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BRIEF COMMUNICATION

Outbreak of extended-spectrum beta-lactamase-producing *Klebsiella pneumoniae* in an intermediate-risk neonatal unit linked to onychomycosis in a healthcare worker

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Abstract

Objective: To describe an outbreak of extended-spectrum beta-lactamase-producing *Klebsiella pneumoniae* in an intermediate-risk neonatal unit.

Methods: After the identification of the first cases, the situation was regarded as an outbreak, and basic preventive measures against nosocomial infections were strictly enforced, and possible sources of dissemination were investigated.

Results: The outbreak lasted for 6 months and affected 36 newborn infants, causing seven infections and 29 colonizations. In the first stage of the outbreak, patients developed infection, but in the second stage, they were asymptomatic and were only identified by surveillance cultures. The outbreak was controlled after the identification and treatment of the healthcare worker who had been diagnosed with onychomycosis and whose hands were contaminated with extended-spectrum beta-lactamase-producing *Klebsiella pneumoniae*.

Conclusion: The detection and control of occult dissemination of this multiresistant bacterium among low-risk newborn infants prevented its endemic dissemination in the neonatal unit, as well as the exposure of critically ill and susceptible patients to the infection.

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Introduction

Klebsiella pneumoniae is a gram-negative rod that colonizes the gastrointestinal tract of healthy individuals. It plays an important role in nosocomial infections, causing outbreaks in critically ill patients in intensive care units. Also, its endemicity has been described in some cases.[1]

The increasing resistance of *Klebsiella pneumoniae* to antibiotics has been a cause for worry since the 1980s after the emergence of extended-spectrum beta-lactamase (ESBL)-producing *Klebsiella pneumoniae*, which is resistant to all cephalosporins,[2] causing outbreaks in neonatal intensive care units.[3-5] This situation has become even more alarming in Brazil after the identification of *Klebsiella pneumoniae* with concomitant expression of IMP-1 metallo-beta-lactamase and of ESBL of the CTX-M type,[6] as the joint production of these enzymes rendered the bacterium resistant to all commercially available antibiotics, including carbapenems.

Studies assessing outbreaks of ESBL-producing *Klebsiella* have demonstrated that its emergence is usually associated with the use of third-generation cephalosporins,[7] that healthcare workers are vectors of transmission to patients,[3-5,8] and that the gastrointestinal tract of colonized patients is its major reservoir. The restriction of third-generation cephalosporins and the

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enforcement of basic preventive measures against nosocomial infections are key factors for the control of ESBL-producing *Klebsiella* outbreaks.

Currently available studies on ESBL-producing *Klebsiella* have predominantly turned their attention to intensive care units, and therefore, there has been a paucity of information about its outbreaks in intermediate-risk neonatal units.

We describe the rare occurrence and the management of an outbreak of ESBL-producing *Klebsiella* in an intermediate-risk neonatal unit, unrelated to the extensive use of third-generation cephalosporins, but linked to chronic colonization of a healthcare worker by onychomycosis.

Description

Outbreak site

The outbreak occurred in the neonatal unit of a university-affiliated hospital in São Paulo, Brazil. This neonatal unit has 17 beds in active use and an average flow of 450 patient-days per month. Newborn infants at intermediate risk (with, for instance, neonatal jaundice, early respiratory distress, congenital syphilis, maternal risk of infection) are treated in this unit. Critically ill patients are referred to the neonatal intensive care unit, returning to the neonatal unit after their clinical recovery.

Description of the outbreak

For simplification, we categorized the outbreak into two epidemiologically different stages.

First stage of the outbreak

There was an outbreak of ESBL-producing *Klebsiella* in the neonatal unit between August and early November 2004 (Figure 1). Two cases of urinary tract infection, two of conjunctivitis and three of bloodstream infection were reported. There were two colonizations, with isolation of the bacterium in urine culture. The overall attack rate was 3% (nine patients in 318 admissions).

The microbiological methods for *Klebsiella* isolation were automated blood culture (Bact Alert), urine culture on blood agar and on MacConkey's agar, and culture of secretions on blood agar. Species identification and antibiogram were automated, with manual confirmation of the ESBL phenotype by double-disc synergism (DDS) using first-generation to fourth-generation cephalosporin discs, aztreonam, and amoxicillin/clavulanate.

The following measures were used for the investigation and control of outbreaks for 3 months:

- notification of the unit staff about the outbreak;
- enforcement of standard and contact precautions, with the use of an alcohol-based gel for hand hygiene;
- investigation of invasive procedures and other possible risk factors common to the affected patients;
- inspection of hospital products, including their contents, packages, and their manipulation, so as to detect any flaws;
- microbiological culture of moisturizing creams and recommendation against the sharing of these creams, used in the perineal region of newborn infants – the cultures were negative;
- restriction of third-generation cephalosporins.

Later, it was found that the most widely used antibiotics in affected newborn infants, before the positive cultures for ESBL-producing *Klebsiella*, were amikacin (in 100% of case-infants) and penicillin (in 78% of case-infants). Third-generation cephalosporin (cefotaxime) was used in only 22% of affected infants.

Second stage of the outbreak

New cases continued to develop even after the implementation of initial control measures. Therefore, in the fourth month of the outbreak, rectal swabs were collected once a week from all hospitalized patients. The collected material was inoculated onto blood agar plates, and the identification, antibiogram and confirmation of the ESBL phenotype were performed as previously described.

Between November 2004 and February 2005, surveillance cultures indicated 27 new cases of ESBL-producing *Klebsiella*, but no new case of infection. The attack rate in this stage of the outbreak was 8% (27 patients in 349 admissions).

In this stage of the outbreak, the most commonly used antibiotics were also amikacin (in 78%) and penicillin (in 74%). Third-generation cephalosporin (cefotaxime) was used in only 15% of affected infants.

The standard measures for outbreak control were enforced with changes in bathing and diaper changing practices and with thorough disinfection of surfaces using 70% alcohol. However, surveillance cultures still indicated new colonization cases. Concomitantly, nosocomial infection rates remained below the average found for the previous years (Figure 1).

In February 2005, the 48 workers of the neonatal unit had their hands inspected, and swabs were collected from the hands of nine workers who had skin lesions of any type. Eight workers had negative hand cultures for ESBL-producing *Klebsiella*. They had either onychomycosis (two cases) or desquamative lesions and fissures (six cases).

A night-shift nurse auxiliary, who had onychomycosis, had positive hand culture for ESBL-producing *Klebsiella*. The nurse auxiliary was furloughed for 1 week, and was treated with oral and topical ciprofloxacin for decolonization of the nail bed, besides receiving oral

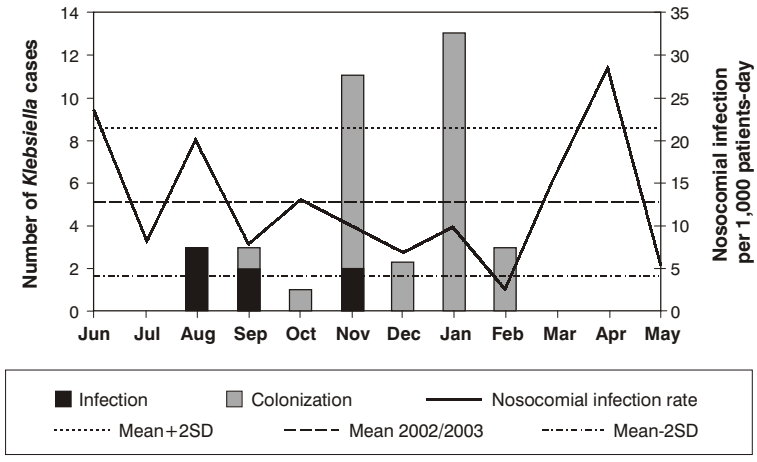

Figure 1 - Colonizations and infections by ESBL-producing *Klebsiella* in the neonatal unit between June 2004 and May 2005

fluconazole for onychomycosis. The swab culture of her nails revealed *Candida spp*, and onychomycosis resolved quickly after treatment.

Outbreak control

After 1 week of treatment, the nurse auxiliary returned to her usual activities and the swab culture of her hands was negative for ESBL-producing *Klebsiella*. Weekly surveillance rectal swabs were collected from the patients until 1 month after the beginning of the nurse auxiliary's treatment, but all of them yielded negative results. The outbreak was regarded as controlled and surveillance cultures were discontinued. After a one-month interval, a new confirmatory test was performed by the collection of rectal swabs from all hospitalized patients, and again, the results were negative.

All the other healthcare workers who had skin lesions on their hands were referred to medical treatment.

Discussion

The second stage of this outbreak shows the occult dissemination of this multiresistant bacterium, which may cause nothing but colonization of a large number of patients at low risk for infections. If the problem had not been detected and controlled, there might have been endemic dissemination with permanent risk of infections among more susceptible patients.

The major limitation of this study is the paucity of data on the genotyping of ESBL-producing *Klebsiella* isolates, since it was not possible to check whether the outbreak was caused by the dissemination of one or more bacterial strains or whether the strain collected from the nurse auxiliary's hands was the same one collected from the patients. Nevertheless, the immediate effect of the treatment, after the failure of all other control measures, suggests a cause and effect relationship.

The outbreak was categorized into two epidemiological stages. In the first one, which lasted 3 months, the bacterium predominantly caused infections and was identified through samples collected for the clinical assessment of febrile patients. In the second one, which lasted longer than 3 months, colonization occurred without infection and was detected by rectal swabs collected by the Division of Nosocomial Infection Control for the detection of occult colonization.

In these two stages, amikacin and penicillin were the most commonly used antibiotics. In this regard, this outbreak of ESBL-producing *Klebsiella* differs from previously described ones, which are usually associated with the use of third-generation cephalosporins.[7] Both amikacin and penicillin are widely used for the treatment of neonatal infections, but their possible participation as a risk factor for ESBL-producing *Klebsiella* colonization, due to environmental exposure, needs further investigation.

In the second stage of the outbreak, healthcare workers fully complied with the preventive measures against nosocomial infections, reducing infection rates and eliminating infections caused by the multiresistant bacterium (Figure 1). Even though there was a large dissemination of the bacterium among patients, it had no

clinical impact during this stage, due to the enforcement of preventive measures against infections.

The collection of swabs from healthcare workers' hands was necessary because none of the previous measures were effective. The swabs were collected only from those workers who had skin lesions on their hands and who were therefore more susceptible to colonization by unusual microorganisms.[9]

The identification and treatment of the colonized worker allowed for the immediate control of the outbreak. We infer that the nurse auxiliary probably acquired ESBL-producing *Klebsiella* from one of her first colonized patients, thereafter becoming a reservoir for the bacterium and then spreading it. This is the second outbreak of ESBL-producing *Klebsiella* involving a healthcare worker with onychomycosis[5] to be described in the literature; therefore, it is necessary that a microbiological study be carried out to determine the possible relationship of this bacterium with fungi, especially *Candida spp*.[10]

The identification of healthcare workers with skin lesions on their hands highlights the importance of a complete program for regular health assessment of these professionals in order to enhance patient quality of care.

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