Infection Control in the NICU

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Objectives
- Discuss nosocomial infections in the NICU
- Device acquired infections
- Ventilator Associated Pneumonia
- Hand washing practices
- Preventing the spread of infections

The Babies
- Infants in Neonatal Intensive Care Units (NICUs) are at high risk for hospital infections
- Risk factors include:
  - Low birth weight
  - Prematurity
  - Congenital malformations
  - Prolonged hospital stay
  - Frequent invasive procedures
  - Total parenteral nutrition
  - Higher risk of developing infections due to incomplete immunity
The Babies
- Incomplete immunity leads to increased infections and higher risk for nosocomial infections
- Considerable economic consequences
- Most health care–associated infections in the NICU result from the instrumentation and procedures required to preserve an infant’s life
- The mortality rate of hospital infections in this age group is reported as between 10-50%

The Babies
- The most common hospital infections in NICUs are:
  - blood stream infection (BSI)
  - pneumonias
- Blood stream infections (BSI) are frequently seen with:
  - central venous catheter (CVC)
  - umbilical catheter (UC)
- Ventilator-associated pneumonias (VAPs) are a common type of hospital infection in some NICU but not reported
- Devices associated infections
- Evidence supports proactive strategies to prevent health care–associated infections in the NICU

Device-associated infections
- Device associated infections may not be completely preventable in NICUs
- Newborn infants, particularly very low birth weight infants, are at increased risk for hospital infections
- Clinicians should aim to decrease these infectious complications by taking the necessary precautions
- Every NICU should evaluate its own device associated infection trends regularly and then compare with the national and international data
- Determine problems and resolve them
- Active surveillance programs are essential for determination of nosocomial pathogens and antibiotic resistance patterns
Three Common Device-Associated Infections

- Central venous catheter
- Umbilical catheter-associated bloodstream infections
- Ventilator-associated pneumonia
  - VAP rate was 13.76/1000 ventilator days
  - VAP also appeared to be an important risk factor for mortality
  - Premature birth, repeated and prolonged intubation and genetic diseases increase VAP frequency
  - Most frequent infective agents were:
    - gram-negative pathogens for VAP
    - coagulase-negative staphylococci for CVC/UC BSIs

Prevention of Central Line Associated Bloodstream Infections

- Most common hospital-acquired infections in the NICU are a result of poor technique
- Methods to reduce central line-associated bloodstream infections recommend
  - Practice guideline for insertion
  - Prophylactic administration of antibiotics
  - Skin emollients to reduce bacteria
  - Promotion of breastfeeding
  - Gowning of visitors

Sepsis and the babies

- Newborn infants are at much higher risk for developing sepsis than children and adults because of their immature immune system
- Sepsis is leading cause of death in neonates with approx 1/250 will be diagnosed with sepsis
- Fetal antibodies are not present < 30 weeks gestation
  - present > 30 weeks gestation when they cross the placenta
Sepsis prevention

- Before Delivery
  - Maternal health and nutrition before delivery
  - Maternal immunization
- During Labor and Delivery
  - Hand washing during delivery reduces rates of neonatal sepsis
  - Intrapartum antibiotic prophylaxis
- After Delivery
  - Hand washing during delivery reduces rates of neonatal sepsis
  - Neonatal immunization
  - Breast feeding

Prevention of Health Care–Associated Pneumonia

- CDC publication doesn’t directly address NICU vented patients
- CDC general recommendations should be followed with focus on prevention of transmission of microorganisms
  - proper sterilization or disinfection and maintenance of equipment and devices
  - prevention of person-to-person transmission of bacteria by use of Standard Precautions as well as other isolation practices when appropriate

Ventilator-Associated Pneumonia in Neonates

- Ventilator-associated pneumonia (VAP) is defined by the Centers for Disease Control and Prevention (CDC) as an episode of pneumonia in a patient who requires a device to assist or control respiration through a tracheostomy or endotracheal tube within 48 hours before the onset of the infection
- VAP infections have a large impact on neonatal morbidity, survival, hospital costs, and length of stay
- VAP is a common cause and accounts for 6.8% to 32.2% of health care–acquired infections among neonates.
VAP Risk Factors

- VAP risk of ventilated neonates
- Opiate treatment for sedation
- Frequent endotracheal suctioning
- Reintubation
- Pneumonia is less common in neonates treated with nasal continuous positive airway pressure (NCPAP) when compared with those intubated on mechanical ventilation
- NICU design and staffing may affect VAP rates
- Neonatal VAP rates decreased significantly when a NICU was moved from a crowded space to a larger unit with 50% more staffing

Pathogenesis

- VAP occurs when bacterial, fungal, or viral pathogens enter the normally sterile lower respiratory tract and lung parenchyma
- Microorganisms responsible for VAP can originate
  - Oropharyngeal
  - Tracheobronchial colonization with pathogenic bacteria begins with the adherence of microorganisms to the epithelial cells of the respiratory tract
  - Organisms causing VAP are often noted in the posterior pharynx

Pathogenesis

- Neonates are likely at greater risk for such aspiration of contaminated oral secretions because uncuffed endotracheal tubes
- Gram-positive organisms in the mouth colonize the trachea and endotracheal tubes within the first 48 hours of mechanical ventilation
- Gram-negative bacilli begin colonizing the endotracheal tube and trachea after 48 hours of respiratory support
Prevention of Health Care–Associated Pneumonia

- Aspiration is a major risk for the development of health care–associated pneumonia
- ETT should be removed ASAP and try NIV
- HOB should be greater than 30 degrees
- Comprehensive oral-hygiene
- Closed-suctioning systems
  - Closed-suctioning methods reduce physiologic disruptions (hypoxia and decrease in heart rate)
  - Closed-suctioning systems could potentially reduce environmental contamination of the endotracheal tube

Prevention of Health Care–Associated Pneumonia

- Tracheal colonization from oropharyngeal contamination is less common among neonates on mechanical ventilation
- Keeping the endotracheal tube and the ventilator circuit in a horizontal position might reduce tracking of oropharyngeal sections down into the lower respiratory tract
- Lateral position also is associated with reduced aspiration of gastric secretions into the trachea
- Using a nonsupine position may reduce the risk of ventilator-associated pneumonia

BEST HAND HYGIENE

- Most effective method for reducing health care–associated infections
- Higher rates of hand hygiene compliance
  - lower rates of central line bloodstream infection
- CDC published guidelines for hand hygiene in health care settings in 2002
- Recent analysis
  - implementation of these guidelines had no effect on hand hygiene compliance rates (mean, 56.6%)
Antiseptic soap or an alcohol-based gel
- Alcohol based preparation is as effective to hand washing
- Larson et al compared the effectiveness of a traditional antiseptic hand wash with an alcohol hand sanitizer in reducing bacterial colonization
- No differences in mean microbial counts on nurses' hands or infection rates among patients in the NICU
- No data to suggest superiority of one method over the other
- Compliance with hand hygiene may be enhanced if alcohol-based products
- May 2009, the World Health Organization published new consensus recommendations for hand hygiene
- Evidence- and consensus-based recommendations

World Health Organization Guidelines
Hand Hygiene
- Recommend hand washing with soap and water for
  - visibly dirty
  - visibly soiled with body fluids
  - toilet use
  - exposure to potential spore-forming pathogens
- Recommend alcohol-based hand rub
  - before and after touching patients
  - before handling invasive devices
  - contact with body fluids or excretions, mucous membranes, nonintact skin, or wound dressings
  - between touching contaminated body site and another body site
  - contact with inanimate surfaces and objects
  - after removing gloves

Breast Feeding Reducing Risk for Infection
- Breast milk has been associated with a lower risk of sepsis and necrotizing enterocolitis in preterm infants
- Immunologic properties of breast milk
  - secretory IgA
  - specific macrophages and lymphocytes
  - secretory molecules with antibacterial properties
  - All may all contribute to this protective effect
Reduce Health Care–Associated Infections in the NICU

- A number of other practices may provide opportunities to reduce colonization of the critically ill neonate with health care–associated pathogens
  - appropriate vaccination of health care workers
    - influenza vaccine
  - cohorting in selected outbreak situations
  - visitation guidelines to identify ill/infected visitors

Antibiotic Use and Misuse

- The use and misuse of antibiotics can be associated with alteration in neonates’ microflora and the development of antibiotic resistance
- Antimicrobial resistance
  - Intrinsic (genetically resistant)
    - resistance of Gram-negative organisms to vancomycin
  - Extrinsic (acquired resistance) by antimicrobial exposure
    - *Staphylococcus aureus* and the extended-spectrum β-lactamase (ESBL)-producing organisms

Antibiotic Use and Misuse

- Judicious use of antibiotic agents in the NICU
- Prolonged use of antimicrobial agents
- Limiting use to only those situations in which a bacterial infection is likely
- Discontinuing empirical treatment when a bacterial infection has not been identified
- Using the narrowest spectrum on the basis of susceptibility testing
- Treating for the appropriate duration
Antibiotic Use and Misuse

- ESBL-producing organisms (primarily Gram-negative enteric agents) are present because of third-generation cephalosporins and other broad-spectrum β-lactam antibiotic agents
- Curtailing the use of third-generation cephalosporins and using other antibiotic agents, such as aminoglycosides for empirical therapy, has been associated with less antibiotic resistance, including ESBL-producing organisms.
- Good infection-control practices also play a significant role in reducing horizontal transmission of antibiotic-resistant bacteria.

Antibiotic Use and Misuse

- The Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America have developed guidelines for "Antimicrobial Stewardship"
- These guidelines are designed to address programmatic changes that improve control of antibiotic resistance
- Strategies that might be helpful in the NICU setting include the following:
  - auditing antimicrobial use of practitioners and providing feedback
  - formulary restriction and preauthorization requirements for selected antimicrobial agents
  - education of prescribers and nurses concerning the role of antimicrobial use and the development of resistance
  - development of clinical guidelines/pathways for selected conditions

Summary

- Immunity is decreased with pre-mature births
- Device associated infections can be minimized with good infection control practices
- Oral care and NIV reduce VAP rates in the NICU
- Catheter associated infections can be reduced proper technique and barrier protection
- Hand washing decreases the spread of infections
- Surveillance techniques work
References


Thank you