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Original article

Bacillus cereus infection: 57 case patients and a literature review

Infection à Bacillus cereus *: 57 cas et revue de la littérature*

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Abstract

Objectives. – We aimed to study the characteristics of patients presenting with a *Bacillus cereus* infection in a university hospital.

Methods. – We performed a retrospective analysis of the clinical, biological, and treatment-related data of patients hospitalized in our university hospital between January 1st, 2008 and December 31st, 2012 and diagnosed with a *B. cereus* infection. We identified a subgroup of patients presenting with bacteremia and looked for risk factors for death within that group of patients.

Results. – We included 57 patients in our study; 31 (54.4%) were hospitalized in a medical ward. We identified 24 bacteremia case patients, including 17 patients presenting with bacteremia alone (29.8%). Other frequently observed infection sites were skin infections (16; 28.1%) and bone and joint infections (10; 17.5%). We recorded 9 deaths (11.8%); 2 patients, despite being on an appropriate antibiotic therapy, died from a medical device-related infection that had not been removed. The empirical administration of a beta-lactam antibiotic was significantly associated with death ($P = 0.022$). Three patients presenting with recurrent bacteremia were identified. The patients only recovered once the infected device had been removed.

Conclusion. – *B. cereus* infections may have various clinical presentations. Prospective data is needed to put forward a consensual treatment approach and guide physicians in choosing the appropriate antibiotic therapy and in removing the infected device.

Keywords: *Bacillus cereus*; Epidemiology; Nosocomial infection

Résumé

Objectifs. – Le but de ce travail était d'étudier les caractéristiques des patients ayant une infection à *Bacillus cereus* au sein d'un centre hospitalier universitaire.

Méthodes. – Nous avons analysé rétrospectivement les données cliniques, biologiques et thérapeutiques des patients pour lesquels un diagnostic d'infection à *B. cereus* a été réalisé au sein de notre CHU entre le 1er janvier 2008 et le 31 décembre 2012. Nous avons identifié un sous-groupe correspondant aux bactériémies pour lequel nous avons cherché des facteurs de risque de décès.

Résultats. – Nous avons inclus 57 patients dont 31 (54,4 %) hospitalisés en médecine. Nous avons colligé 24 bactériémies dont 17 bactériémies isolées (29,8 %). Ensuite, les localisations les plus fréquentes étaient les atteintes cutanées (16 patients, 28,1 %) et ostéo-articulaires (10 patients, 17,5 %). Les décès ont concerné 9 patients (11,8 %), dont 2 avec matériel infecté et non retiré malgré une antibiothérapie adaptée. L'administration d'une β-lactamine comme antibiothérapie probabiliste était significativement associée au décès ($p = 0{,}022$). Des bactériémies récurrentes ont été recensées pour 3 patients et ont été résolues seulement après l'ablation du matériel infecté.

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Conclusion. – Les infections à *B. cereus* peuvent avoir plusieurs présentations cliniques. Des données prospectives semblent nécessaires afin de pouvoir proposer une attitude thérapeutique consensuelle, notamment pour guider le clinicien vis-à-vis de l'antibiothérapie et de l'ablation de matériel.

Mots clés : Bacillus cereus ; Épidémiologie ; Infection nosocomiale

1. Introduction

Bacillus cereus is a gram-positive or gram-variable bacillus. It is an aero-anaerobic toxin-producing bacterium (4 hemolysins, 3 phospholipases including an emetic one, and 3 necrotizing enterotoxins) [1]. *B. cereus* belongs to the *Bacillus* genus, along with *Bacillus anthracis*, *Bacillus mycoides*, *Bacillus pseudomycoides*, *Bacillus thuringiensis*, *Bacillus weihenstephanensis*, and *Bacillus toyonensis* [2,3]. The natural reservoir for *B. cereus* consists of decaying matter, fresh and salt waters, vegetables, and the intestinal tract. *B. cereus* is ubiquitous in nature and its vegetative cells can stay in soil. Its toxins can resist extreme soil or food conditions. Colonization of the human intestine is done *via* the oral and fecal routes. The bacterium attaches to the intestinal epithelium and sporulates [1].

B. cereus is able to resist the main disinfectants, grow at high temperatures, and form a biofilm on industrial or biomedical devices. It is, therefore, frequently found in food-processing and hospital settings [4]. Biomedical device-related contamination may be the cause of nosocomial infections [5–7]. *B. cereus* is the third cause of foodborne illnesses [8]. Infections occurring outside of the digestive tract and due to direct inoculation or systemic dissemination have been reported [1,5–7,9,10].

However, very few *B. cereus* case patients have been reported in the literature. Our aim was to take an inventory of the *B. cereus* case patients reported in our hospital from 2008 to 2012 and describe their clinical presentations.

2. Patients and methods

2.1. Patient selection and data collection

We performed a retrospective analysis of the clinical, biological, and treatment-related data of patients diagnosed with a *B. cereus* infection who were hospitalized in our university hospital between January 1st, 2008 and December 31st, 2012. We did not include patients with an incomplete medical record. Collected data included the age at diagnosis, sex, year of diagnosis, hospital ward where the sample was taken, immunosuppressive therapy, and sample and infection sites. We calculated the Charlson comorbidity score. We indicated the nosocomial origin of the infection according to national recommendations [11]. We recorded one death during the hospital stay.

We identified a group of patients presenting with bacteremia. Within that group, we distinguished patients presenting with bacteremia alone from those associated with an identified portal of entry. We specified the first-line empirical antibiotic therapy received (before getting the results of the blood culture), any modification to the antibiotic therapy based on the antibiogram results, the presence of any biomedical device and any removal of such, as well as its culture, the patient's death when occurring at the same time as the isolation of *B. cereus*, and the time between the first positive culture and the patient's death.

2.2. Statistical analysis

We performed a descriptive analysis of patients' characteristics and *B. cereus* infection or colonization. We compared the characteristics of the infection group with that of the colonization group using Pearson's Chi^2 test or Fisher's exact test for categorical variables and Mann-Whitney U-test for continuous variables. A result < 0.05 was considered statistically significant. We used the same method to compare the bacteremia group of patients with those presenting with other infection sites. Within the bacteremia group of patients, we tried to look for an association between the patient's death and age, sex, the ICU admission, the admission to the oncology and hematology ward, the comorbidity score, the presence of a solid tumor, of a hematological disorder or an ongoing cytostatic chemotherapy, and the first-line antibiotic therapy. We performed the analyses using the 11.0 version of the STATA software (Stata statistical software, Stata Corporation, college station, Texas, USA).

3. Results

We included 57 patients during the study period; 31 were male patients (54.4%). The mean age was 61.8 ± 23.5 years. Thirty-one (54.4%) of these 57 patients were hospitalized in medical wards (six in the oncology and hematology ward; 7.9%), 15 (26.3%) in surgical wards (10 of them were hospitalized in the orthopedic surgery ward), eight (14%) in the ICU, and three (5.3%) in the neonatal ICU. The Charlson comorbidity score was 2.5 ($\pm$ 2.2). A nosocomial infection was diagnosed in 38 patients (70.4%). The in vitro susceptibility of *B. cereus* to antibiotics is indicated in Table 1.

The infection sites are indicated in Table 2. Most patients presented with bacteremia alone (17; 29.8%), skin infections (16; 28.1%), and bone and joint infections (10; 17.5%). With regard to skin infections, seven were superficial (three surgical site infections and four post-traumatic wound infections) and nine were in deep tissues (four surgical site infections and five superinfections of a cutaneous ulcer). A total of nine patients died (11.8%); they all presented with bacteremia.

A total of 24 patients out of 57 presented with bacteremia (42.1%); 13 of them were male patients (54.2%). The mean age