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Original Article

Paediatrics Section

Neonatal Nosocomial Infections: A Kashmir Experience

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ABSTRACT

Introduction: Nosocomial Infection (NI) is associated with substantial morbidity and mortality in neonates admitted to Neonatal Intensive Care Units (NICUs). These infections are growing globally and are associated with future life post-infection morbidity, increased length of stay in the hospital, and healthcare costs.

Aim: To determine the frequency of neonatal NI and most common sites of infections in our NICU.

Materials and Methods: The study was conducted at NICU of Department of Pediatrics, GB Pant Hospital, an associated hospital of Govt Medical College, Srinagar, from April 2017 to September 2017. Neonates admitted for more than 48 hours in the NICU, who developed infections as evidenced by the clinical and/or laboratory parameters were included in the study. A p-value of <0.05 was considered statistically significant.

Results: Of the 300 neonates studied, 160 were males and 140 were females, among whom 12 were extreme premature (<28 weeks of gestation), and 30 were very low birth weight (<1500 grams). The incidence of NI rate in our NICU was 37.33% with prematurity and low birth weight as major risk factors (p<0.05). Sites of infection were primary blood stream infections in 70(62.52%), pneumonia in 20(17.85%), meningitis in 10(8.92%), and others 12(10.71%). Among the studied neonates we found, *Klebsiella* in 45(40%), *Staphylococcus aureus* in 34(30%), *E. Coli* in 11(9.8%), *Acitinobacter* in 7(6.25%), *Pseudomonas* in 3(2.67%) and others 12(10.71%).

Conclusion: This study emphasizes the high incidence rate, sites and types of microorganisms causing NI at NICU so that appropriate antibiotics can be judiciously used. This study highlights the need for the development of robust measures to reduce the incidence rate of NI.

Keywords: Bacteria, Incidence, Neonatal intensive care unit

INTRODUCTION

Hospitals and other health care delivery units are the potential source of infection to the admitted patient(s). As per National Nosocomial Infections Surveillance system, a nosocomial infection is defined as a localized or systemic condition that results from adverse reaction to the presence of an infectious agent(s) or its toxin(s) that was not present or incubating at the time of admission to the hospital [1]. These infections are opportunistic, and microorganisms of low virulence can also cause disease in hospital patients who have depressed immune system. It has been reported that most cases of NI are typically exogenous arising from any part of the hospital ecosystem, including people, objects, food, water, and air in the hospital [2]. Occurrence of NI depends on presence of risk factors for such infections like prematurity, low birth weight, therapeutic interventions, nasogastric/orogastric tube placement, endotracheal intubation, central venous catheters insertion, Total Parenteral Nutrition (TPN), peripheral intravenous lines, venipuncture or needle stick blood draws and urinary catheters [3,4].

Clinically sepsis presents as apnea (55%); feeding intolerance, abdominal distension, or guaiac-positive stools (43%); need for increased respiratory support (29%); and lethargy and hypotonia (23%). An increase in abnormal white blood-cell count (46%), unexplained metabolic acidosis (11%) or hyperglycaemia (10%) is the most common laboratory indicators [5]. Gram-negative nosocomial sepsis often presents with a more rapid clinical deterioration and is commonly associated with shock and coagulation problems. A set of clinical signs (apnea, bradycardia, etc.,) and laboratory values (leukocytosis, immature white blood cells, neutropenia, and elevated c-reactive protein or interleukins) suggest the diagnosis of sepsis, but they have poor positive predictive value. Despite these limitations, the combination of clinical signs and laboratory findings has been used to define "clinical sepsis" and is often used to decide whom to treat and when to stop treatment. The uncertainty generated by the absence of good predictors for nosocomial sepsis is one of the causes for the overuse of antibiotics. While pneumonia, urinary tract infections, meningitis, and sepsis are all important causes of NI, sepsis is the most commonly reported. Conversely, sepsis frequently accompanies pneumonia, urinary tract infections, and meningitis.

NI occurs at an incidence of around 30% and in the developing countries, it is estimated to cause 40% of all neonatal deaths [6,7]. NI include bloodstream infections, pneumonia, urinary tract infections, meningitis, secondary skin infections, and eye, ear, nose, or throat infections. The causative organisms may be bacterial, viral, or fungal in origin [8,9].

Despite major advances in neonatal care, NI remain a major cause of preventable morbidity and mortality in developing countries where infection rates are relatively higher due to overcrowding of hospitals, poor infection control practices, lack of supervision and inappropriate use of limited resources. The present study reports on the incidence and aetiology of neonatal NI in our tertiary care NICU.

MATERIALS AND METHODS

This prospective, observational study was conducted in NICU of post graduate department of Pediatrics and Neonatology, GB Pant General Hospital, an associated hospital of Govt. Medical College, Srinagar, J&K, India; from April 2017 to September 2017. Ethical clearance from the Institutional Ethical Committee was obtained prior to the start of this study.

It included all newborns (up to 28 days of age) who stayed as in-patients for 48 hours after admission and did not have any clinical and/or laboratory evidence of infection within first 48 hours of NICU stay. Exclusion criteria included: refusal by parent or the legal guardian to participate in the study, any neonate whose mothers were having sepsis or genitourinary tract infection within 7 days of the delivery and neonates with severe congenital anomalies due to discontinuity of skin and mucus membranes.

With the parent or legal guardian consent, all neonates admitted to NICU were followed for development of NI from admission to discharge or death. All neonates admitted to the NICU during the study period and fulfilled the inclusion criteria were included in this study. At admission, complete clinical assessment was carried out on all the admitted neonates, by neonatology residents and the data was entered into a predesignated proforma. Birth weight was measured in addition to clinical signs of sepsis like respiratory dysfunction (apnea, signs of respiratory distress), circulatory dysfunction (poor peripheral circulation, hypotension, and prolonged capillary refill), GIT dysfunction (abdominal distension, feeding intolerance, hepatomegaly and jaundice) and neurological dysfunction (irritability, hypotonia, lethargy). In addition, use of antimicrobials, medical devices like endotracheal tube/mechanical ventilation, central venous catheter, urinary catheter, peripheral arterial/venous catheter and feeding tube were also recorded.

For all neonates admitted to the NICU, blood specimens were collected under all aseptic precautions and processed for bacteriological studies like full blood count with differentials, C-reactive protein, microbiological confirmation of diagnosis by blood culture, culture of other specimens (according to the site of infection) like urine and tracheal aspirate cultures were done, as and when needed. CSF culture was performed in all neonates who had clinical signs of meningitis or bacterial growth in blood culture. All specimens were cultured on specific media for identification of the organism and antibiotic susceptibility test was also done. Blood samples were again taken on day third from all neonates for complete blood count, peripheral blood smear, CRP, blood culture to diagnose NI.

RESULTS

Out of 300 neonates studied, 160 were males, average gestational age was 35±2 weeks, 190 (63.33%) were delivered by cesarean section and 110 (36.66%) were born by spontaneous vaginal delivery. The most common primary reasons for NICU admission was respiratory distress syndrome, in 190(63.0%), followed by prematurity in 50(16.67%) as shown in [Table/Fig-1]. The most common therapeutic interventions and manipulations done were IV cannulation in 112 patients, followed by endotracheal tube in 34(30%), as shown in [Table/Fig-2]. Similarly, the most common site of NI among the studied population was primary blood stream infections in 70(62.52%), followed by pneumonia in 20(17%) as shown in [Table/Fig-3]. The most common pathogen from positive blood culture was *Klebsiella* in 45(40%) followed by *Staphylococcus aureus* in 34(30%) as depicted in [Table/Fig-4].

The incidence of NI increases with decrease in birth weight (90% for <1500 gm and 57.5% for <1500-2500gm.) as well as in gestational age (91.7% for gestational age <28 week and 54.9% for 29-32 gestational weeks) as is depicted in [Table/Fig-5].

Clinical condition	Number (N)	Percent (%)
Respiratory distress	190	63.33
Prematurity	50	16.67
Perinatal asphyxia	30	10.00
Neonatal Jaundice	20	6.76
Congenital Anomalies	10	3.33

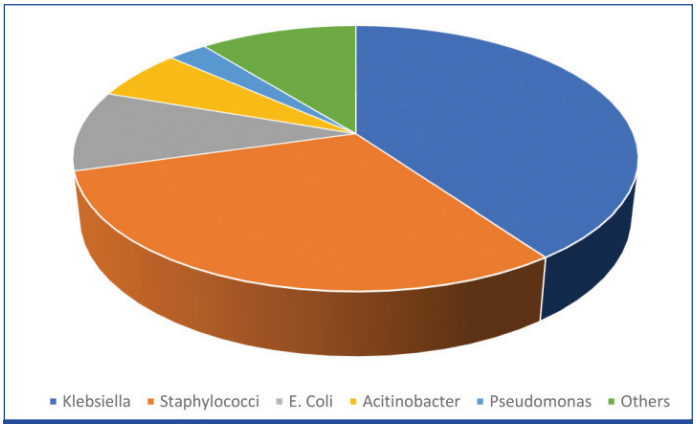
[Table/Fig-1]: Reasons for NICU admission.

Therapeutic intervention	Number	Percent (%)
Umbilical catheterization	28	25.00
Endotracheal tube	34	30.53
*I.V cannula	112	-
Intragastric tube (orogastric/nasogastric)	19	16.96
Therapeutic Parentral Nutrition	24	21.4
Exchange Transfusion	7	6.25

[Table/Fig-2]: Interventions among the neonates with NI.
*All the neonates who developed NI had IV cannulation

Site	Number (112)	Percent (%)
Primary blood infection	70	62.52
Pneumonia	20	17.85
Meningitis	10	8.92
Others	12	10.71

[Table/Fig-3]: Site of nosocomial infection among the neonates with NI (N=112).



[Table/Fig-4]: Most common infectious agent among the neonates with NI (N=112).

Birth weight in Grams	Number	Infected	Non-infected	Incidence	p-value
<1500	30	27	3	90.0	0.001
1500-2500	120	69	51	57.5	0.001
>2500	150	16	134	10.7	0.001
	300	112	188		0.001
Gestational age in weeks					
<28	12	11	1	91.7	0.001
29-32	51	28	23	54.9	0.011
33-37	108	34	74	31.5	0.001
>37	129	39	90	30.2	.01

[Table/Fig-5]: Incidence of nosocomial infection by birth weight and gestational age.

DISCUSSION

In our study period, 381 neonates were admitted in NICU, among whom 13 were discharged from the NICU in the first 48 hours. Five neonates died within 48 hours of life and 63 had signs of infection at the time of admission. So, neonates who met inclusion and exclusion criteria were 300. Out of these 300 neonates who fulfilled the study population criteria, 112 neonates were identified as having NI, both clinical and laboratory parameters were negative for infection at hospital admission but were positive after 48 hours of stay at NICU, resulted into an infection rate of 37.33%. This is similar with the study done by Kamath S, where NI rates were 38 infections per 100 NICU admissions [10]. Similar results were also observed Mohammed D, where 161/418 (38.5%) developed NI [11]. In another study by Dal-Bó K et al., the incidence of NI was 45.8% [12], where as another elegant study by Orsi GB et al., who on evaluation of 575 neonates found, 76 (13.2%) neonates developed NI, including 36 Bloodstream Infections (BSIs), 33 pneumonias, 19 urinary tract infections, 8 conjunctivitis, and 4 omphalitis [13]. However, neonatal NI were found to be lower (<10%) in a study conducted by Hammoud MS et al., and Waggoner-Fountain LA et al., [14,15].

NI can be caused by any organisms but few organisms are particularly responsible for hospital-acquired infections. Among the studied neonates we found, *Klebsiella* in 45(40%), *Staphylococcus aureus* in 34(30%), *E.coli* in 11(10%), *Acitinobacter* in 7(6.66) and *Pseudomonas* in 3 (2.67%). These finding are similar to studies done by Leal YA, and Shim GH [16,17]. It is pertinent to mention here that studies from various centers of the world suggest that *Klebsiella* species,

Escherichia coli, *Staphylococcus aureus*, and Group B Streptococci (GBS) predominate in Early-Onset Neonatal Sepsis (EONS), while late-onset neonatal sepsis (Nosocomial infections) is predominantly caused by Gram-positive pathogens (*Streptococcus pneumoniae, Streptococcus pyogenes, S. aureus)* and GBS in developing countries [18], which is contrary to our findings, which could be because of high density of gram negative microbiome at our NICU.

During the NICU stay neonates undergo various procedures and interventions which expose them to nosocomial environment. Our study population was exposed to, IV cannula in all patients (100%), endotracheal tube in 34(30%), umbilical catheterisation in 28(25%), intragastric tube in 19(17%), and therapeutic parentral nutrition in 24(21%), exchange transfusion in 7(6.66%), which was similar to study conducted by Tavora AC et al., [19].

Regarding the site of infection we found primary blood stream infections in 70(62.5%), pneumonia in 20(17.8%), meningitis in 10(9%), and others 12(11%) each. These findings are quite similar to the observations made by Cauto RC et al., where, 358 neonates out of 1051 were diagnosed as NI, among whom most common site of infection was primary blood stream infections (54.5%) followed by pneumonia (12.8%), and central vein associated infection [20]. A cohort study by Nagata E et al., showed, of 225 neonates with NI the site of infection was pneumonia (40%), primary blood stream infections (16.7%) skin and soft tissue infections (14.9%) and meningitis in 9.6% [4]. The presence of risk factors was studied, which is similar to this study except pneumonia, which was more frequent NI in their study possibly because of different methodologies and the adopted criteria for the classification of NI. Pertaining to the risk factors for NI ($p<.05$) their study showed birth weight, gestational age, mechanical ventilation, total parenteral nutrition, umbilical catheter, use of antibiotics, and intubation in the delivery room, which is similar to our study.

Current study shows that low birth weight <1500 gm and prematurity as the important neonatal risk factors for NI (p-value<0.05). This observation is in conformity with other studies which indicate that the risk of NI increases with reduction in gestational age and birth weight, because of lack of efficient structural barriers, protective endogenous microbial flora and mature immune system [21-24].

LIMITATION

There were several limitations in our study. Being a single center of short duration with small sample size, this study fails to generalize the results and draw scientific conclusions.

CONCLUSION

Despite major advances in neonatal medicine, NI are common life-threatening problems. However, improved antenatal care, hand washing, aseptic manipulation, ameliorated feeding strategies, are important preventive measures against common NI.

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