Rapid Screening of Urine for Bacteria and Cells by Using a Catalase Reagent

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Five hundred urine samples were tested for cells and bacteria by using a commercial dipstick, a catalase screening device, standard culturing, and chamber counts. The sensitivities of the catalase test were 83% for all samples and 97.6% for specimens containing significant numbers of leukocytes and bacteria. The catalase screening test is simple to perform and should prove useful for the detection of urinary tract infections.

In recent years, an impressive number of devices have been advanced for the detection of bacteria and blood cells in urine. Clinical laboratories require speed, simplicity, and accuracy. Rapid elimination of negative specimens reduces labor and allows for more efficient laboratory work flow. Unfortunately, rapid urine screening methods have often traded specificity for sensitivity and simplicity. We have examined the performance characteristics of a rapid catalase screening device based on the production of foam from specimens containing human cells and bacteria. The test is based on the presence of catalase activity in blood cells as well as bacteria, with the exception of most species of *Streptococcus* and *Aerococcus*.

Five hundred urine specimens obtained in the morning were submitted in sterile sealed plastic containers from the inpatient and outpatient areas of a 750-bed general hospital. Specimens were not refrigerated, were processed within 1 h of voiding, and were agitated prior to each successive examination. Each test type was performed by a separate individual; results were not collated until the completion of the study. Statistical analyses were done with the chi-square and Student t tests.

Aliquots of 0.001 ml were applied to the surface of MacConkey agar plates (Pasteur Diagnostics, Marnes La Coquette, France) and 5% human blood agar plates (Columbia agar base; Oxoid Ltd., Basingstoke, Hampshire, United Kingdom) with a stainless steel calibrated loop (Medical Wire & Equipment, Corsham, Wiltshire, United Kingdom) (2). Bacterial colony counts and species identification were performed by standard techniques following overnight incubation at 37°C. A significant concentration of bacteria was defined as ≥100,000 CFU/ml (5).

All direct erythrocyte and leukocyte counts were performed on uncentrifuged urine by one individual using a single counting chamber and microscope throughout the study. Counts in excess of 10,000/ml were considered significant for either cell type (1, 10). The following parameters were determined by a separate technician using urine dipsticks (Ames Multistix 10 SG; Ames Diagnostics, Elkhart, Ind.) and an automatic reader (Ames Clinitek 200): bilirubin, blood, pH, protein, urobilinogen, nitrite, and leukocyte esterase. This product was chosen because it is in current

use at our institutions. A single lot of fresh dipsticks was used during the entire study.

URISCREEN (Diatech Diagnostica, Ltd., Ness Ziona, Israel) was supplied as a predispensed powder in plastic tubes. A listing of ingredients is not presently available. In accordance with manufacturer instructions, 2.0 ml of urine was poured into each reagent tube. Four drops of 10% hydrogen peroxide was added, and the test was interpreted after 2 min. The presence and amount of foam (+ to + + + +) were recorded (Fig. 1); the discriminative power of the results is enhanced by a blue dye present in the reagent.

Statistical analyses are presented in Table 1. Bacteriuria ($\geq 10^5$ CFU/ml) was present in 135 samples; pyuria ($\geq 10^4$ leukocytes per ml) was present in 185; and erythrocyturia ($\geq 10^4$ erythrocytes per ml) was present in 177. Significant concentrations of both cells and bacteria were lacking in 216 samples. The catalase reagent was more sensitive in detecting abnormal urine than were the dipstick nitrite test for bacteriuria ($P < 10^{-6}$) and the dipstick for erythrocyturia ($P < 10^{-4}$). The sensitivities of the catalase and leukocyte esterase tests for the detection of pyuria were similar. The specificity of the dipstick nitrite test for bacteriuria exceeded the specificity of the catalase test for abnormal urine ($P < 10^{-6}$).

The predictive value of a positive catalase test was higher than those for leukocyte esterase ($P = 0.001$) and blood ($P = 10^{-5}$) in the dipstick test; a negative leukocyte esterase reaction had a higher predictive value than did a negative catalase test ($P = 10^{-4}$). When analysis was limited to samples containing abnormal concentrations of both bacteria and leukocytes, the sensitivity and predictive value of a negative catalase test increased to 97.6 and 98.7%, respectively.

The sensitivity of the catalase test exceeded 87% when more than one formed element was present in urine; catalase was the only reagent to consistently detect samples having abnormal concentrations of all three elements together. Negative catalase tests were recorded for 13 urine specimens having significant concentrations of bacteria. Of these, 10 demonstrated neither pyuria nor hematuria on microscopic examination, and 9 contained bacterial species known to be catalase positive. The distribution of pH and positive tests for protein, urobilinogen, and bilirubin did not differ among samples showing false-positive or false-negative reactions for nitrite, leukocyte esterase, or blood in the dipstick test or catalase.

Although the mean concentrations of bacteria, erythro-

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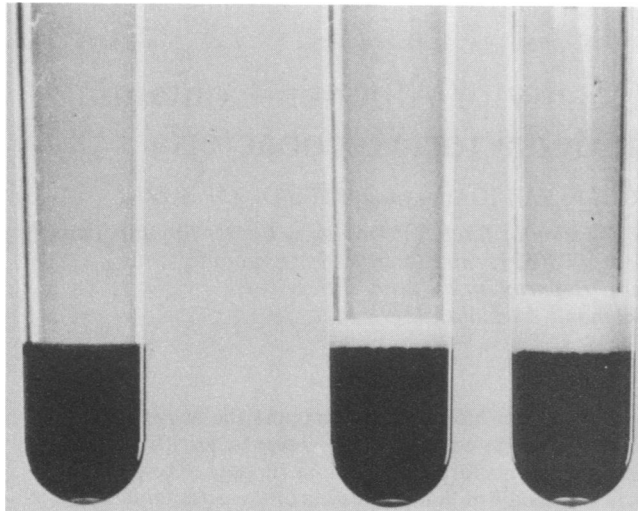† Present address: Department of Microbiology, Ichilov Hospital, 6 Weitzman St., Tel-Aviv 64239, Israel.

FIG. 1. Development of foam from urine samples demonstrating (left to right) negative, 2+, and 4+ catalase reactions.

cytes, and leukocytes increased among specimens with increasingly strong catalase reactions, the differences were not statistically significant. Nevertheless, a one-plus (+) reaction was recorded for 47 of 62 (75.8%) false-positive catalase tests (insignificant cell and bacterial concentrations) and only 91 of 229 (39.7%) true-positive catalase tests ($P < 10^{-5}$). Data for specimens containing lower counts of bacteria ($\geq$10,000/ml to <100,000/ml) or cells ($\geq$1,000/ml to <10,000/ml) were insufficient for meaningful analysis. Nevertheless, bacterial counts in this range may be significant in certain clinical circumstances.

In most instances, false-negative catalase reactions (significant bacteriuria present) were associated with acellular

TABLE 1. Comparison of rapid catalase test with urine dipstick[a]

Test	Sensitivity	Specificity	Predictive value of a:	
			Positive test	Negative test
Urine dipstick				
Nitrite	41.5 (10^{-6})	92.3 (10^{-6})	67.5 (NS)	82.2 (NS)
Leukocyte	76.8 (NS)	74.5 (NS)	64.5 (<10^{-3})	87.0 (<10^{-4})
Erythrocyte	66.3 (10^{-4})	76.4 (NS)	59.9 (10^{-5})	72.9 (NS)
Catalase reagent	83.0	70.9	78.7	76.3

[a] Data are reported as percentages (P value when compared with the catalase reagent). NS, $P > 0.05$. Note that sensitivity, specificity, and predictive values for the catalase reagent refer to the detection of one or more abnormalities in any given specimen.

urine samples. Since the presence of bacteria without pyuria may be indicative of contamination (10), the failure of the catalase test in such specimens may be irrelevant in the clinical setting.

The nitrate reduction test is characterized by unacceptably low sensitivity and high specificity (4). False-negative tests are associated with abnormal concentrations of urobilinogen, a urine pH of <6.0 (10), and bacteriuria due to gram-positive cocci or nonfermentative bacilli, such as *Pseudomonas* spp. The sensitivity of nitrite tests in our series did not differ when analyzed by bacterial species ($P > 0.5$).

Other investigators have reported the sensitivity of the leukocyte esterase test to be as high as 90% (7, 9). Ascorbic acid, phenazopyridine, or abnormal concentrations of protein may interfere with the reagent (3, 6). There was no apparent explanation for the poor performance of the dipstick in this study. The combined testing of nitrite and leukocyte esterase resulted in a sensitivity of 84%, considered unacceptable in a recent review (8).

Our study suggests that the catalase reagent offers a simple and sensitive test for the rapid screening of urine. Samples exhibiting positive reactions will require routine urinalysis as well as culturing, since the reagent detects both bacterial and somatic cells. The catalase test is more sensitive than the Ames Multistix for detection of bacteriuria and hematuria and should offer a useful alternative for urine testing in clinics, hospital wards, and clinical laboratories.

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