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Short Communication

Group B streptococcal transmission via a prolonged colonizer in a neonatal intensive care unit

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Abstract This article reports five invasive Group B streptococcal (GBS) infections that occurred in a neonatal intensive care unit for about 3 months. This outbreak might have been associated with a prolonged GBS colonized infant and adjacent environmental contaminations. Infection control interventions prevented the additional spread of GBS infections.

Introduction

Group B streptococcus (GBS) is one of the leading causes of invasive infections in neonates.[1] Early-onset GBS disease within the first 6 days of life may be related to vertical transmission from the mother to the infant, and intrapartum antimicrobial prophylaxis could be effective to reduce the early-onset disease.[2] However, the transmission route of late-onset disease between 7 days and 3 months of life is poorly understood, and the main burden of GBS infections in neonates remains.

Outbreaks of bacterial infections have been reported in neonatal intensive care units (NICUs) with serious morbidity

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Table 1 Basic information and laboratory results of sterile fluid from cases.

Case	Delivery and admission information	Blood culture	CSF findings					
			WBC (/μL)	RBC (/mm^3)	PMNLs (%)	Protein (mg/dL)	Glucose (mg/dL)	Culture
1	GA 29^{+0} weeks, 1.19 kg Preterm management	GBS	3040	0	68	369	14	NG[b]
2[a]	GA 23^{+0} weeks, 0.61 kg Home delivery	GBS	—	—	—	—	—	—
3	GA 33^{+6} weeks, 1.73 kg 2nd of triplet	GBS	24000	10	85	658	11	GBS
4	GA 37^{+2} weeks, 2.81 kg Transfer to TTN	GBS	2400	10	90	393	16	GBS
5	GA 34^{+0} weeks, 2.22 kg 1st of twin	GBS	3360	3	79	118	36	NG[b]

[a] CSF analysis could not be done in case 2 because of the unstable clinical status.
[b] No growth.
CSF, cerebral spinal fluid; WBC, white blood cell; RBC, red blood cell; PMNLs, polymorphonuclear leucocytes; GA, gestational age; GBS, group B Streptococcus; TTN, transient tachypnea of newborn.

and high economic burden. Gram-negative bacteria cause most outbreaks in NICUs, but some gram-positive bacteria have shares.[3] Although uncommon, nosocomial transmissions of GBS can occur from healthcare workers.[4] We describe 5 serial late-onset GBS infections occurring in a NICU and the infection control measures implemented.

Methods

Hospital setting

The Jeju National University's Hospital has a level III NICU with 16 beds in a large space including 2 isolated rooms. The infants' beds are changed during their stay in the NICU depending on their clinical conditions. Our hospital had applied a weekly routine surveillance protocol to all infants who were admitted to the NICU, and the protocol was used to monitor only the colonization of *Staphylococcus aureus*.

The outbreak

Invasive GBS infections occurred in 5 neonates in the NICU between January 24 and April 8, 2018. The clinical summaries of the 5 neonates are shown in Table 1. All 5 neonates had GBS bacteremia, and 4 neonates developed meningitis. Four neonates who were clinically diagnosed with meningitis had cerebral spinal fluid (CSF) pleocytosis, but GBS was microbiologically confirmed in only 2 babies. In 2 babies, CSF analysis was performed 1 day after the administration of antibiotics because they were clinically unstable.

The first two cases involved extremely low birth weight infants, and GBS was isolated on hospital days 14 and 18, respectively. Incubators in the first two cases were located next to each other. After 40 days, a secondary case occurred, and the third GBS infection occurred on hospital day 13. Case 3 involved the 2nd infant of triplets, and the other 2 siblings were healthy. Of the triplets, only case 3 was adjacent to case 2. Case 4 and 5 infants were discharged after intensive care without complications. However, they were readmitted to the NICU because of fever and irritability 6 and 11 days after discharge, respectively. During the second hospital stay, GBS bacteremia and meningitis were confirmed in both. During the initial hospital stay of case 4 and 5, they were respectively adjacent to case 2. The brief timeline of the 5 serial GBS infections are shown in Fig. 1.

The treatments for invasive GBS infections were individualized. Penicillin and gentamicin were administered in cases 1 and 2 for 3 weeks. The patients in the latter 3 cases were treated by ampicillin and gentamicin due to the shortage of penicillin in our hospital, and the durations of treatment were 19, 18, and 19 days, respectively.

Microbiologic investigation

Clinical specimens including skin swabs from patients were grown on blood agar plates. After gram-positive cocci were noted after 1-day incubation, bacterial isolates were identified using Vitek II ID-GPC (bioMérieux, Durhan, NC, USA). The washing solutions for environmental devices in

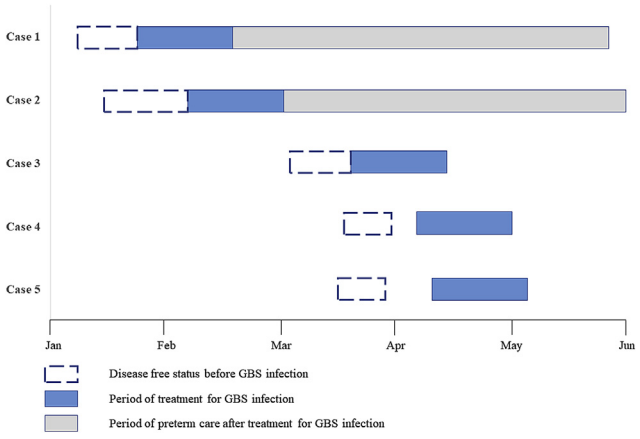

Fig. 1. Timeline showing serial *Streptococcus agalactiae* infections in NICU.

the NICU were aseptically loaded, and environmental culture was referred to the inspection center of Green Cross Medical Foundation.

We performed several methods to confirm the identity of GBS isolates. Based on the results of Vitek II ID-GPC, antimicrobial susceptibility was compared. Molecular identification of GBS was investigated depending on capsular polysaccharide-based serotypes and sequence types. GBS serotypes were determined using multiplex PCR assays by the analysis of unique band patterns.[5] Multilocus sequence typing (MLST) was performed by sequencing the internal fragments of 7 housekeeping genes. GBS sequence types were determined using the *Streptococcus agalactiae* MLST database (http://pubmlst.org/sagalactiae/).

Ethical approval

This study was approved by the institutional review board of the Jeju National University Hospital (No. 2018-11-004).

Results

Implementation of infection control measures

After the 4th GBS infection occurred, the infection control team was activated. Nasal and axillar swab cultures were obtained from all hospitalized and discharged infants sharing the hospital period. Transtracheal aspirates were investigated for available infants. Nasal and hand swab cultures were obtained from all 29 medical staff. GBS was isolated from the tracheal aspirates, axilla, and nasal mucosa in case 2. GBS was not isolated from medical staff and other hospitalized infants. Another sample of GBS was found in the nasal mucosa of the sibling of the patient in case 5. Environmental screening was performed on 22 possible sites around the GBS isolated infants. GBS was not isolated in any environmental devices except at 1 site: the valve of the suction system used in case 2.

Hand hygiene and obligative gowning were recommended for all medical staff during bedside procedures. The patient in case 2 was isolated in a separate room, and clinically stable infants were transferred to the general ward. Chlorhexidine gluconate (CHG) 0.5% sponge bathing was applied in case 2; however, GBS was not eliminated on the patient's skin until discharge. All reusable plastic bottles of the suction system in our NICU were changed to disposable products. Environmental cleaning including other medical instruments with the possibility of being contaminated was emphasized. After the intervention was initiated, no further GBS infections occurred in the NICU, and the infants were discharged.

Microbiologic investigation

Six GBS isolates (5 clinical isolates and 1 environmental isolate) were investigated to confirm the microbiological identity. All the isolates showed identical antimicrobial susceptibility. According to molecular serotyping and MLST, all the isolates were identical as serotype III, ST-17.

Discussion

This study demonstrates serial invasive GBS infections in a NICU. Although not common, the horizontal transmission of GBS might account for a substantial proportion of late-onset GBS infections. However, causative environmental sources are difficult to identify. This report revealed a GBS outbreak in a NICU that was related to a prolonged colonizer who had recovered from GBS infection. All 5 GBS isolates had identical antimicrobial susceptibility and were identical serotype III ST-17. Before the outbreak, the cases of invasive GBS infections in our hospital were one or two in a year, and all infections were community acquired. Although all GBS isolates unrelated to the outbreak were not investigated, they were different strains such as serotype III ST-89 and other serotypes.

GBS are inhabitants of the gastrointestinal and genitourinary tracts, and transmission of GBS from the mother to the infant occurs commonly before or during delivery. GBS were not isolated from all maternal vaginas, except in case 2, because the patient in case 2 was born at home without prenatal screening. Uncommonly, GBS can colonize the pharynx, skin, or environmental resources. A prolonged colonizer could be the source of reemerging GBS infections, like that in case 2. Although the costs should be compared to the benefits, our encounter of a GBS outbreak encouraged routine surveillance, including the risk of GBS to us.

CHG use in NICUs has increased for methicillin-resistant *S. aureus* decolonization and central line-associated infection.[6] CHG bathing was not the routine protocol for decolonizing GBS; we attempted to perform twice 3-day CHG sponge bathing with a 7-day interval. Although the decolonization failed, nosocomial transmission of GBS like that described in our report suggested identifying the decolonization method for GBS.

Several epidemiological studies have shown that serotype III ST-17 GBS strains are hypervirulent and strongly associated with neonatal meningitis, including those in South Korea.[7,8] MLST characteristics of GBS strains seem to be associated with anatomic sites, but ST-17 GBS strains do not have higher colonization rates or tendencies to the throat and skin.[9] The phylogenetic diversity of colonizing GBS shows that other pathogenic factors such as pilli or fibrinogen other than capsular polysaccharides affects colonization in humans.[10]

Our study implies the importance that infection control practices such as cohort isolation, hand hygiene, and environmental cleaning can prevent the outbreak of GBS. After the outbreak, our NICU has adopted more rigorous routine weekly screening measures without confining *S. aureus*. This policy can be helpful in neonates who could be vulnerable to nosocomial infections.

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Declaration of Competing Interest

All authors report no conflicts of interest relevant to this article.

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