Evaluation of Laser Light Scattering Technology in Rapid Diagnosis of Urinary Tract Infections in Children

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Abstract

Background and Aim: Urinalysis (UA) has been routinely used as a screening tool prior to microbial culture set-up in many labs. BacterioScan 216Dx instrument utilizes laser light scattering technology to detect bacterial growth in urine and results are available in 3 hrs. The aim of this study was to compare the performance of 216 DX and UA against culture as gold standard.

Methods: Clean-catch, unpreserved, either UA positive (leukocyte esterase > trace, or nitrite positive or white blood cells >5/hpf) or UA negative samples from children age <18 years were tested by 216Dx within 24 hours of sample collection. ‘Presumptive positive’ samples by 216Dx were further confirmed by MALDI-TOF. Specificity and sensitivity of 216Dx and UA was determined against urine culture.

Results: Total of 205 urine samples were included in this study, of which 48.0% (98/205) and 52.0% (107/205) were UA positive and negative respectively. 77.0% of samples were collected from female and median age was 108 months. Overall sensitivity, specificity, positive and negative predictive value (PPV and NPV) of 216Dx and UA are shown in Table 1. Of 27 true positive (TP) samples by 216Dx, UA positive samples were collected and culture was set up according to lab SOP following UA testing.

BacterioScan Assay: 3D ul of urine was mixed with 2.5 ml of tryptic soy broth (TSB; Pasteur) inside the detection cuvette. Multi-culture was loaded directly into the BacterioScan 216Dx device and continuously read for approximately 3 h. Results were provided as either ‘presumptive positive’ or ‘presumptive negative’ by the device.

MALDI-TOF Identification: After BacterioScan results, ‘Presumptive positive’ samples were transferred from cuvette into 2.0 ml tube, centrifuged for 5 min at 13,000 rpm. Supernatant was removed and pellet was used for direct MALDI-TOF identification (Bruker), according to lab SOP.

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Methods:

Clean-catch, unpreserved, either UA positive (leukocyte esterase > trace, or nitrite positive or white blood cells >5/hpf) or UA negative samples from children age <18 years were tested by 216Dx within 24 hours of sample collection. ‘Presumptive positive’ samples by 216Dx were further confirmed by MALDI-TOF. Specificity and sensitivity of 216Dx and UA was determined against urine culture.

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Total of 205 urine samples were included in this study, of which 48.0% (98/205) and 52.0% (107/205) were UA positive and negative respectively. 77.0% of samples were collected from female and median age was 108 months. Overall sensitivity, specificity, positive and negative predictive value (PPV and NPV) of 216Dx and UA are shown in Table 1. Of 27 true positive (TP) samples by 216Dx, UA positive samples were collected and culture was set up according to lab SOP following UA testing.

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Table 1.

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>&lt;50K CFU/ml</th>
<th>50-99K CFU/ml</th>
<th>100K CFU/ml</th>
<th>UA negative samples (no. of CFU/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E. coli</strong></td>
<td>4</td>
<td>1</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td><strong>K. oxytoca</strong></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1 (&lt;100K CFU/ml)</td>
</tr>
<tr>
<td>Staph epidermidis</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>E. coli</td>
<td>70 (91.0%)</td>
<td>1 (3.0%)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2.

Based on the results of the study, BacterioScan significantly improved the early detection of common flora/contamination.

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Fig 1.

Fig 2.

Fig 3.

Fig 4.

Summary and Conclusions:

- Although sensitivity is comparable, BacterioScan has higher specificity (79.5%) than urinalysis (80.2%) and can be used as an alternative screening tool to detect presence or absence of pathogens.
- Due to BacterioScan’s high negative predictive value (98.6%), negative urine samples can be reliably screened out within 3 hours, thus reducing the urine culture work-up, its associated cost and unnecessary antibiotic use.
- BacterioScan more accurately detected mixed flora/contamination as true negative than urinalysis (65.0% vs 53.0%).
- When paired with MALDI-TOF, BacterioScan accurately (77.0%) identified the organism within 4 hours. Simultaneously, accuracy was increased to 96.0% compared to BacterioScan alone (81.0%).
- Overall, BacterioScan can potentially reduce the overall urine culture work-up turn-around time from 24-72 hours to 5-4 hours, resulting better patient management.