Original Article

Antibiotic prophylaxis in children with ureteric stents: Bliss or misery?

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Abstract

Introduction: The risk of urinary tract infection (UTI) in patients with a ureteric stent is influenced by several factors such as duration of stenting. Antibiotic prophylaxis has been previously used for the prevention of UTI in patients with common urological pathologies. The aims of this study were to evaluate the incidence, to identify the risk factors of symptomatic UTI in pediatric patients with ureteric stents, and to review the effectiveness of antibiotic prophylaxis in reducing the rate of symptomatic UTI compared to a no intervention (control) group.

Materials and Methods: This was a retrospective cohort study that was held at a tertiary hospital in Jeddah, Saudi Arabia. The study included 110 pediatric patients who were younger than 18 years and who required ureteric stent insertion. Disregarding gender difference, the patients were divided into two main groups: an antibiotic group and a control group. The patients in the antibiotic group (Group 1) received continuous antibiotic prophylaxis from the date of ureteral stent insertion until removal, while the patients in the control group (Group 2) received antibiotics during the perioperative period only.

Results: A total of 110 patients were included in the final analysis. Group 1 patients who were given antibiotic prophylaxis during the presence of ureteric stent were 54 patients (49%). Group 2 patients who were only given antibiotic during the perioperative period were 56 (51%). Males compromised 73% ($n = 80$) of the sample population, while females were 27% ($n = 30$). The prevalence of symptomatic UTI was significantly reduced from 25% in the control group to 7% in the antibiotic group ($P < 0.004$).

Conclusion: Antibiotic prophylaxis has significantly reduced the risk of symptomatic UTI by 68% in comparison to the control group.

Keywords: Antibiotic prophylaxis, bacteriuria, ureteric stent and pediatric, urinary tract infection, urogenital disease

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INTRODUCTION

Ureteric stents are essential urological tools used for temporary drainage of the upper urinary tract.[1] However, their indwelling nature is complicated by a feeling of discomfort, irritative voiding symptoms, and/or urinary tract infection (UTI).[2] Generally, UTI contributes to about 40% of nosocomial infections; 80% of that is associated with urinary catheters and stents.[2] Therefore, the placement of ureteric stents should be carried out only when indicated.

The risk of UTI in patients with ureteric stents increases with urinary bacterial concentration and is directly proportional with the duration of stenting.[3] *Escherichia coli* was the most commonly isolated pathogen from urine cultures in stented patients.[4]

Antibiotic prophylaxis has been used previously for the prevention of UTI in patients with common urological pathologies (vesicoureteric reflux, recurrent UTI, etc.). However, there is limited evidence in the literature about the efficacy of antibiotic prophylaxis in reducing the rate of UTI.[2] Moreover, there is a lack of reports about its efficacy in the pediatric population with stents.

The aims of this study were to evaluate the symptomatic UTI incidence, to identify the risk factors of symptomatic UTI in pediatric patients with ureteric stents, and to review the effectiveness of antibiotic prophylaxis in reducing the rate of symptomatic UTI as compared to a no intervention (control) group for the sake of expectantly changing medical practices, standardizing patient care, and improving the quality of patient care.

MATERIALS AND METHODS

Study criteria

This is a retrospective cohort study where all patients who required ureteric stenting from January 2002 to December 2011 were classified into two main groups, regardless of age and gender. In Group 1, patients received antibiotic prophylaxis during the presence of the ureteric stent, starting from stent insertion until stent removal. In Group 2, patients received antibiotic treatment in the perioperative period only. The study was carried out at a tertiary hospital in Jeddah, Saudi Arabia. Following the approval of the institutional review board, patients' medical records were accessed, and all required information was gathered.

All patients with documented UTI at the time of ureteric stent insertion, patients who were stented to treat an infected obstructed system, patients with indwelling urethral catheter or required catheter insertion during the presence of ureteric stent, patients who needed antibiotic therapy for other medical reasons, and patients with known history of allergy or contraindication to antibiotic prophylaxis were excluded from the study.

Data about significant comorbidities (chronic renal failure and chemotherapy), stents (types, sizes, indications, and stenting durations), cultures (collection dates, results, and sensitivities), and antibiotics (types, doses, durations, and routes of administration) were recorded. All urine samples in this study were collected through cystoscopy during stent removal.

Research design and data collection

This chart review is a retrospective cohort study. Medical records of the patients who fulfilled the inclusion criteria were reviewed. Then, they were classified according to the antibiotic practice of the adult and pediatric urologists at the same tertiary hospital into two groups. Group 1 consisted of patients receiving antibiotic prophylaxis started on the day of stent insertion and continued throughout the duration of stent presence until the day of stent removal. In this group, the antibiotic prophylaxis of choice was trimethoprim 2 mg/kg per day for the full duration of stent presence.

Group 2 consisted of patients who did not receive any antibiotic prophylaxis during the presence of a ureteric stent, but only during the perioperative period of the stent insertion, from the day of stent insertion up to 3 days postoperatively, and they were considered the control group. In this group, the antibiotics received were cephalosporin, and it was a full-treatment dose.

The stent insertion was indicated for two main surgical reasons: reimplantation of the ureter and pyeloplasty.

Primary and secondary outcomes

The primary outcomes were asymptomatic bacteriuria and symptomatic UTI. Asymptomatic bacteriuria was defined as the presence of bacteria in the urine of patients who have neither symptoms nor signs. Bacteriuria was defined as a single bacterial growth of 10^5 colony-forming unit/ml in urine culture on clean catch urine, $>10^3$ colony-forming units/ml on an in-and-out catheter specimen, or suprapubic puncture specimen between postoperative days 2 and 10.

Symptomatic UTI was suspected in patients with symptoms that include pain (flank, lower abdominal), lower urinary tract symptoms (dysuria, frequency, urgency, or incontinence), hematuria, or fever.

The secondary outcomes included the frequency of urinary tract infection, lower urinary tract symptoms (dysuria, frequency, urgency, or incontinence), fever with negative cultures, incidence of hospitalization, sepsis, septic shock, mortality, and the outcome of asymptomatic bacteriuria.

Fever was divided into low-grade fever (any temperature ≥37.3°C and <38°C), moderate-grade fever (any temperature ≥38°C and <38.5°C), and high-grade fever (any temperature ≥38.5°C).

Statistical analysis

Analysis was formed using Statistical Package for the Social Sciences, version 19.0 (SPSS, Inc., Chicago, IL, USA). Independent sample *t*-test was used to compare the age and the duration of the stenting between the two groups. Logistic regression and univariate and multivariate analyses were done to detect significant risk factors. Chi-square test was used to analyze the categorical data; two-sided. Data sets were recorded as means (standard deviations) if the data were normally distributed or as medians (1st and 3rd quartiles) if the data were skewed. A $P < 0.05$ was considered statistically significant.

RESULTS

A total of 110 patients were included in the final analysis. Group 1 patients who were given antibiotic prophylaxis during the presence of ureteric stent were 54 patients (49%). Group 2 patients who were only given antibiotic during the perioperative period were 56 (51%). Males were 72.7% ($n = 80$), and females were 27.3% ($n = 30$). The median age at stent insertion was 2 years (3.7 months to 8 years). Comorbidities were prevalent in 40 patients (36.4%). The mean duration of stenting was 2 months.

Illustrations of the two groups are included in Table 1. The overall stent size ranged between 3 Fr for 39% ($n = 43$) and 8 Fr for 2% ($n = 2$). Details of overall stent size are presented in Figure 1. Furthermore, stent size according to the two groups is shown in Figure 2.

The prevalence of symptomatic UTI was significantly reduced from 25% (14/56) in the control group to 7% (4/54) in the antibiotic group ($P < 0.004$). Antibiotic prophylaxis has significantly reduced the risk of symptomatic UTI by 68% in comparison to the control group (adjusted odds ratio = 0.32, confidence interval: 0.21–0.63). Furthermore, it was shown that longer stenting duration and larger stent size were significantly associated with higher risk of symptomatic UTI as displayed in Table 2.

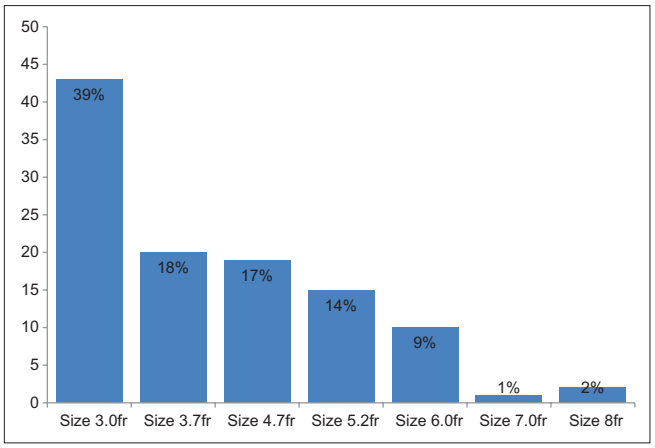

Figure 1: Overall stent size

Table 1: The demographics of the two groups

Variable	Antibiotic group (*n*=54)	Control group (*n*=56)	*P*
Gender			
Male	39 (72%)	41 (73%)	0.91
Female	15 (28%)	15 (27%)	
Comorbidities	12 (22%)	28 (50%)	0.002
Mean age at surgery, years (SD)	2.19 (3.54)	6 (4.7)	<0.001
Mean duration of stent, months (SD)	1.4 (0.699)	2.88 (2.3)	<0.001
Stent size	See graphs		<0.001

SD: Standard deviation

Table 2: Prognostic factors of symptomatic urinary tract infection

Factors	Adjusted OR	95% CI	*P*
Antibiotic prophylaxis	0.32	0.21-0.63	0.004
Stent duration	0.84	0.48-0.83	0.012
Stent size	0.72	0.53-0.94	0.04

CI: Confidence interval, OR: Odds ratio

Asymptomatic bacteriuria was detected in 18% ($n = 20$). Eight patients (15%) were from Group 1 and 12 patients (21%) were of Group 2. Of 7 patients (6%) who were identified with stent-related symptoms, 2 (3%) were of Group 1 and 5 (9%) patients from Group 2.

DISCUSSION

Ureteric stents play an essential role in everyday urological practice. However, evidence shows that patients who had ureteral stents suffered bothersome side effects, which either were present during the stenting time or were present later postoperatively.[5] It has also been highlighted that complication rates were directly related to the duration of stenting.[6]

Since ureteric stents are foreign bodies, they could be contaminated by bacterial biofilm, leading to excessive, yet potentially critical, urological complications, and even though growth in urine culture was used to diagnose

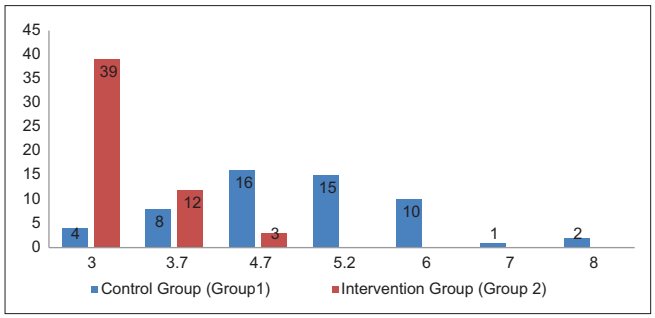

Figure 2: Stent size according to groups

bacteriuria, the absence of the latter does not firmly confirm that the stent, by itself, is not contaminated. Malpositioning of the ureteric stents is also considered as another risk factor symptomatic bacteriuria.[7-9] Despite being significant in other studies, comorbidities, gender, and age at stent insertion were not significantly associated with higher incidence of UTI in our study.

This study showed higher incidence of symptomatic UTI in comparison to previously published reports for the increase of significant risk factors such as stent duration >3.5 months and stent size ≥5.2 Fr as well. Therefore, it is essential to monitor stents, and the decision for removal should be made at the earliest appropriate time. Byword, Richter *et al.* shed light on the importance of within-an-easy-reach follow-up to investigate any morbid manifestations and take proper actions.[10] In addition, it should be taken into consideration that these endorsements may need to be fixed according to the patients' characteristics.

As stated in other researches, the Cochrane database has shown few feeble results that antibiotic prophylaxis reduces the rate of UTI and bacteriuria.[2] However, in this study, it was proven that antibiotic prophylaxis usage reduced significantly the incidence of symptomatic UTI by 68%. This result can only be supported, up to the recently published articles, by Lusardi, who meta-analyzed studies concerning the antibiotic prophylaxis for such procedure in adults, and the limited evidence elucidated similar outcome, aside from reduction in other infection morbid manifestations such as pyrexia and pyuria.[11]

In our institution, there were two Canadian trained urologists who performed all those abovementioned procedures, with different background training. One urologist had good exposure to pediatric urology cases throughout his/her training, and he/she used small-sized stents for a short duration with the use of antibiotic prophylaxis. The other urologist had a 6-month rotation in pediatric urology during his/her junior training years, and he/she relayed on using large-sized stents and keeping it for longer duration. The two different practices were mainly the result of the physicians' previous education or experience in the field. These practices have affected the outcome of the patient development, whether lead to poor or better outcome.

As it showed, patients treated by the urologist who used a small-sized stent and less duration with the use of prophylaxes had less infection rate in comparison to the other practice. However, antibiotic prophylaxes cannot be solely depended on, for it has been reported that neither the antibiotic prophylaxes nor the type of indwelling catheter (whether antiseptic or antimicrobial coated) does not reduce the infection rate significantly.[12] Thus, the practice of the physicians using smaller stents and less duration was more important than using the antibiotic prophylaxes usage.

In the end, the message we would like to deliver is that antibiotic prophylaxes will reduce the infection rate, but the practice *per se* will significantly reduce the infection rate; this includes using appropriate instruments and less duration of contamination.

Limitations

This study had some limitations to be considered. The retrospective nature of the study design was one of the weaknesses. This study also had a small sample size. Further, the measured effect was in overestimation due to measurement bias (urine sample collection technique). Finally, selection bias (unbalanced groups' features) was also a limitation to this project.

CONCLUSION

Antibiotic prophylaxis has reduced the incidence of symptomatic UTI in pediatric patients with ureteric stents by one third. It was discovered that stent duration should not be longer than 3.5 months, and the stent size should not exceed 5.2 Fr in pediatric patients.

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Conflicts of interest

There are no conflicts of interest.

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