Diagnostic Microbiology and Infectious Disease 84 (2016) 7–11

Contents lists available at ScienceDirect

Diagnostic Microbiology and Infectious Disease

journal homepage: www.elsevier.com/locate/diagmicrobio

MALDI-TOF is not useful in the diagnosis of catheter colonization based on superficial cultures: results from an in vitro study

María Guembe [a,b,*], María Jesús Pérez-Granda [c,d], Raquel Cruces [a,b], Belén Rodríguez-Sánchez [a,b], Adrián Ruíz [a], Luis Alcalá [a], Emilio Bouza [a,c,e]

[a] Department of Clinical Microbiology and Infectious Diseases, Hospital General Universitario Gregorio Marañón, Madrid, Spain
[b] Instituto de Investigación Sanitaria Gregorio Marañón (IiSGM), Madrid, Spain
[c] CIBER Enfermedades Respiratorias-CIBERES (CB06/06/0058), Madrid, Spain
[d] Cardiac Surgery Postoperative Care Unit, Hospital General Universitario Gregorio Marañón, Madrid, Spain
[e] Medicine Department, School of Medicine, Universidad Complutense de Madrid, Madrid, Spain

ARTICLE INFO

Article history:
Received 13 July 2015
Received in revised form 7 September 2015
Accepted 27 September 2015
Available online 24 October 2015

Keywords:
Central venous catheters
In vitro model
MALDI-TOF
Colonization
Superficial cultures
Skin culture
Hub culture

ABSTRACT

We compared in an vitro model the yields of matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) and conventional culture (CC) for the detection of catheter colonization with superficial catheter samples (SS). We used blood culture bottles (BCB) with an inserted cannula and incubated at 37 °C. The BCB were manipulated with different contaminations and when a BCB turned positive, SS were obtained to perform both techniques. To compare both techniques we analyzed the mean time to colonization (MTC) and the mean time to a result (MTR). The MTC (SD, days) by CC and MALDI-TOF was as follows: hub, 0.59 (0.79) versus 1.07 (1.39), $P = 0.06$; surface: 0.62 (0.67) versus 0.82 (0.81), $P < 0.001$. The MTR (SD, days) of CC and MALDI-TOF was as follows: hub: 1.58 (0.79) versus 2.25 (1.48), $P = 0.04$; surface: 1.62 (0.67) versus 1.95 (0.80), $P < 0.001$. In general, the use of MALDI-TOF performed directly with SS was no better than CC and did not anticipate colonization results.

1. Introduction

Catheter-related bloodstream infection (C-RBSI) is a major nosocomial infection with high rates of morbidity and mortality (Maki et al., 2006; Palomar et al., 2013). Guidelines for the diagnosis of C-RBSI recommend performing diagnostic procedures with or without the catheter in place (Mermel et al., 2009). Current conservative techniques for the diagnosis of catheter colonization, such as differential time to positivity or superficial skin and hub culture, have proven effective in patients whose treatment requires placement of a catheter (Blot et al., 1999; Bouza et al., 2007; Bouza et al., 2005; Catton et al., 2005; Cercenado et al., 1990; Guembe et al., 2013; Raad et al., 2004). However, these conservative techniques for diagnosis of catheter colonization require at least 48 hours to yield a result. Therefore, new, faster diagnostic tools are necessary.

Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) has proven useful for the rapid identification of microorganisms isolated from culture and microorganisms isolated directly in clinical samples and has improved the appropriateness of antibiotic therapy (Carbonnelle and Nassif, 2011; Ferreira et al., 2010; Giebel et al., 2010; Guembe et al., 2014; Spanu et al., 2012; Vlek et al., 2012).

We used an in vitro model based on superficial samples of different etiologies to compare the yield of MALDI-TOF MS with that of conventional culture (CC) for the detection of catheter colonization.

2. Methods

2.1. Setting

The study was carried out in the laboratory of the Clinical Microbiology and Infectious Disease Department at Hospital General Universitario Gregorio Marañón, Madrid, Spain.

2.2. Laboratory procedure

The model consisted of 40 blood culture bottles (BCB) with an inserted cannula and a needle-free closed connector. Each line was handled twice a day while 1 mL of saline solution was instilled according to the following approaches: 10 lines were handled with gloves impregnated with a 0.5 McFarland solution of *Staphylococcus aureus* ATCC 29213, 10 lines were handled with gloves impregnated with a 0.5 McFarland solution of *Escherichia coli* ATCC 35218, 10 lines were handled with gloves impregnated with a 0.5 McFarland solution of *Candida parapsilosis* ATCC 22019, and 10 lines were handled without gloves

* Corresponding author. Tel.: +34-91-586-080-27; fax: +34-91-504-49-06.
E-mail address: mariaguembe@hotmail.com (M. Guembe).

http://dx.doi.org/10.1016/j.diagmicrobio.2015.09.019
0732-8893/

(hand model). The BCB were incubated in a BACTEC System at 37 °C under continuous shaking for up to 10 days. When a BCB turned positive, superficial samples were obtained daily for up to 10 days or until they turned positive by semiquantitative CC (up to 48 hours of incubation) and MALDI-TOF (4 and 24 hours of incubation).

The main variables for comparing MALDI-TOF and CC were the mean time to colonization (MTC) and the mean time to a result (MTR).

Samples were obtained using 2 cotton swabs (1 for CC and 1 for MALDI-TOF) rubbed on the BCB surface around the insertion site and 2 alginate swabs (1 for CC and 1 for MALDI-TOF) rubbed on the inner surface of the hub. The swabs for the MALDI-TOF were placed into 1 mL of saline and the solution was divided into 2 samples to perform MALDI-TOF after 4 and 24 hours' incubation at 37 °C (Fig. 1).

All cultures were incubated for up to 48 hours at 37 °C under aerobic conditions. The microorganisms recovered from superficial cultures were counted and identified by their phenotypic characteristics.

In the hand model, colonizing microorganisms were counted and phenotypically identified daily before contact with the catheter.

Values were recorded on a data collection form.

2.3. Definitions

2.3.1. Time to detect colonization

The time for each technique to detect the presence of microorganisms since Day 0 (when the BCB turned positive).

2.3.2. Time to obtain a result

The time for each technique to identify the microorganism (time to detect colonization + incubation time).

2.4. Statistical analysis

Normally distributed continuous variables were compared using the *t* test or ANOVA; non-normally distributed variables were compared using the Mann–Whitney *U* or Kruskal–Wallis. Categorical variables were evaluated using the chi-square or 2-tailed Fisher exact test. Values are expressed as the mean (SD) for continuous variables and as percentages, when applicable, for categorical variables. Statistical significance was set at a 2-tailed $P < 0.05$ was used to determine statistical significance.

Kaplan–Meier survival curves and the log-rank test were used to compare the MTC and MTR between the different types of manipulation. The correlation between the number of colonies of both the surface and the hubs and MTR was evaluated using Spearman's rho.

The statistical analysis was performed using IBM SPSS Statistics for Windows, Version 21.0.

3. Results

We detected an overall colonization rate of 95.0% (38/40) for the BCB. CC detected 100% (38/38) of colonized superficial samples, which were distributed as follows: 21 (55.3%) in surface samples, 9 (23.7%) in hub samples, and 8 (21.1%) in both surface and hub samples ($P < 0.001$). MALDI-TOF detected 92.1% (35/38) of colonized superficial samples, which corresponded to 20 (57.1%) in surface samples, 7 (20.0%) in hub samples, and 8 (22.9%) in both surface and hub samples ($P < 0.001$). The 3 samples out of the 38 in which MALDI-TOF did not detect colonization were those colonized by *C. parapsilosis* (2 hubs and 1 surface).

The mean (SD) MTC of CC and MALDI-TOF was as follows: hub, 0.59 (0.79) versus 1.07 (1.39) days, $P = 0.06$; surface: 0.62 (0.67) versus 0.82 (0.81) days, $P < 0.001$ (Fig. 2).

The mean (SD) MTR of CC and MALDI-TOF was as follows: hub: 1.58 (0.79) versus 2.25 (1.48) days, $P = 0.04$; surface: 1.62 (0.67) versus 1.95 (0.80) days, $P < 0.001$ (Fig. 3).

E. coli was detected quickest in both surface and hub samples either by CC or MALDI-TOF (Figs. 2 and 3).

All positive CC were detected after 24 hours' incubation. MALDI-TOF was positive after 24 hours' incubation in 26 samples (74.3%) and after 4 hours' incubation in 9 out of the 35 samples (25.7%). Of the 9 samples in which MALDI-TOF was positive after 4 hours' incubation, 8 (88.9%) corresponded to the *E. coli* model; 4 were hub samples ($P = 0.16$) and 5 surface samples ($P < 0.001$) (Table 1).

The mean (SD) MALDI-TOF score in hub and surface samples was, respectively, 2.21 (0.37) and 2.20 (0.18).

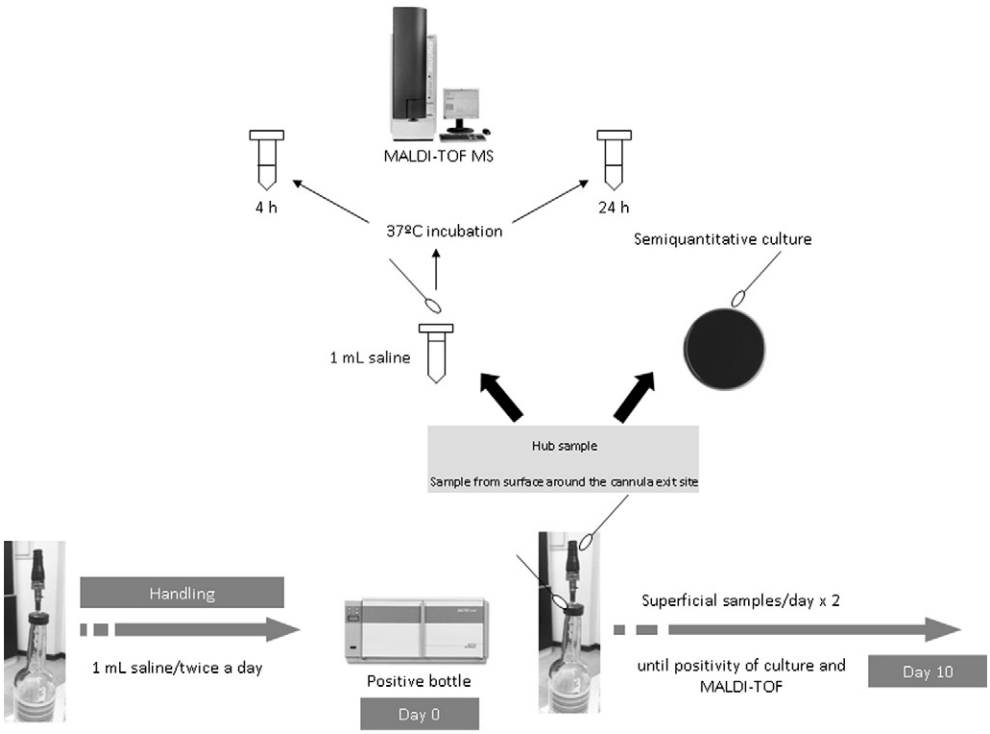

Fig. 1. Laboratory procedure.