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Pattern of nosocomial infections in the special care baby unit of the Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria

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Abstract *Background:* Sepsis contributes significantly to newborn deaths in Nigeria. A significant proportion of severe infections in the newborn may be health care-related.
Objective: To determine the prevalence, types and risk factors for nosocomial infections in the Special Care Baby Unit of a Nigerian Tertiary Hospital.
Method: A cross-sectional survey of consecutively admitted infants aged 0 to 28 days with signs of infections or who developed signs of infection following admission. Infants with or without nosocomial infections were compared for the clinical and laboratory details.
Results: Out of 356 infants, 32 (8.9%) had between 1 and 3 nosocomial infections while 48 (13.5%) had community-acquired infections. Half of babies with nosocomial infections were preterm and weighed less than 2kg. A significantly higher proportion of babies with nosocomial infections were inborn ($p < 0.000$) and stayed longer than 7 days on admission ($p = 0.034$). Bacteraemia was significantly more frequent among babies with nosocomial infections ($p = 0.014$) while superficial skin and mucosal infections occurred to similar extents in both groups. Klebsiella and Proteus species were the leading isolates among babies with nosocomial infections. Nasogastric intubation was significantly more frequently performed among babies with nosocomial infections ($p = 0.045$).
Conclusion: The present study revealed that hospital acquired infection is an important cause of morbidity in the newborn unit.

Keywords: Bacteraemia; Hospital -acquired infections; invasive procedures; newborns

Introduction

Neonates are particularly susceptible to infection because of their immature immune system in addition to several invasive diagnostic and therapeutic procedures and interventions required for their management.[1-3] Studies from developed countries have reported that nosocomial infection is an important cause of morbidity and mortality among neonates despite advances in neonatal intensive care.[4-6]

A recent national epidemiological survey of newborn deaths in Nigeria suggested that severe infections were responsible for 22% of all newborn deaths in the country.[7] This is very similar to 24.8% reported from a review of newborn deaths recorded at the Olabisi Onabanjo University Teaching Hospital (OOUTH), Sagamu, Nigeria between 1996 and 2005. [8] It is also important to add that sepsis-related case fatality rate at the same centre in a study conducted between 2006 and 2008, was 32%. [9] In addition to deaths, severe infections in the newborn may also be associated with severe morbidities such as shock, necrotizing enterocolitis and meningitis which might leave severe sequelae in the survivors. Therefore, every measure required for the reduction of the burden of sepsis in the newborn needs to be put in place.

The overall contribution of nosocomial infections to cases of newborn sepsis varies in centres from different parts of the world, depending on the level of newborn care in practice. Although, referred infants are mostly affected by severe infections,[9] inborn babies may also be infected vertically or horizontally. The former commonly presents as Early-Onset sepsis while the latter commonly presents as Late-Onset sepsis or Nosocomial Sepsis. [10]

Surveillance reports between 1999 and 2001 at OOUTH, Sagamu, Nigeria revealed that the neonatal unit recorded all the cases of hospital-acquired infection in the pediatric service of the hospital. [11] The Special Care Baby Unit

(SCBU) of the hospital, with 20 cot and incubator spaces, was established as a sub-unit of paediatric service in 1989. The unit offers basic care for acutely-ill newborn infants while facilities for intensive care such as mechanical ventilation, blood gas analysis and parenteral nutrition are not available. The unit receives high -risk infants delivered in the maternity unit of the hospital as well as infants referred from the lower levels of health care located within and outside Sagamu community. Thus, the unit is compartmentalized with inborn infants separated from referred infants to prevent cross-infections. A recent study conducted at the same centre between 2006 and 2008 showed that referred babies and inborn babies constituted 54.5% and 45.5% respectively of the cases of Late-Onset sepsis in the unit.[12]

The role of surveillance as an important tool in the prevention of hospital- acquired infection has been emphasized. [10] This study is a step in that direction as it was designed to evaluate the prevalence, types and some of the factors related to health care associated infections in the SCBU of OOUTH, Sagamu, Nigeria.

Method

This cross-sectional survey was conducted in the Special Care Baby Unit (SCBU) of OOUTH, Sagamu, Nigeria between January and September, 2008. As mentioned above, this unit only provides basic care for high-risk infants with medical disorders such as preterm birth, low birth weight and the associated problems, intrapartum-related injuries, jaundice, infections and minor surgical conditions. The unit is managed by at least two Consultants, resident doctors, medical interns and nurses, most of whom are specialized in paediatric care. The scope of care available for infants with sepsis had been described in detail in another publication. [9] In addition, first-line antibiotics employed in the treatment of newborn sepsis in the unit include cefuroxime and gentamicin based on previous reports of antibiogram in the unit. [13] The choice of antibiotics is usually tailored to the pattern of antibiotic susceptibility reported by the laboratory. Microbiologic services available in the hospital include routine bacteriologic analysis of specimens; facilities for anaerobic bacterial, fungal or viral cultures are not routinely available.

The study population consisted of consecutive infants aged 0 to 28 days admitted with signs of infection or who developed features of infection whilst on admission. The latter group was in turn, sub-divided into those who developed signs of infection within or after the first 48 hours of admission. Informed consent was obtained from the primary care givers available at the point of recruitment into the study.

Demographic and clinical data were obtained from all the infants admitted into the study. These data included age and body weight on admission, gender, estimated gestational age (EGA), place and type of delivery

Others included the type of infection, clinical findings, procedures, interventions and device use, as well as the results of bacteriologic examination of specimens. Cases of nosocomial infections were determined using modified CDC definitions.[14] Inborn infants were the babies delivered in OOUTH while the out-born infants were referred babies. Data were analyzed using SPSS 17.0 statistical package. Babies with nosocomial infections were statistically compared with babies with community acquired infections using clinical characteristics, pattern of infections and spectrum of isolates. Proportions and mean values were compared using the Chi-Squared test and Student's t-test respectively. P-values less than 0.05 defined statistical significance.

Result

During the study period, 356 infants were admitted into the unit of whom 80 (22.5%) had infections. They consisted of 50 male and 30 female infants with male-to-female ratio of 1.7:1. The 80 infants with infections had a mean EGA of 35.9 ± 3.9 weeks and a mean weight of 3.3 ± 0.9kg.

The general characteristics of these 80 infants are depicted in Table 1. Most of the infants were males (62.5%), term (60.0%), single ton (87.5%), out-born (72.5%), weighed > 2.0kg (58.8%) and were hospitalized for > 14 days (52.5%). The frequency of obvious infections in this population varied between one and three with a mean of 1.6 ± 0.6.

Forty-eight babies (60.0%) had community-acquired infections while 32 (40.0%) had nosocomial infections. The infants with nosocomial infections constituted 8.9% (32/356) of the total admissions while infants with community acquired infections constituted 13.5% (48/356) of the total admissions. The babies with community-acquired infections had higher EGA compared with those who acquired infection in the hospital. This difference lacked statistical significance (36.6 ± 3.3 weeks Vs 34.9 ± 4.5 weeks; t = 1.95, p = 0.055). Similarly, the mean weight of babies admitted with infections was similar to that of babies with nosocomial infections (3.4 ± 0.8kg Vs 3.2 ± 0.9kg; t = 1.04, p = 0.301).

Table 1: Clinical characteristics of 80 babies with infections

Characteristics		Frequency (%)
Type of birth	Singleton	70 (87.5)
	Multiple	10 (12.5)
Place of birth	Inborn	22 (27.5)
	Out-born	58 (72.5)
Gender	Female	30 (37.5)
	Male	50 (62.5)
Gestational Age (weeks)	< 28	5 (6.2)
	29 – 32	13 (16.3)
	33 – 36	14 (17.5)
	> 37	48 (60.0)
Birth weight (kg)	0.5 – 1	2 (2.5)
	1.1 – 1.5	16 (20.0)
	1.6 – 2.0	15 (18.8)
	> 2.0	47 (58.9)

Comparison of the babies admitted with and without obvious infections

Table 2 depicts the comparison of the clinical details of babies admitted with infections and babies with nosocomial infections. A significantly higher proportion of babies admitted with infections were out-born ($p = 0.000$) and stayed for 7 days or less on admission ($p = 0.034$). Higher proportions of babies hospitalized with obvious infections also had records of prolonged rupture of membrane, prolonged labour and history suggestive of asphyxia but without statistical significance. Preterm birth, weight on admission $\leq$ 2kg, multiple gestation, abdominal delivery and requirement for intubation at birth had no statistical association with development of nosocomial infections.

Table 2: Comparison of babies with and without obvious Infections

Parameters	Babies admitted with infections (n = 48)	Babies with nosocomial infections (n =32)	P-values
Male sex	29 (60.4)	21 (65.6)	0.637
Preterm birth	16 (33.3)	16 (50.0)	0.136
Weight $\leq$ 2kg	17 (35.4)	16 (50.0)	0.194
Multiple births	6 (12.5)	4 (12.5)	1.000
Out-born	42 (87.5)	16 (50.0)	0.000
Caesarean Section	10 (20.8)	10 (31.3)	0.292
PROM*	15 (31.2)	6 (18.8)	0.213
Intubation at birth	3 (6.3)	3 (9.4)	0.603
Prolonged labour	12 (25.0)	6 (18.8)	0.512
Presence of asphyxia	20 (41.7)	11 (34.4)	0.512
Duration of hospitalization $\leq$ 7 days	14 (29.2)	3 (9.4)	0.034

*Pr olonged Rupture of Membranes

Pattern of infections among babies admitted with or without obvious infections

Bacteraemia was significantly more frequent among babies with obvious nosocomial infections ($p = 0.014$) as shown in Table 3. The prevalence of ophthalmia, omphalitis, phlebitis, superficial skin infections and gastrointestinal tract infections were similar in both groups. However, respiratory tract and urinary tract infection was remarkably rare in both groups.

Comparison of the pattern of clinical isolates among babies with obvious infections

In Table 4, Gram-negative bacilli, particularly Klebsiella species, were the leading isolates among babies in both groups. Staphylococcus aureus and Klebsiella species were the leading isolates among babies admitted with infections whereas Klebsiella and Proteus species were the leading isolates among babies with nosocomial infections. None of the comparisons of isolates reached the level of statistical significance.

Table 3: Comparison of pattern of infections among babies admitted with infections and babies with nosocomial infections

Infections	Babies admitted with infections (n = 48)	Babies with nosocomial infections (n = 32)	p-values
Ophthalmia	13 (27.1)	8 (25.0)	0.836
Omphalitis	11 (22.9)	4 (12.5)	0.242
Phlebitis	11 (22.9)	5 (15.6)	0.424
Superficial skin infections	6 (12.5)	3 (9.4)	0.665
Bacteraemia	2 (4.2)	7 (21.9)	0.014
Septicaemia	27 (56.3)	15 (46.9)	0.411
Respiratory infections	3 (6.3)	2 (6.3)	1.000
Urinary tract infections	1 (2.1)	0 (0.0)	0.310
Gastrointestinal infections	7 (14.6)	3 (9.4)	0.490

Table 4: Comparison of bacterial isolate types among babies with and without nosocomial infections

Isolates	Babies admitted with infections (n = 48)	Babies with nosocomial infections (n = 32)	p-values
Atypical coliforms	3 (6.3)	2 (6.3)	1.000
E.coli	2 (4.2)	2 (6.3)	0.675
Klebsiella spp.	8 (16.7)	10 (31.3)	0.126
Proteus spp.	2 (4.2)	5 (15.6)	0.076
Pseudomonas spp.	3 (6.3)	1 (3.1)	0.530
Staph. Aureus	8 (16.7)	4 (12.5)	0.609

Comparison of the possible factors predisposing babies to nosocomial infections

Table 5 shows that nasogastric intubation was more frequently performed among babies with nosocomial infections with statistical significance ($p = 0.045$). Although intravenous infusion was more frequently carried out among babies admitted with obvious infections, the difference did not reach level of significance. Intravenous cannulation, airway suctioning, assisted ventilation and clinical procedures like minor surgeries and blood transfusions were performed at similar rates in both groups of babies.

Table 5: Comparison of the procedures which may predispose to nosocomial infections

Procedures	Babies admitted with infections (n = 48)	Babies with nosocomial infections (n = 32)	p-values
Nasogastric Intubation	19 (39.6)	20 (62.5)	0.045
IV Cannulation	29 (60.4)	21 (65.6)	0.637
Blood transfusion	16 (33.4)	14 (43.8)	0.346
Phototherapy	18 (37.5)	17 (53.1)	0.168
Intranasal oxygen	21 (43.8)	11 (34.4)	0.402
Suctioning	20 (41.7)	13 (40.6)	0.926
Assisted ventilation	17 (35.4)	8 (25.0)	0.325
Minor surgery	1 (2.1)	1 (3.1)	0.770
Intravenous infusion	11 (22.9)	3 (9.4)	0.118

Discussion

The prevalence of nosocomial infections in the present study was 8.9%. This is comparable to 7.8% reported in a neonatal intensive care unit (NICU) in Singapore [15] but remarkably lower than 19.2% and 21.4% reported in a Saudi NICU and an Egyptian NICU respectively. [16, 17] In addition, the prevalence of hospital-acquired infections in different settings in Europe and North America has been reported to vary between 7% and 24%. [14, 18] Therefore, the relatively lower prevalence of 8.9% in the present study might reflect the non-NICU setting of the study. It is important to add that the present study was conducted in a SCBU rather than NICU where nosocomial infections are expectedly more common. The difference lies in the tendency to use more invasive procedures such as endotracheal intubation, mechanical ventilation and total parenteral nutrition in NICU rather than SCBU. [10] In addition, infection control practices have been institutionalized in our hospital since 1999 when the Infection Control Unit was established. This unit oversees the teaching and adoption of measures relevant to the prevention of nosocomial infections by all cadres of health workforce.

A large number of the infections in the present study were blood stream infections. This is consistent with the findings in other studies in North America and Europe[18] and few developing countries.[15-17] Blood stream infections are frequently reported in nosocomial neonatal infections in the intensive care unit.[19] This is closely related to the use of intravenous catheters both peripheral and central. The prominent role of superficial infections like ophthalmia, phlebitis and omphalitis in the developing world setting has been extensively described. [10] Cost-effective interventions such as stringent hand washing techniques, liberal use of disinfectants and prevention of overcrowding are useful in the control of these infections. [10, 20, 21]

Most of the pathogens isolated from both groups of neonates were Gram negative bacilli. This finding is consistent with other reports that Gram negative bacilli are the main pathogens in neonatal hospital acquired infections. [19, 22,23] Unlike other studies which reported the predominance of Coagulase Negative Staphylococcus (CONS) [15, 16] there was no isolation of CONS in the present study. This is difficult to explain since another study from the same centre had earlier reported the role of CONS in LOS.[12] The major challenge poised by these pathogens lies in the high incidence of multi-drug resistance resulting in limited therapeutic options and high morbidity and mortality. [9] This calls for judicious use of antibiotics in newborn units to minimize the emergence of resistant strains of pathogens. Therefore, neonatal units need to have evidence-based protocols on the use of antibiotics.

In the present study, the risk of nosocomial infection was not significantly higher among preterm babies and babies weighing less than 2kg unlike previous reports. [15] A previous study at the same centre suggested that the prevalence of Late-Onset sepsis was higher among infants delivered at EGA less than 32 weeks and weighing less than 1.5kg. [12] Ordinarily, such small babies tend to have greater degree of immune immaturity and are more likely to require invasive procedures and stay longer on admission. Although, previous studies have suggested associations between mechanical ventilation and intravenous cannulation, [15, 16] that observation was not made in the present study. We speculate that the observation in the present study might be related to the small number of infants studied.

The significant association between nasogastric intubation and nosocomial infection in the present study may be borne out of the fact that this population of infants are often too small or too ill to feed by direct sucking. Therefore, tube feeding becomes a ready vehicle for nosocomial sepsis particularly when the tube is left in-situ for a long time just as total parenteral nutrition has been reported to be associated with nosocomial sepsis in other settings. [16] For resource-poor settings where shortage of nursing personnel might militate against the insertion of a tube prior to every episode of feeding, frequent replacement of in-situ nasogastric tubes may be effective in the prevention of tube feeding-related sepsis.

Conclusion

In conclusion, the present study revealed that hospital acquired infection is an important cause of morbidity in the newborn unit. The prevalence and types of nosocomial infections in a Nigerian Special Care Baby Unit are comparable to what had been reported in Neonatal Intensive Care Units in many parts of the world. This suggests that even in the absence of major invasive procedures, the morbidities associated with nosocomial infections in a Special Care Baby remains significant. It is important that every newborn unit has a written policy on guidelines for the control of hospital care-related infections. This may include training of all cadres of staff, environmental and equipment cleanliness, stringent control of antibiotic use, stringent hand hygiene practices and minimal use of invasive procedures. It is important that the existing infection control programmes should be strengthened.

Author's Contributions
OOA and FMB conceived and designed the study. OTA analyzed and interpreted the data. All the authors drafted and edited the manuscript. All the authors made substantial contributions to the intellectual content of the manuscript.
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