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INCIDENCE AND RISK FACTORS ASSOCIATED WITH NOSOCOMIAL INFECTIONS IN A NEONATAL INTENSIVE CARE UNIT OF PHILIPPINE CHILDREN'S MEDICAL CENTER AND ITS CONTROL

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ABSTRACT

Objective: The objectives of this study are:1) To identify nosocomial infection in the NICU and their sources 2) To describe the risk factors of infection 3) To assess efficacy of standard infection control interventions to decrease the morbidity and mortality in the NICU.

Methods: All patients admitted in the NICU from August to October 2001 were included in the study. The following data were included: age of gestation, birthweight, place and type of delivery, APGAR score, underlying illness, clinical and laboratory profile, medical interventions, cultures done and antibiotics given. Maternal factors noted were the following: age, gestational history, maternal infection, premature rupture of membrane, premature labor signs and symptoms and laboratory data including cervical culture and histopathology of the placenta to check for chorioamnionitis. Environmental cultures were collected monthly during the investigation. The antimicrobial susceptibility of the isolates was compared with that of the patient. The data were analyzed using EPIInfo software. Relative risk and exact 95% confidence intervals were calculated.

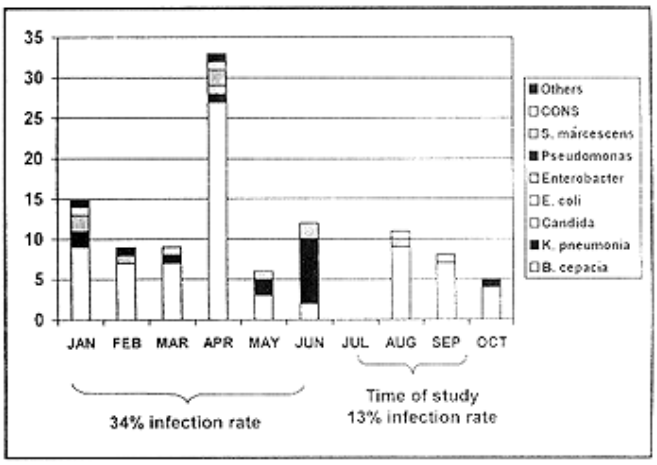
Results: There were 148 patients admitted of which 19 were septic and 129 were not septic. The following increased the risk of acquiring nosocomial infections; mechanical ventilation, peripheral and umbilical vein catheterization, amino acid and intralipid transfusion, PRBC and FFP transfusion and use of antibiotics particularly ceftazidime and imipenem. Among the maternal factors, PROM and chorioamnionitis increased the risk of infection. The most common organisms isolated from the patient were: *Burkholderia cepacia, Candida albicans, Klebsiella pneumonia and Pseudomonas aeruginosa.* From the environement the following were cultured: *Pseudomonas, Enterobacter, Burkholderia, CONS, Acinetobacter* and *Bacillus subtitis*. Infection control measures were strictly reinforced during the time of study. The infection rate decreased from 34% to 13%.

Conclusion: Gram negative bacteria accounted for most of the nosocomial infections. Medical interventions and maternal infection are the risk factors for neonatal nosocomial infections. Strict adherence to infection control measures can decrease nosocomial infections.

INTRODUCTION

Neonatal Intensive Care Unit (NICU) patients are at high risk for nosocomial infections because of their inherent illness and underdeveloped immunologic function. Moreover they are prone to prolonged hospitalization and frequent invasive procedures[1]. At Philippine Children's Medical Center, the Infection Control Committee (ICC) has a surveillance of nosocomial infections thru systematic collection of the results of all cultures and antibiograms so that when an abnormal increase in incidence of a particular organism is noted, the most appropriate means of control and prevention could be instituted early.[2] An outbreak of nosocomial bloodstream infections due to *Burkholderia cepacia* occurred in this institution last April 2001. Infection control measures particularly cohorting of patients were done causing a decrease in incidence of *B. cepacia.* However, an outbreak of Klebsiella ensued from May to June 2001 (Figure 1). The NICU was then closed for admission during the month of July and was thoroughly cleaned. When the NICU was reopened for the month of August, a protocol from the infection control committee was strictly implemented and this study was also started.

Figure 1. Nosocomial infections in the NICU Jan-October 2001



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Keywords: neonatal infections, nosocomial infections

Review of Literature/Significance of the study

Previous studies have found the incidence of NICU nosocomial infections to be 5-32%.[3,4,5] A study done by Bañez et al in PCMC revealed a 22.2% incidence of nosocomial infections and 31.7% of these infections occured in the NICU.[6] During the B. cepacia outbreak last April 2001,the infection rate was 65%. A retrospective study was already done to identify the risk factors for *B. cepacia* infection. The following were identified as risk factors: presence of underlying illness such as pneumonia, invasive procedures such a mechanical ventilation, umbilical catheterization, jugular cut down, amino acid infusion, fresh frozen plasma transfusion and antibiotic use such as imipenem and cefotaxime.[7] Numerous local studies focused on retrospective analysis of the risk factors of nosocomial infection in NICU.[8,9] To date there has been no local prospective study among high risk patients analyzing maternal risk factors like cervical cultures and histopathology of the placenta and elimination of potential nosocomial reservoirs in order to institute strategies to prevent the development of nosocomial infection and therefore lead to substantial reduction in morbidity and mortality.

The objectives of this paper are:

1. To determine incidence rate of nosocomial infection among neonates
    a. To identify the organisms isolated causing nosocomial infection
    b. To determine distribution of organisms responsible for nosocomial infections
2. To determine maternal and neonatal risk factors for nosocomial infections.
3. To determine the distribution of organisms isolated from the environmental cultures.
4. To determine efficacy of standard infection control measures in controlling nosocomial infections in a neonatal intensive care unit.

Setting

This is a prospective cohort study conducted between August 1,2001 up to October 31, 2001 in the Neonatal Intensive Care Unit of Philippine Children's Medical Center. The unit admits medical and surgical neonates born in the perinatal unit (which caters to high risk neonates and high risk mothers) and referred from outside. It is staffed by 3-6 residents (regular plus rotating residents), 3 fellows, one consultant who is assigned for 2 weeks, a permanent nursing staff who provides care in a 1:2-1:1 nurse-patient ratio.

Inclusion criteria

All inborn and outborn admissions to the NICU from 1 August to 30 October 2001 were included in the study.

Definitions

Nosocomial infections are those that patients acquire after admission to the hospital. This includes all infections whether acquired during delivery or during hospitalization unless evidence indicates transplacental transmission.[10,11]

A septic patient is defined as a patient who has at least one positive culture of any body fluids (whether blood, CSF, tracheal aspirate, urine, stool etc.) plus any two or more of the following: temperature >38°C or < 36°C; respiratory rate > 60/min; heart rate of >120/min; white blood cell count of >25,000 or < 5,000. To identify cases cultures on admission and all subsequent cultures were checked and recorded daily.

Non-septic patients are neonates admitted in the NICU with no growth on culture of any body fluid (whether blood, CSF, tracheal aspirate, urine, stool, etc.)

Clinical sepsis means systemic response to possible infection. It was under not septic category in this study.

Cohorting means septic patients are separated from non-septic patients.

Dedicated gowning means one gown per patient.

Methodology

A.) A standard data sheet was filled-up on a daily basis to facilitate gathering of information

B.) Histopathology examination of the placenta was done to check for chorioamnionitis or any pathologic abnormality. The data were incorporated in the questionnaire.

C.) Infection Control Measures

a) *Sanitation of environment*

1. NICU was cleaned with soap and water first followed by 1% acetic acid for the floors and 0.25% acetic acid for the equipments. Ultraviolet light was used for 2 hours after thorough cleansing. This was done monthly.

b.) Hand washing guidelines were strictly implemented.

a. All persons whether they handled patients or not were obliged to wash hands prior to entry.

b. Handwashing was done before and after examining any single patient.
c. Single use hand towels or hand dryer was used.
d. Foot pedaled soap dispensers and knee controlled sinks were also used.

c.) Use of gloves.
a. Gloves were strictly worn for any special procedure done to the patient like IV insertion, suctioning and handling of contaminated materials
b. All used gloves were discarded after each use.

d.) Dedicated gowning was observed by all NICU personnel.

e.) Date of insertion of IVF of all patients were recorded in their respective NICU 24 hour flow sheet. It was changed every 3 days.

D.) Care of NICU equipment
a. Ventilator tubings were routinely changed every 3 days. Water from ventilators and humidifiers were likewise changed every eight hours.

E.) Cohort system
a. Patients
1. NICU patients infected and exposed to any organism were transferred to a second Intensive Care Unit. They stayed there until discharge. Only new patients were admitted at NICU. However, if they had growth of any organism, they were also transferred or isolated from other neonates.
2. Patients with growth of any organism were monitored daily by the NICU fellow and Infectious Disease Fellow and treated accordingly. Judicious use of antibiotics was implemented.
3. Non-septic patients at NICU remained there until discharge or transferred to the intermediate care neonatology unit.

F.) Procedure review and environmental culturing
Environmental cultures were obtained monthly for 3 months during the study period. The antimicrobial susceptibility of isolates were noted. All cultures were incubated at 37°C for 72 hours. All organisms were identified by Vitek (BioMericux, Vitek , Hazelwood, MO). Antimicrobial sensitivity vs. resistogram were noted by disk diffusion Cultures of the following were done once a month for three months during the study period:
a.) Random hand swab of personnel after washing (fellows, residents, nurses,midwives,respiratory therapist)
b.) Equipments (ventilator including patient connector, junction of tubing, humidifiers; IV cannulas;suction machines;nebulizers;incubator walls)
c.) Environmental culture(sink drains, faucet handle, soap dispenser,water supply, storage tank, pipings in O2 and pipings in compressed air)
d.) Other hospital materials including providone iodine, heparin, disinfectants, distilled water
e.) Laminar flow hood

DATA ANALYSIS

EpiInfo software(Version 6.01) were utilized for data collection and SPSS, version 10 (Statistical Package for Social Sciences) software were utilized for statistical analysis.

Incidence rate of nosocomial infections were calculated by determining the number of neonates who developed infection among the admitted neonates during the study period. In addition, frequencies and percentages were computed to determine the distribution of organisms responsible for nosocomial infections.

Univariate analysis was used to determine whether neonatal and maternal factors were risk factors for nosocomial infections among neonates. Specifically, crude odds ratio (cOR) with corresponding 95% confidence interval (C.I.) and p-value were computed without consideration of controlling the other factors. Level of significance was set at 0.05.

Univariate logistic regression was employed to investigate the crude associations between independent variables and risk factors to predict mortality

Lastly, frequencies and percentages were calculated to determine the distribution of organisms isolated from the environmental cultures.

RESULTS

A total of 148 patients were admitted in the NICU from August 1,2001 to October 31,2001 of which 19(13%) were septic while 129(87%) were not septic. The incidence rate of nosocomial infection during the time of study was13%.

CULTURE RESULTS AMONG NEONATES

The nineteen patients who were septic all had nosocomial infection. One patient had 4 culture positive results(2 *B. cepacia* and 2 *Candida*). Another patient had 4 culture positive results all *B. cepacia*. Two more patients had 2 blood cultures positive for *B. cepacia*. The rest of the ill patients had 1 organism isolated.

A total of 28 organisms were cultured from the patients. (See Figure 1) The most common of which was *B. cepacia*(n=23) followed by *Candida* (n=2) then *Klebsiella (n=1) Pseudomonas(n=1) CONS(n=1).*

The *B. cepacia* comprised 82 % of the infections. Resistance patterns of patients' strains and environmental strains were compared. They were resistant to aminoglycosides, imipenem, cefotaxime and ceftazidime. They were susceptible to meropenem,ciprofloxacin, piperacillin-tazobactam and cefepime.(See Figure 2)

Prior to the study, the infection rate was 34%(see Figure 1). During the study when infection control measures were strictly enforced, infection rate decreased to 13%. Moreover, there was decreasing trend in the number of nosocomial infections from August to October 2001. Comparing August-October 2000 and August to October 2001 there was also decrease in the number of nosocomial infections during the time of study.(See Figure 3)

Figure 2.Antibiotic resistance patterns of *B. cepacia*(patients vs. environment)

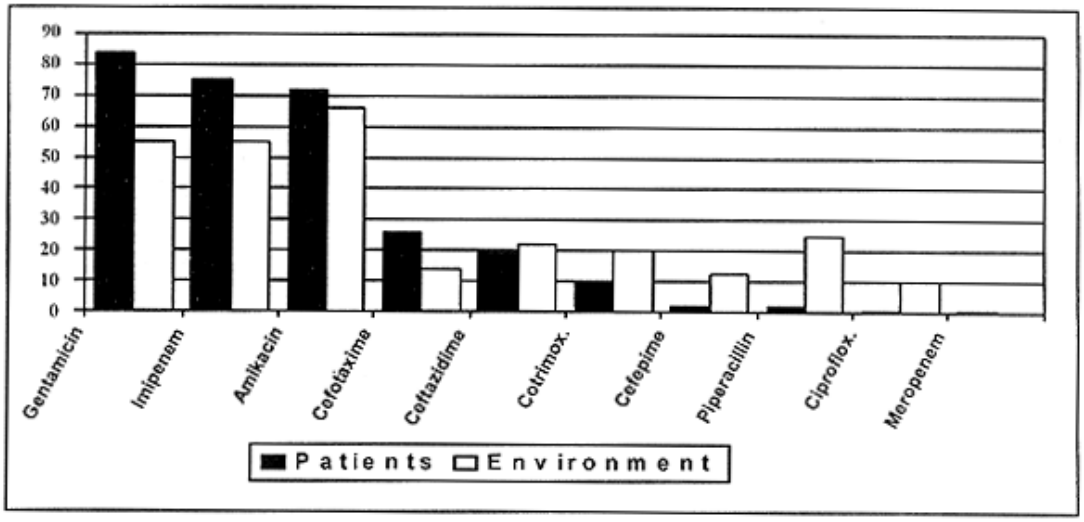
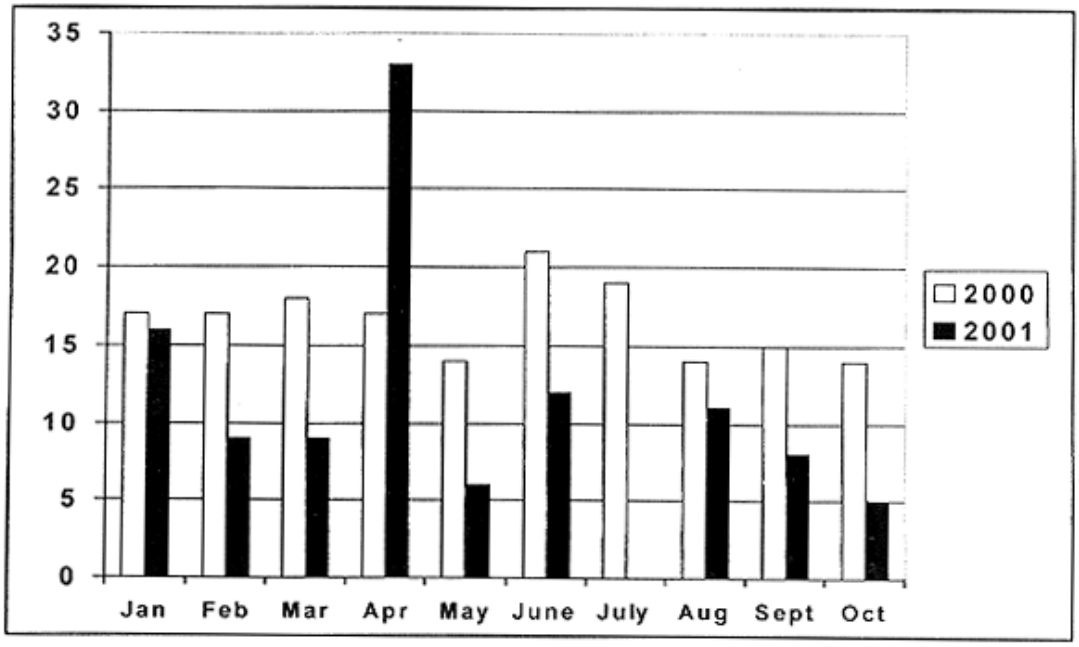


Figure 3. Organisms cultured from patients in NICU from Jan - Oct (2000-2001)



MATERNAL AND NEONATAL FACTORS

Out of the148 patients, there were 71 males and 77 females. Among the males, 13(18.3%) were septic. For the females 6(7.8%) were septic while 71(92.2%) were not. In this study sex was not a risk factor for infection. (See Table 1)

Among the neonates, 103 were full term of which 2(1.9%) were septic. There were 45 premature neonates of which 17(37.8%) were septic. Prematurity predisposed patients to acquire nosocomial infection (cO.R.=30.67;95% CI =140.72)

On statistical analysis, there was a significant association between invasive procedures and acquisition of nosocomial infection. Cases were more likely to have undergone medical interventions such as cardiopulmonary resuscitation, mechanical ventilation, umbilical and peripheral catheterization.

The use of blood products was also significantly associated with nosocomial infection. Cases were more likely to have been given packed red blood cells, fresh frozen plasma, cryoprecipitate and albumin. Amino acid and intralipid use was also significantly associated with nosocomial infection.

Maternal risk factors for nosocomial infections among neonates were tabulated in table 4. Among the maternal factors the following were associated with increased risk to acquire nosocomial infection: premature labor, premature rupture of membrane and presence of chorioamnionitis.

Table 1. Neonatal Risk Factors for Nosocomial Infections among neonates in NICU-PCMC, August to October 31, 2002

Risk Factors	Septic		Not Septic			Odds Ratio	95% Confidence Interval	P value
	No.	%	No.	%	Total			
Gestational Age						30.67	6.69-140.72	0.00***
Preterm	17	(37.8)	28	(62.2)	45			
Fullterm**	2	(1.9)	101	(98.1)	103			
Total	19	(12.8)	129	(87.2)	148			
Sex						2.65	0.95-7.41	0.054
Male	13	(18.3)	58	(81.7)	71			
Female***	6	(7.8)	71	(92.2)	77			
Total	19	(12.8)	129	(87.2)	148			
Birthweight						8.39	2.9-23.56	0.00
<1500gms	12	(35.3)	22	(64.7)	34			
>1500gms**	7	(6.1)	107	(93.9)	114			
Total	19	(12.8)	129	(87.2)	148			
APGAR						1		0.02
1-3	4	(36)	7	(64)	11			
4-7	8	(24)	25	(76)	33			
7-9**	6	(6)	94	(6)	100			
Total	18	12.5)	126	(87.5)	144			

Table 2. Medical Interventions Done

Risk Factors	Septic		Not Septic			Odds Ratio	95% Confidence Interval	P value
	No.	%	No.	%	Total			
Mechanical Ventilation						46.08	9.83-215.97	0.00***
Yes	17	(47.2)	19	(52.8)	36			
No**	2	(1.9)	103	(98.1)	105			
Total	19	(13.5)	122	(86.5)	141			
Resuscitation Given						12.89	4.25-39	0.00
Yes	10	(50)	10	(50)	20			
No	9	(7.2)	116	(92.8)	125			
Total	19	(13.1)	126	(86.9)	145			
Antibiotic use prior to sepsis						1.36	1.2-1.6	0.00***
Yes	0		75	(100)	75			
No	19	(26.8)	52	(73.2)	71			
Total	19	(13)	127	(87)	146			
Umbilical Catheterization						21.78	5.87-80.82	0.00***
Yes	16	(40)	24	(60)	40			
No**	3	(3)	98	(97)	101			
Total	19	(13.5)	122	(86.5)	141			
Peripheral vein catheterization						1.514	1.255-1.826	0.00
Yes	19	(33.9)	37	(66.6)	56			
No**	-		85	(100)	85			
Total	19	(13.5)	122	(86.5)	141			
Central catheterization						2.27	0.224-23.14	0.44
Yes	1	(25)	3	(75)	4			
No**	17	(12.8)	116	(87.2)	133			
Total	18	(13.1)	119	(86.9)	137			
Urinary Bladder Catheterization						1.28	0.14-11.57	0.59
Yes	1	(16.7)	5	(83.3)	6			
No**	18	(13.5)	115	(86.5)	133			
Total	19	(13.7)	120	(86.3)	139			
NPO						19.86	4.39-90.19	0.00
Yes	17	(31.5)	37	(68.5)	54			
No**	2	(2.2)	87	(47.8)	89			
Total	19	(13.3)	124	(86.7)	143			
Operation done						5.67	1.16-27.67	0.049
Yes	3	(43)	4	(57)	7			
No**	16	(11)	121	(89)	137			
Total	19	(13.2)	125	(86.8)	140			

Table 3. Fluids given to patients

Risk Factors	Septic		Not Septic			Odds Ratio	95% Confidence Interval	P value
	No.	%	No.	%	Total			
Packed RBC use						181.667	21.47-1536.9	0.00***
Yes	15	(62.5)	9	(37.5)	24			
No**	1	(0.9)	109	(99.1)	110			
Total	16	(11.9)	118	(88.1)	134			
Platelet Use						0.092	0.054-0.158	0.00***
Yes	4	(100)	0		4			
No**	12	(9.2)	118	(90.8)	130			
Total	16	(11.9)	118	(88.8)	134			
Fresh Frozen Plasma use						58	10.521-319.73	0.00***
Yes	8	(80)	2	(20)	10			
No**	8	(6.5)	116	(93.5)	124			
Total	16	(11.9)	118	(88.8)	134			
Cryoprecipitate use						16.71	1.423-196.34	0.04***
Yes	2	(66.7)	1	(33.3)	3			
No**	14	(10.7)	117	(89.3)	131			
Total	16	(11.9)	118	(88.1)	134			
Albumin						16.857	1.435-198.014	0.04**
Yes	2	(66.7)	1	(33.3)	3			
No**	14	(10.9)	118	(89.3)	132			
Total	16	(11.9)	119	(88.1)	135			
Amino Acid use						20.53	6.17-68.37	0.00
Yes	10	(58.8)	7	(41.2)	17			
No**	8	(6.5)	115	(86.5)	133			
Total	18	(12.9)	122	(87.1)	140			
Intalipid Use						25.24	5.7-111.65	0.00
Yes	7	(70)	3	(30)	10			
No**	11	(8.5)	119	(91.5)	130			
Total	18	(12.9)	122	(87.1)	140			

ENVIRONMENTAL CULTURE RESULTS

A total of 146 cultures were done of which 47.9% revealed no growth while 52.1% revealed growth of the following organisms in decreasing order: *P.aeroginosa* (15.1%),*CONS* (9.6%), *B. cepacia* (7.5%), *B.subtilis* (5.5%), *S.marcescens* (4.1%) *K.pneumonia* (3.4%),*Acinetobacter* (2.7%), *Citrobacter* (1.4%) *Pseudomonas flurescens* (1.4%).

P. aeruginosa were cultured in the following: suction machine, faucet, water supply, sink, ventilator, humidifier, junction of tubings, patient connector and breast pump humidifier.

CONS were cultured from the following: handswab, incubator, ventilator, junction of tubings and patient connector.

B. cepacia were cultured from the following: ventilator, humidifier, junction of tubings, filter, patient connector, suction machine, nebulizer, nebulizing kit, intravenous cannula and hand swab.

B. subtilis were cultured from the following: incubator, faucet, ventilator, junction of tubing's and nebulae.

S. marcescens were cultured from the following: breast pump humidifier, distilled water, sink drain nebulizing kit, and suction machine.

K. pneumonia were cultured from the following: breast pump humidifier, incubator, sink and suction machine.

The following consistently had no growth during the monthly cultures: disinfectant, betadine, ventilator piping & salbutamol solution

DISCUSSION

Transmission of infection within a hospital requires 3 elements: a susceptible host, an agent and the environment.[10]

According to the Center for Disease Control, for an infection to be defined as nosocomial, there must be no evidence that the infection was present or incubating at the time of hospital admission. An infection that occurs in the following situations is considered nosocomial (1) infection that is acquired in the hospital and is evident after hospital discharge (2) newborn infection that is the result of passage through the birth canal.[11]

Nosocomial infections are serious adverse events that complicate the hospitalization of patients and results in considerable morbidity and mortality, increased length of stay and increased health care cost.[12]

THE HOST

Newborns in general are more susceptible to nosocomial infections because of immaturity of their immune system and their structural barriers. Their defenses are particularly inadequate because placental transfer of antibodies has not been completed and because of immaturity of immunologic defenses.[13]

Low gestational age increases the risk of acquiring nosocomial infections. In this study, premature patients had an increased risk of acquiring nosocomial infection than mature patients. Infants before approximately 28 weeks of gestation do not have the benefit of transplacentally acquired maternal antibody. Moreover, the fragile skin of premature infants is less resistant to trauma and the resulting microbial invasion.[14]

Low birth weight has also been demonstrated to increase the risk of nosocomial infections.[15] Our patients less than 1500 grams developed nosocomial infections more than those weighing more than 1500 grams. This is in agreement with the report of Hudone who noticed 15-20 times incidence of nosocomial infections in patients weighing less than 1500 grams.[16]

The very procedures to keep prematures and ill newborns alive such as those needed for adequate hydration, nutrition, monitoring and ventilation are all invasive procedures which disrupt normal barriers to infection.[2]

The use of mechanical ventilation, umbilical and peripheral catheterization pose great risks of acquiring nosocomial infection. These results confirm previous studies.[7] The neonates' lack of an established normal bacterial flora provides no natural "colonization resistance" against pathogens entering the upper respiratory tract. The process of intubation itself introduces organisms to the respiratory tract.

Systemic infections related to the use of intravascular catheters include blood stream infections occurring as a result of microbial colonization of the catheter and contamination of fluid. or medications infused through the catheter. Biofilm composed of host proteins and microbial exopolysaccharide coats the external and internal catheter surfaces soon after insertion and may enhance the ability of microorganism to persist in catheter surfaces and evade host defenses.[17] These are the probable reasons why umbilical and peripheral catheterization predisposed patients to acquire nosocomial infection in this study.

Interestingly, urinary bladder catheterization did not increased the risk of acquiring nosocomial

infection. This is probably because indwelling urinary catheters are used infrequently in NICU patients.

This research also illustrates once again that the use of blood products particularly PRBC and FFP increases the risk of acquiring infection. Organisms maybe introduced during insertion of intravenous lines or the blood product maybe contaminated.

In this study, the use of total parenteral nutrition also increases the risk of acquiring nosocomial infection. This is in agreement with the study of Mayo et al who studied risk factors for *B. cepacia* in neonates.[7] Solutions for parenteral nutrition usually contain 10% dextrose and amino acids. If contaminated the glucose content of the solution may play a role by enhancing the survival and multiplication of the organism. Contamination of pharmaceutical products has been reported to be responsible for outbreaks because sterility testing may not detect low frequency contamination.

Maternal factors like premature rupture of membrane, chorioamnionitis and premature labor increased the risk of acquiring nosocomial infection in this study.

In this study, the placentas were sent to the histopathology laboratory to check for chorioamnionitis. Chorioamnionitis increases the risk of the baby to acquire infections probably due to ascending infection occurring after premature rupture of membrane of labor in patients with multiple vaginal examination. The Center for Disease Control defines these and other infections transmitted via the birth canal as nosocomial infections.[18] Management is based on the principles that antibiotic should be given as soon as diagnosis is made. Therefore, histopathology of the placenta is very important.

Growth on endocervical cultures in this study did not increased the risk of nosomial infection. This is probably because only few patients had endocervical cultures.

One limitation of the study was that analysis was done using univariate logistic regression only because the number of patients in the study was not sufficient to perform multivariate analysis.

THE ENVIRONMENT/AGENT

The distribution of organisms responsible for nosocomial infections in this study was not similar to those reported by other investigators. Studies abroad[1] and some local studies[16] showed that *E. coli* followed by CONS were the most common predominant organisms.

In this study, gram negative organisms that were commonly cultured from patients include *B. cepacia, Klebsiella and Pseudomonas.* The introduction and use of third generation cephalosporins were followed by the emergence and dissemination of these gram negative rods.

Sites of contamination should be sought during outbreak investigation since any environment can be an infection risk to specific highly susceptible individuals. Environmental cultures done monthly showed that the following organisms were most commonly cultured: *P. aeruginosa, CONS, B. cepacia, B. subtilis, S. marcescens and K pneumonia.* This shows importance since these may be possible sources. All of these materials should be negative for any organisms. Growth of an organism from the environment doesn't mean that it is the source of outbreak. Routine environmental culture should not be done unless recommended by the infection control committee.

Substantially less is known about the properties of specific microorganisms that render them more of less pathogenic in hospitalized patients. For the most part it remains a mystery why some microorganisms colonize many patients but produce few infection in others cause devastating epidemic of the disease.[19]

B. cepacia, an ubiquitous organism from the Pseudomonas family was the most common organism cultured from patients comprising 82% of the infections and was also seen in the environment. They are typical water organisms and have been isolated from a number of environmental reservoirs that contain water. Thus a number of wet or moist environmental reservoirs, including sink drains from which these organism may be aerosolized when the water taps are opened maybe sources of infection[17]. The equipments with *B cepacia* may be sources of infection based on the antibiogram since the resistance patterns of both the cultures from patients and environment were almost the same.

B. cepacia, the most common organism causing nosocomial infection in this institution caused outbreak last April 2001. Since they thrive well in moist environments, sanitation of environment was strictly adhered, ventilator tubings were changed every 3 days and water from ventilators and humidifiers were changed every 8 hours. Handwashing was emphasized. Cohorting of septic patients was also done. During the time of study, it was still the most common organism cultured; however, the infection rate from 34 % already decreased to 13% when infection control measures were strictly implemented. Moreover, there was a decreasing

trend in the number of infections from August to October 2002. Compared to August-October 2001 there was decrease in number of nosocomial infections during the time of study.

Therefore, surveillance for nosocomial infection is essential to identify outbreaks and detect unsuspected reservoirs of pathogens. Containment of infection requires the identification of contaminated equipment, education regarding infection control methods, strict adherence to infection control measures and judicious use of antimicrobial agents.

CONCLUSIONS

The most common nosocomial infections in our NICU were usually gram (-) organisms particularly B cepacia, Klebsiella and Pseudomonas. Other organisms were Candida and CONS.

Maternal risk factors for infection were presence of fever, premature rupture of membrane and chorioamnionitis.

The medical interventions predisposing to infection were mechanical ventilation, umbilical catheterization, use of total parenteral nutrition, giving of blood products like PRBC,FFP and platelet concentrate and antibiotic treatment.

Nosocomial infection can be controlled through strict implementation of standard infection control procedures exemplified by strict handwashing, use of foot pedaled soap dispensers and knee controlled sinks, use of gloves, judicious use of antibiotics, routine changing of IV sites and ventilator tubings every 3 days and cohorting of patients.

RECOMMENDATIONS

Understanding the risk factors for nosocomial infections in neonates may guide us in the allocation of resources in infection control and focus research efforts. The data from this study can be used as a basis for intrahospital and interhospital comparisons of controlling nosocomial infections.

To prevent nosocomial infection surveillance among high-risk patients and identification and elimination of potential nosocomial reservoirs should be done. Prevention of nosocomial infections outbreak depends primarily on the timely implementation of and strict compliance with infection control measures specifically designed to interrupt transmission of the microorganisms involved as done in this study.

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