NOSOCOMIAL INFECTIONS: A THREAT TO NEONATES IN ICU

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Abstract: Patients are no doubt better treated in hospitals than anywhere else; however congregating a large number of sick under a single roof could easily facilitate the transmission of infectious disease from one patient to another. Nosocomial infections, even in this modern era of antibiotics, continue to remain an important and formidable consequence of hospitalization. Intensive Care Units (ICUs) are considered as high risk areas since they admit seriously ill patients more susceptible to develop infections. The risk of infection varies with the type of ICU. Also the type of pathogen varies with infection site. Various factors influence the development of such infections viz. the microbial agent, Patient susceptibility, Environmental factors & Bacterial resistance. With this background in view, the current research project was undertaken to study the prevalence, risk factors, and bacterial spectrum of nosocomial infections in Neonatal Intensive Care Units.

Introduction: Neonatal Intensive Care Units (NICUs) were developed in the 1950s and 1960s by pediatricians to provide better temperature support, isolation from infection risk, specialized feeding, and access to specialized equipment and resources. Newborns receiving care in Neonatal Intensive Care Unit are at increased risk of nosocomial infections because of immaturity of the immune system and barrier functions of the skin and gastrointestinal tract. The invasive diagnostic and therapeutic procedures they undergo also add to the risk factors. The NICU patients are at high risk nosocomial blood stream infection because of the prolonged hospitalization and frequent invasive procedures [1]-[3]. Besides prematurity and extreme low birth weight, the neonates in the current study were admitted to NICU for perinatal.

asphyxia, extreme cases of preeclampsia/eclampsia, major birth defects, sepsis, neonatal jaundice, and respiratory distress syndrome due to immaturity of the lungs. Their hospital stay prolonged with the severity of their cause of admission that put them to the increased risk of nosocomial infections. Multidrug resistant Gram negative bacilli belonging to the family *Enterobacteriaceae* have been increasingly responsible for infections among the neonates admitted to the Neonatal Intensive Care Unit in many countries including India. *Klebsiella pneumoniae* constitutes a majority of these pathogens [4]-[6]. Number of different nosocomial pathogens was isolated in this study and the multidrug resistant organisms were subjected to phylogenetic analysis.

Materials and Methods:

To study the incidence rate of nosocomial infections in Neonatal Intensive Care Unit, all newly admitted patients during the study period were considered. A total of 150 patients were included in the current study. A written consent was obtained from the parent or guardian. Patient's history was noted, wherein clinical details of the patient were recorded with respect to presence, type and duration of discharge, previous history of similar illness, duration of the present illness and antibiotic therapy.

Different specimens were collected from the

patients admitted to intensive care units during study period. The samples from different sites from the admitted patients were collected and processed immediately for isolation and identification of causative organism using standard protocols. Different samples included blood, endotracheal aspirate, cerebrospinal fluid, urine, Gastric lavage and pus. These samples were streaked on Blood agar, MacConkey's agar, Chocolate agar, Nutrient agar to isolate the bacterial pathogens. Any growth was identified upto species level using various biochemical tests which included Catalase test, Coagulase test, 6.5% NaCl, Bile Solubility test, Esculine Hydrolysis test, Nitrate reduction test, Carbohydrate fermentation test, Motility, Lysine Decarboxylase, Hugh Leiffson test, Oxidase test, Indole test, Methyl red test, Vogus Proskeur test, Citrate utilization test, Triple Sugar Iron fermentation test, Urease test. Based on the results of these tests the organisms were confirmed upto species level with the help of Bergey's Manual of Systemic and Determinative Bacteriology.

Isolated organisms were then studied for their sensitivity to different antibiotics. Antibiotic susceptibility was determined using the Kirby–Bauer method and the results were interpreted as per National Committee for Clinical Laboratory Standards (NCCLS) guidelines. Nosocomial Infections were confirmed based upon patients' clinical data. Results were noted and analyzed statistically. 16SrRNA testing of the isolated multi drug resistant pathogens was performed.

Observations &Results:

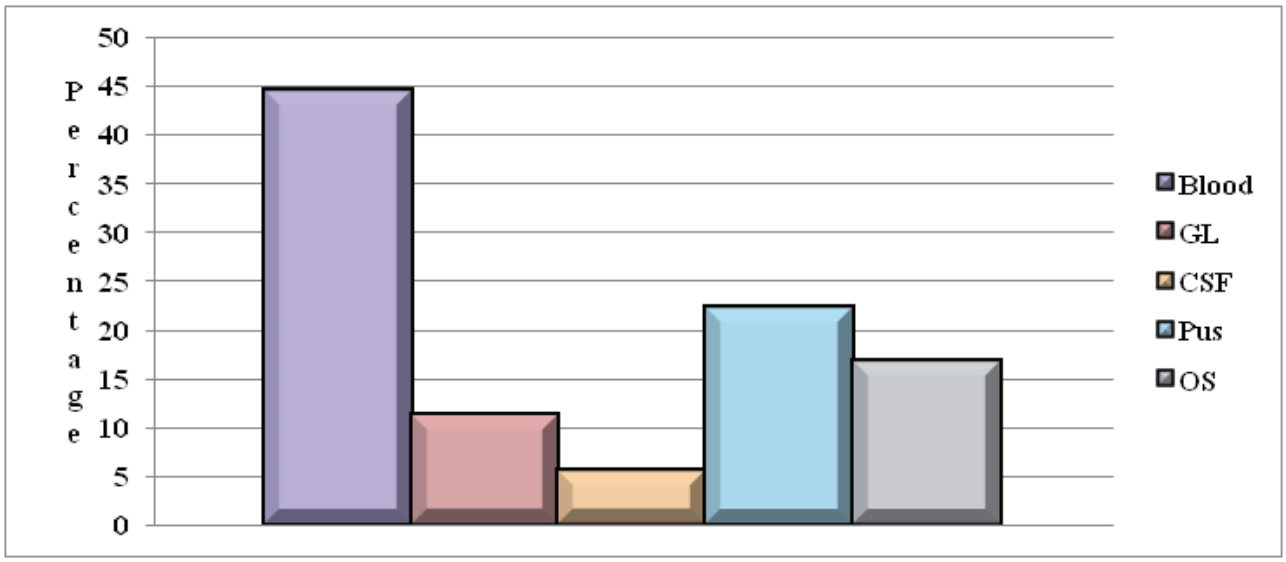
A total of 150 patients were studied. The gestation period of the newborns admitted during the study ranged between 24 to 40 weeks. Out of all the different samples collected, there were total 12% samples found to be positive for nosocomial infections. From the results of the biochemical tests, most of the nosocomial pathogens identified up to species level involved *Staphylococcus aureus, Streptococcus faecalis, Klebsiella pneumoniae, Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa etc*. **(figure 2)**. Among the results of antibiotic sensitivity teststhe overall sensitivity percentage to imipenem and amikacin was highest followed by vancomycin and teicoplanin.

One isolate of *Acinetobacter baumannii* and *Proteus vulgaris* each showed maximum multiple resistance patterns. Antimicrobial Sensitivity pattern shown by the nosocomial pathogens isolated from samples are shown below **(Table 1)**. All the positive sample results were analyzed using one way ANOVA using SPSS statistical package (Version 9). Blood samples showed mean positive value of 45.54±1.21, indicating Bacteremiato be highest in the group and also it is found extremely significant at 95% confidence limit **(figure 1)**. Additionally occurrence of *S. aureus* and *E faecalis* is significant at 95% confidence interval as compared to other organisms.

Table 1 Antibiotic Sensitivity Pattern								
Organisms	**Antibiotic Sensitivity Pattern**							
	Va	**Pg**	**Co**	**Cd**	**Er**	**Lz**	**Rc**	**Tec**
Enterococcus faecalis 1	S	S	**R**	**R**	**R**	S	**R**	S
Enterococcus faecalis 2	S	**R**	S	**R**	**R**	**R**	**R**	S
Enterococcus faecalis 3	S	**R**	**R**	S	**R**	S	**R**	S
Enterococcus faecalis 4	S	S	**R**	**R**	S	**R**	S	**R**
Staphylococcus aureus 1	S	**R**	S	S	S	S	**R**	S
Staphylococcus aureus 2	S	**R**	**R**	**R**	S	S	**R**	S
Staphylococcus aureus 3	S	S	S	**R**	**R**	**R**	**R**	S
Staphylococcus aureus 4	**R**	S	S	S	**R**	**R**	S	S
Staphylococcus aureus 5	S	**R**	**R**	S	S	**R**	S	**R**
Streptococcus pyogenes 1	S	S	**R**	S	S	S	**R**	S
Streptococcus pyogenes 2	S	**R**	**R**	S	**R**	**R**	S	S
	Am	**Pg**	**Gm**	**Im**	**Cb**	**Cf**	**Rp**	**Ak**
Klebsiellapneumoniae 1	**R**	S	S	S	**R**	S	S	S
Klebsiellapneumoniae 2	S	S	**R**	S	S	S	S	S
Peudomonas aeruginosa 1	S	S	**R**	S	**R**	S	S	S
Salmonella typhi	S	**R**	S	S	**R**	**R**	S	S
Acinetobacter baumanii 1	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**
Acinetobacter baumanii 2	S	S	S	S	**R**	**R**	**R**	S
Proteus vulgaris	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**

Am – Ampicillin, Pg – Penicillin, Gm – Gentamicin, Im – Imipenem, Cb – Cefuroxime, Cf – Cefotaxime, Rp – Ceftriaxone, Ak – Amikacin, Va – Vancomycin, Co – Co-Timoxazole, Cd – Clindamycin, Er – Erythromycin, Lz – Linezolid, Rc – Ciprofloxacin, Tec – Teicoplanin

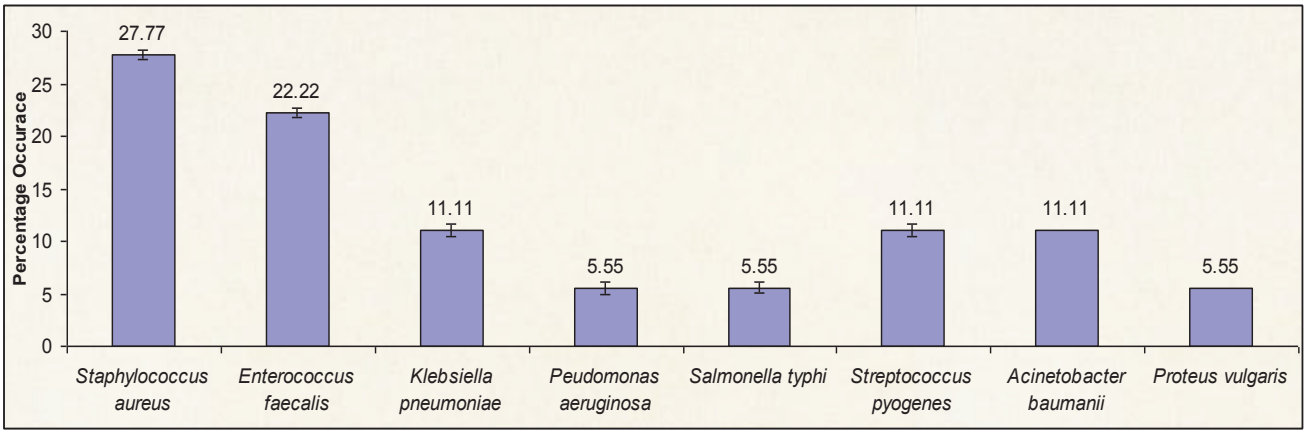
Figure 1 Percentage Positive Samples (Samples)



9 out of 68 female patients and 9 out of 82 male patients were found positive. Patients in spite of having appropriate gestational age showed maximum positive results. Patients with low gestational age showed other complications with few infections. Most of the infections were detected within 5 days after admission to ICU. Even after having moderate APGAR score (Activity, Pulse, Grimace, Appearance, Respiration) most of the neonates showed low immunity. Ventilator & Intravenous line (Peripheral) were the sites that showed maximum use of invasive devices in patients. As per the findings, 'Extremely low birth weight' could be one of the major risk factors for the infection.16S rRNA analysis confirmed the isolates to be *Acinetobacter baumanii* & *Pseudomonas aeruginosa* with 100% & 99% similarity respectively.

Discussion: The increasing rate of incidence of nosocomial infections is giving alarming signals to health care professionals [7]. Infected or colonized patients, health care providers are the major source of nosocomial infections. Medical equipment, contaminated supplies and lack of aseptic practices also lead to the problem [8]. ICU patients have 5–10 % more probability of infections and NICU patients are in a state of immunocompromised conditions; which further increases due to the disorders for which they get admitted to the hospitals [9]. Payman Salamati et al have shown that 'The frequency of nosocomial infections has increased in recent decades as a result of this increased survival of low-birth-weight infants [10]. NICU-acquired infections are associated with increased mortality rates, prolonged duration of hospitalization in survivors and increased cost of neonatal health care [11]. Pillay, et al have reported that 'An Outbreak of neonatal infection with *Acinetobacter* is linked to contaminated suction catheter' [12]. Overuse of antibiotics has introduced multidrug resistant nosocomial pathogens which are a point of concern [13]. In the present study, there was a case in neonatal intensive care unit that the neonate after 5 days of admission to the intensive care unit showed presence of *Enterococcus faecalis* in the cerebrospinal fluid sample tested. This was previously cited in a study by Guardado et al [14].

Figure 2 Percentage Positive Samples (Organisms)



Conclusion: Nosocomial Infections need to be controlled by taking proper precautionary measures by everyone related to hospital. The immunocompromised state, the disease and medical equipments in ICU make neonatal patients more susceptible to such infections. In the present study, the female patients were more susceptible than male patients and neonates with appropriate gestational age were seemed to be more prone to these infections. The overall incidence of nosocomial infections in neonatal intensive care unit was 6.61% as 18 positive samples were indentified among 272 samples tested. APGAR score did not show any effect on incidence of nosocomial infection in the present study. It was observed in the study that the chances of acquiring such infections increase with increased stay in ICU. The blood was found to be the most common site of infection. Phylogenetically analyzed strain of *Acinetobacter baumannii* and *Proteus vulgaris* were found resistant to all antibiotics in the study. Appropriate preventive measures will help reducing nosocomial infections. Various risk factors identified that make patients susceptible to the nosocomial infections included prolonged intensive care unit stay, overuse of antibiotics, and duration of indwelling catheterization. According to the Centre for Disease Control guidelines, major areas of emphasis to control nosocomial infections should include: educating and training of personnel who inserts and maintains catheters, using maximal sterile barrier precautions during central venous catheter insertion, avoiding routine replacement of central venous catheters as a strategy to prevent infection and using antibiotic impregnated short-term central venous catheters if the rate of infection is high.

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