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Short report

Bacillus species pseudo-outbreak: construction works and collateral damage

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SUMMARY

We describe the investigation and management of a pseudo-outbreak of *Bacillus* spp. bacteraemia associated with construction work in an emergency department (ED). During the pseudo-outbreak period 59 out of 3469 (1.7%) blood cultures yielded *Bacillus* spp. versus 24 out of 7628 (0.31%) in 2012. Material, surfaces, and air samples showed environmental contamination. Cases rapidly declined following the implementation of infection control measures and the end of construction. Construction works at the ED caused environmental contamination that most probably led to the pseudo-outbreak of *Bacillus* bacteraemia. In hospital settings, the lack of correctly implemented effective barriers during construction may place patients and healthcare providers at risk as well as lead to pseudo-outbreaks.

Introduction

Bacillus species are Gram-positive, aerobic, or facultative-anaerobic endospore-forming bacilli that are ubiquitous in nature.[1] Spores are resistant to heat and many chemicals, including most hospital disinfectants, and therefore they persist for prolonged periods on surfaces.[2] Most *Bacillus* spp. are considered to have little or no pathogenic potential and therefore most clinical isolates are considered as contaminants. Nosocomial outbreaks of *Bacillus* spp. infections have been previously reported in neonatal and adult intensive care units (ICUs), and in surgical units.[3,4] Pseudo-outbreaks are, however, more frequent than true outbreaks.[5] Both situations have been previously associated with dissemination of *Bacillus* spp. in hospital settings. They have been related to products, as well as equipment such as gloves, hospital linens, central venous catheters, alcohol prepared solution, alcohol prepared pads, and blood culture bottles and environments such as

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ventilation machinery and construction dust.[3,4,6–9] The purpose of the present report is to describe the epidemiological investigation conducted and the measures applied to control a *Bacillus* spp. pseudo-outbreak occurred during extensive construction work in an area of our hospital.

Methods

Setting

Hospital Universitari Mútua Terrassa is a 450-bed acute care institution in Barcelona, Spain, with 26,000 hospital admissions per year, from a population base of 350,000 inhabitants. The emergency department (ED) is located underground at basement level 1. Beginning in April 2013, three fans were installed in the ED due to failure in the air-conditioning system.

Identification of the problem

In mid-July 2013 the Microbiology Department reported increased rates of isolation of *Bacillus* spp. from blood cultures beginning in late June. No other clinical samples were positive for *Bacillus* spp. During the first week of June 2013, the demolition of the roof and walls in the ED were carried out in order to build new cubicles. No assessment by the infection control unit was requested before beginning the construction project. The construction work area was not well delineated and a project plan to monitor measures to control dust was not implemented. Construction work was completed the last week of July.

Study design

An epidemiologic investigation was conducted/An epidemiologic investigation of what appeared to be a pseudo-outbreak was conducted. A case was defined as an inpatient with a blood culture yielding *Bacillus* spp. from June 2013 to October 2013. Cases were categorized as 'contamination' (only one positive culture out of two blood cultures), 'probable contamination' (more than one positive culture in a patient whose clinical course was inconsistent with bacteraemia and/or for whom there was another infectious disease to explain clinical symptoms), and 'true infection' (one or more blood cultures obtained from a patient with compatible clinical syndrome and without another clinical explanation). Using data from our Bloodstream Infection Surveillance Program (BISP) the incidence of *Bacillus* spp. isolates in the previous 12 months was analysed for comparison.

Outbreak investigation

An infection control task force was created with participation from infection control professionals, ED doctors and nurses, medical and nursing management, maintenance department, cleaning service and the construction department. An investigation of environmental contamination with *Bacillus* spp. was implemented utilizing environmental samples from materials, surfaces, and air. Material samples were collected from items placed on surfaces of working desks in the ED as well as 10th and 11th floor patient rooms and the ICU. The blood culture phlebotomy technique was reviewed. All the materials required for this procedure were also cultured, including gloves, cotton swabs, rubber diaphragm of blood culture bottles (Bact/ALERT, bioMérieux, Marcy l'Etoile, France) and the alcoholic chlorhexidine skin preparation solution. Samples were obtained by rubbing moistened gauzes repeatedly over equipment and materials used in patient care and over designated sites. Using sterile gloves, the gauzes were first immersed in a screw-cap sterile container with 10 mL of thioglycolate broth, then rubbed over designated sites, returned to the container and 10 mL more of medium was added. Gloves were removed, and hands were washed. The containers were incubated overnight at 37°C and then subcultured to blood agar (bioMérieux). Samples were also taken from working desk, from all return air grilles and air diffusers, as well as from air-inlet duct surfaces of the ED using a swab specimen collection inoculated into a tube with transport media (Deltalab, S.L., Barcelona, Spain). Air samples were collected using an air-sampler (SAS Super 90). Per sample 200 L was collected, with an airflow rate of 90 L/min following manufacturer's instructions. Air samples were obtained just below ventilation grids in the ceiling in six ED areas: three on the surface of ventilation grids, and three of them 20 cm away from the air outlet. A total of 18 samples were taken. After air sampling, cartridges containing agar were incubated overnight at 37°C. Colonies with compatible morphology from all primary and sub-cultures were further identified. Environmental samples from the ED were collected during three periods: period 1 (during construction work period), period 2 (one month after the end of construction work), and period 3 (two months after the end of construction work) (Table I).

Culture and typing

The isolation of *Bacillus* spp. was done on blood agar plates read after 24–48 h at 37°C. A presumptive identification of colonies with compatible morphology was done by microscopy after Gram-staining. Final identification at species level was performed by matrix-assisted laser desorption/ionization mass spectrometry (Bruker Daltonics, Bremen, Germany). No quantitative cultures were performed.

Repetitive element sequence-based polymerase chain reaction (Rep-PCR) (Diversilab, bioMérieux) was performed for epidemiological analysis of isolates.

Intervention

After the beginning of construction work, a bundle of measures was implemented in order to control *Bacillus* spp. contamination. On July 19th, the construction work area was demarcated and closed with rigid shields, allowing only

Table I
Enviromental cultures

Sample	No. positive/no. cultured (%)			*P*
	Period 1	Period 2	Period 3	
Material	2/9 (22.2)	6/14 (42.9)	6/10 (60)	
Surfaces	39/41 (95.1)	5/25 (20)	9/27 (33.3)	
Air (aspiration)	6/6 (100)	2/6 (33.3)	1/6 (16.7)	
Total	47/56 (84)	13/45 (29)	16/43 (37)	<0.001

Period 1: construction work period.
Period 2: one month after cleaning.
Period 3: two months after cleaning.