stent, as being reported to occur in up to 25% of cases depending on indwelling duration; however, positive urine cultures are only found among 10% of patients with stent colonization.[14,15] Several studies looking at the colonization of ureteral stents upon removal have shown that a significant number of stents are colonized despite the use of prophylactic antibiotics, suggesting that prophylaxis is ineffective to prevent the interaction of bacteria with the surfaces of stents.[16-18] However, in these studies and routine practice, the presence of a bacterial biofilm is not generally detected until the scheduled stent removal (i.e., the majority of patients did not develop a symptomatic UTI) which indicates that the presence of bacterial colonization or even a biofilm on the surface of a stent does not necessarily lead to infection, especially in patients with intact immune systems. Overall, 66 (82.5%) patients had a postoperative stent and accounted for 8 (72.7%) of the UTIs. So the rate of UTI among post-operative stent patients was 12.1%, which indicates that stenting in the present study might not increase the risk of postoperative infection. All of these stents were removed with cystoscopy, and antibiotics were used at the time of cystoscopies. Moltzahn et al. reported a 9.5% UTI rate following ureteroscopy with postoperative stenting, and they concluded that continuous low-dose antibiotic treatment during the entire stent-indwelling time did not reduce the quantity or severity of UTIs compared with the peri-interventional antibiotic prophylaxis only.[13] The rate of infection for group 1 was 12.5%, and 15% for group 2, but the rate was not significantly different (P = 0.74). Chew et al. reported the rate of UTI in patients with perioperative antibiotics only and patients with continuous post-operative antibiotics (4.8% and 10.2, P = 0.1457), respectively.[19] However, it is important to recognize that failing to reach statistical significance could also be due to the small sample size. Postoperative antibiotics were associated with increased rates of infection; however, these findings are congruent with the AUA Best Practice Policy Statement, which does not support the use of postoperative antibiotics beyond 24 hours following Ureteroscopy.[8,11] The choice of antibiotic for prophylaxis should take into account the effectiveness, tolerability, and cost. The spectrum must be large enough to cover normal and pathogenic flora. In patients with prolonged hospitalization, we should be aware of the hospital flora and have in mind the risk of potential infection, the target organ, and the role of local inflammation.[20,21] For the genitourinary tract, fluoroquinolones, cephalosporins, and aminoglycosides have been recommended for antibiotic prophylaxis because of their prolonged half -life, a relatively broad spectrum of action, minimal side effects and low price.[22] Both fluoroquinolones and cephalosporins have proven useful in antibiotic prophylaxis[23] without apparent differences in efficacy between these two antibiotic classes.[3] Although there is no standard policy in our hospital regarding the choice of antibiotic, there are hospitals where antibiotics used for prophylaxis are changed periodically according to the local sensitivity spectrum. Moreover, it should be noted that there are compelling reasons to limit antibiotic prescription to the extent possible. Most notably, the overuse of antibiotics will promote antibiotic resistance, as increasing the exposure of bacterial species to antibiotics unnecessarily will increase their chances of developing resistance mechanisms, making it significantly more difficult to treat them with the antibiotics currently available. Infections with MRSA, *P. aeruginosa*, and *Stenotrophomonas* are only a few examples of difficult to treat bacterial strains. Exposing bacterial strains to antibiotics unnecessarily will only limit the number of agents available to treat the infection.

Conclusion

In patients undergoing ureteroscopic stone treatment who had a negative baseline

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urine culture, the rates of postoperative UTI was not reduced by continuous postoperative antibiotic prophylaxis and a single intraoperative dose of antibiotic is quite sufficient to prevent postoperative UTI. The benefits of implementing this approach across the urological community are likely to include reduced healthcare costs, fewer treatment-related adverse effects, and decreased selective pressure for resistant organisms.

Competing interests

The authors declare no competing interests.

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