Prevalence and bacteriological profile of neonatal sepsis in newborn intensive care unit of a tertiary care hospital in Central India

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ABSTRACT

Background: Neonatal sepsis (NS) is the most common cause of neonatal mortality responsible for about 30–50% of total neonatal deaths in developing countries. Surveillance of causative organisms and their antibiotic sensitivity pattern promotes the rational use of antibiotics and antibiotic stewardship. **Objectives:** The objectives of this study were to study the prevalence of NS in newborn intensive care unit of a tertiary hospital of Central India and to isolate the most common organism involved in sepsis in our setting. **Materials and Methods:** A retrospective study was conducted and relevant data of the neonates diagnosed with culture-positive sepsis were obtained from the case records during the period from February 2018 to February 2019. Culture-positive sepsis was defined as the isolation of bacterial pathogen from blood in neonates with clinical suspicion of sepsis. **Results:** A total of 223 neonates were enrolled. The major morbidities were hyperbilirubinemia (23.3%), birth asphyxia (14.3%), sepsis (53.8%), and respiratory distress (32.7%). The main causes of neonatal mortality were birth asphyxia (9.8%), prematurity (18.83%), sepsis (32.23), hyaline membrane disease (13.4%), and meconium aspiration syndrome (13.9%). A total of 120 cultures were found to be positive. The most common organism isolated was *Staphylococcus aureus* (39.3%) followed by *Klebsiella pneumoniae* (34%). *Candida albicans* was also isolated. **Conclusion:** Culture-positive NS accounted for 53.8% of all cases and is the major cause of mortality (32.28%) in the present study. Sepsis caused by Gram-positive bacteria was the most common among the neonates, although mortality was more in Gram-negative sepsis. Therefore, empirical regimen should be modified based on antibiogram of the isolates.

Key words: *Bacteria, Blood culture, Morbidity, Mortality, Neonatal sepsis*

Neonatal sepsis (NS) is a major cause of morbidity worldwide and one of the three primary causes of 2.7 million deaths every year [1]. Over 600,000 of these deaths are attributed to infections alone and 99% of these deaths take place in developing countries [2]. South Asia accounts for 3.5 million cases per year [3]. Although population-based figures are unavailable, the bulk of these sepsis-related neonatal deaths are considered to be taking place in rural India, where more than 60% of the Indian population lives. In the context of the worldwide threat of antimicrobial resistance, India's condition is considered starker than any other place [4], and neonatal infections form an important piece in the equation. Although there is no consensus on the exact modalities, various home-based regimens of empiric injectable and oral antibiotics are promoted in many developing country settings, including India [5]. The present study was done to determine the prevalence of NS in the newborn intensive care unit (NICU) and to isolate the common organisms involved.

MATERIALS AND METHODS

This is a retrospective study done in the tertiary care hospital of Central India after obtaining approval from the Institutional Ethical Clearance Committee. All newborns of age <28 days with informed consent from parents/guardians were included in the present study. Infants, aged >28 days, orphans, and infants for whom consent could not be taken from guardians, were excluded from the study. A purposive sampling method was adopted to collect the required data, as shown in Fig. 1.

We analyzed the data of the culture of NS cases from February 2018 to February 2019. A semi-structured questionnaire-based detailed pro forma was used to collect the data, retrospectively including details of antenatal, natal, and postnatal periods. All the newborns included in the present study were assessed for the gestation age clinically by New Ballard Score. Neonates with high index of suspicion for sepsis and showing signs and symptoms were noted. Relevant investigations (sepsis screening, blood culture, and sensitivity) sent were analyzed accordingly.

Blood for bacterial culture was collected aseptically and 2 ml of blood was added to each of the two bottles containing 20 ml of Tryptone Soya Broth (HiMedia Labs., Mumbai, India). The bottles were incubated aerobically at 37°C for 7 days and subcultured on sheep blood agar and MacConkey agar overnight, for 48 h or for 7 days or for an in-between period when visible

turbidity appeared. In positive cases, Gram-positive isolates were identified at the species level by conventional biochemical and serological tests [6]. In the cases, where coagulase-negative *Staphylococcus aureus* (CONS) was isolated in the first 3 days of life, a repeat blood culture was performed to confirm the infection.

Proven sepsis was defined as the presence of clinical features of sepsis along with the isolation of an organism in the blood culture. All organisms were classified based on the time-point at which the blood was collected for culture as those causing early-onset sepsis (EOS – ≤ 72 h of life) and those causing late-onset sepsis (LOS – >72 h of life). Thorough clinical examination was done and the treatment was provided as per standard protocols. The outcome of cases was also noted. The definitions and terminologies described in the study were based on standard sources approved and adapted by the National Neonatology Forum of India.

RESULTS

Of 223 newborns enrolled, 91 were inborn and remaining 132 were outborn with gender ratio being 2.37:1. Of the 132 outborn deliveries, 25 delivered occurred at primary health centers, 48 at community health centers, 45 at DHs, 6 at home, and 3 were delivered on the way to hospital. Among enrolled neonates, 150 were term, 49 preterm, 20 late preterm and 4 post-term with 39 neonates being small for date, 170 appropriate for date, and 4 were large for date.

The major morbidities noted in these neonates were sepsis (53.8%) and respiratory distress (32.7%), followed by hyperbilirubinemia (23.3%), birth asphyxia (14.3%), seizure (8.9%) hematological problems (5.3%), congenital malformations (4.48%), metabolic problems (4%), and miscellaneous (0.8%).

Sepsis (32.23) and prematurity (18.83%) were the two most common causes of mortality, followed by meconium aspiration syndrome (13.9%), hyaline membrane disease (13.4%), birth asphyxia (9.8%), sudden infant death syndrome (6.89%), pneumothorax (5.3%), congenital malformations (4.48%), and hydrops fetalis (0.89%).

A total of 120 cultures were found to be positive out of 223 cases (53.8.0%). The most common organism isolated was *S. aureus* (39.3%) followed by *Klebsiella pneumoniae* (34%) and *Escherichia coli* (15%). Other organisms were much less in number which included pathogenic streptococci (3.4%), CONS (3.1%), *Pseudomonas* (1.2%), *Acinetobacter* (1%), and *Enterobacter* (0. 5%) species. *Candida albicans* also isolated in 1% of cases.

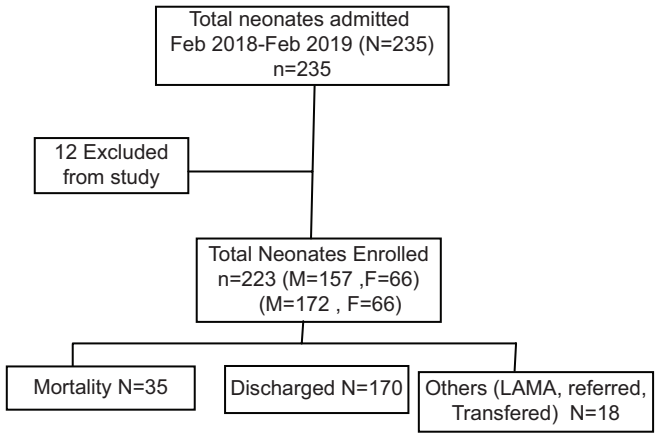

Figure 1: Sampling method

DISCUSSION

Empirical antibiotics should be started immediately after obtaining cultures as NS is an important cause for mortality [7]. Although blood culture is the gold standard for the diagnosis of NS, the use of intrapartum antibiotics and empirical antibiotics before collecting blood for culture decreases the yield of culture [8,9]. For choosing the appropriate empirical therapy, one should be aware of the common organisms causing EOS and LOS so that the antibiotic resistance and emergence of multidrug resistance (MDR) organisms can be reduced.

The blood culture positivity in neonates with clinical suspicion of sepsis was 53.8% during the given study period which was similar to the study done by Mohsen *et al*. [10]. It was only 18% in a study done by Bhat *et al*. [11] and 26.57% in a study conducted by Roy *et al*. [12]. In a study done by Hamer *et al.*, the blood culture results of NS from South Asian region showed *Klebsiella* in 23%, *E. coli* in 12%, S. aureus in 9.8%, and Group B *Streptococcus* in 0.8% of cases with NS during the first 28 days of life [13].

The results from the present study showed the predominance of Gram-positive organisms over Gram-negative organisms, which are in accordance to the results obtained by Rashmi and Praveen [14]. Two tertiary care centers in India contributed data on 34 bacterial isolates. In this report, S. aureus predominated, followed by Acinetobacter spp., Enterobacter spp., *E. coli*, and Klebsiella [15]. The results were in accordance to the present study. The study conducted by Apparao *et al*. showed *S. aureus* (40.3%) as the most common bacterial isolate. The other Gram-positive organisms to be isolated were streptococcal species and CONS [16]. National Neonatal Perinatal Database 2002–2003 data showed that the most common organisms causing NS were *K. pneumoniae* followed by *S. aureus* [17].

In developing countries, rates of bloodstream infections have been reported to be 1.7–33/1000 live births, with rates in Asia clustering around 15/1000 live births [18]. The rate of admission of EOS and LOS and the prevalence of organisms and their sensitivity patterns were similar [19]. This may be due to the fact that the vertical transmission and the horizontal spread of infection play an important role in EOS in hospitalized neonates [20,21]. The antibiotics used should be specific based on culture and sensitivity.

Regular antenatal care, special care of at-risk neonates such as preterm and low birth weight babies, exclusive breastfeeding, proper hand washing, early diagnosis, and appropriate management of infection all remain as major pillars in controlling sepsis in neonates. Therefore, the knowledge of prevailing strains and the antibiotic sensitivity patterns in the region is mandatory

for each center due to temporal changes in the causative organisms and their antibiotic susceptibility. Periodic evaluations not only reveal the recent trend of increasing resistance to commonly used antibiotic but also help in implementation of a rational empirical therapy.

There were few limitations of this study. Statistical analysis could not be carried out. Although the bacteriological profile was studied, we did not analyze the specific antibiotics used. The growth pattern of the organisms associated with EOS and LOS was also not studied.

CONCLUSION

Every NICU should develop their antibiogram to have appropriate antibiotic stewardship and decrease the incidence of MDR. Therefore, empirical regimen should be modified accordingly.

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