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Assessment of anaerobic blood cultures in pediatric oncology patients

Manuel Monsonís Cabedo^a, Susana Rives Solá^b, Antoni Noguera-Julian^c, Mireia Urrea Ayala^d, Ofelia Cruz Martínez^b, Amadeu Gené Giralt^{a,*}

^a Department of Microbiology, Hospital Sant Joan de Déu, Esplugues de Llobregat, Barcelona, Spain

^b Department of Haematology and Oncology, Hospital Sant Joan de Déu, Esplugues de Llobregat, Barcelona, Spain

^c Infectious Diseases Unit, Department of Pediatrics, Hospital Sant Joan de Déu, Esplugues de Llobregat, Barcelona, Spain

^d Infections Control Unit, Hospital Sant Joan de Déu, Esplugues de Llobregat, Barcelona, Spain

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ABSTRACT

Introduction: The routine use of a single aerobic bottle for blood culture in pediatric patients has become commonplace, as anaerobic bacteria are not frequently involved in clinically significant infections. The aim of this study was to assess the usefulness of routinely performing anaerobic blood cultures in pediatric oncology patients.

Methods: Prospective study was conducted on pediatric (<18 years) patients affected with febrile syndrome after receiving chemotherapy for hematological or solid malignancies. Samples were inoculated into pediatric aerobic and standard anaerobic bottles (BacT/Alert automatic system). Strains were considered clinically significant, or deemed as contaminants, depending on isolation circumstances and clinical criteria.

Results: A total of 876 blood cultures from 228 patients were processed during the 21-month study period (January 2014 to September 2015). Baseline diagnosis included 143 solid tumors and 67/18 cases of leukemia/lymphoma. Bacterial growth was detected in 90 (10.2%) blood cultures for 95 different isolates, of which 62 (7.1%)/63 isolates were considered clinically significant. Among the latter, 38 (60.3%) microorganisms grew in both aerobic and anaerobic bottles, 18 (28.6%) only in aerobic bottles, and 7 (11.1%) only in anaerobic bottles. Gram-negative bacilli (33; 52.4%), mainly from the *Enterobacteriaceae* family, were the most frequently isolated microorganisms. Overall, only 3 out of 90 isolates (3.3%) were strict anaerobes (*Propionibacterium acnes*), and all of them were deemed contaminants.

Conclusion: Strict anaerobes did not cause significant infections in febrile pediatric oncology patients, and anaerobic blood culture bottles offered no additional advantages over aerobic media. Our results suggest that routine blood cultures should be solely processed in aerobic media in this group of patients.

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Palabras clave:

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Valoración del hemocultivo anaerobio en pacientes oncológicos pediátricos

RESUMEN

Introducción: En pacientes pediátricos es habitual el procesamiento de hemocultivos únicamente en medio aerobio, debido a la escasa relevancia de los microorganismos anaerobios en la etiología infecciosa habitual. El objetivo de este estudio es valorar la utilidad del uso rutinario del medio de cultivo anaerobio en pacientes oncológicos pediátricos.

Métodos: Estudio prospectivo en pacientes pediátricos (<18 años) en tratamiento quimioterápico de procesos oncológicos con síndrome febril. Las muestras se inocularon en botellas aerobias pediátricas y anaerobias estándar (sistema automático BacT/Alert). Las cepas aisladas fueron consideradas clínicamente significativas o contaminantes en función de las circunstancias de aislamiento y la clínica del paciente.

Resultados: Durante el periodo de estudio (enero 2015-septiembre 2016) se procesaron 876 hemocultivos procedentes de 228 pacientes diagnosticados de tumores sólidos (143) y leucemia/linfoma (67/18).

* Corresponding author.

E-mail address: agene@hsjdbcn.org (A. Gené Giralt).

Se detectó crecimiento en 90 (10,2%) hemocultivos y se aislaron 95 cepas, de los cuales 62 (7,1%), correspondientes a 63 cepas, se consideraron clínicamente significativos. Entre estos últimos, 38 (60,3%) microorganismos crecieron en ambas botellas, 18 (28,6%) únicamente en aerobiosis y 7 (11,1%) únicamente en anaerobiosis. Bacilos gram negativos (33; 52,4%), mayoritariamente enterobacterias, fueron los más frecuentemente aislados. Solo 3 (3,3%) de los microorganismos aislados eran anaerobios estrictos (*Propionibacterium acnes*), y todos ellos fueron considerados contaminantes.

Conclusión: Microorganismos anaerobios están raramente involucrados en infecciones en pacientes oncológicos pediátricos, y la utilización de botellas anaerobias no ofrece ninguna ventaja adicional. Según nuestros resultados es suficiente el uso de medio aerobio en el procesamiento de los hemocultivos en este tipo de pacientes.

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Introduction

Infections are a frequent complication in patients with oncologic and hematologic malignancies, bloodstream infections (BSI) being one of the most common and severe, mainly accounted for chemotherapy-induced neutropenia alongside invasive procedures. Standard procedures for processing blood cultures (BC) in adult patients include both aerobic and anaerobic bottles, but in pediatric patients, anaerobic bacteria are not frequently involved, particularly in BSI.¹⁻³ Nowadays, in pediatric patients the routine use of a single aerobic bottle for BC has become commonplace.

In our hospital, according to our protocol, blood samples from pediatric patients are inoculated only in pediatric aerobic bottles, except in selected patients presenting with clinical conditions that increase the risk of anaerobic infection, such as neutropenia, corticosteroid therapy or central venous catheters.¹⁻³

Although chemotherapy and treatment procedures for malignant diseases have evolved swiftly in recent years, updated information on anaerobic etiology of BSI in this specific group of pediatric patients is lacking. The aim of this study was to assess the current etiology of BSI in our geographical area and the usefulness of routinely performing anaerobic BC in pediatric oncology patients presenting with fever, usually in the setting of chemotherapy-induced neutropenia (FN).

Material and methods

We present an observational prospective study in a cohort of oncology pediatric patients (<18 years at inclusion) that present with fever during chemotherapy, in most cases during neutropenia periods, in Hospital Sant Joan de Déu (Barcelona), a tertiary-care pediatric-maternal university hospital with 350 beds that serves a geographical area containing approximately two million people; our center also receives patients from the rest of Catalonia and Spain who require treatment for severe illnesses. The local ethics committee approved the study.

Blood samples were routinely taken by trained officers, split in two equal volumes and inoculated into one pediatric aerobic BacT/Alert PF bottle and into one standard anaerobic BacT/Alert SN bottle, to be later processed using BacT/Alert (BioMérieux, Durham, NC, USA) automatic incubation system. Our BC collection protocol recommends an optimal blood sample of at least 4 mL per bottle. In this study, due to the characteristics of the patients, the final volume was usually only between 1 and 2 mL per bottle, although any volume available was accepted. Most samples were obtained from intravascular devices (IVD), usually a one-lumen tunneled central venous catheter (Port-A-Cath). BC were performed at onset of each FN episode, and again after 48–72 h if fever persisted despite antibiotics. Isolates were considered clinically significant if one of the following criteria were met: (a) when the isolated

microorganism was considered a usual pathogen (e.g. enteric gram-negative rods); (b) when a microorganism usually considered contaminant (e.g. coagulase-negative staphylococci) was isolated in both aerobic and anaerobic bottles during the first 48 h of incubation; (c) when the same usually contaminant strain was persistently isolated in consecutive BC; or (d) was IVD-related: BSI was judged to be IVD-related when fever coincided with the use of the device, when the same strain was isolated from BC and the device exit site, when resolution of symptoms coincided with the removal of the IVD or when the same microorganism was isolated from the device culture after its removal.

In order to establish the clinical significance of each isolate, clinical and microbiological data were collected and assessed prospectively together with the physician in charge of the patient. Dubious cases under full antibiotic treatment were considered clinically significant in this study.

Statistical analysis

Categorical variables were described as percentages, and continuous variables as mean/standard deviation (SD) or median/ranges.

Results

During the 21-month study period (January 2014–September 2015), 876 BC (aerobic and anaerobic paired bottles) from 228 patients (43.4% females, mean age: 6.7 years (SD: 4.9), ranging from 6 months to 18 years) were processed in the microbiology laboratory. Baseline diagnosis included solid tumors $n = 143$ (affecting central nervous system, $n = 62$; muscular and skeletal, $n = 28$; kidney $n = 12$; histiocytosis $n = 10$; and others $n = 31$), acute leukemia ($n = 67$) and lymphoma ($n = 18$). Among patients with solid tumors, there were 22 patients that had received an autologous peripheral blood stem cell transplantation. No patient included in this study underwent an allogeneic stem cell transplantation.

Bacterial growth, yielding 95 isolates, was detected in 90 BC (10.2%) of which 62 (7.1%), corresponding to 63 isolates, were considered clinically significant and 28 (3.2%), corresponding to 32 isolates (17 coagulase-negative staphylococci, 5 viridians streptococci group, 5 *Micrococcus* spp., 1 *Corynebacterium* spp., 1 *Moraxella* spp. and 3 *Propionibacterium acnes*), were deemed contaminants. In 5 BC two different microorganisms were simultaneously isolated, of which only one case (*Escherichia coli* and *Klebsiella pneumoniae*) was considered true bacteremia.

Taking into account only the 63 clinically significant microorganisms (Table 1), 38 (60.3%) of them grew in both aerobic and anaerobic bottles, 18 (28.6%) only in aerobic bottles and 7 (11.1%) (1 *Staphylococcus aureus*, 2 coagulase-negative staphylococci, 1 *Streptococcus pneumoniae* and 3 *E. coli*) only in anaerobic bottles. Altogether, 56 clinically significant isolates (88.9%) grew in aerobic bottles and 45 (71.4%) in anaerobic bottles.

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