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Nosocomial infection surveillance in an Egyptian neonatal intensive care unit

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SUMMARY

Background: Nosocomial infections (NIs) have become a matter of major concern and an important cause of morbidity and mortality in neonatal intensive care units (NICUs).
Aim: The objective of this study was to determine the incidence, anatomical sites and causative organisms of NI in an Egyptian NICU, and to assess the impact of NI on length of stay and mortality.
Methods: This was a descriptive hospital-based study carried out for 12 months in the NICU of the Mansoura University Children's Hospital. NI rates were calculated using different denominators (overall nosocomial infection rate, nosocomial infection incidence density, device-specific infection rates and device-days infection rates).
Findings: Of the 238 neonates evaluated, 49 developed 51 nosocomial infective episodes, equating to an incidence rate of 21.4% or 13.8 infections per 1000 bed-days. Pneumonia was the most frequently occurring infection (11.3%) followed by bloodstream infection (8.8%). The most frequently isolated organisms were *Klebsiella* spp. (33.3%) followed by *Escherichia coli* (21.6%). NIs were associated with prolonged hospital stay.
Conclusion: NI is a significant problem in the Mansoura University Children's Hospital NICU. Gram-negative bacteria, especially *Klebsiella* spp., were the predominant causes of neonatal NI, as has been described in other studies from developing countries.

Introduction

Nosocomial infections (NIs) are a major public health problem worldwide, but particularly in developing countries. Despite intensive surveillance and preventive measures, NIs occur frequently in neonatal intensive care units (NICUs), where they are a leading cause of morbidity and mortality.[1,2] There is a wide variation in the reported incidence rates of NI between NICUs, but rates are generally higher in developing countries. In this setting, rates of at least 30% are typically found, and NI has been estimated to cause 40% of all neonatal deaths.[3]

Monitoring NI rates is increasingly regarded as an important contributor to safe and high-quality healthcare, especially in intensive care units.[4] However, there have been few studies of NI in Egyptian NICUs. The objectives of this study were to determine the incidence, sites and causative organisms of NI in the NICU of Mansoura University Children's Hospital, and to determine the impact of NI on length of stay and mortality.

Methods

The NICU at Mansoura University Hospital is a public, teaching and tertiary care referral unit with an annual

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admission rate of 500–600 newborns. It receives newborns from the hospital obstetric department and also serves as a referral centre for several hospitals and healthcare centres in Dakahlia Governorate.

During the 12-month study period (from 1 November 2009 to 31 October 2010), 238 neonates who were free from infection at time of admission were admitted to the NICU for ≥48 h. Of these, 9.2% were extremely low birth weight (<1000 g) and 24.4% had birth weights between 1000 and 1500 g. Gestational ages were <29 weeks in 7.6%; 29–33 weeks in 26.1%; and 34–36 weeks in 34.5%. Mechanical ventilation and parenteral feeding were used in 48.7% and 71.4% of the neonates for at least part of their NICU admission.

These infants were monitored prospectively by the attending hospital staff for the occurrence of nosocomial infections, using the following standardized definitions based on those developed by the US Centers for Disease Control and Prevention (CDC)[5]:

- Bloodstream infection (BSI): the presence of the pathogens in blood culture with clinical signs of infection. BSI was considered to be central venous catheter (CVC)-related when an organism of the same species, and with the same antibiotic sensitivities, was isolated from the catheter segment and peripheral blood.
- Pneumonia: unstable respiratory conditions with chest radiographic examination that shows new or progressive infiltrate and an organism isolated from blood culture or endotracheal aspirate. Pneumonia developing ≥48 h after initiation of mechanical ventilation was considered to be ventilator-associated.
- Urinary tract infection (UTI): isolation of $\geq 10^5$ organisms/mL in a urine sample collected from the bladder by in–out catheterization.

Microbiology methods

Samples (blood, cerebrospinal fluid, endotracheal tube aspirates, peritoneal fluid, urine, etc.) were collected and processed according to Koneman *et al.* and processed using standard methods.[6,7]

Infection control methods

A trained infection control nurse was available at the unit at all times. The NICU had a hand hygiene policy, but audits of staff compliance were not undertaken. Disinfectant dispensers filled with Betadine 7.5% were provided at hand-wash basins, and clean towels for hand-drying were sufficiently available. Sterile and clean non-sterile gloves were used during neonatal care according to the procedures performed. CVCs were inserted and cared for using care bundle protocols. Umbilical vein catheters were used for a maximum of 14 days provided they were in a satisfactory position with no fluid leaks. If redness developed around the exit site of any intravascular catheter it was changed immediately. Urinary catheters were routinely changed every 72 h. Surveillance cultures were not routinely undertaken, but were sometimes used when an outbreak was suspected.

Data analysis

To help facilitate inter-hospital comparison we used CDC-recommended indices to measure infection rates: overall nosocomial infection rate (total number of NIs per total number of discharges); nosocomial infection incidence density (total number of NIs per 1000 patient-days); device-specific infection rates (number of device-related infections per number of devices utilized): and device-days infection rates (number of device-related infections per 1000 device-days).[5] Data were analysed using SPSS version 16 (SPSS Inc., Chicago, IL, USA). The chi-square test was used for comparison between mortality in the infected and non-infected neonates. Mann–Whitney test was used to compare length of hospital stay of both groups. $P \leq 0.05$ was considered significant.

Results

Fifty-one episodes of nosocomial infections were diagnosed in 49 neonates, giving an overall nosocomial infection rate of 21.4% (two neonates had two separate infection episodes), and a nosocomial infection incidence density of 13.8 per 1000 days. Three types of infection were diagnosed: pneumonia was the most frequent (11.3%), followed by bloodstream infection (8.8%) and UTI (3.1%).

Klebsiella species accounted for 33.3% of isolates, and were the most frequent cause of both BSI and pneumonia, followed by *Escherichia coli* (21.6%). *Candida* species were isolated from 9.8% of infected neonates (Table I). No multidrug-resistant Gram-negative bacteria were detected.

Device-specific infection rates were as follows: CVC-associated BSI (18.6%), ventilator-associated pneumonia (13.6%) and urinary catheter-associated UTI (5.2%). Device infection rates were respectively 23.1, 19.0 and 15.9 per 1000

Table I
Distribution of causative agents among 51 episodes of neonatal nosocomial infection

Causative agent	No. (%) episodes of infection by site			
	BSI	Pneumonia	UTI	Total
	($N = 21$)	($N = 27$)	($N = 3$)	($N = 51$)
Coagulase-negative staphylococci	7 (33.3%)	2 (7.4%)	0	9 (17.6%)
Escherichia coli	3 (14.3%)	5 (18.5%)	3 (100%)	11 (21.6%)
Pseudomonas spp.	2 (9.5%)	7 (26.0%)	0	9 (17.6%)
Klebsiella spp.	8 (38.1%)	9 (33.3%)	0	17 (33.3%)
Candida spp.	1 (4.8%)	4 (14.8%)	0	5 (9.8%)

BSI, bloodstream infection; UTI, urinary tract infection.