EFFECTIVE INTERVENTION IN A NEONATAL INTENSIVE CARE UNIT OF A TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: To determine the frequency of pathogens before and after intervention in a Neonatal Intensive Care Unit (NICU) of tertiary care hospitals.

Study Design: Cross sectional study.

Place and Duration of Study: This study was conducted at the department of microbiology Army Medical College/National University of Medical Sciences in collaboration with Neonatal Intensive Care Unit (NICU) of Military Hospital Rawalpindi, Pakistan, from Sep 2016 to Sep 2017.

Material and Methods: All neonates admitted in neonatal intensive care unit during study period were included in the study; study was conducted in three phase pre implementation stage, implementation of infection control measures phase and post intervention phase.

Results: The frequency of blood pathogens in NICU decreased from 39.8% before intervention to 21.5% after intervention and there was complete eradication of few pathogens.

Conclusion: Almost 18% decrease in health care associated infections (HAIs) was observed after very simple intervention in NICU.

Keywords: BSI (blood stream infections), HAIs (health care associated infections), NICU (neonatal intensive care unit).

INTRODUCTION

Neonatal sepsis is a major problem and in developing countries it remains the main cause of mortality and morbidity in newborns[1-4]. Estimates from the World Health Organization (WHO) indicate that 40% of the mortality in children is due to sepsis in neonatal period[5,6]. Every year 2.6% million neonates die and 99% of it in middle and low income countries and out of these three fourth of these deaths occur in first week of birth[7].

Health care associated infections (HAIs) affects 15% of admitted patients in developing countries and 7% in developed countrieson average. In Europe annually four million people are affected by HAIs with around 37000 deaths[8].

Neonates in NICU are more susceptible to infections due to their low immunity, umbilical cauterization, parenteral nutrition and invasive procedures. Frequent use of antibiotics in NICU also facilitates the invasion by antibiotic resistant nosocomial pathogens[9]. In early neonatal infections risk factors include low immunity, low birth weight, maternal colonization of group B Streptococcus infection, prolonged ruptured of membranes and intraamniotic infection. Active surveillance showed early neonatal infection caused by Gram negative rods while late neonatal infection caused by Gram positive cocci and candida[10].

Pathogens responsible for neonatal sepsis vary from place to place and even vary from time to time in same hospital settings. There is very little difference clinically between sepsis caused by unknown pathogens and sepsis caused by identified pathogens[11]. Neonatal sepsis is a clinical emergency and needs prompt diagnosis and aggressive treatment. Blood culture continues to be the gold standard for diagnosis of neonatal sepsis[12,13].

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The health care workers, equipments and the environment constitute more of the problem in the transmission of microorganisms. In case of infection to neonates there is increased risk of morbidity and mortality so in neonatal intensive care unit isolation precautions are required to prevent infection, colonization and transmission of multi drug resistant pathogens as worst outcomes are associated with multi drug resistant pathogen as compared to infections due to susceptible pathogen[14].

Annually in United States there are two million nosocomial infections out of which 50 to 60% are due to multi drug resistant isolates. Data shows that in neonatal intensive care unit multi drug resistant Gram negative rods, vancomycin resistant enterococci (VRE) and methicillin resistant Staphylococcus (MRSA) are showing increasing resistance day by day[15].

Globally in many studies, significant reduction in blood stream infections are noted after simple interventions like stressing the importance of hand washing among staff, use of masks and gloves, proper sterilization of instruments and cleanliness of treatment trolley[16].

Hand hygiene is fundamental, simplest, least expensive and most effective measure to prevent spread of hospital associated infections and antimicrobial resistance[17]. CDC published guidelines about hand washing practices in hospitals in 1975 and 1985. Hospital infection control practices advisory committee (HICPAC) in 1995 recommended use of antiseptic agent without water or antimicrobial soap after interaction with patient infected with multi drug resistant pathogens. CDC revised its guidelines in 2002 and recommended alcohol based hand rub after interacting infected patient. Alcohol based hand rubs are gold standard for hand hygiene, it is also less time consuming, more effective and less irritating for skin than soap and water[18-20].

Studies proved that hand hygiene compliance is significantly increased after interactive educational programs and free availability of alcohol based hand rubs in patients care area[20].

The rationale of study was that in few months an increase of blood stream infections in neonatal intensive care made us to look into matter and find cause.

PATIENT AND METHODS

It was cross sectional study carried out at the department of Microbiology/Army Medical College/National University of Medical Sciences in collaboration with the NICU of Pak Emirates Military Hospital Rawalpindi, Pakistan. It was done in three phases.

Non probability consecutive sampling technique was used.

In first pre implementation stage of study total 502 blood culture specimens of neonates admitted in NICU of Pak Emirates Military Hospital Rawalpindi from September 2016 to February 2017. Out of these 200 are positive cultures (39.8%). Various pathogens isolated were *Stenotrophomonas maltophilia*, *Accinetobacter baumannii, Klebsiella pneumoniae*, *MRSE* and *Candida spp*.

In second stage of study In March 2017 surveillance sampling was done in NICU. Sterile swabs were used to obtain samples from incubators, treatment trolleys, hand sanitizer dispenser, cots, warmers, detainers, counters, nursing counters and weighing machine. The sterile swabs were dipped into sterile saline and rubbed in circular motion of the surface. Sterile swabs were transported to the laboratory with minimum delay and plated out on Blood and Mac Conkey agar plates and incubated at 35C for 48 hours. Any growth observed during this period was dealt in the conventional way using colony morphology, Gram stain, motility and biochemical profile (analytical profile index 20E biomerieux). Antibiotic testing was done by Kirby Bauer Method.

Simple infection control measures were taken NICU was fumigated, sterilization of instruments, cleanliness of treatment trolleysand disinfection of NICU were ensured. Use of masks and gloves, hand hygiene of doctors, nurses and

every member of patient care team and other personnel were ensured.

In third follow up stage total samples of blood cultures of neonates admitted in NICU for next six months from April 2017 to September 2017 were 344.

Data analyzed by using SPSS version 20. For qualitative variables frequency and percentages were calculated.

RESULTS

In pre implementation stage maximum culture positive samples showed growth of *Stenotrophomonas maltophilia, Accinetobacter baumannii, Klebsiella pneumonia, Pseudomonas aeruginosa,* methicillin resistant coagulase negative *Staphylococcus*, MRSA, *Enterococcus spp, Serratia marcescens, Escherichia coli, Klebsiella oxytoca, Citrobacter freundii, Serratia marcescens* and *Candida spp*.

The following microorganisms were isolated from swabs taken. *Stenotrophomonas maltophilia* from treatment trolley. *Klebsiella pneumoniae* from cot and treatment trolley, MRSE from cots, warmers, ward pillars and counters, *Accinetobacter baumannii* from cots and *Pseudomonas aeruginosa* from the sanitary basin. There anti-biogram/ resistogram patterns were compared and found same.

After intervention in NICU total blood cultures of neonates admitted in NICU from April 2017 to September 2017 were 344 showing a decline from 39.8% to 21.5%. There was a marked reduction in *Pseudomonas aeruginosa, Enterococcus spp. Serratia marcescens, Klebsiella pneumoniae, Accinetobacter baumannii, Enterobacter spp, Candida, Stenotrophomonas maltophilia*, MRSE and complete eradication of *Escherichia coli*, *Citrobacter freundii, Klebsiella oxytoca* and *MRSA* from NICU (table).

Table: Frequency of pathogens pre intervention and post intervention.

Microorganisms	Pre intervention	Post intervention
Total samples	502	344
No growth	302 (60.1%)	270 (78.4%)
Positive samples	200 (39.8%)	74 (21.5%)
Stenotrophomonas maltophilia	32 (6.3%)	26 (7.6%)
Accinetobacter baumannii	31 (6.1%)	12 (3.4%)
Klebsiella pneumoniae	27 (5.3%)	15 (4.3%)
MRSE	17 (3.3%)	3 (0.9%)
Serratia marcescens	16 (3.1%)	6 (1.7%)
Enterococcus spp	13 (2.5%)	4 (1.2%)
Pseudomonas aeruginosa	13 (2.5%)	4 (1.2%)
Klebsiella oxytoca	10 (1.9%)	-
Escherichia coli	10 (1.9%)	-
Citrobacter freundii	9 (1.7%)	-
MRSA	3 (0.5%)	-
Enterobacter spp	4 (0.7%)	2 (0.5%)
Candida spp	15 (2.9%)	02 (0.5%)

DISCUSSION

A steady increase in the number of isolates from the neonatal intensive care unit of the Military Hospital, prompted us to look into it. A careful surveillance led to certain compromises being made in the hospital infection control. Immediate measures were suggested to the incharge of the unit who implemented them in letter and spirit. Stringent infection control measures saw a rapid decline in blood stream infections (BSI) in the months that followed.

HAIs are serious concern in a NICU as they are the major cause of mortality, morbidity, long stay at hospital and high cost[18].

In Pakistan a study was conducted at the NICU of Aga Khan University hospital Karachi, and it reported sustained reduction in blood stream infections by using simple infection control measures[16,21].

Another study conducted in Argentina in ICUs of tertiary care hospital in 2005 concluded that by improving hand hygiene there was a decrease in nosocomial infections from 47.55 per 1000 patient days to 27.93 per 1000 patient days[22].

Another study was conducted in neuro intensive care unit Liberec hospital and confirmed that infection control measures are very efficient and by implementing them there is a low rate of antibiotic resistant bacteria and nosocomial infections to 4.2%[23].

An interventional study with follow up was conducted from March 2001 to February 2004 among health care workers at neonatal care unit of Children hospital, University of Geneva Hospitals which reported improvement of compliance from 42 to 55% across study phase after introducing education programof hand hygiene. HAI were also monitored and marked reduction in infections in neonates were observed[24].

University of North Carolina Hospitals implemented in all inpatient areas a new program of hand hygiene (clean in clean out) in 2013, it was simple program that all health personnel including doctors, nurses, assistants, therapists and all other health personnel clean hands before entering and after leaving patient rooms and it showed 10% improvement of hand hygiene and 14% reduction in HAIs[25].

In Taiwan a study was conducted in level 3 NICU and it showed that with improved hand hygiene there was decrease in nosocomial infections from 15.3% to 10.69% per 1000 patients[18].

Implementation of strategies within NICU that can influence hospital acquired infections need a team effort by all participants involved in care of these neonates. There are simple ways by which we can reduce the transmission of pathogens from patient to patient, equipment to patients and from staff to patients. A study was conducted in 2015 in Emergency Department of 475 bedded hospital in Toronto, Ontario, Canada and it concluded that by reducing crowd in emergency department improves hand hygiene compliance[16].

There is evidence that improved hand hygiene has decreased transmission of infection. Hand hygiene before and after touching the patient, after contact with body secretions, after touching wound and dressing and even after touching medical instruments must be ensured to reduce the frequency of nosocomial infections in neonates[20].

Minimizing venipuncture, reduction of duration of mechanical ventilation and central line use are best practices to minimize nosocomial infections[15]. Prolonged use of empirical broad spectrum antibiotic increases the risk of resistant bacteria. Improved practices of antibiotic prescription reduce the rate of antibiotic resistance and patient outcome. Studies indicate that 30 to 50% antibiotics are unnecessarily and inappropriately prescribed and it contributes to the antibiotic resistant bacteria[11].

Along with other preventive measures environmental cleaning with High efficiency particulate (HEPA) filters in NICU is also very essential to prevent transmission of some pathogens like Clostridium difficile, vancomycin resistant enterococci (VRE), Acinetobacterspp and MRSA so it should not be ignored[25].

CONCLUSION

This study showed that after implementing simple infection control measures in neonatal intensive care unit there was substantial decrease in HAIs.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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