



Antibiotics for urethral catheterization in children undergoing cystography: retrospective evaluation of a single-center cohort of pediatric non-toilet-trained patients

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Abstract

Antibiotics are often used to prevent post-catheterization urinary tract infections (UTIs) in patients undergoing cystography. However, there is no universally accepted protocol and the literature data are conflicting. We aimed to determine prevalence and risk factors of post-cystography UTIs in non-toilet-trained children. We retrospectively evaluated 216 non-toilet-trained children not assuming antibiotics when undergoing cystography. Only the patients with dilated vesico-ureteral reflux (VUR) assumed antibiotics just after the exam (within 15 min). One hundred eleven patients without vesico-ureteral reflux (VUR) and 29 patients with non-dilated VUR did not receive post-procedure antibiotics and did not develop UTIs. Out of the 76 patients who showed a dilated VUR and received post-procedure antibiotics, only 5 (6.6%) developed a UTI. The most significant factor associated with post-cystography UTIs was the presence of dilated VUR ($p = 0.005$) with the presence of bilateral VUR also being significant ($p = 0.02$).

Conclusion: Patients without dilated VUR or bilateral VUR could not benefit from antibiotic prophylaxis for cystography.

What is Known:

- There is no universally accepted protocol about antibiotic administration in children undergoing cystography.
- Literature data are conflicting.

What is New:

- Among 216 non-toilet-trained children undergoing cystography, 111 patients without vesico-ureteral reflux (VUR) and 29 patients with non-dilated VUR did not receive post-procedure antibiotics and did not develop UTIs. Out of the 76 patients who showed a dilated VUR and received post-procedure antibiotics, only 5 (6.6%) developed a UTI.
- The most significant factor associated to post-cystography UTIs was the presence of dilated VUR ($p = 0.005$) with presence of bilateral VUR also being significant ($p = 0.02$).

Keywords Urinary catheterization · Cystography · Urinary tract infections · Vesico-ureteral reflux · Children

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Introduction

When performing voiding cystourethrography or isotopic cystography, antibiotics are often used to prevent post-catheterization urinary tract infections (UTIs). However, there is no universally accepted protocol and the literature data are conflicting [1, 4]. We feel that a focused post-procedure prophylaxis might work well. Thus, this is the standard procedure at our center. Hereby, we report a retrospective analysis of the patients who underwent this procedure at our center between April 2014 and April 2017.

Material and methods

We retrospectively evaluated the clinical data of the non-toilet-trained patients consecutively undergoing voiding cystourethrography or isotopic cystography (both referred to as “cystography” in this manuscript) from April 2014 to April 2017. The study was approved by our Research Ethical Committee and informed consent was obtained before any procedure. Inclusion criteria were (i) sterile procedure of urethral catheterization; (ii) normal urinalysis at catheterization; (iii) not taking any antibiotic.

Four hundred eighty-eight patients were eligible of whom the following were excluded: 15 subjects because of positive urinalysis results at catheterization, 199 because taking antibiotics while undergoing cystography, and 58 patients because toilet-trained. Therefore, 216 patients were enrolled. Clustering of vesico-ureteral reflux (VUR) grades was adapted, classifying grades III–V as “dilated” and grades I–II as “non-dilated.”

Within 15 min after the end of the cystography, the protocol of antibiotic administration was the following: (i) if VUR was not present or a non-dilated VUR was detected, we did not administer any antibiotic; (ii) if dilated VUR was present, we administered 5 mg/kg of intramuscular netilmicin followed by oral amoxicillin clavulanate at the dose of 25 mg/kg every 12 h for 5 days. Post-catheterization UTIs were defined by the presence of urinary leukocytes and/or nitrites, positive urine culture, and fever > 38 °C [2], within 7 days from cystography. We only considered the development of febrile UTIs, representing the only potential danger for the kidneys (scar formation). Moreover, it is difficult to diagnose with certainty a non-febrile UTI in non-toilet-trained patients because symptoms such as pain at micturition, urgency, and urinary incontinence are often undetectable.

p values < 0.05 were considered statistically significant. Differences for continuous variables were analyzed with the independent-sample *t* test for normally distributed variables and with the Mann-Whitney test in case of non-normality. Given that there were only 5 UTIs detected, Fisher’s exact *p* values were used when comparing the characteristics of

the patients with UTIs with those of patients not presenting UTIs. The Stat-Graph XVII software for Windows was used for all statistical analyses.

Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on request.

Results

Our population presented a median age at catheterization of 3.8 months (lower quartile 1.9–upper quartile 8.5 months) (range 1–29 months). One hundred thirty-four (62%) patients were males. One hundred five out of 216 patients (48.6%) showed VUR. Among patients with VUR, 76 (72.4%) out of 105 showed dilated VUR and 29 non-dilated VUR (27.6%). Thirty patients showed (28.6%) bilateral VUR. The duration of catheter placement was 76.3 ± 29.8 min (range 30–120 min). The overall post-catheterization UTIs prevalence was 2.3%.

The one hundred eleven patients without VUR and the 29 patients with non-dilated VUR did not receive post-procedure antibiotics and did not develop UTIs.

Out of the 76 patients who showed a dilated VUR and received post-procedure antibiotics, only 5 (6.6%) developed a UTI (Table 1). Among these 5 patients, only two (aged 31 and 45 days, respectively) were hospitalized on a precautionary basis and treated with parenteral intravenous ceftazidime. The other three patients aged 4, 6, and 24 months were not hospitalized and were orally treated with ciprofloxacin.

Both dilated and bilateral VUR were significantly associated with the development of post-cystography UTIs (Table 1).

Table 1 Clinical characteristics comparing patients presenting and not presenting post-cystography UTI

	Presenting UTI (<i>n</i> = 5)	Not presenting UTI (<i>n</i> = 211)	<i>p</i>
Age at catheterization, months	7.4 (4.3–12)	3.8 (1.9–0.8.4)	0.34
Male sex, no. (%)	4 (80)	130 (61.6)	0.65
Phimosis (in the male patients), no. (%)	2 (50)	62 (47.6)	0.99
VUR, no. (%)	5 (100)	100 (47.3)	0.03
Dilated VUR, no. (%)	5 (100)	71 (33.6)	0.005
Bilateral VUR, no. (%)	3 (60)	27 (12.8)	0.02

For age at catheterization, median and lower and upper quartiles are shown

UTI, urinary tract infection; VUR, vesico-ureteral reflux

Discussion

In the past year, two studies on the use of antibiotics for performing cystography have been published but the results were conflicting [1, 4]. Johnson et al. found post-cystography UTIs in 1% of the 1108 children evaluated (51% on peri-procedural antibiotics) and the factors associated to post-procedural UTIs were pre-existing urologic diagnosis, abnormal cystogram, and use of peri-procedural antibiotics [1]. The authors concluded that the risk of post-procedural UTI in patients undergoing cystography is very low and that children undergoing cystography should not be given peri-procedural antibiotic prophylaxis for the sole purpose of preventing post-procedural UTIs [1]. On the other hand, Sinha et al. in a randomized controlled trial demonstrated that performing cystography without antibiotics significantly increases the odds of having post-cystography-acquired UTI such as having an abnormal pre-cystography ultrasound scan [3]. Similarly, in the past, Rachmiel et al., showed a prevalence of symptomatic UTIs following cystography of 1.7% in 421 patients taking antibiotic prophylaxis, with the presence of VUR as a major risk factor for UTIs post-cystography [4].

However, considering these results together, one might conclude that the patients that could benefit from peri-procedural antibiotics are only the patients with VUR. The present study confirms this supposition further restricting the population at major risk of the post-procedural UTIs. In fact, although only 5 out of 76 patients with dilated VUR developed a UTI, we showed that VUR in general is associated with post-cystography UTIs with the dilated VUR being the most significantly associated factor. Moreover, none of the patients without VUR or with non-dilated VUR showed post-cystography UTIs despite the fact that none of them assumed peri-procedural antibiotics.

In our center, the standard procedure was to administer intramuscular netilmicin in patients with dilated VUR in order to cover the patients against nosocomial infections of bacteria resistant to the most commonly used antibiotics. However, this route can be painful and potentially dangerous especially in small infants and was probably not really necessary. For this reason, in the last 8 months, we modified our protocol by administering to patients with dilated VUR oral ciprofloxacin 12.5 mg/kg every 12 h for the 5 days following the catheterization. We are not yet able to present sufficient data; however, our feeling is that this procedure provides similar outcomes to that presented in this paper.

Among the limitations of the study, there is the retrospective design and the lack of information about the prevalence of post-cystography non-febrile UTIs.

In conclusion, the antibiotic prophylaxis for preventing post-cystography UTIs could be administered only after the test and only to the patients with dilated or bilateral VUR (detected at the cystography just done). This approach, however, implies a very strict collaboration between radiologists and pediatricians with communication “in real time” of cystography results in order to promptly administer antibiotics (within few minutes after the test) to the patients with dilated or bilateral VUR.

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Authors' contributions *Study concept and design:* Marzuillo, La Manna, Miraglia del Giudice.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Marzuillo, Guarino, Stanco.

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Study supervision: Rambaldi, La Manna, Esposito, Miraglia del Giudice.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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