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Comparison of a PCR coupled with electro-spray ionization mass spectrometry (PCR/ESI-MS) with other microbiological methods (blood culture and 16S rDNA PCR followed by sequencing) to diagnose bloodstream infections

Jan Tkadlec*[1], Eliška Bébrová[1], Jan Beroušek[2], Jaroslava Adámková[3], Vendula Martínková[3], Claus Moser[4], Dragos Florea[5], Pavel Drevinek[1]

[1]*2nd Faculty of Medicine, Charles University and Motol University Hospital; Department of Medical Microbiology*

[2]*2nd Faculty of Medicine, Charles University and Motol University Hospital; Department of Anaesthesiology and Intensive Care Medicine*

[3]*1st Faculty of Medicine, Charles University and Motol University Hospital; 3rd Department of Surgery*

[4]*Department of Clinical Microbiology, Rigshospitalet*

[5]*National Institute for Infectious Diseases*

Background: Rapid and accurate detection of pathogens causing bloodstream infections (BSI) remains one of the challenges of today's microbiology. As blood cultures are found to be positive in only 30-40% of patients with serious BSI[1], alternative tests with a higher sensitivity are needed. Broad range PCR coupled with electro-spray ionization mass spectrometry (PCR/ESI-MS) is a semi-automated system able to detect and identify more than 800 pathogens associated with BSI and several genes of antibiotic resistance within 6 hours. We compared the performance of PCR/ESI-MS with conventional blood culture (BC) and other commercially available panbacterial PCR followed by sequencing (PCR-seq) with the aim to evaluate the potential and usefulness of implementing the PCR/ESI-MS into the BSI diagnostics.

Material/methods: We examined 111 blood samples from 87 consecutive patients with clinical suspicion of BSI who were hospitalized at the ICU of the surgical department or at the intensive care medicine unit between February - April 2016, and June - September 2016. Each sample was examined simultaneously by conventional blood culture (BACTEC™ FX, Beckton Dickinson, USA) panbacterial PCR targeting the 16S rRNA gene (UMD SelectNA, Molzym, Germany) and PCR/ESI-MS (IRIDICA BAC BSI, Abbott, USA).

Results: In total, 99 samples were included into the analysis (12 samples were excluded due to technical reasons or incomplete results). Results of PCR/ESI-MS were positive for 50 samples whereas BC and PCR-seq were positive in 19 and 26 samples, respectively. In total 39 out of 50 PCR/ESI-MS positive results were regarded clinically relevant due to detection of bacteria that was in likely association to the clinical status and the cause of BSI and 1/ not detected pathogenic agent by any other methods, or 2/ shortening time to positivity (6 hours for PCR/ESI-MS compared to average 56 hours for BC and 28 hours for PCR-seq).

<table>
<tr><th>PCR/ESI-MS</th><th>BC</th><th>PCR-seq</th><th>No.</th><th>No. of PCR/ESI-MS significant results</th><th>Why clinically significant?</th></tr>
<tr><td>+</td><td>-</td><td>-</td><td>31</td><td>24</td><td>not detected by any other method</td></tr>
<tr><td>+</td><td>+</td><td>+</td><td>13</td><td rowspan="3">15</td><td rowspan="3">shortening time to positivity</td></tr>
<tr><td>+</td><td>-</td><td>+</td><td>5</td></tr>
<tr><td>+</td><td>+</td><td>-</td><td>1</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>39</td><td rowspan="4">Not applicable</td><td rowspan="4"></td></tr>
<tr><td>-</td><td>+</td><td>-</td><td>2</td></tr>
<tr><td>-</td><td>+</td><td>+</td><td>3</td></tr>
<tr><td>-</td><td>-</td><td>+</td><td>5</td></tr>
<tr><td>Total</td><td></td><td></td><td>99</td><td>39</td><td></td></tr>
</table>

Conclusions: The present study shows that in a high proportion of cases clinically relevant bacteria were detected by PCR/ESI-MS only. Moreover, the time to positivity was much shorter compared to other methods. We believe that brand-new technology is becoming a valuable tool in microbiological diagnostics of the BSI.

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[1] Cohen, J. et al. Sepsis: a roadmap for future research. The Lancet Infectious Diseases, 2015 Vol. 15, Issue 5.