A dipstick test for urinary tract infections

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INTRODUCTION

Early and reliable diagnosis of urinary tract infections is important in infants and children. Clinically the diagnosis of an infection can be difficult as symptoms are non-specific and the only way to reliably exclude or confirm a urinary tract infection is by the analysis of a urine specimen. Traditionally the gold standard method for diagnosis has been in microscopic analysis and qualitative culture of a specimen of urine. Recently, urinary reagent strips have been available to test for markers of infection. Two markers, leucocyte esterase and nitrite, have been combined on one dipstick to screen for urinary tract infections.

The laboratory analysis in this hospital costs £1.72. for each urine microscopy and culture undertaken. It costs an additional £6.23. for bacterial identification and antibiotic sensitivities if the culture shows a growth. A dipstick test (Multistix 8SG, Bayer Diagnostics, Bayer, Hampshire, UK.) costs 16.5p.

In this paediatric accident and emergency (A&E) department urine analysis is undertaken on many children who attend with non-specific signs and symptoms of infection. If clinicians and laboratory staff can be satisfied that a strip test is a suitable screening test for infection for all urines this would reduce patients waiting times and be cost effective.

Keywords: children, dipstick, screening, urinary infection

METHOD

Until the study began all urine specimens were sent routinely to the laboratory for microscopy, culture and sensitivity. A presumptive diagnosis of urinary tract infection was made if a leucocyte count of more than 100 cells cmm^{-1} was reported. For a 6-week period in August and September 1993 urine specimens were tested by nurses in the A&E department with a reagent Multistix 8SG strip.*The results were recorded. The same urine specimen was then sent to the laboratory for microscopy, culture

and sensitivity. The results of these two tests were compared and the predictive value of the presence of nitrites, leucocytes and protein on the reagent strip test for the presence of a urinary tract infection was evaluated. The total cell count was also correlated with the presence or absence of growth on culture.

RESULTS

A total of 248 specimens of urine were tested by reagent strip and formally analysed by microscopy, culture and sensitivity. Seventy-three were bag specimens, and 175 were mid-stream specimens. Of the 248 specimens 19 (7.7%) were positive on culture, 201 (81%) had no growth, 27 (11%) showed a mixed or no significant growth and one was post-antibiotic. No positive culture was found with all three markers (leucocyte esterase, nitrite and protein) negative. Nine specimens were positive for all three markers and all had a pure growth on culture.

The leucocyte esterase reagent strip was positive in 17 of 19 (89.5%) urine samples with a pure growth on culture. Two urine samples with a pure growth on culture were leucocyte esterase and nitrite negative but were positive on testing for protein. The protein reagent strip was positive in 142 (57%) of 248 cases. In many negative cultures protein was present. Only 17 (11%) had a pure growth on culture. Two positive cultures were negative on protein testing but were positive to leucocyte esterase testing. The white cell count in urine samples was correlated with the presence or absence of growth on culture (see Table 1). On microscopy a white cell count of $>100 \text{ cmm}^{-1}$ identified 15 (79%) of the 19 positive urinary tract infections. The final diagnosis in children who had urine specimens with leucocyte counts of $100\text{--}500 \text{ cmm}^{-1}$ but no pure growth on culture are listed in Table 2.

Three urine specimens showed a mixed growth on culture. In six urine specimens the leucocyte count was greater than $500 \text{ cells cmm}^{-1}$ but there was no pure growth on culture. The diagnoses in these children were: perianal abscess (1); urinary tract infection on antibiotics (2); labial lacerations (2); viraemia (1); and perianal bleeding (1).

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*Multistix 8SG reagent strip tests for glucose, ketones, specific gravity, blood, pH, protein, nitrites and leucocytes.

Table 1. The number of white cells in urine samples correlated with bacteriological culture results

Number of white cells cmm ⁻¹	Number of urine samples	Culture results
0	152	0 with growth
1–50	48	1 with growth
50–100	11	3 with growth
100–500	22	6 with growth
>500	15	9 with growth

Table 2. Diagnoses in children with leucocyte counts of 100–500 white cells cmm⁻¹ but no pure growth on culture

Diagnoses	No. of children
Viraemia	2
Glomerulonephritis	1
Kawasaki's disease	1
Upper respiratory tract infection	1
Hepatitis A	1
Mesenteric adenitis	2
Food poisoning	1
Constipation	1
Nappy rash	1
Septicaemia	1
Febrile convulsion	1
Allergic rash	1

There were nine cultures with a mixed growth. Three of these were bag specimens from babies, one was from a child treated with antibiotics, three children had viral infections, one an allergic rash and one non-specific abdominal pain (? mesenteric adenitis). Only three specimens that were leucocyte positive with a leucocyte count >100 white blood cells without pure growth on culture were from boys. All three had definite diagnoses of glomerulonephritis, Kawasaki's disease or viraemia.

DISCUSSION

In a study in which 1000 urine samples from children were reagent strip tested and the results compared with formal analysis of the urine it was found that if the leucocyte esterase and nitrite markers were absent there was a negative predictive value for infection of over 98%.¹ Lejeune *et al.*² undertook a study in children under the age of 18 months using leucocyte esterase, nitrites and protein as markers for infection and found an overall negative predictive value for infection of 99.4%. Woodward and Griffiths tested urine specimens of 130 children in a surgical

ward, mainly with the symptom of abdominal pain in whom urinary tract infections needed to be excluded. They compared the results of reagent strip testing for leucocyte esterase and nitrites with those obtained from formal laboratory analysis and found the absence of the two markers confirmed a sterile urine in all cases. If one marker was present there was a possibility of urinary tract infection (positive predictive value of 12.5%). They concluded that the reagent strip was a good screening method and if both markers were negative no further investigations for infection were needed. If both were positive a urine infection would be present and if one marker was present formal microscopy and culture would be needed before a urine infection could be confirmed.³

In our study children were presenting to an A&E department with a wide variety of medical and surgical problems. Before the study all urine specimens had been sent to the laboratory for analysis. A presumptive diagnosis of urinary tract infection was made if a leucocyte count of greater than 100 white cells cmm⁻¹ of urine was reported from the laboratory. Although the laboratory is prompt in its dealing with specimens there is inevitably time taken for this test to be done, especially out of hours when staff have to be called in from home to do the test.

Our study showed a 100% negative predictive value if all three markers (leucocyte esterase, nitrite and protein) were absent. If urine was positive to any of these three markers and analysed in the laboratory no urine infection was missed though a significant number (123, 85%) had no growth. This is a result of the large number of children with proteinuria, largely because of fever or a systemic illness.

This audit has changed the working practice in the department. All urine specimens in the A&E department is now tested by reagent strip. If they are negative for all three markers for infection, the urine specimen is discarded and the absence of urinary tract infection is assumed. If any of the three markers is present the urine is sent to the laboratory immediately for microscopy, culture and sensitivity. If the urine is reported to have >100 white cells cmm⁻¹ of specimen a urinary tract infection is assumed and treatment commenced. The presence or absence of a urinary tract infection is confirmed or denied by the subsequent culture and sensitivity results. The exception to this policy is in children known to have complex renal problems as non-nitrite forming organisms (e.g. some pseudomonas strains and B. haemolytic streptococcus) could theoretically give a negative strip test.

This change in investigation for possible urinary tract infection has meant that children are not having to wait so long for urine results. They wait 3–5 min for the results of the dipstick test compared with 15–60 min when tested in the laboratory and less urine samples (about half the previous number) are sent to the laboratory for further analysis, thus allowing that service to be used more efficiently.

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