



## ORIGINAL

# Differential time to positivity of blood cultures: A valid method for diagnosing catheter-related bloodstream infections in the intensive care unit

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### KEYWORDS

Catheter-related infections;  
Diagnosis;  
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Central venous catheterization

### Abstract

**Purpose:** The validation in critical patients with short-term catheters of a method for diagnosing catheter-related bloodstream infection (CR-BSI), based on the differential time to positivity (DTP) of blood cultures.

**Methods:** Patients suspected of having CR-BSI were included. Two peripheral vein blood cultures and a catheter hub blood culture were simultaneously carried out. The responsible catheter was removed and tip cultured. Times to positivity of all blood cultures were automatically registered. CR-BSI was diagnosed when all the cultures were positive for the same microorganism and DTP  $\geq$  120 min. This diagnosis was compared with the one obtained using the standard method.

**Results:** 226 cases suspected of CR-BSI were analyzed during a 20-month period. A total of 19 removed catheters were associated with CR-BSI. Seven cases of polymicrobial cultures (4 with CR-BSI) were discarded from the final analysis due to the impossibility of determining the time to positivity for each individual microorganism. Using the DTP method, 12 out of 15 CR-BSI cases were diagnosed (sensitivity 80%, specificity 99%, PPV 92%, NPV 98%). In a ROC curve, we found a cut-off value of 17.7 h in positivity of hub blood cultures that may be useful for diagnosing CR-BSI.

**Conclusion:** DTP can be a valid method for CR-BSI diagnosis in critically ill patients, avoiding unnecessary catheter withdrawal.

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**PALABRAS CLAVE**

Infección asociada a catéter;  
 Diagnóstico;  
 Cuidados intensivos;  
 Cateterización venosa central

## Tiempo diferencial en la positivización de los hemocultivos: un método válido para el diagnóstico de la bacteriemia asociada a catéter en la unidad de cuidados intensivos

**Resumen**

**Objetivo:** La validación, en pacientes críticos con catéteres de corta duración, de un método diagnóstico de la bacteriemia asociada a catéter (BAC) basado en la diferencia en el tiempo de positivización (DTP) de hemocultivos.

**Material y Métodos:** Se incluyeron pacientes con sospecha de BAC en los que se realizaron 2 hemocultivos de sangre periférica y un hemocultivo a través de la luz distal del catéter sospechoso, antes de la retirada y cultivo de la punta del mismo. Se registraron automáticamente los tiempos de positivización de todos los hemocultivos. Diagnosticamos BAC cuando todos los hemocultivos fueron positivos para el mismo microorganismo y el DTP  $\geq$  120 minutos. La exactitud de este método diagnóstico fue comparada con la obtenida mediante el método estándar.

**Resultados:** Se analizaron 226 casos de sospecha de BAC durante 20 meses. En 19 de ellos se diagnosticó BAC mediante el método estándar. En 7 casos los hemocultivos fueron polimicrobianos (4 de ellos asociados a BAC) por lo que tuvieron que ser descartados para el análisis final dada la imposibilidad de determinar el tiempo de positivización de cada microorganismo por separado. Siguiendo el método basado en el DTP, 12 de los 15 casos de BAC fueron diagnosticados correctamente (sensibilidad 80%, especificidad 99%, VPP 92%, VPN 98%). En una curva ROC, encontramos un punto de corte de 17.7 horas en el tiempo de positivización del hemocultivo a través de catéter que puede ser útil para el diagnóstico de BAC.

**Conclusion:** La DTP puede ser un método válido para el diagnóstico de BAC monobacteriana en pacientes críticos con catéteres de corta duración, evitando la retirada innecesaria de catéteres.

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**Introduction**

Catheter-related bloodstream infections (CR-BSI) are among the most common nosocomial infections in critical patients and are associated with significant morbidity and mortality.<sup>1-3</sup> Besides a conventional blood culture, the standard method of CR-BSI diagnosis involves withdrawing the infection-suspected catheter to culture the tip.<sup>4</sup> Thus, a definitive diagnosis of CR-BSI can be only established retrospectively, when the same pathogen is isolated from both the blood and the catheter tip cultures. Only 15–20% of the catheters withdrawn turn out to be responsible for the bloodstream infection. The need for a reliable method to assess CR-BSI without catheter withdrawal has led to the development of diverse catheter-conserving methods in recent years.<sup>5,6</sup>

One such method is the differential time to positivity (DTP) between blood cultures obtained from the catheter hub and peripheral blood. This method, which has already been validated for long-term catheters,<sup>7,8</sup> is based on the direct relationship between the blood bacterial load and the time required for a positive culture. If the catheter is the source of infection, the blood from the hub will have a higher bacterial load and therefore the time to culture positivity will be shorter compared to that of the peripheral blood culture.

However, when tested in short-term catheters or patients without malignancy, the DTP method has yielded discrepant results.<sup>9-12</sup> We aimed to validate the method in short-term catheters, which are commonly used in the intensive care unit.

**Materials and methods**

We included prospectively all patients with a central venous catheter in place for more than 72 h, admitted to the medical-surgical critical care unit of our institution (Hospital de Sabadell, Barcelona, Spain) between February 2005 and September 2006 and clinical symptoms of infection like fever, leukocytosis or shock, in whom other possible sources of infection, different than a possible CR-BSI, were previously ruled out. The hospital's Ethics Committee approved the study and waived the requirement for patient consent due to the observational nature of the study, the anonymous data collection and because all the clinical procedures, except one single blood culture (the hub-blood one), represented standard of care in these patients since every patient in our unit with a suspected CR-BSI had two peripheral blood cultures and removal of every catheter in place for more than 72 h as the standard of care. We excluded patients with long-term ( $\geq$ 30 days) or Swan-Ganz catheters.

For each suspected case, the following samples were collected and processed:

- Two serial blood samples (10 ml of blood each sample) from a peripheral vein obtained 30 min apart. Samples were cultured in aerobic (5 ml) and anaerobic (5 ml) media.
- One blood sample from the distal lumen of the catheter (first 5 ml of blood after discarding non-hematological contents), which was cultured in aerobic media, at the same time of the first peripheral blood sample.

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