

## OUTBREAK INVESTIGATIONS

# *Serratia marcescens* outbreak causing septicemia in neonatal intensive care unit: Substantiation of single source

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## ABSTRACT

We investigated an outbreak of *Serratia marcescens* (*S. marcescens*) in NICU of our hospital and are reporting the characteristics of this outbreak along with interventions leading to its resolution.

In the month of September and November 2016, seven neonates were identified with blood cultures positive *S. marcescens* septicemia. To identify the source of the isolate surface swabs were taken from different environmental sources. All *S. marcescens* isolates were identified by Vitek automated identification system, API 20 E and their antibiogram pattern and further genotyping was done by pulse field gel electrophoresis.

During surveillance, 25 blood cultures of newborns were analyzed, 32 environmental samples along with hand swabs of 10 healthcare workers (HCWs) were taken. Seven neonates had blood culture positive *S. marcescens* sepsis. Only one environmental source (water flasks) yielded *S. marcescens* with similar antibiogram suggesting the same strain which was further confirmed by pulse field gel electrophoresis.

Timely delivery of culture and sensitivity results, good liaison and effective communication between neonatologist and microbiologist, targeted antimicrobial therapy helped in saving the life of six neonates suffering from *S. marcescens* septicemia.

## KEY WORDS

*S. marcescens*, neonatal septicemia, neonatal intensive care unit (NICU)

## INTRODUCTION

Low birth weight and pre-term neonates are at high risk for contracting healthcare associated infection (HAIs). Recent advances in NICU have allowed provision of care with increasingly higher acuity to preemies with lower gestational age. Despite these advances there is increased incidence of HAIs among neonates (1). These HAIs can be of different types but the most life threatening is late onset neonatal sepsis (LOS). LOS is difficult to diagnose clinically because of nonspecific signs and symptoms. *Serratia marcescens* has emerged as an important nosocomial pathogen in LOS (2). It is a ubiquitous pathogen that tends to colonize neonatal skin and alimentary tract and spreads via environmental dissemination and hands of healthcare workers (HCW) (3). We investigated an outbreak of *S. marcescens* in NICU of our hospital and report the characteristics of this outbreak along with interventions that led to its cessation.

## METHODOLOGY

In September 2016, within the span of a few days, two phenotypically similar. *S. marcescens* isolates were identified from blood cultures of neonates admitted in our NICU. This clustering warranted the need to investigate the occurrence of an outbreak in NICU. Diagnosis of LOS was made on the basis of clinical features, raised C-reactive protein (CRP), low platelet counts, and positive blood culture. All the isolates had a similar antibiogram.

### Patients

Before the start of surveillance in the affected unit, *S. marcescens* was isolated from the blood cultures of three neonates. The index case was identified as a baby girl referred from another hospital. She was delivered weighing 1560 gm. at 30 weeks of gestation by a lower segment cesarean section (LSCS) due to severe pregnancy induced hypertension with

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raised Doppler indices. She presented with respiratory distress soon after birth and was placed on nasal continuous pressure airway pressure (nCPAP) and transferred to our setup. A diagnosis of grade 2 respiratory distress syndrome (RDS) along with presumed sepsis was considered. First line antibiotics (Ampicillin and Amikacin) were started and a septic screen was done at 12 hours of age. Supportive care with attention to fluids, electrolytes and temperature management was ensured. Initial CRP was 27g/dl. On day 4 after birth, 24 Sep 2016, the baby expired. Her blood culture yielded growth of *S. marcescens* one day before the death of baby.

During the next 10 days, blood culture from two other neonates had growth of *S. marcescens*. One of them was a late preterm born at 36 weeks of gestation and admitted for establishing feeds. He had episodes of frequent desaturations on day 5 of life. A presumed diagnosis of late onset sepsis was made and later cultures yielded growth of *S. marcescens* in his blood. The other one was admitted to NICU with the history of

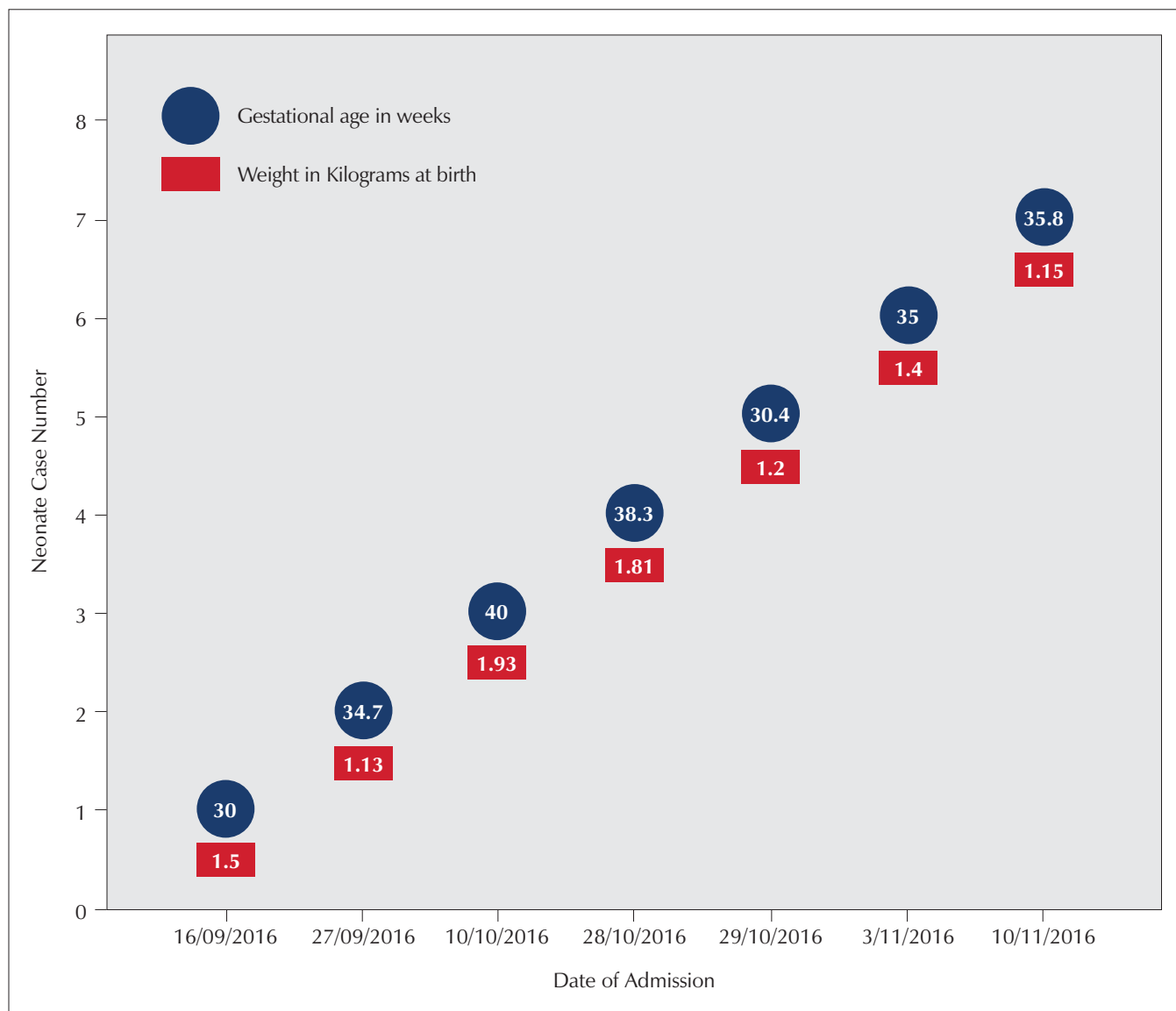
prolonged neonatal jaundice and was diagnosed with neonatal hemochromatosis. He started having feed intolerance at day 24 of life and was suspected of having late onset sepsis. A septic screen was done along with a blood culture which yielded growth of *S. marcescens*. All isolates had a similar antibiogram giving an indication of an outbreak in NICU.

In subsequent weeks, four more neonates, one with neonatal jaundice and three with prematurity were admitted for establishment of feed also developed late onset sepsis secondary to the same *S. marcescens*.

All culture positive neonates were treated with Meropenem and Amikacin as per the sensitivity. They responded well to treatment, evidenced by a falling CRP and normalization of sepsis markers.

*Bacterial identification*

All blood samples were received in automated BACTEC™ bottles. Once flagged positive by BACTEC™ system, Gram staining was carried out. Initial results were communicated to the attending



neonatologist for specific Gram negative cover. At the same time samples were sub cultured on blood and MacConkey agar and plates were incubated at  $35 \pm 2^\circ \text{C}$  for 18 hours. Next day isolate was identified by colony morphology, Gram staining and basic biochemical tests. All suspected isolates were confirmed by API 20 E (bio Mérieux, Marcy L'Etoile, France) and VITEK 2 (bio Mérieux, Marcy L'Etoile, France) Gram negative panel.

#### Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was carried out by disk diffusion method and results were interpreted as per Clinical & Laboratory Standards Institute (CLSI) recommendations. Further test for minimum inhibitory concentrations (MICs) were carried out by VITEK 2 using N2O2 card.

#### Surveillance and environmental investigation

To identify the source of this outbreak, 32 environmental samples were taken from NICU including incubators, cradle, feeding trolley, suction fluid, laryngoscope, stethoscope, feeding cup, water flask, antiseptic solution, suction tube, door knobs, nursing counter. Hand swabs from 10 HCWs, including one neonatologist, one resident, one house officer, four nursing staff, two sanitary workers and one food handler were taken. The swabs were inoculated on blood agar, MacConkey agar and incubated at  $35 \pm 2^\circ \text{C}$  for 18-48 hours and all isolates were identified as per standard protocol. An isolate identified as *S. marcescens* was confirmed by API 20 E and further confirmed by VITEK 2 Gram negative panel.

#### Genotyping

PFGE was used to create a DNA fingerprint of *S. marcescens* isolates and confirm the source of the outbreak.

## RESULTS

An outbreak of *S. marcescens* was identified from 16 Sep to 29 Nov 2016 in a 20 cots tertiary care NICU. Before the start of surveillance in the affected unit, *S. marcescens* was isolated from the blood cultures of three neonates with clinical suspicion of septicemia. An infection control meeting was held between neonatologist, nursery staff and microbiologist to establish infection control measures. Environmental samples including surface swabs and hand swabs of HCW were negative for *S. marcescens*. However, samples from one environmental source, water flask yielded growth of multiple organisms including *S. aureus*, *K. pneumonia* and *S. marcescens*. *Serratia* isolates from blood cultures of seven neonates and the one isolated from water flask had similar biochemical profile and antibiogram confirming the possible source.

#### Clinical details of neonates

Neonatal septicemia caused by *S. marcescens* was diagnosed in seven neonates out of 25 who were admitted in NICU during this time period.

#### Microbiological results

*S. marcescens* was isolated from blood samples of seven neonates and one environmental source, a water flask.

Antimicrobial susceptibility pattern was substantially observed and maintained. All isolates were sensitive to amikacin, imipenem, meropenem, doxycycline and tigecycline and resistant to ampicillin, amoxicillin-clavulanate, cefepime, ceftriaxone, ciprofloxacin, cotrimoxazole, gentamycin, tazobactam-piperacillin.

By PFGE typing, seven isolates from blood samples and the isolated *S. marcescens* from water flask had the same strain (pattern A). This specific clone was responsible for the outbreak from Sept. to Nov., suggesting cross-transmission of particular isolate in the NICU.

## DISCUSSION

*S. marcescens* is an important nosocomial pathogen, responsible for hospital acquired infections in neonates (4). Gastmeier *et al.* reported 33 outbreaks in NICU caused by *Serratia spp* with the mortality rate of 7.7 % (9). Whereas in our case only one neonate, the index case, out of seven positive cases expired. Timely delivery of culture and sensitivity results, good liaison and effective communication between neonatologist and microbiologist were major factors that contributed to the successful management of the disease. In addition to this, cohorting of neonates whose blood culture were positive for *S. marcescens* and introduction of bundled interventions to improve hand hygiene in HCW, disinfection of environmental surfaces by using intermediate level disinfectants like isopropyl alcohol along with good cleaning practices for food utensils items helped in curbing the spread and preventing further transmission of the pathogen. Moreover, pathogen specific antibiotic therapy, intensive efforts by targeted post outbreak surveillance and implementation of infection control measures with special focus on horizontal infection prevention approaches played a major role in cessation of an outbreak.

*S. marcescens* is an environmental microorganism that colonizes neonates through various routes such as skin, respiratory tract, gastrointestinal and genitourinary and can cause life threatening septicemia (5). *S. marcescens* bacteremia in neonatal ICUs is typically associated with an outbreak generally linked to environmental sources (3,4,6,7,8).

This report describes a successfully contained severe neonatal septicemia outbreak caused by *S. marcescens*. Since the source was removed and strict infection control measures were followed, no new cases were reported.

Unlike reports of other outbreaks described elsewhere (3,5) in this outbreak septicemia was likely, secondary to environmental source (water flask) being used in feed preparation for the neonates.

Blood stream infections are not only the most frequent health care-associated infections in NICU outbreaks, they also represent the most frequent endemic infections in neonates (9,10). Extensive use of indwelling catheters and prolonged parenteral nutrition in sick infants are among the major causes for the high prevalence of bloodstream infections. As in present scenario, all the neonates suffering from septicemia had prolonged stay because of co-morbid conditions and acquired the infection during their stay in the hospital.

*S. marcescens* outbreak represents a serious challenge in hospitals especially in NICUs. Therefore extensive surveillance procedures are essential in infection control, whilst implementation of standard measures, such as maintaining hand hygiene, cleaning of hospital environment and multidisciplinary effort plays a crucial role in successfully controlling an outbreak.

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