

Urine collection techniques in children

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Urinary tract infections (UTIs) are an important cause of acute and chronic morbidity in children. Long-term complications include hypertension and decreased renal function caused by renal scarring. The accurate diagnosis of UTI in children is necessary to ensure appropriate therapy and follow-up for those who need it, and to avoid unnecessary therapy, hospital admission, and further evaluation in those who do not. The manner in which urine is collected and processed before it is cultured can affect the validity of the culture result.

Children who are toilet trained can provide clean voided urine samples. Samples of urine from children who are not toilet trained can be obtained by "clean voided" bag samples, suprapubic bladder aspiration (SPA), and transurethral bladder catheterization (TUBC). SPA and TUBC are invasive but are the only valid ways to collect urine for culture in infants and children with unexplained fever who are younger than two years of age and ill enough to merit immediate antimicrobial therapy [1].

The procedures for obtaining and processing urine samples in children are reviewed here. The diagnosis, treatment, and subsequent evaluation of UTIs in children are discussed separately.

CLEAN VOIDED BAG SAMPLES – The practice of obtaining urine specimens by the "clean voided" bag appeals to medical staff and parents because it is noninvasive. However, it should **not** be used to obtain urine samples for culture [1]. Appropriate collection of clean voided bag urine samples requires proper cleansing, rinsing, and drying of the perineum before application of the bag, immediate removal of the bag after urine is voided, and prompt processing of the urine.

Cultures of urine specimens obtained by clean voided bag have an unacceptably high rate of false positive results compared to catheterized specimens (63 percent versus 9 percent in one prospective study of 7584 children younger than two years) [2]. An adverse outcome (delayed diagnosis and treatment, unnecessary recall, unnecessary treatment, unnecessary hospital admission, and unnecessary radiologic investigation) occurred in 132 of the 3440 children who had a false positive urine culture.

According to the guidelines of American Academy of Pediatrics Subcommittee on UTI, clean voided bag urine samples are acceptable for urinalysis in infants

and children between two months and two years of age who have unexplained fever and do not appear ill enough to require immediate antimicrobial therapy. An infant or young child should never receive antibiotics on the basis of a urinalysis from a clean voided bag urine specimen. Thus, another urine sample for urinalysis and culture should be collected by invasive means if the urinalysis from the bag sample suggests a UTI by any of the following [1]:

- Positive leukocyte esterase or nitrite test
- Greater than 5 white blood cells per high-power field (spun urine)
- Presence of bacteria on Gram stained urine (unspun urine)

Monitoring the clinical course of the infant or child without antibiotic therapy is a reasonable course of action if the urinalysis is not suggestive of UTI. However, a negative urinalysis does not exclude a UTI (show table 1) [1].

CLEAN VOIDED SAMPLES – Children who are toilet trained can provide clean voided urine samples. The following steps should be performed to minimize the degree of bacterial contamination:

- Local disinfection of the meatus and adjacent mucosa should be performed with a nonfoaming antiseptic solution; this region then should be dried with a sterile swab to avoid mixture of the antiseptic with urine.
- Contact of the urinary stream with the mucosa should be minimized by pulling back the foreskin in boys who are uncircumcised and by spreading the labiae in girls.
- The first voided specimen should be discarded because the initial urine flushes urethral contaminants. The second, midstream sample is the one that should be sent to the laboratory.

SUPRAPUBIC BLADDER ASPIRATION – Suprapubic bladder aspiration is a safe and effective method for obtaining urine specimens in infants and young children (we usually do not perform this procedure in children who are older than two years). The distended bladder, which extends above the level of the pubic symphysis into the lower abdomen, is easy to access percutaneously. Success is more likely if the bladder can be percussed or palpated and the child has not emptied the bladder in the 60 minutes before the procedure [3,4]. Percussion or palpation of the bladder may stimulate urination in some children.

This method represents the gold standard in the diagnosis of UTI [5-7]. In one study, clean voided bag, clean voided, and SPA urine samples were obtained on the same day from thirty hospitalized children between the ages of one day and three years [7]. Compared to the other collection methods, SPA yielded no cultures with mixed growth or colony count less than 10000 per mL/urine,

suggestive of contamination (0 versus 73 percent for mixed growth from both bag and clean voided samples; and 0 versus 6 percent and 13 percent for intermediate growth from clean voided and bag samples, respectively).

The following steps are performed [8,9]:

- The child is restrained in the supine and frog leg position. This position permits adequate stabilization of the pelvis (show figure 1).
- The site for needle insertion, in the midline, approximately one to two centimeters above the pubic symphysis, is widely prepared with povidone-iodine solution.
- The planned puncture site may be locally anesthetized with lidocaine. Many practitioners do not perform this step because they believe it is more painful than the procedure itself.
- The urethral opening should be occluded just before needle insertion because the procedure will stimulate urination in many children. This is accomplished by squeezing the penile urethra in boys or applying urethral pressure to the meatus in girls [8].
- A 1.5 inch, 22-gauge needle attached to a 5 mL syringe is inserted one to two centimeters above the pubic symphysis. The needle should be angled 10 to 20 degrees cephalad and advanced under negative pressure until urine returns (show figure 2). The needle should be partially withdrawn and redirected at an angle more perpendicular to the frontal plane if the initial attempt is unsuccessful.

Urine is not likely to be obtained after the third attempt [3]. Thus, one can either perform transurethral bladder catheterization or wait 15 to 30 minutes for the bladder to become more distended [10].

Complications – Minor complications, such as microscopic hematuria, are common. Major complications, such as gross hematuria [11,12] and anterior abdominal wall abscess, are rare [13]. Intestinal perforation can occur if a loop of bowel overlies the bladder, but the small puncture rarely leads to peritonitis [8,14]. Intestinal (or other viscus) perforation can be avoided if the procedure is not performed in children who have abdominal distension, organomegaly, volume depletion, or congenital anomalies of the gastrointestinal or genitourinary tract [4,13,14].

TRANSURETHRAL BLADDER CATHETERIZATION – The catheterization of the urethra is another safe and effective method for obtaining urine samples for culture in most infants and children. The procedure can be difficult in uncircumcised boys who may need to have suprapubic aspiration if the

urethral meatus cannot be identified.

An explanation of the anatomy and the indications for the procedure should be given to parents and caregivers before transurethral bladder catheterization is performed to avoid unnecessary parental anxiety about the manipulation of their child's genitals. In addition, whether the child has a latex allergy must be determined because the condition is common in children with spina bifida and other conditions that require frequent bladder catheterization.

The following steps are performed:

- The child is restrained in the supine and frog leg position. This position permits adequate stabilization of the pelvis and complete visualization of the external genitalia.
- The anterior urethra is cleansed thoroughly with povidone-iodine solution.
- A sterile lubricant jelly is applied to the end of an appropriately sized catheter (5 French for children younger than 6 months; 8 French for those between 6 months and adolescence, and 10 French for adolescents).

Boys

- The foreskin of the glans is retracted gently to permit complete visualization of the urethral meatus if the boy is uncircumcised. The foreskin must be repositioned after the procedure to prevent paraphimosis.
- The urethra is straightened by using the nondominant hand to hold the penis perpendicular to the lower abdomen (show figure 3). Gentle traction is applied.
- The catheter is inserted with the dominant hand until urine returns [8].

Girls

- The urethra may be difficult to visualize in girls. An assistant often is needed to retract the labia majora (show figure 4).
- The catheter is inserted into the urethral meatus until urine returns (show figure 5). Catheters that are inadvertently placed in the vagina may be left in place to serve as a landmark for subsequent attempts.
- The first few drops of urine obtained should be discarded to prevent contamination of the urine with urethral organisms or cells. A prospective study comparing early and later urine samples obtained by TUBC in 86 children demonstrated that inclusion of the early stream urine increases false positive

results on urinalysis for white blood cell counts and bacteria detection [15].

Complications – Complications of bladder catheterization are minimal and include urethral trauma and microscopic hematuria. In addition, catheterization can cause iatrogenic infection. However, this risk was assessed by the AAP subcommittee on UTI and found to be extremely low, and no change was made in the recommendation to perform the procedure [1].

COMPARISON OF SUPRAPUBIC BLADDER ASPIRATION AND TRANSURETHRAL BLADDER CATHETERIZATION – Few studies have compared suprapubic bladder aspiration and urethral catheterization in infants and children:

- One hundred infants younger than six months of age and being evaluated for febrile illness, suspected UTI, or sepsis were randomly assigned to undergo SPA or TUBC. TUBC was more successful (100 versus 46 percent) but took more time (mean time of 81 versus 17 seconds) than did SPA [4]. In addition, TUBC was 100 percent successful after failed SPA.

- Thirty-three neonates who required sterile collection of urine were randomly assigned to urine collection by SPA or TUBC [16]. TUBC was more successful (81 versus 65 percent), but the volume of urine obtained more often was insufficient for analysis (69 versus 41 percent).

- Urine samples from 42 children, aged three months to 10 years, were obtained by SPA and TUBC after elective surgery. TUBC samples were divided into into first and second portions [6]. Sterile cultures were obtained more often from SPA than from second TUBC sample, and more often from second than from first TUBC sample (95 versus 80 versus 60 percent). When cultures with nonpathogenic organisms or colony counts less than 10,000 per mL/urine were assumed to be contaminated, the agreement between SPA and TUBC for "sterility" was 98 percent for the second portion and 93 percent for the first.

PROCESSING OF URINE SAMPLES – The urine sample should be sent immediately to the bacteriology laboratory because bacteria will continue to proliferate in the warm medium of freshly voided urine, leading to increased bacterial counts. If such immediate dispatch is not possible, the container should be transported in iced water and then stored in a refrigerator at 4°C. Cooling stops bacterial growth until the urine is plated on culture medium and incubated. However, urinary leukocytes may be altered by refrigeration, possibly affecting interpretation of the urinalysis.

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