The Prevalence of Nosocomial Infections and Associated Risk Factors in Pediatric Patients in Tikur Anbessa Hospital

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Abstract

Little is known about nosocomial infections and associated risk factors among children in Ethiopia.

The aim of the study is to generate data on nosocomial infection in children that will serve as a base for further studies and to develop prevention interventions. A case control study was done on 111 cases and 222 controls from pediatrics wards of Tikur Anbessa Hospital, Aug 2002-Dec 2003. Nosocomial infection rate was 5 per 100 discharges. A total of 143 nosocomial infections were detected in 111 cases. The commonest infection was pneumonia 39.8%. Specimen for culture and sensitivity was taken from 63/143(44.1%) infections and organisms were isolated in 43 infections. And 14 different type of bacteria were found. E coli, klebsiella pneumoniae and pseudomonas species were the most frequently isolated organisms. The resistance to ampicillin was 91.9% , gentamycin 67.2%, , ceftriaxone 50%, norfloxacin 18.3%, and ciprofloxacin 15.4%. Age less than one year, malnutrition, admission to orthopedics unit, peripheral intravenous line and prolonged hospitalization were significantly associated with nosocomial infection. In conclusion surveillance for high risk patients, education of health personnel, proper isolation technique, hand washing or use of glove and gowns, avoid prolonged hospitalization when possible and reestablishment of infection control committee are needed for prevention of nosocomial infection. And antimicrobial therapy should be guided based on drug susceptibility pattern of bacteria isolated from patients with nosocomial infection in the hospital.

Introduction

Nosocomial infections result in considerable morbidity and mortality, prolongation of hospitalization and increases patient care expenditure (1).Published data about nosocomial infection rate in Ethiopian pediatric patients are not currently available. But there were two reports on outbreak of *klebsiella* at the Etho-Swedish Children's Hospital. The first report was on outbreak of gentamycin-resistant *klebsiella* bacteremia between February 1988 and February 1990, and infection control committee was functioning at that time (2).The second report was on outbreak of *klebsiella oxytoca* at Ethio-Swedish hospital in 1992 and 1993(3).

Nosocomial infection rates in pediatric patients in other countries range from 1.2 to 10.3 infections per 100 discharges. In most studies the infection rate varies by age and ward or service. The highest infection rate was seen in infants younger than one year of age (1,4-7).

The predominant site of infection differs by the population studied and the type of surveillance performed. Respiratory tract and gastrointestinal tract infections were common in some studies and surgical wound infection was common in other studies. Gram negative bacteria, Gram positive bacteria, and viruses were incriminated as the predominant causes of nosocomial infection in various places (1, 5, 7-9).

Determinants of infection include host factors, prior invasive procedures, use of catheters, use of antibiotics and exposure to other patients, visitors or health care providers with contagious diseases (10). Nosocomial infections can be transmitted by contact, common source, air or vectors. Most nosocomial infections in infants and children result from contact transmission via the hands of personnel (1,11-13). Malnutrition is the most common cause of secondary immunodeficiency (14-16). The cumulative probability that an individual will experience at least one nosocomial infection increases with increasing exposure to the hospital (1,11). Depressed level of consciousness increases the likelihood of reflux of gastric contents and aspiration into lower airway leading to Pneumonia (11, 16-19). Antimicrobial therapy reduces the concentration of normal flora and

allowing antimicrobial resistant microorganisms to gain a foothold. Any patient taking antibiotics for prophylaxis or treatment may become a source of highly resistant organisms. Immunocompromised hosts are more likely to have nosocomial infection(11,12,18,20,21). Percutaneously inserted peripheral intravenous catheters are associated with a low rate of local infection in children and blood stream infections are rare. Nosocomial infections also are caused occasionally by contaminated intravenous fluids or blood products (1,3,11,22,23) .

Surveillance for infection is the first step in identifying nosocomial infection and suggesting methods of prevention (10). Surveillance, by itself, is an effective process to decrease the frequency of hospital acquired infections (24).

Methods and Materials

A case control study was conducted reviewing medical records of children who were discharged from pediatric wards of Tikur Anbessa Hospital from August 2002 to December 2003. Neonates were excluded because the risk factors for nosocomial infections for neonates are different from others. Additionally the medical records of the emergency ward were incomplete and those who were discharged from the emergency ward were excluded.

The sample size was calculated with assumption of prevalence of malnutrition in hospitalized children in Ethiopia to be 50% which makes p2=0.5 and p1=0.66. Calculated sample size was: total sample size=333, Cases=111 and controls=222 with confidence interval (CI) =95%, odds ratio (OR) =2 , Zα=1.96 and Zβ=0.84. Cases are patients with nosocomial infection who were discharged from pediatric wards excluding neonates and those who were discharged from the emergency ward. They were identified after all charts of patients who were discharged from August 2002 to December 2003 were reviewed. For each case the next two discharged patients without nosocomial infection were taken as controls from registration book excluding neonates and those discharged from emergency ward.

Data was collected from charts of cases and controls using structured format that include age, sex, primary diagnosis, weight, length, community acquired infection, the ward and the service the patient was admitted, procedure that was done, nosocomial infection by site, culture and sensitivity result, use of antibiotics, use of chemotherapy, use of steroid, level of consciousness, HIV status, duration of stay in hospital, the status of admitted child at discharge.

Operational Definitions:

Nosocomial infections are infections acquired during hospital care which are not present or incubating at admission. Infections occurring more than 48 hours after admission are usually considered nosocomial. Infection that is acquired in the hospital becomes evident after hospital discharge is considered nosocomial. Definition to identify nosocomial infections have been developed for specific infection sites. These are derived from those published by the Center for Disease Control and Prevention(CDC) in the United States of America or during international conferences and are used for surviellance of nosocomial infections (24,25).

Short duration nasotracheal or orotracheal intubation is defined as intubation only during general anaesthesia while Long duration nasotracheal or orotracheal intubation is intubation for respiratory failure(19). Orotracheal or nasotracheal intubation is all episodes of orotracheal or nasotracheal intubation with in the period of one week prior to the onset of nosocomial pneumonia will be considered. Nasogastric intubation is the presence of a nasogastric intubation will be accepted when it was present for at least two days within the period one week prior to the onset of nosocomial infection (pneumonia) (19).

Wasting and stunting were based on calculating weight as a percentage of reference median weight for height and height as a percentage of reference median height for age (26). Nutritional status for under-five was according to the welcome classification (27).

Data was entered into SPSS 10.4 statistical software and it was analyzed using EPI info 6. After analysis result was presented using descriptive statistics, chi-square determination,

and p-value and odds ratio calculation. P-value was considered as significant if it was less than 0.05. Multiple regression analysis was done using SPSS to control the effect confounding factors.

Results

A total of 1701 patients were discharge from pediatric wards excluding neonatal ward and emergency ward in 2003. Of these 85 patients had acquired nosocomial infection at discharge. Hence, nosocomial infection rate was 5 per 100 discharges in 2003 in these wards. Charts of 111 cases and 222 controls who were discharged from pediatrics wards from August 2002 to December 2003, excluding neonatal and emergency wards were reviewed analyzed. Among 111 cases 85 were discharged in 2003 and 26 were discharged in 2002.

Of all cases with nosocomial infection 86(77.5%) had nosocomial infection once, 21(18.9%) twice, 2(1.8%) three times, and 2(1.8) four times. So, 143 nosocomial infections were detected in 111 cases. The majority of nosocomial infections were detected in the 2nd week and after the 2nd week . Out of 143 nosocomial infections 10(7%) of them were detected in the first three days after admission, 17(11.9%) between the 4th and 7th day, 50(35%) between 8th and 14th day, 21(14.7%) between 15th and 21st day and 45(31.4%) nosocomial infections were detected after 21 days of admission.

The commonest site of nosocomial infection was pneumonia 39.8% followed by gastroenteritis 11.9% and primary blood stream infection 10.9%(Table 1).The predominant site of infection was pneumonia in pediatrics, general surgery, neurosurgery, plastic surgery, tumor therapy unit, and ENT unit. In burn unit the predominant site of infection was skin and soft tissue infection. And in orthopedics upper respiratory tract infection was the commonest nosocomial infection detected followed by skin and soft tissue infection. Surgical wound infection was the second predominant site of nosocomial infection in patients who were discharged from general surgery.

Specimen for culture and sensitivity was taken from 63/143(44.1%) nosocomial infections. Among 63 nosocomial infections for which specimen were collected for culture and sensitivity test 30 (47.6%) were from blood, 11(17.5%) were from urine and 15(23.8%) were

from pus and the remaining 7(11.1%) were from other body fluids.

The result of culture and sensitivity test was positive in 43/63(68.3%) of nosocomial infections. A total of 62 different isolates were found from those with positive culture result. A single organism was isolated from each of 27 nosocomial infections and two or more bacteria were isolated from 16 nosocomial infections. When the isolates were classified by the type of organism, 14 different types of bacteria were isolated. *Escherichia coli* was the most frequently isolated organism followed by *klebsiella pneumoniae*, *pseudomonas species*, and *coagulase negative staphylococci* as shown in Table 3.

Drug susceptibility test for gentamycin was done for 61 of isolates and 41/61(67.2%) were resistant . And 11/60(18.3%)of isolates were resistant to norfloxacin . In similar way 18/36(50%) were resistant to ceftriaxone. Drug susceptibility for cloxacillin was done only for three isolates. (Table 4)

Infants under one year of age (29days-11mo), children with moderate wasting (Waterlow classification), children admitted to orthopedics unit, peripheral intravenous line, and prolonged hospitalization were found to have significantly increased nosocomial infection. And factors such as sex, weight for age according Wellcome classification, height for age according to Waterlow classification, ward, infection at admission, surgical intervention, urgency of surgery, type of surgical wound, duration of operative procedure, duration of stay before surgical intervention, orothracheal intubation, nasogastric intubation, urinary catheterization, bronchoscopy, prior treatment with antibiotics, chemotherapy or steroid, depressed level of consciousness, and HIV status were not significantly associated with the development of nosocomial infection. Majority of children with nosocomial infection (66.7%) stayed more than 21 days before discharge when compared to only 7.2% of controls stayed more than 21 days. (Table 5)

Among 222 controls, 175(78.8%) were discharged after improvement, 18(8.1%) were discharged in the same or worse condition, and 29(13.1%) died. Of 111 cases, 77(69.4%) were discharged after improvement, 13(11.7%) were discharged in the same or worse condition, and

21(18.9%) died. Children with nosocomial infection had no significant increased risk of death when compared to those without nosocomial infection (p value=0.157).

Discussion

Nosocomial infection rate in this study was with in the range which was observed in other studies (1, 4, 6, 7). The predominant site of nosocomial infection was pneumonia followed by gastroenteritis, and primary blood stream infection. This was similar to the study done Welliver and Mc Laughlin. (7).Though 49(44%) of patients with nosocomial infection were admitted to surgical service in this study, surgical wound infection was not common. It accounted for only 5.6% of all nosocomial infections.

Specimen for culture and sensitivity was not taken in 80(55.9%) of nosocomial infection and they were treated empirically. But isolated organisms are usually resistant to commonly used antibiotics for nosocomial infection like gentamycin and ceftriaxone. According to this study, it does not seem rational to treat nosocomial infection empirically with the above mentioned antibiotics in Tikur Anbessa hospital. Antimicrobial therapy should be guided based on drug susceptibility pattern of organisms isolated. The proportion of isolated bacteria resistant to floroquinolones was less when compared to the proportion of resistance to other antibiotics. Changing or rotating standard group of antibiotics used for empiric therapy has been efficacious in limited studies. The role of floroquinolones in the treatment of serious infections in children does not appear to be compromised by safety concerns since arthralgia and quenolone-induced cartilage toxicity were low and episodes of arthralgia were mostly reversible (12,28).

In this study Gram negative bacilli were commonly isolated organisms which constituted 46/62(74.2%) of all isolated bacteria. In reports from the 1960s and 1970s from USA Gram negative bacteria accounted for more than 50% of the infections which is similar to our study (1,5,7-9). It is not possible to differentiate whether the isolated coagulase negative staphylococci were contaminant or etiologic agent from this study since only one blood culture sample was taken and details of blood culture and clinical response to treatment was not available. (10,25).

Disruption of the physical barrier occurs in burn patients and in those with degloving injury. Admission to orthopedics unit was significantly associated with nosocomial infection in this study. But admission to burn unit in the hospital was not significantly associated with nosocomial infection. (10,12). Increased risk of nosocomial infection in infants less than one year of age and in nutritionally compromised patients was seen in other studies as it was seen in this study (1, 5, 7, 14-17). Children admitted to tumor therapy unit and those who took anti neoplastic chemotherapy have no significantly increased nosocomial infection unlike other studies (18).

The effect of peripheral intravenous line on the occurrence of nosocomial infection needs further prospective study since canula related septicemia is considered when the same organism is isolated from canula and blood. Even though increased mortality is expected in patients with nosocomial infection, mortality of patients with nosocomial infection was not increased in this study when compared to the control group (1, 11, 23).

Effective targeted surveillance for high risk patients, staff education, use of proper isolation techniques and effective infection control practice such as hand washing before and after patient contact or use of glove and gowns are recommended for the prevention of nosocomial infection. Prolonged hospitalization should be avoided as much as possible since it is significantly associated with the development of nosocomial infection. And reestablishment of infection control committee is also required.

Table 1. Distribution of nosocomial infection by site , Tikur Anbessa hospital, August 2002-December 2003.

.Site of nosocomial infection	frequency	%
Pneumonia	57	39.9
Gastroenteritis	17	11.9
Primary blood stream infection	15	10.9
Urinary tract infection	13	9.1
Skin and soft tissue infection	13	9.1
Upper respirator tract infection	9	6.3
Surgical wound infection	8	5.6
Central Nervous System infections	2	1.4
Others	7	4.9
Systemic infection	2	1.4
Total	143	100

Table 2. Site of nosocomial infections by the service in Tikur Anbessa hospital, August 2002-December 2003.

Service	Site of nosocomial infection										Total
	SWI (%)	UTI (%)	URTI (%)	Pneumonia (%)	Skin & soft tissue (%)	primary blood stream infection(%)	Gastro Enteritis (%)	CNS(%)	Other(%)	Systemic infectio(%)infection	
Pediatrics	0	8 (18.2)	0	27 (61.4)	1 (2.3)	5 (11.4)	4 (9)	0	0	0	44
General surgery	5 (26.3)	2 (10.5)	0	7 (36.8)	1 (5.3)	0	2 (10.5)	1 (5.3)	1 (5.3)	0	19
Neuro surgery	0	0	1 (10)	3 (30)	2 (20)	0	1 (10)	1 (10)	1 (10)	0	10
Plastic surgery	1 (50)	0	0	1 (50)	0	0	0	0	0	0	2
Burn unit	1 (7.1)	1 (7.1)	0	3 (21.4)	4 (28.6)	2 (14.3)	1 (7.1)	0	0	1 (7.1)	14
Tumor therapy	0	1 (3.2)	1 (3.2)	11 (35.5)	1 (3.2)	8 (25.8)	6 (19.3)	0	3 (9.7)	0	31
ENT	0	0	1 (16.7)	3 (50)	0	0	1 (16.7)	0	1(16.7)	0	6
Orthopedics	1 (5.9)	1 (5.9)	6 (35.3)	2 (11.8)	4 (23.5)	0	2 (11.8)	0	0	1 (5.5)	17
Total	8	13	9	57	13	15	17	2	7	2	143

SWI=surgical wound infection UTI=urinary tract infection
URTI= upper respiratory tract infection CNS= central nervous system

Table 3 Types of organism isolated from children with nosocomial infection in Tikur Anbessa hospital, August 2002-December 2003.

Organism isolated	Frequency	%
Escherichia coli	11	17.7
Klebsiella pneumoniae	9	14.5
Pseudomonas species	9	14.5
Coagulase negative staphylococci	6	9.7
Acinetobacter species	5	8.1
Klebsiella oxytoca	4	6.5
Salmonella species	4	6.5
Staphylococcus aureus	3	4.8
Proteus vulgaris	3	4.8
Citrobacter species	3	4.8
Shigella species	2	3.2
Group A streptococci	1	1.6
Morganella morgagne	1	1.6
Enterobacter cloaca	1	1.6
Total	62	100

Table 4 Drug susceptibility pattern of bacteria isolated from children with nosocomial infections in Tikur Anbessa Hospital, August 2002- December 2003.

Antibiotics	No. of isolates tested	sensitive	Intermediate sensitive	Resistant
Ampicillin	62	4(6.5%)	1(1.6%)	57(91.9%)
Gentamycin	61	20(32.8%)	0	41(67.2%)
Norfloxacin	60	47(78.3%)	2(3.3%)	11(18.3%)
Trimethoprim-Sulfamethoxazole	58	10(17.2%)	2(3.5%)	46(79.3%)
Tetracycline	58	13(22.4%)	2(3.5%)	43(74.1%)
Chloramphenicol	55	8(14.5%)	0	47(85.5%)
Ceftriaxone	36	13(36.1%)	5(13.9%)	18(50%)
Augmentin	31	8(25.8%)	5(16.1%)	18(58.1%)
Doxycycline	25	5(20%)	1(4%)	19(76%)
Amoxicillin	24	2(8.3%)	1(4.2%)	21(87.5%)
Naldixic Acid	22	12(54.5%)	0	10(45.5%)
Nirofurantoin	19	6(31.6%)	1(5.3%)	12(63.1%)
Amikacin	14	11(78.6%)	1(7.1%)	2(14.3%)
Ciprofloxacin	13	9(69.2%)	2(15.4%)	2(15.4%)
Penicillin G	13	0	2(15.4%)	11(84.6%)
Erythromycin	13	4(30.8%)	3(10%)	6(46.2%)
Methicillin	11	2(18.2%)	3(27.3%)	6(54.5%)
Carbencillin	8	2(25%)	3(37.5%)	3(37.5%)
Kanamycin	4	0	2(50%)	2(50%)
Cephalotin	4	0	2(50%)	2(50%)
Cloxacillin	3	0	2(66.7%)	1(33.3%)
Lincomycin	3	1(33.3%)	2(66.7%)	0

Table 5 Risk factors associated with nosocomial infection in pediatric patients, Tikur Anbessa Hospital, August 2002-December 2003.

Variables		Control		Case		OR	P value	Adjusted OR (95% CI)
		Number	%	Number	%			
Age in month	1-11	35	15.8	31	27.9	2.21(1.03-4.79)	0.042	6.373(2.16-18.83)
	12-59	85	38.3	33	29.7	0.97(0.48-1.97)	0.937	0.741(0.296-1.856)
	60-119	52	23.4	27	24.3	1.30(0.61-2.76)	0.577	1.155(0.421-3.169)
	120-180	50	22.5	20	18	1		
Weight for height	>=90%	143	66.2	58	54.7	1		
	80-89%	44	20.4	21	19.8	1.18(0.62-2.24)	0.709	0.94(0.41-2.18)
	70-79%	22	10.2	19	17.9	2.13(1.02-4.46)	0.0447	3.68(1.46-9.30)
	<70%	7	3.2	8	7.6	2.82(0.88-9.13)	0.09	2.28(0.52-10.04)
Peripheral intravenous line	No	23	10.4	3	2.7	1		
	Yes	199	89.6	108	97.3	4.16(1.15-17.82)	0.025	7.566(1.009-56.708)
Use of antineoplastic chemotherapy	No	215	96.8	89	80.2	1		
	Yes	7	3.2	22	19.8	7.59(2.94-20.35)	0.000001	0.006(0.00-12)
Duration of stay before discharge	<7 days	74	33.3	2	1.8	1		
	8-14 days	62	27.9	19	17.1	11.34(2.4-73.44)	0.00032	13.43(2.65-68.08)
	15-21days	40	18	16	14.4	14.8(3.02-98.38)	0.00005	9.29(1.74-48.64)
	>21 days	46	7.2	74	66.7	59.52(13.41-368.48)	0.00000	70.15(13.96-352.46
Service	General surgery	72	32.4	16	14.4	1		
	Pediatrics	90	40.5	38	34.2	1.9(0.94-3.89)	0.079	1.68(0.42-6.71)
	Plastic surgery	10	4.5	2	1.8	0.90(0.0-5.09)	0.785	1.21(0.19-7.56)
	ENT	14	6.3	4	3.6	1.29(o.31-5.001)	0.945	1.83(0.36-9.21)
	Neurosurgery	6	2.7	5	4.5	3.75(o.85-16.41)	0.096	2.89(0.53-15.59)
	Orthopedics	21	9.5	15	13.5	3.21(1.26-8.27)	0.012	4.86(1.31-18.01)
	Burn unit	4	1.8	7	6.3	7.88(1.77-37.27)	0.003	4.89(0.93-25.83)
	Tumor therapy unit	5	2.3	24	21.6	21.6(6.47-77.05)	0.000	1778.85(0.00-34)

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