

A SIMPLE METHOD FOR SELECTING URINE SAMPLES THAT NEED CULTURING

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Urinary tract infections (UTI) are common in infancy and childhood, and are associated with potentially serious long-term consequences of renal scarring, hypertension and chronic renal failure.¹ UTI is essentially a microbiological diagnosis, and thus requires urine culture for confirmation. Collecting, transporting and processing urine samples is financially costly, raises anxiety in, and causes inconvenience to, the children and their parents or caregivers. Rationalization of the whole process of urine testing would, therefore, be highly desirable.

As part of an audit of the Children's UTI Clinic at South Tyneside District General Hospital, England, the reliability of two tests (dipstick for leukocyte esterase and nitrite, and microscopy for pus cells) was assessed. Because of encouraging preliminary results, a prospective study was conducted.

Subjects and Methods

The results of 490 urine samples collected from 279 children (88 boys, 191 girls) aged 4 days to 15 years, were analyzed. Except for two samples, all urine specimens were collected as clean-catch or midstream in younger and older children, respectively, and as clean-catch, by suprapubic aspiration, catheter samples, or by using the Newcastle urine collection pad²⁻⁴ in infants and children who were still in diapers. In one ill and febrile 2½-month-old baby, two bag samples yielded a pure growth. Attempts to obtain a suprapubic sample failed, and the baby was treated with IV antibiotics as clinically indicated. The samples were delivered fresh (within 2 hours of voiding) to the laboratory for microscopy and culture.

The two tests employed in the study were:

- Dipstick for leukocyte esterase and nitrite (using Nephur-Test + Leuco, Boehringer Mannheim). The result was recorded as +ve if either or both were positive, and -ve if both were negative.
- Simple microscopy of fresh uncentrifuged urine for pus cells done by the microbiology laboratory. It was

the practice of the laboratory to report the result recorded as positive if there were any number of pus cells/high-power field, and negative if there were no pus cells at all.

The results of these two tests were compared with the final urine culture reports. A urine culture was reported as positive when there were >10 colony-forming units (CFU)/mL of urine, or any number of CFU in a urine sample obtained by suprapubic aspiration (SPA). Any growth of <10 CFU/mL of urine, except for those obtained by SPA, was considered negative. Urine cultures which revealed either mixed growth or unusual organisms were either repeated or the child was reviewed. These were excluded from further analysis.

Results

A total of 441 specimens (90%) were negative, and 49 (10%) were positive on culture. Organisms isolated were 39 *E. coli*, 5 *Staphylococcus epidermidis*, 2 *Proteus* spp., 2 *Klebsiella* spp., and 1 *Streptococcus faecalis*.

To assess the positive and negative predictive values (PPV and NPV) of dipstick and/or microscopy, results were grouped into three categories depending on whether dipstick alone (irrespective of microscopy result), microscopy alone (irrespective of dipstick result), or both tests were considered.

Dipstick Alone

Of 129 samples with positive dipstick, 34 (26.4%) yielded a positive and 95 (73.6%) yielded a negative culture. Dipstick was negative in 361 samples, with a positive culture in 15 (4.2%), and a negative culture in the remaining 346 (95.8%) samples. This confirms previous observation that dipsticks are better at excluding UTI when the readings are negative than in confirming a diagnosis of UTI when they are positive.⁵

Microscopy Alone

Urine microscopy was positive in 120 samples, of which 37 (30.8%) yielded a positive and 83 (69.2%) produced a negative culture. Microscopy was negative in 370 samples, which yielded 12 (3.2%) positive and 358 (96.8%) negative cultures. Using the strict criteria adopted by this study, urine microscopy for pus cells is better at excluding UTI when no pus cells are seen than in confirming the diagnosis when microscopy is positive.

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TABLE 1. *The positive and negative predictive values (expressed as percentage).*

| | Total number of urine samples | Number (%) of positive urine cultures | Number (%) of negative urine cultures |
|------------------------------|-------------------------------|---------------------------------------|---------------------------------------|
| Dipstick for leukocytes | | | |
| Positive | 129 | 34 (26.4) | 95 (73.6) |
| Negative | 361 | 15 (4.2) | 346 (95.8) |
| Microscopy for pus cells | | | |
| Positive | 120 | 37 (30.8) | 83 (69.2) |
| Negative | 370 | 12 (3.2) | 358 (96.8) |
| Both dipstick and microscopy | | | |
| Positive | 78 | 28 (35.9) | 50 (64.1) |
| Negative | 319 | 6 (1.9) | 313 (98.1) |

Dipstick and Microscopy Combined

There were 78 samples where both tests were positive, and 28 (35.9%) of them yielded a positive and 50 (64.1%) produced a negative culture. It is interesting to note that even if both tests are positive, two-thirds of the samples were negative on culture. For 319 samples where both tests were negative, the vast majority of cultures (313 or 98.1%) were negative too and only 6 samples (1.9%) had positive cultures. These six samples came from children who were asymptomatic and none of them was <1 year old, but they all subsequently received a full course of appropriate antibiotics.

Discussion

The dipstick testing of urine for leukocyte esterase and nitrite has been extensively assessed in adults,⁶ but there are only a few reports of their use in children. Wiggelinkhuizen et al. compared dipstick testing with formal urine analysis of 1137 children and concluded that the dipsticks were a reliable screening technique.⁷

Over the past few years, a number of studies have been conducted on children to assess the feasibility of various screening protocols to predict positive and negative urine cultures. These studies evaluated the positive and negative predictive values of urine dipstick testing for leukocyte esterase and nitrite combined with: microscopy of a centrifuged urine for pus cells and bacteria,⁸ semiquantitative gram-stained smear of uncentrifuged urine,⁹ and microscopy of centrifuged urine for pus cells, bacteria and erythrocytes.¹⁰ One study assessed the predictive values of microscopy alone of fresh uncentrifuged urine using three kinds of microscopes.¹¹ Although these studies gave very high predictive values, they employed methods other than a simple microscopy of an uncentrifuged urine.

This study was conducted in a district general hospital on 490 fresh urine samples reliably tested for the presence of leukocyte esterase and nitrite on dipstick, and for pus cells on microscopy. When either the dipstick or microscopy alone was positive or when both were positive, the chances of a positive culture were 26.4%, 30.8% and 35.9%, respectively. This suggests that even if both tests are positive, it is much more likely to get a negative culture than a positive one, and will not be of practical value in the process of selecting samples for culture.

A negative dipstick test alone (361 samples) and a negative microscopy alone (370 samples) had negative predictive values of 95.8% and 96.8%, respectively. This may be adequate in the asymptomatic older child, but in ill febrile children, a higher negative predictive value is required. In these ill children, the combined negative dipstick and microscopy, which has a negative predictive value of 98.1%, virtually excludes urinary tract infection.

The number of infants included in this study was small (22 or 7.9% of the total), but a similar previous study¹² conducted on samples collected from children under 18 months of age gave a comparable negative predictive value of 98.5%. The NPV raised to 99.4% when absence of proteinuria was included. The author is of the opinion that provided the samples are collected and tested freshly, this method can be safely recommended for use in infants too.

The routine use of urine microscopy in hospital clinics and wards was advocated by Robins et al. more than two decades ago.¹⁴ Widespread use of the new dipsticks, coupled with microscopy for pus cells performed on fresh samples by adequately trained doctors, would dramatically cut down the number of samples sent for culture and this, in turn, would cut down on costs. To achieve this, access to a simple basic microscope and a counting chamber should be provided for medical staff working on children's wards and outpatient clinics with suitable prior training. This could be extended to general practitioners working in large practices.

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