

ORIGINAL

Addressing a challenge: Methods of urine collection in pre-continent children

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Abstract

Introduction: Urinary tract infection (UTI) is a common infection occurring in childhood seen at pediatric emergency departments, and obtaining a sterile urine sample is essential for diagnosis. However, acquiring such samples in pre-continent children poses a challenge, and there are several collection methods with different advantages and limitations. Clinical practice guidelines differ in their recommendations for urine collection methods in clinically stable, pre-continent children.

Objectives: To describe contamination rate of the clean-catch method in this population.

Methodology: Observational, retrospective, and descriptive study including urinary samples from hemodynamically stable children aged 0-24 months. Demographic and therapeutic variables were assessed.

Results: A total of 288 samples were collected using the clean-catch method, with a contamination rate of 15.3% (14.7% in boys vs. 15.7% in girls). Interestingly, a decrease in contamination rates was observed with increasing age; 45% of the contaminated samples were from children under 3 months old, with 60% of these belonging to girls ($p=0.3$). The differences in contamination rates between those under 3 months and the rest of the sample were statistically significant (OR 1.97, 95% CI 1.02-3.78).

Conclusions: According to this study, contamination rates through the clean-catch collection method are significantly higher in children under 3 months compared to older children, suggesting that this method may not be suitable for this age group. However, this collection method may be acceptable in children older than 3 months who are hemodynamically stable and suspected of having UTI.

ABORDANDO UN RETO: MÉTODOS DE RECOGIDA DE ORINA EN NIÑOS NO CONTINENTES

Resumen

Introducción: La infección del tracto urinario (ITU) es una patología frecuente en Urgencias Pediátricas y se precisa una muestra de orina estéril para su diagnóstico. Su obtención en niños precontinentes supone un reto y existen varios métodos de recogida con distintas ventajas y limitaciones. Las guías de práctica clínica son heterogéneas en sus recomendaciones sobre el método de recogida de orina en los niños precontinentes clínicamente estables.

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Objetivos: Describir la tasa de contaminación de la recogida “al acecho” en esta población.

Metodología: Estudio observacional, retrospectivo y descriptivo incluyendo muestras urinarias de niños de 0-24 meses, hemodinámicamente estables. Se recogen variables demográficas y terapéuticas.

Resultados: Se obtienen 288 muestras mediante recogida “al acecho” con el 15,3% de tasa de contaminación (14,7% niños vs. 15,7% niñas). Se observa que la tasa de contaminación disminuye a medida que aumenta la edad y se encuentra que el 45% de las muestras contaminadas corresponden a menores de 3 meses, siendo el 60% de estas procedentes de niñas. Las diferencias entre las tasas de contaminación de los menores de 3 meses comparado con el resto de la muestra sí fueron significativas (OR 1,97, IC95% 1,02-3,78).

Conclusiones: Según este estudio, en menores de 3 meses la contaminación mediante recogida “al acecho” es significativamente superior que en niños mayores, por lo que este método podría no ser adecuado en esta franja de edad. Sin embargo, podría ser un método de recogida aceptable en niños mayores de 3 meses, hemodinámicamente estables con sospecha de ITU.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common infections in childhood, and it is the leading bacterial infection in children presenting with fever without an apparent source⁽¹⁾. UTI accounts for 5.9% of pediatric consultations in primary care, increasing to 7.3% when considering children under 3 years of age⁽²⁾. In infants under 24 months old with fever, its prevalence reaches 7%⁽³⁾. However, the clinical presentation in younger children is often nonspecific and should be suspected in an infant with fever without source, vomiting, irritability, or reduced feeding. The timely diagnosis of UTI has significant implications for the child as delayed initiation of treatment may result in complications, including kidney injury or sepsis.

Although urine sediment examination or dipstick results can guide clinical decisions and treatment initiation, the definitive diagnosis of UTI is based on a positive urine culture result. Therefore, the collection of a sterile urine sample is required and, especially in pre-continent children, this can be a challenge in clinical practice. Obtaining poor quality samples can lead to misdiagnosis, unnecessary testing, and inappropriate antibiotic therapy.

Several urine collection strategies are available, each with different advantages and limitations, including noninvasive methods, such as the perineal urine bag and clean-catch collection, as well as invasive methods, such as suprapubic aspiration or bladder catheterization. [Table 1](#) provides a summary of the characteristics of these urine collection methods.

In general, noninvasive methods require more time to obtain the sample and have higher contamination rates. On the other hand, invasive methods, while minimizing false positives, require more clinical experience to perform the techniques, are painful for children, and may cause complications such as urinary tract injury or secondary infections.

In terms of economic cost, a study conducted at an Australian center found that bladder catheterization is the most cost-effective method for pre-continent children. Among

non-invasive methods, the clean-catch method was identified as the most cost-effective. In this study, the most significant determinant of cost was time occupying a hospital bed⁽⁴⁾.

Different authors propose the clean-catch collection as the method of choice for stable pre-continent children. The technique is easy to perform and non-invasive, with contamination rates similar to bladder catheterization, and is even suggested to be equivalent to the mid-stream urine sample in continent patients^(5,6).

According to one study, the clean-catch collection method was successful in 74% of cases with a mean sample collection time of 30 minutes (IQR 11-66 minutes), and a ‘missed’ first sample in 16% of cases. No differences were found in the contamination rates according to the time taken to obtain the sample, but they were higher in girls (41%) than in boys (29%), especially in children under 6 months of age⁽⁷⁾.

In younger infants, the Quick-Wee method can be used, which consists of gently rubbing the suprapubic area in circles with a cold saline-soaked gauze to stimulate micturition. Using this method, 31% of infants aged 1-12 months voided in less than 5 minutes⁽⁸⁾.

We reviewed various clinical guidelines and consensus statements updated within the last 10 years on the diagnosis of UTI in the pediatric population.

- All guidelines agree that a urine sample collected in a bag can be used to rule out UTI, but in case of a positive result, this sample should not be submitted for urine culture because of its high contamination rate and a new sample should be collected by another method.
- In unstable or critically ill children, all guidelines agree that the method of collection should be invasive (bladder catheterization or suprapubic aspiration).
- Clean-catch collection is considered acceptable for urine culture analysis by all guidelines, except for those from the United States. According to guidelines from Canada, Switzerland (for children older than 3 months), Australia, and the United Kingdom, clean-catch collection is the method of first choice for pre-continent and clinically stable children.

TABLE 1. Summary of urine collection methods in pre-continent children.

	Non-invasive		Invasive	
	Urine bag	Clean-catch	Catheterization	Suprapubic aspiration
Procedure	A sterile bag is placed over genitals to collect urine	Wait until the child voids spontaneously and the sample is collected in a sterile container	Insertion of urethral catheter, which is removed when the sample is obtained	Insertion of a needle into the bladder to aspirate urine
Advantages	Useful to rule out UTI if the result is negative ⁽⁹⁾	Least contamination in non-invasive method. Stimulation methods in infants may increase success	Low contamination. Good collection success rate	Very low contamination. May be performed with ultrasound-guidance
Limitations	High contamination. Not suitable for culture	Time-consuming. Missed samples	Invasive and painful. Equipment and expertise required	Most invasive and painful method. Equipment and expertise required
Contamination rate⁽¹⁰⁾	18-88% (mean 48%)	4.5-27% (mean 20%)	8-28% (mean 15%)	1-9% (mean 4%)
Cost in British pounds (£)⁽¹¹⁾	112£	52-65£	49£	52£

The recommendations of the guidelines and consensus statements reviewed in this article are summarized in [Table 2](#).

The objectives of this study were to describe the contamination rate of urine cultures collected by the clean-catch method in pre-continent children under 2 years of age and to analyze whether there are differences in contamination rates according to sex and age in this population.

MATERIALS AND METHODS

An observational, descriptive, and retrospective study was conducted in the emergency department of a secondary-care hospital (Hospital Universitari Mutua Terrassa, Barcelona) between January 1 and December 31, 2022.

For this study, electronic discharge summaries were reviewed and the variables age, sex, collection method, and urine culture results (positive/negative/contaminated) were recorded.

Hemodynamically stable children aged 0 to 24 months who visited the Emergency Department of our center with clinical manifestations compatible with UTI were included. Children with urogenital malformations were excluded.

A urine study was indicated for patients presenting with fever without a source persisting for more than 24 hours, accompanied by irritability and/or urinary symptoms. The preferred method for urine collection was the clean-catch technique.

Contaminated urine cultures were defined as those showing growth of different types of bacteria, while samples were considered UTI positive if there was growth of $> 10^5$ CFU/mL of a single uropathogen when urine was collected using the clean-catch method and $> 10^4$ CFU/mL in samples collected via bladder catheterization.

Regarding statistical analysis, quantitative variables were expressed as measures of central tendency and dispersion, with their normality assessed using the Kolmogorov-Smirnov

test. Categorical variables were expressed as percentages. Qualitative variables were compared using the χ^2 test. A significance level of 0.05 was used in all comparisons. There was no conflict of interest.

RESULTS

A cohort of 298 patients was analyzed, with a non-normal distribution according to the statistical analysis. The median age was 0.58 years (7 months) with an interquartile range of 0.84. Overall, 59.7% were girls and 40.3% boys. Regarding age distribution, 32% of patients were under 3 months, 16.4% were between 3 and 6 months, 28% were between 6 and 12 months, and 23.6% were older than 1 year, as illustrated in [Figure 1](#).

Urine was collected via bladder catheterization in only 5 patients, with no contaminated urine cultures detected. However, the sample size was too small for statistical analysis.

In the remaining cases ($n=293$), urine was collected using the clean-catch method showing a total contamination rate of 15.3%. There were no significant differences in sample contamination rates between male (14.7%) and female (15.7%) patients ($p=0.8$), with a prevalence ratio (PR) of 1.03.

The sample was stratified by age and the corresponding contamination rates are shown in [Table 3](#).

It was observed that the overall rate of contaminated samples decreased with increasing patient age, although this trend did not reach statistical significance ($p=0.19$). Forty-five percent of the contaminated samples were from children under 3 months of age, with 60% of these samples coming from girls. However, this difference was not statistically significant ($p=0.3$). Conversely, the difference in contamination rates between children younger than 3 months and those older than 3 months was statistically significant (OR 1.97, 95%CI 1.02-3.78).

TABLE 2. Summary of clinical practice guideline recommendations.

Guideline/Consensus	Country/region	Year	Recommendations
Reaffirmation of AAP clinical practice guideline: the diagnosis and management of the initial urinary tract infections in febrile infants and young children 2-24 months ⁽¹²⁾	US	2016	<ul style="list-style-type: none"> The specimen needs to be obtained through catheterization (discarding the first drops of urine to avoid contamination) or suprapubic aspiration, indistinctly Urine collected in a bag or via a clean-catch method is only suitable for urinalysis and if positive, a sterile specimen should be collected using invasive methods for urine culture
Recommendations on the diagnosis and treatment of urinary tract infection ⁽¹³⁾	Spain	2019	<ul style="list-style-type: none"> Urinary catheterization or ultrasound-guided suprapubic aspiration is the method of choice in urgent situations Clean-catch collection may be considered in non-urgent situations
Updated Italian recommendations for the diagnosis, treatment and follow-up of the first febrile urinary tract infection in Young children ⁽¹⁴⁾	Italy	2019	<ul style="list-style-type: none"> Clean-catch collection is recommended in primary care centers. In hospital settings, bladder catheterization is recommended, although clean-catch collection is accepted as a secondary option. In infants under 6 months and < 10 kg, micturition-stimulating methods should be considered
Urinary tract infection in infants and children: diagnosis and management ⁽¹⁵⁾	Canada	2020	<ul style="list-style-type: none"> Urine collection in pre-continent children is recommended indistinctly with clean-catch, bladder catheterization, or suprapubic aspiration methods Bagged samples can only be used for initial screening to rule out UTI
Swiss consensus recommendations on urinary tract infections in children ⁽¹⁶⁾	Switzerland	2020	<ul style="list-style-type: none"> A bagged sample should only be used to rule out the diagnosis of UTI Samples collected using the clean-catch method, bladder catheterization, or suprapubic aspiration are accepted. Bladder catheterization is recommended for children under 3 months of age, and clean-catch collection for older children, while suprapubic aspiration is considered as a secondary option
South Australian Paediatric Clinical Practice Guidelines Urinary Tract Infection in Children ⁽¹⁷⁾	Australia	2021	<ul style="list-style-type: none"> Suprapubic aspiration is recommended as the gold standard in infants with sepsis under 6 months of age In children older than 6 months with signs of sepsis or following a failed suprapubic aspiration, bladder catheterization is recommended In cases where the sample is not required urgently, clean-catch collection is recommended The use of urine collection bags is not recommended even though a negative urinalysis would rule out UTI
Urinary tract infection in under 16s: diagnosis and management ⁽¹⁸⁾	United Kingdom	2022	<ul style="list-style-type: none"> It is recommended to use a clean-catch collection method whenever possible. When it is not possible, bladder catheterization or ultrasound-guided suprapubic aspiration should be used

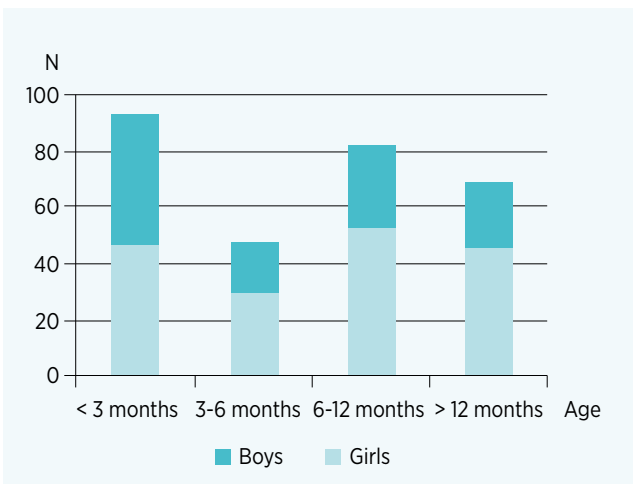


FIGURE 1. Sample distribution by age and sex.

DISCUSSION

Obtaining a sterile urine specimen in pre-continent children can be difficult and all methods have their limitations. Choosing the appropriate method of urine collection, especially in this population, requires a balance of factors such as clinical setting, available resources, speed of specimen collection, invasiveness, contamination rate, cost, and even parental and/or clinician preference. The collection method of choice differs among the different pediatric emergency departments in our country and clinical practice guidelines from various countries and societies do not provide unanimous recommendations regarding the method to use in pre-continent children. Currently, there is a debate in the literature regarding the optimal urine collection method for these patients.

In our study, the contamination rate associated with clean-catch collection was similar to that obtained by urinary

TABLE 3. Percentage of contaminated samples according to age and sex.

Age	Girls	Boys	TOTAL
0-3 months	12/47 (25.5%; 95%CI 15.3-39.5)	8/47 (17.0%; 95%CI 8.9-30.1)	20/94 (21.3%; 95%CI 14.2-30.6)
3-6 months	4/30 (13.3%; 95%CI 5.3-29.7)	3/18 (16.7%; 95%CI 5.8-39.2)	7/48 (14.6%; 95%CI 7.2-27.2)
6-12 months	7/53 (13.2%; 95%CI 6.5-24.8)	3/29 (10.3%; 95%CI 3.6-26.4)	10/82 (12.2%; 95%CI 6.8-21.0)
> 12 months	4/46 (8.7%; 95%CI 3.4-20.3)	3/23 (13.0%; 95%CI 4.5-32.1)	7/69 (10.1%; 95%CI 5.0-19.5)

catheterization as described in the reviewed literature^(5,6). However, it should be noted that in patients under 3 months of age, the contamination rate with this method is significantly higher than in other age groups, with no statistically significant differences between sexes, indicating that it may not be an appropriate method for the youngest patients. In this age group, considering bladder catheterization or using micturition-stimulation methods in collaboration with healthcare personnel could be options to limit the number of contaminated samples, although further studies are necessary to evaluate the contamination rate associated with the latter method.

According to the findings of this study, in children older than 3 months it would be acceptable to use the clean-catch collection method for urine culture.

Nevertheless, the primary limitation of this study is its small sample size. Therefore, it would be important to conduct a prospective, multicenter study to compare the methods of urine collection in pre-continent patients with suspected UTI.

CONCLUSIONS

The ideal method of urine collection should be minimally invasive, sensitive, specific, simple, and fast, but all techniques have their limitations. Current clinical practice guidelines vary in their recommendations for urine collection methods in clinically stable, pre-continent children. Most of the literature reviewed advocates for the use of the clean-catch collection method in this population, as it is a non-invasive test.

The findings of our study suggest that clean-catch urine collection in children under 3 months of age is associated with high contamination rates; however, it may be a suitable method for obtaining samples in pre-continent children older than 3 months who are clinically stable and suspected of having a UTI at the pediatric emergency department.

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