

Impact of rapid microbial identification directly from positive blood cultures using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry on patient management

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Abstract

For septic patients, delaying the initiation of antimicrobial therapy or choosing an inappropriate antibiotic can considerably worsen their prognosis. This study evaluated the impact of rapid microbial identification (RMI) from positive blood cultures on the management of patients with suspected sepsis. During a 6-month period, RMI by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) was performed for all new episodes of bacteraemia. For each patient, the infectious disease specialist was contacted and questioned about his therapeutic decisions made based on the Gram staining and the RMI. This information was collected to evaluate the number of RMIs that led to a therapeutic change or to a modification of the patient's general management (e.g. fast removal of infected catheters). During the study period, 277 new episodes of bacteraemia were recorded. In 71.12% of the cases, MALDI-TOF MS resulted in a successful RMI (197/277). For adult and paediatric patients, 13.38% (21/157) and 2.50% (1/40) of the RMIs, respectively, resulted in modification of the treatment regimen, according to the survey. In many other cases, the MALDI-TOF MS was a helpful tool for infectious disease specialists because it confirmed suspected cases of contamination, especially in the paediatric population (15/40 RMIs, 37.50%), or suggested complementary diagnostic testing. This study emphasizes the benefits of RMI from positive blood cultures. Although the use of this technique represents an extra cost for the laboratory, RMI using MALDI-TOF MS has been implemented in our daily practice.

Keywords: Blood culture, clinical impact, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry, rapid diagnosis, sepsis

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Introduction

Sepsis is a major cause of morbidity and mortality in hospitalized patients. In the USA, 750 000 cases of severe sepsis occur annually [1]. In Europe, sepsis occurs in more than

35% of the patients in the intensive care unit. More than 50% of patients who experience septic shock do not survive [2–4].

The management of bacteraemic patients can be improved by the administration of the appropriate treatment without delay [5–7]. Molecular techniques allow for rapid microbial identification (RMI) from blood samples but have limitations, in particular the high cost per analysis and the need for antimicrobial susceptibility testing [8].

Because it allows the identification of microorganisms in a few minutes instead of the hours required by biochemical techniques, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) is a promising

alternative diagnostic tool [9]. Since its commercialization at the beginning of the twenty-first century, many new strategies to perform RMI directly from clinical samples have been evaluated [10–13]. Recently, inexpensive strategies that allow RMI within 20 min after the blood culture becomes positive were described [14,15].

Currently, the usefulness of RMI is still debated. Arguments for RMI state that RMI could lead to the faster adoption of the appropriate antibiotic regimen and help to identify the cause of the sepsis if it is unknown. The still limited information concerning the susceptibility of the microorganisms to antimicrobials is a weakness of RMI [16,17].

The primary aim of this study was to prospectively evaluate the theoretical impact of RMI from positive blood cultures on the clinical management of bacteraemic patients in our hospitals. The compliance with the recommendations of the infectious disease specialist (IDS) was also retrospectively evaluated to determine the real clinical impact of the RMI technique.

Materials and Methods

Location

The Saint-Pierre University Hospital and the Jules Bordet Institute are university-affiliated medical centres located in Brussels, Belgium. Saint-Pierre is a public hospital with vast experience in infectious diseases. Jules Bordet is the only

hospital in Belgium that is completely dedicated to cancer. Both institutions are served by the same laboratory, which is open on weekdays from 07.30 until 20.00 h and on Saturday and Sunday from 08.00 until 16.00 h. Positive blood culture bottles are analysed during these time periods. During the night, medical microbiologists and IDSs are on call for emergencies.

Collection of blood cultures and inclusion criteria

From September 2011 to March 2012, the first positive blood culture for each bacteraemic episode in patients from both hospitals was prospectively enrolled in the study. All positive cultures for the same patient obtained within 3 days of each other and presenting the same Gram staining results were considered as belonging to the same episode. When staphylococcal morphology was observed in the Gram staining, RMI was always performed to confirm or rule out contamination.

MALDI-TOF MS RMI

The positive blood cultures (Bactec Plus Aerobic and Bactec F Lytic Anaerobic; Becton Dickinson, Franklin Lakes, NJ, USA) were prepared and analysed according to a previously described in-house protocol [14]. The spectra were acquired on a Microflex LT system (Bruker Daltonics, Bremen, Germany) and subsequently analysed using MALDI BIOTYPER AUTOMATION CONTROL AND BIOTYPER 3.0 software. At that time, the database (V3.1.2.0) included 3995 spectra. The analyses were performed in batches twice daily. The RMIs were classified as 'reliable' or 'unreliable' according to previously

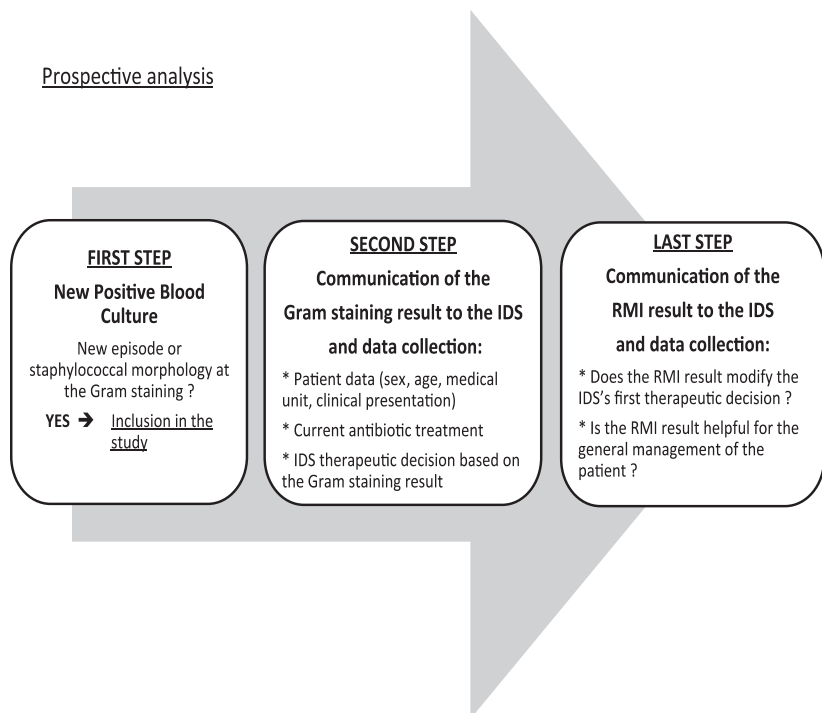


FIG. 1. Design of the prospective analysis.

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