Evaluation of a Leukocyte Dip-Stick Test Used for Screening Urine Cultures

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Received 12 April 1984/Accepted 10 July 1984

A 2-min leukocyte esterase dip-stick test for pyuria was used to screen 409 consecutive clinical specimens received for culture. The leukocyte esterase dip-stick test proved to be a sensitive and inexpensive means of screening urine specimens for the absence of leukocytes and, by inference, for the absence of significant bacteruria.

More than half of all urine specimens received for routine culture in community hospital settings will not contain culturable pathogenic bacteria, whereas a small but significant portion of the culture-positive specimens will contain various levels of "contaminating" organisms assumed to have originated not from the urinary tract but from skin, vaginal, or perianal sources (4, 5). By definition, urine specimens having bacteria or yeasts derived solely from contaminating sources would not contain leukocytes or other evidence of ongoing urinary tract infection and could reasonably be exempted from the normal bacteriological work-up. The advantages of a screening procedure that would reliably and economically separate specimens which contained evidence of clinical infection from those which did not are thus obvious. The introduction of Chemstrip (Bio-Dynamics, Indianapolis, Ind.) urine dip-sticks, which includes the leukocyte esterase test (LET), appears to offer precisely this possibility through biochemical detection of lysed leukocytes in the voided specimen.

The Chemstrip 9 version was selected for evaluation, and a total of 412 consecutive urine specimens from all sources were processed. Three specimens (<1%) were grossly bloody and not suitable for dip-stick testing. Gross specimen color and clarity were recorded immediately upon receipt for the remaining 409 specimens, as were the dip-stick "9" results for LET, blood, protein, and nitrite (glucose, ketones, urobilinogen, bilirubin, and pH are also important for increased LET sensitivity; earlier package inserts had recommended a 1-min wait, and most current literature reflects the prior instruction.

Gram stains were performed on all specimens by allowing 20 µl of uncentrifuged urine to dry on a slide without spreading. This procedure is traditionally assumed to produce ≥1 bacterium and ≥1 leukocyte per oil immersion field when the count is ≥10⁵ CFU/ml and pyuria is present (1). Although still controversial, an acceptable normal level of leukocytes in urine is ≤5 per mm³; excretion at levels of ≥20 cells per mm³ is assumed by most physicians to have clinical significance (2, 3). The level of reliable detection of leukocytes by the LET has been reported to be ≥20 cells per mm³ (3).

Routine aerobic 24-h quantitative cultures were made by spreading 1.0 µl of uncentrifuged urine onto one 5% sheep blood tryptic soy agar plate and one eosin methylene blue plate. Cultures were typically evaluated after 24 h of incubation at 35°C, but 48 h was allowed when there was an obvious discrepancy between Gram stain and culture results. A significant positive culture was defined as one having ≥5 × 10⁶ CFU/ml (voided) or ≥1 × 10⁹ CFU/ml (any catheterized specimen) for less than three species of bacteria or ≥1 × 10⁶ CFU of yeast per ml (any specimen).

Of 409 urine specimens screened, 63 were judged not to have clinical significance: 4 with questionable Gram stains (rare leukocytes) but negative culture and LET results; 11

<table>
<thead>
<tr>
<th>Contamination</th>
<th>LET positive/ Gram stain positive</th>
<th>LET positive/ Gram stain negative</th>
<th>LET negative/ Gram stain positive</th>
<th>LET negative/ Gram stain negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanty*</td>
<td>4</td>
<td>13</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Gross*</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Charted evidence of bedpan collection or vaginal contamination</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

* Scanty contamination, Slight growth of skin or vaginal flora.
* Gross contamination, >10³ CFU/ml of >2 organisms.
* Includes four questionable Gram stains (rare leukocytes) from patients with no evidence of infection.

determined on dip-stick "9"). Dip-stick test reactions were observed and recorded at the time intervals specified by the package insert except that a final LET reading was not made until a full 2 min had elapsed. This 2-min distinction is with charted evidence of bedpan collection or vaginal contamination; and 48 which contained viable bacteria but fell within our existing in-house criteria for contamination (Table 1). Although not universally standardized, these criteria appeared to reflect the general clinical laboratory approach to contaminated urine specimens (1, 2, 5, 6). There were no voided specimens containing fewer than 5 × 10⁴ CFU of

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bacteria per ml in which physicians felt the isolate had clinical significance.

Of the 346 noncontaminated specimens, 179 (52%) had negative LET, culture, and Gram stain results (Table 2). An additional nine specimens with negative LETs were culture positive: three were positive for leukocytes by Gram stain, whereas six were negative (five of the latter patients were immunocompetent, and the sixth was possibly immunocompromised by prednisone therapy for advanced rheumatoid disease). For the purposes of this investigation, a false-negative LET was defined as a negative LET result from specimens with a significant positive culture. The predictive value of a negative LET (for a negative culture) was therefore 95% (179/188).

Quantitative cultures were positive for 96 of 158 urine specimens with a positive LET. The predictive value of a positive LET (for a positive culture) was thus only 61% (96/158), and no further attempt was made to correlate nitrite or other test results with specimens with a positive LET. Since 8 of the 62 culture-negative specimens revealed leukocytes by Gram stain, however, an unidentified portion of the 39% apparent false-positive results might be attributable to viral, chlamydial, or anaerobic pathogens.

Our data indicate that the LET, if used as the sole criterion for not culturing urine specimens, had a sensitivity of 91.4% (96/105). Two of the nine specimens with false-negative LETs had positive nitrite tests (Table 3). If negative results for both the LET and the nitrite test had been made the criteria for not culturing, the accuracy would have increased to 93.3% (98/105), and the number of nonproductive cultures would have increased by 13 (Table 2). No consistent increase in sensitivity could be effected by incorporating protein or blood dip-stick results or both, whereas inclusion of any combination of positive results for these tests would have greatly increased the number of nonproductive cultures. Inclusion of a gross appearance criterion such that only lightly colored and clear specimens would be subject to LET screening would have eliminated at least four of the false-negative LETs (Table 3), but the probable concomitant increase in nonproductive cultures was not evaluated.

In summation, of the 346 noncontaminated specimens, 52% (179/346) were correctly identified as culture negative by a negative LET, whereas 4.8% (9/188) were falsely negative. Inclusion of a negative nitrite test into screening criteria would have lowered the false-negative rate to 3.7% (7/188). Although any false-negative rate may be unacceptable to some clinicians, the advantages of reduced costs and immediate turnaround for greater than 50% of all urine specimens should be carefully weighed in comparison.

The skilled and dedicated assistance of the Microbiology Laboratory personnel is gratefully acknowledged.

**LITERATURE CITED**


