

Device associated nosocomial infection in NICU: a prospective observational study.

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ABSTRACT

Nosocomial infections (NIs) are the most important current challenge faced by neonatal intensive care units (NICUs). Although systematic surveillance is an integral part of all approaches to decreasing NIs, the current methods for recording healthcare-associated infections in our country are grossly inadequate. To determine the prevalence and risk factors for device-associated infections in a tertiary care center in eastern India. This prospective observational study was undertaken in the NICU, Department of Pediatrics, SCB Medical College, Cuttack, and SVPPGIP, Cuttack. Neonates who stayed in the NICU for more than 48 hours and needed one or more devices (e.g. ventilator or CVL) are included in this study. They were observed for nosocomial infections. In this study, we included 630 neonates. A total of 94 neonates were found to have a nosocomial infection. The patient, days were 2516 days. During the period of study, central line days were found to be 173 days and ventilator days, 710. The prevalence of nosocomial infection was found to be 14.9%. Male babies were more likely to have nosocomial sepsis. Staphylococcus aureus was found to be the major organism. Nosocomial infection in NICU graduates who are put on several devices is an important preventable problem. The present study reveals that sepsis (LOS) and pneumonia are major device-associated infections. Staphylococcus aureus is most commonly associated with E. coli and Klebsiella. Their prevention can be achieved by applying strict protocols for sepsis.



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1. Introduction

Nosocomial infections (NIs) are infections that develop in hospitalized patients and are neither present nor incubating at the time of admission to the hospital. NIs are generally a chain of events whereby a source or reservoir of microorganisms is transmitted by some method to a susceptible host. The organisms causing infections can come from either the patient's own endogenous flora or from external sources, including hospital staff, equipment, or even food, water, walls, floors, and some other surfaces.

According to the World Health Organization report, there are about 5 million neonatal deaths a year, of which 98% occur in developing countries. Out of these, 1.6 million deaths occur due to the neonatal infections. The major proportion of these is hospital acquired infections (HAIs). NIs are the most important current challenge faced by the neonatal intensive care units (NICUs) [1]. As per the National Neonatal-perinatal Database (NNPD), in the year 2002-2003, systemic infections (18.6%) were the second most common cause of neonatal deaths [2]. In the modern day, nosocomial infection is the an important cause of neonatal morbidity and mortality in hospitals. However, its reporting has been non-uniform. The reported incidence of nosocomial sepsis in neonates from India ranges from 1.5% to 37% [3].

Neonates present a unique and highly vulnerable patient population. Due to immature immune systems, altered cutaneous barriers and invasive diagnostic and therapeutic interventions, they are always under a serious threat of hospital acquired infections.

Although systematic surveillance is an integral part of all approaches to decreasing NIs, the current methods for recording healthcare associated infections in our country are grossly inadequate.

As a result, a risk-based approach to calculating healthcare-associated infection rates in accordance with international standards is urgently needed.

So we aimed to assess the neonatal population at risk for device associated neonatal nosocomial infections at a NICU in a tertiary care paediatrics hospital and identify the prevalence and risk factors of device-associated infections in NICU so that we can plan to develop an asepsis protocol to prevent them.

2. Materials and methods

This prospective observational study was undertaken in the NICU, Department of Pediatrics, SCB Medical College, Cuttack and SVPPGIP, Cuttack during the period of June 2009 to July 2011. For that time period, newborns admitted to the NICU and staying for more than 48 hours who required one or more devices were considered for the study sample, with special consideration given to ventilator and central venous line.

Exclusion criteria: Those newborn patients admitted to the hospital and not put on any devices such as ventilators, IV lines, or central lines were excluded from this study.

Patient age, gender, body weight (demographic profile), clinical manifestations (clinical profile), types and numbers of devices used in the previous 48 hours, types of microorganism isolated, sensitivity and resistance details of isolated microorganisms, disease outcome, and cause of death were all collected and recorded on a standard Pro forma. Surveillance information note sheet was filled up.

Hospital acquired (nosocomial) infections were defined in accordance with the National Nosocomial Infection Surveillance (NNIS) definition of the Centers for Disease Control and Prevention [4].

The calculation of Device Associated Infection (DAI) rates was done by using the formula:

$$\frac{\text{Numbers of device associated infections for an infection site} \times 1000}{\text{Numbers of device days}}$$

Similarly, the calculation of the Device Utilization Ratio (DUR) was done by using the formula:

$$\frac{\text{Number of device days} \times 1000}{\text{Number of patient days}}$$

3. Results

In this study, the duration of surveillance was 280 days, including a total number of 630 neonates. Ninety-four neonates were found to have nosocomial infection.

The total number of patient days was 2516 days. During the period of study, central line days were found to be 173 days and ventilator days, 710. The prevalence of nosocomial infection was found to be 14.9%.

Males predominated over females, with a male to female ratio of 2:1. Preterm babies constituted 62 (66%), while term babies constituted 32 (34%) in this study.

The majority of cases 53 (56.4%) developed nosocomial sepsis within 4-7 days of admission to NICU.

The central catheter associated BSI was 110/1000 device days and the ventilator associated pneumonia rate was 43.6/1000 days.

The commonest organism isolated from blood was *Staphylococcus aureus* 11 (64.7%), followed by *Streptococcus pyogenes* 3 (17.6%), *E. coli* 2 (11.8%), and *Klebsilla pneumoniae* 1 (5.9%) (Table 1).

(Table 2) shows the sensitivity and resistance of *Staphylococcus aureus* to various antibiotics.

A total of 25 (26.7%) of the study cohort died due to nosocomial sepsis. Fifty-seven (60.5%) patients recovered, and 12 (12.8%) were LAMA.

Table 1. Different parameters of Nosocomial infected paediatric patients.

Parameters	Numbers (%)
Sex	Male 63 (67%)
	Female 31 (33%)
Gestational Age	Preterm 62 (66%)
	Term 32 (34%)
Birth Weight	<2500 g 68 (72.4%)
	>2500 g 26 (27.6%)
Duration of Onset	0-3 days 38 (40.4%)
	4-7 days 53 (56.4%)
	8-14 days 3 (3.2%)
Culture from various sites	Blood 17 (18.1%)
	ET Tube 13 (12.2%)
	Umbilical Catheter tip 2 (2.1%)
	Urine 1 (1.3%)
	Stool 1 (1.3%)
Organisim isolated from blood	<i>Staphylococcus aureus</i> 11 (64.7%)
	<i>E.coli</i> 2 (11.8%)
	<i>Streptococcus pyogenes</i> 3 (17.6%)
	<i>Klebseilla pneumonia</i> 1 (5.9%)

Table 2. Sensitivity and resistance of *Staphylococcus aureus* to different antibiotics.

Antibiotics	<u>Sensitivity</u> Numbers(%)	<u>Partial Sensitivity</u> Numbers(%)	<u>Resistance</u> Numbers(%)
Amikacin	9 (81.8)	2 (18.2)	-
Amoxyllin/Clav	-	-	8 (72.7)
Cefotaxim	-	-	8 (72.7)
Ceftazidime	-	-	8 (72.7)
Netimycin	9 (81.8)	1 (9.1)	1 (9.1)
Piperacillin Tazobactam	8 (72.7)	3 (27.3)	-
Linezolid	10 (90.9)	1 (9.1)	-
Meropenem	4 (36.4)	6 (54.5)	1 (9.1)
Vancomycin	-	9 (81.8)	1 (9.1)

4. Discussion

The factors responsible for infection being more severe in newborn patients include the increased survival of premature infants following prolonged neonatal ICU stays, use of endotracheal cannules and mechanical ventilators, which interfere with local pulmonary defence to the mechanisms that reduce gastric acidity, such as H2 blockers.

Parenteral hyperalimentation (can convey pathogenic agents to patients and to prolonged and frequent use of antibiotics such as cephalosporin and aminoglycosides, where selective pressure promotes colonisation with resistant pathogens.

In this study, the prevalence of nosocomial infection was found to be 14.9% as compared to 2.8%–21.6% [5], [6].

The study by [7] showed females to be affected more than males. But in our study, males were affected more. This may be due to the prevalent practise of admitting male babies to healthcare facilities first, as well as the fact that female babies are immunologically more competent, as a possible locus of gene for immunoglobulin synthesis is on the X-chromosome, accounting for the relative resistance of female infants to infection. [8] also reported that male infants had about a four-fold increased risk of developing sepsis compared to females.

According to the study report, prematurity and low birth weight are major risk factors for sepsis in newborns [3], [9]. Similar findings were observed in our study.

The duration of stay in the ICU is an important risk factor for the acquisition of nosocomial infections. After 96 hours in the PICU, 53 patients, or 56.4%, developed nosocomial infection. This could be explained by the fact that the longer the duration of hospital stay, the greater is the contact of the patient with health-care personnel, often in a crisis situation; greater exposure to environmental micro-organisms, and more

frequent are invasive procedures—all contributing to an increased risk of nosocomial infections. This observation was in accordance with the study done by [10] in which 90% of children with nosocomial infections developed the infection after 7 days of stay.

In this study, the calculation of device utilisation ratio was done while reporting HAIs, as this gives an idea of the sickness level in a unit. We found units with sicker and smaller babies had higher device utilisation and a higher infection rate.

In a previous study from India, the overall nosocomial infection rate was 16.8/1000 patient days. The device associated infection rate was 11.9/1000 device days [3].

The current study found that central catheter-associated BSI was 110/1000 device days and ventilator-associated pneumonia was 43.6/1000 device days, which is 3.5 times higher than other studies [11].

Cutaneous lesions and invasive procedures are predisposing factors for the occurrence of focal lesions, bacteremia, meningitis, or pneumonia. The main reservoir of the bacterium is the hospital staff, and contamination usually occurs through the hands and is mostly in overcrowded, understaffed units.

Staphylococcus aureus colonises the skin, nasopharynx, and gastrointestinal tract and spreads via the hands of healthcare workers. This increase in *S. aureus* LOS could be related to the excessive load of very low birth weight babies without a concomitant expansion of facilities. This implies a need for better adherence to hand hygiene practices, cohorting and isolation, periodic surveillance and decolonization of health workers.

The microbiological profile of a previous study revealed a predominance of Gram-positive cocci isolates (67%) and Gram-negative bacilli (33%). Among the bacteriological profiles, *S. aureus* constituted the majority (65%), out of which MRSA accounted for 40%. In a study done by [12], the most frequently isolated organism was *S. aureus*, followed by coagulase-negative *Staphylococcus*. Overall, Gram positives (60.2%) were more common than Gram-negatives (31.8%). In a similar study by [13], the most common nosocomial pathogens were coagulase-negative staphylococci (19%) and *S. aureus* (14%).

In our study, *Staphylococcus aureus* was the most common organism isolated from blood, and the mortality rate due to nosocomial sepsis was 26.7%, which is quite higher than other study findings. [14].

Another study from India showed multidrug resistant *Klebsiella* species were the commonest organisms causing nosocomial septicemia and pneumonia caused by *Pseudomonas aeruginosa* [15].

5. Conclusion

Neonatal nosocomial infections are a relevant problem. The present study observation reveal that in neonatal intensive care unit, sepsis and pneumonia are frequently diagnosed (especially those caused by *S.aureus*, *E.coli*, *K.pneumoniae*).

Their could be prevented if hospitals have effective infection control policies such are maintaining physical area, equipments, patient ratio and washing of hands of concern hospital staffs, as this is the most effective measures avoiding bacterial transmission and propagation). Newborn umbilical cord care, use of central venous catheter and other invasive procedure with maximum barrier precaution and early breast feeding should be followed.

6. References

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