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Original article

A six-month *Serratia marcescens* outbreak in a Neonatal Intensive Care Unit

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ABSTRACT

Objective: To investigate a *Serratia marcescens* (*S. marcescens*) outbreak in a Neonatal Unit in a tertiary university hospital.

Methods: Descriptive study of children admitted to the Unit with *S. marcescens* infection from November 2012 to March 2013. Conventional microbiological methods for clinical and environmental samples were used. The clonal relationship between all available isolates was established by molecular methods. A multidisciplinary team was formed, and preventive measures were taken.

Results: *S. marcescens* was isolated from 18 children. The overall attack rate was 12%, and the case fatality rate in the Intensive Care Unit was 23.5%. The most prevalent types of infections were pneumonia (6), conjunctivitis (6), and bloodstream infection (5). Clinical isolates and environmental isolates obtained from an incubator belonged to a unique clone. The clonal relationship between all *S. marcescens* strains helped us to identify the possible source of the outbreak.

Conclusion: Isolation of *S. marcescens* from stored water in a container, and from the surface of an incubator after cleaning, suggests a possible environmental source as the outbreak origin, which has been perpetuated due to a failure of cleaning methods in the Unit. The strict hygiene and cleaning measures were the main factors that contributed to the end of the outbreak.

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Brote epidémico por *Serratia marcescens* en una Unidad de Cuidados Intensivos Neonatales

RESUMEN

Objetivo: Investigar un brote por *Serratia marcescens* (*S. marcescens*) en una unidad de neonatología en un hospital universitario de tercer nivel.

Método: Estudio descriptivo de los pacientes ingresados en la Unidad de noviembre de 2012 a marzo de 2013. Se usaron métodos microbiológicos convencionales de muestras clínicas y ambientales. La relación clonal de los aislados disponibles se llevó a cabo mediante estudio molecular. Se formó un equipo multidisciplinar a partir del cual se tomaron las medidas preventivas.

Resultados: Se aisló *S. marcescens* en 18 niños. La tasa global de ataque fue del 12% y la letalidad en la Unidad de Cuidados Intensivos llegó al 23,5%. Los tipos de infección más frecuentes fueron la neumonía (6), conjuntivitis (6) y bacteriemia (5). Tanto las muestras clínicas como las ambientales obtenidas de una incubadora pertenecían a un único clon. La relación clonal entre todas las cepas de *S. marcescens* permitió identificar la posible fuente de infección del brote.

Palabras clave:

Unidades de Cuidados Intensivos

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Infección nosocomial

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Conclusión: El aislamiento de *S. marcescens* en agua almacenada en un contenedor y en la superficie de una incubadora tras su limpieza sugiere una posible fuente ambiental como el origen del brote, perpetuado por fallos en los métodos de limpieza en la Unidad. El cumplimiento estricto de la higiene de manos y mejora en la limpieza fueron los principales factores que contribuyeron a la finalización del brote.

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Introduction

Serratia marcescens is considered an opportunistic pathogen able to produce serious infections in Neonatal Intensive Care Units (NICU) with high morbidity and mortality, and the latter could reach 44% in low birthweight.¹

S. marcescens can survive in damp environments and colonize the respiratory and/or gastrointestinal tract, as well as in hands of patients and healthcare workers, accounting for 5–15% of all nosocomial infections in NICU, and has been isolated for a long time in some nosocomial outbreaks.^{2,3}

Strict preventive measures are required to control these infections, primarily because of the great difficulty to eradicate this bacterium from these Units during an outbreak. Secondly, some of these strains have the ability to be resistant to multiple antibiotics which may hinder their treatment, and this fact could have severe consequences in low birthweight infected patients.⁴ In this paper, we describe the epidemiological investigation of a *S. marcescens* nosocomial outbreak at the NICU that allowed us to identify a possible environmental source and undertake the preventive measures to control it, as well as to define areas for improvement in order to prevent the appearance of new cases.

Methods

Area and period of study

Since November 2012 to March 2013, a *S. marcescens* nosocomial outbreak occurred at the Neonatal Unit (NU) of the University Hospital Virgen del Rocío in Seville, which it is also a regional tertiary reference center for other provinces of Andalusia (Spain). The NU is newly built since 2011, and is subdivided into three areas: General Neonatology (32 beds), Intermediate Care Unit (ICU) with 16 beds, and Neonatal Intensive Care Unit (NICU) with 12 beds.

This Unit served a total of 1790 inpatients in 2011, with an average stay of 8.7 days per patient. None of the three Units share health personnel except the pediatric postgraduate residency training on duty.

Epidemiological research

The 11th of December 2012, the outbreak was declared when five cases were already diagnosed in the NICU. Subsequently, more cases were identified at the NICU and ICU, with a total of 18 children involved, and the last case being detected in March 2013.

Study population included all patients infected and admitted to NICU and ICU from the first detected case. Case definition was any patient admitted to NICU or ICU, since November 2012 to March 2013, with a *S. marcescens* positive culture.

According to the site of infection and the clinical symptoms, we classify children as confirmed cases (when *S. marcescens* was isolated from sterile fluid samples and/or from non-sterile sites and clinical symptoms were present) and colonized/carrier cases (when the bacteria was isolated from non-sterile sites in the absence of signs and/or symptoms of infection).

The Service of Preventive Medicine collected cases data by individual inquiry protocol. Variables including personal identifiable information, intrinsic risk factors and those associated with infection and related procedures were collected.

Environmental study

During 2013, an extensive environmental study, which included 42 samples, was conducted to search for a potential source of *S. marcescens*.

Microbiological study

Environmental and clinical samples were processed following the Proceedings of the Spanish Society of Clinical Microbiology and Infectious Diseases, SEIMC (Environmental Microbiological 2nd Edition (42), 2012) and incubated for 7 days. Environmental samples were collected at three different dates: November 2012, February 2013 and December 2013.

The *S. marcescens* isolates were preliminarily identified by mass spectrometry (MALDI-TOF-MS Brucker®, Microflex LT instrument software and database Flexcontrol Biotyper 3.0 2.0 (Bruker Daltonics)). Isolates were stored at –70° until the realization of molecular study.

The phenotypical identification and susceptibility testing was performed with MicroScan Walkaway system (Beckman Coulter Inc.). Susceptibility testing was performed by standard methods in accordance with the European Committee on Antimicrobial Susceptibility Testing – (EUCAST) performance standards.

On January 29, 2013 a study of conjunctival and rectal carriage of *S. marcescens* to the 14 inpatient children of the Unit was performed. Pulsed field electrophoresis (PFGE) analysis on all the available strains isolated from clinical and environmental samples was performed, following the modified protocol described by Shi Zhi-yuan et al., using the *SpeI* restriction enzyme.⁵ Electrophoresis patterns obtained were captured with GelDoc™ XR + with Image Lab™ Software. These patterns were compared using the Bioinformatics FPQuest™ Software system, BIO-RAD. Dendogram was performed by the Dice coefficient and UPGMA (tolerance 2%), and the pulsotypes obtained were interpreted according to the Tenover criteria.⁶

Statistical analysis

The attack rate (AR) or *S. marcescens* infection incidence of inpatient children at the Unit (number of new cases among all patients at risk), the case fatality rate (number of deaths among infected) and *S. marcescens* mortality (deaths of all patients at risk) were calculated. The risk population was considered in all the inpatient children at the affected Units during the outbreak period.

A time, place and person descriptive analysis of the cases was performed. Categorical variables were represented by frequency tables and quantitative numerical summaries [mean and standard deviation, median and interquartile range (IQR)].

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