Residência RP Pediátrica
Publicação Oficial da Sociedade Brasileira de Pediatria

Submitted on: 05/03/2016
Approved on: 01/13/2017

ORIGINAL ARTICLE

Profile of late-onset infections in a neonatal intensive care unit

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Keywords:
infection, intensive care units, neonatal, central venous catheters, infant, newborn, epidemiology.

Abstract

This is a retrospective study that analyzed the records of 93 newborns hospitalized at the neonatal intensive care unit (ICU) of the Santa Mônica Teaching Maternity Hospital, in Maceió, Brazil, from July 1 to December 31, 2010, with the objective of defining the etiological profile, prioritizing measures to control cases, evaluating the implemented strategies, and reducing mortality rates in the service. The studied variables were gestational age, birth weight, vascular catheters, mechanical ventilation, prolonged hospitalization, and antibiotic use. Exclusion criteria were neonatal infections occurring up to 48 hours of life or 48 hours of hospitalization. The result of the statistical analysis performed using the chi-square test was 35%, with an accuracy of 10 and a significance level of 5%. The mean incidence of late healthcare-related infection in the neonatal ICU in 2010 was 36% in the sample studied. Conclusion: The best method for controlling neonatal infections is to identify the etiological profile and intensify surveillance to develop specific strategies as well as reduce their incidence, mortality rates, and hospital costs. Keywords: Neonatal Intensive Care, Prematurity, Health Care Related Infections (IRAS), Epidemiology, Prevention.

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DOI: 10.25060/residpediatr-2018.v8n2-04

INTRODUCTION

Currently, owing to major technological and therapeutic advances in neonatal intensive care, the survival of premature and low-birth-weight newborns (NBs) has been extended. On the other hand, there is a burden of increased neonatal infections, which are the most frequent complications and are the leading cause of neonatal death[1,2,3].

Neonatal infections are a common and serious problem, with an incidence varying according to the level of care and the population involved, being particularly high in premature infants. They increase patients' length of hospital stay, morbidity, and mortality, in addition to treatment costs, and are thus regarded as a public health problem[1,2,3].

The highest occurrence of deaths from infection is mainly in low-birth-weight NBs (< 2,500 g) and, especially, in very-low-birth-weight NBs, weighing less than 1,500 g. Considering that each neonatal intensive care unit (NICU) has specific characteristics, showing different rates of infection with quite significant variation[1,2,3,4,5], the classification of infections into early-onset and late-onset is dissimilar between institutions and researchers.

Some consider neonatal infections as early-onset when clinical manifestations occur up to 48 h after birth, whereas others consider them as early-onset when clinical manifestations occur up to 72 h after birth[1-4]. Early-onset infections usually arise due to contamination by bacteria in the birth canal or are secondary to maternal bacteremia. Late-onset infections, occurring after 48 h of life, usually arise due to contamination by microorganisms in the microbiota of each institution.

In the present study, infection was considered as late-onset when it occurred after 48 hours of life, according to the 2008 guidelines from the Brazilian National Health Surveillance Agency (ANVISA).

The main risk factors for healthcare-associated infections (HAIs) are prematurity, low birth weight, long length of hospital stay, mechanical ventilation, use of broad-spectrum antibiotics, and invasive procedures, in addition to factors related to the place of hospitalization, such as overcrowding and disproportion between the number of NBs hospitalized and the number of healthcare professionals[2,3,5,10].

The diagnosis of infections in NBs is often difficult because manifestations are nonspecific and may be confused with those in other diseases characteristic of this age group. Infections can be manifested as one or more of the following signs: worsening of overall health status, hypo- or hyperthermia, hyperglycemia, gastric residue, respiratory failure, shock, and bleeding[4,5,11,12].

In addition to the clinical evaluation, laboratory tests must be available, including complete blood count with platelets, C-reactive protein, and cultures, especially blood cultures, to better direct the diagnosis and conduct[13]. According to topography, the most frequent infections are first venous catheter-associated bloodstream infections, followed by ventilator-associated pneumonia, infections of the gastrointestinal tract, and meningitis[4,5,6,7,8].

The most frequently found etiologic agents are coagulase-negative staphylococci (CNS), followed by gram-negative bacteria such as *Escherichia coli*, *Klebsiella* spp., and thirdly fungi, with a higher frequency of *Candida*, both in developed countries and in Brazil[1,2,3,4,5,6,14].

Epidemiological surveillance of hospital infections as a whole in neonatal units is essential to establish an effective prevention program. It refers to active, continuous, and systematic observation and collection, analysis, and interpretation of the data related to infection; definition of the etiological profile; identification of risk factors; prioritization of control measures; and evaluation of strategies implemented by the hospital-acquired infection control (HAIC) team of each institution[1,2,3,5].

For infection prevention and control in NICUs, recommendations for the healthcare team include adequate staff numbers and some routine procedures, such as proper hand hygiene, which is the most effective preventive measure against neonatal infection; use of emollient alcohol from individual wash bottles for each patient; and adequate asepsis and antisepsis of the newborn skin with chlorhexidine when performing invasive procedures. There are also preventive measures related to the handling and administration of parenteral nutrition, surveillance, and protocols for weaning from mechanical ventilation as well as infection prevention and care strategies for the use of a central venous catheter (CVC), following multi-disciplinary guidelines for insertion and maintenance, use of appropriate dressings, and early withdrawal, based on recommendations from the U.S. Centers for Disease Control and Prevention[5,6,7,8,9,15,16].

This study aimed to demonstrate the clinical and epidemiological profiles of HAIs in a NICU as well as the specific guidelines and measures to reduce the incidence of infection and mortality rates.

METHODOLOGICAL CONSIDERATIONS

This is a retrospective study in which we analyzed the medical records of 93 NBs who were hospitalized in the NICU of the Santa Mônica Teaching Maternity Hospital, in Brazil, from July 1 to December 31, 2010, and were followed up until discharge from the unit or death. The study included all patients with gestational age (GA) from 25 weeks to 36 weeks and 6 days, including those born in the hospital and those admitted from other institutions or born at home.

Exclusion criteria for the study were as follows: for NBs born in the hospital, those presenting clinical evidence of infection up to 48 hours of life and for those born at home or in other institutions, those presenting clinical evidence of infection on admission or up to 48 hours of hospitalization.

The institution is a high risk pregnancy reference maternity of State of Alagoas, located in the city of Maceió, Brazil, with 15 neonatal intensive care beds for the Brazilian Unified

Health System (SUS) to provide secondary health care.

Data collection was performed using records from the hospital's Medical Archives and Statistics Service, with the help of prospective follow-up spreadsheets for hospital-acquired infection surveillance devised by the hospital HAIC team, based on the methods proposed by ANVISA.

The results of the culture samples sent by the hospital laboratory for bacteriological tests were computed from the database of the hospital's Laboratory Medicine and Pathology Center.

To meet the objective proposed in the study, the following variables were assessed: GA, birth weight, length of stay in the unit, antibiotic use, and length of venous catheter use.

The analyzed outcomes were clinical and epidemiological profiles of late-onset HAIs, through the identification of risk factors, main etiologic agents, and most frequent infection types in the NICU.

Infections were diagnosed and classified according to the ANVISA manual "National Criteria for Healthcare-Associated Infection" (*Critérios Nacionais de Infecção Relacionada à Assistência à Saúde*) (2008).

To calculate infection indicators, we considered the cumulative incidence of infection (number of infections divided by the total sum of discharges, deaths, and transfers, multiplied by 100) and the density of infection incidence (number of infections divided by the total number of patients/day, multiplied by 1,000).

Statistical analysis was performed using the chi-square test. Using statistical inference for each estimated point of the variables, we estimated the 95% confidence interval (Gardner, 1989). Calculations were made using the SPSS® application (version 13.0).

This study was submitted to the Research Ethics Committee of the Alagoas State University for the Health Sciences (UNCISAL) and approved on April 17, 2013, under register no. 1835.

The references follow this journal's standards.

Articles related to the topic and previously published in this journal have been consulted and cited.

RESULTS

The results of this study were based on data collected using a form containing the variables to be studied and obtained from the records of the NBs hospitalized in the NICU of Santa Mônica Maternity Hospital from July 1 to December 31, 2010. There were a total of 156 admissions to the NICU during the study period. After applying the exclusion criteria, 93 NBs remained in the study.

GA during the study period varied from 25 weeks to 36 weeks and 6 days. The group with GA less than or equal to 34 weeks represented 67.2% of the premature infants, whereas that with GA of 34 weeks and 1 day to 36 weeks and 6 days corresponded to 32.8% of the preterm NBs. The incidence of prematurity was 59.8%, corresponding to 93 NBs.

Regarding birth weight, there was a higher number of NBs who weighed less than 1,500 g at birth and were small-for-gestational-age in the studied group.

The total rate of antibiotic use was 87%; in NBs with GA less than or equal to 34 weeks, this rate increased to 98.2%, whereas for those born between 34 weeks 1 day and 36 weeks 6 days, it was 49%.

The length of stay in the NICU ranged from 15 to 50 days.

The following was observed for the use of catheters: umbilical catheter 41%, CVC 43%, PICC 16%, and venous dissection 0%.

Of the 93 NBs studied, 20.6% of the cultures from all body sites for all late-onset HAIs were positive, versus 64.7% negative cultures. No material for culture was collected from 14.6% of the patients, and the causative agent was not identified.

Positive cultures accounted for 42% of all cases. NBs who weighed more than 1,500 g had positive cultures in 26.8% of cases in comparison to 69.2% of negative cultures.

In the study period, neonatal infection was present in a total of 74% of cases, with a predominance of early-onset HAI in 64% of cases, arising from the maternal and perinatal characteristics of the assisted population, in comparison to late-onset HAI in 36% of cases, considering the neonatal characteristics of inpatients, the length of stay in the unit, and treatment interventions.

The most frequently found etiological agent was CNS, present in 11 (19.2%) of 57 HAIs; Extended spectrum beta-lactamases (ESBL) producing *Klebsiella pneumoniae* was observed in 5 events; and *Candida* sp. occurred in 5 cases, with less severe infections and a 70% survival rate. These were followed by gram-negative bacilli and fungi.

Regarding topography, we found that 71% of the cases registered were primary bloodstream infections without microbiological confirmation, 21% were infections of the gastrointestinal system, 4% were nonspecific infections, and 4% were skin and tissue infections.

DISCUSSION

One of the biggest concerns of NICUs worldwide is nosocomial infection and late-onset infection, that is, infection acquired after 48 hours of life, which is one of the best indicators of quality[17].

In agreement with the literature, the epidemiology of the infections diagnosed in the study period was due to the unit's infrastructure characteristics and human resources, the inpatient profile, the length of stay in the NICU, and the prevention and diagnosis methods available[1,2,3].

To understand the determining factors and epidemiologic profile of infections in the studied period, we highlight the many aspects involved as follows:

We observed 36% of late-onset HAIs, among which the most commonly registered was primary bloodstream infection. According to Richtmann[15], the main hospital-acquired infection in an NICU is central line-associated sepsis.

Blood culture was the epidemiological criterion that was considered as the gold standard in this diagnosis. Healthcare institutions must be properly structured, and professionals must be properly trained for this purpose. In the study period, we failed to obtain culture collection from 14.6% of the patients.

The major risk factors for this HAI are ICU hospitalization, mechanical ventilation, neutropenia, use of CVC, and low birth weight[4].

During the study period, the incidence of late-onset infection was 36%. We know that the premature newborn is extremely vulnerable to infection, is subjected to several invasive procedures, and has high potential to be infected and spread bacteria to the whole unit[7,8,9,10].

FINAL CONSIDERATIONS

Regarding venous access, our study included a large number of patients with peripheral access and umbilical catheterization. According to the *Guidelines for the Prevention of Intravascular Catheter-Related Infections*[6], every NB who will need venous access for more than 6 days should receive a central venous access, PICCs being the first choice, with appropriate measures to prevent infection[14,15,16,17].

Due to clinical instability and variability, the mean length of hospital stay of a premature NB, depending on GA, can reach 80 days[15,18,19]. In our study, the length of stay in the ICU ranged from 15 to 50 days.

According to Calil[16] and based on the rate of antibiotic use in the study period, we believe that improper use of antibiotics can lead to the development of multidrug-resistant bacteria, making infections more difficult to treat and increasing the morbidity and lethality of the condition.

This study identified that the many infection control and prevention measures applied to the hospital environment, the health care team, and the newborn represent a major challenge to all those involved in neonatal care and must be encouraged, supervised, and controlled as parameters to identify the etiological profile of infections and maintain the quality of care and the health status of this population.

HAIs in neonatology constitute a very frequent and serious problem nationwide. They represent one of the best indicators of quality in the ICU. The assessment of the control process and the etiological management show a significant structural fragility and constitute a challenge to be overcome with priority[2,4].

The incidence of this type of infection varies according to the level of care and the population involved, being particularly high in NBs in neonatal ICUs, especially the premature ones[2,3,18].

Premature NBs have particular immune system features that make them susceptible to develop infections. Hospitalization exposes them to a series of devices and instruments harboring pathogens that can break into the mucous and skin barriers, further increasing the risk of infection[16,17,18,19].

GA, low birth weight, and length of stay in the NICU are the main risk factors for the development of HAIs. Team training and personal capacitating, infrastructure, good practices in invasive care, and strict adherence to hand hygiene techniques and compliance with the protocols can affect neonatal infection and mortality rates[1,2,3,4,5,6,7,8,9].

The prevention and control of late-onset HAIs constitute a major challenge for neonatal care, and the best approach involves identifying the etiological profile and intensifying the surveillance to develop specific strategies for reducing their incidence, mortality rates, and hospitalization costs[10,11,12,13,20].

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