

A 23-week gestational age neonate was born to a 16-year-old G1P0 with no prenatal care by Caesarean section because of breech presentation at Coliseum Medical Center in Macon, Georgia in April 2007. Neonatal history was significant for low Apgars (1 at 1 min, 3 at 5 min, and 4 at 10 min), a birth weight of 526 g, and encephalomalacia secondary to extensive posterior fossa hemorrhage among other complications. Following transfer, the infant was treated at Scottish Rite Hospital for necrotizing enterocolitis (NEC) from mid-April to mid-June 2007 and transferred back to her place of birth. She was then transferred in stable condition to the Medical College of Georgia (MCG) in July 2007 for evaluation and treatment of retinopathy of prematurity. Within 2 days of admission at MCG, the patient devolved apnea, bradycardia, and abdominal distension. The patient was immediately started on gentamicin, cefotaxime, and vancomycin for presumed sepsis. An abdominal X-ray (Figure 1) showed pneumatosis consistent with NEC, and blood cultures later grew 2 morphotypes of *Enterobacter sakazakii*, both susceptible to gentamicin and cefotaxime (Figure 2). Vancomycin was stopped.

Discussion

*Enterobacter sakazakii* is a yellow-pigmented, motile, peritrichous, gram-negative bacillus that has been associated with sepsis, necrotizing enterocolitis (NEC), meningitis, and brain abscesses in infants. Infants at greatest risk are those who are less than 28 days old (neonates), preterm, low-birth-weight, and immunocompromised. Here, we present a case of a 23-week gestational age neonate showing pneumatosis consistent with NEC on X-ray, whose blood cultures grew 2 morphotypes of *E. sakazakii*. The patient eventually stabilized with resolution of the pneumatosis without surgical intervention for NEC.
infant and a second (admitted to Scottish Rite, also having a positive blood culture for *E. sakazakii*) received formula, it was of the ready-to-feed variety, which is sterile (unlike powdered) and therefore not usually associated with this pathogen.\(^2\)

The organism has a biochemical profile similar to that of *Enterobacter cloacae*, but it is always D-sorbitol negative and positive for extracellular deoxyribonuclease unlike *E. cloacae*.\(^4\) In addition, *E. sakazakii* is the only *Enterobacter* species that produces yellow-pigmented colonies (with the exception of *Pantoea agglomerans*, formerly in the genus *Enterobacter*). Furthermore, its yellow-pigment is stronger at 25°C than at 36°C. *Enterobacter sakazakii* grows rapidly on trypticase soy agar with 2- to 3-mm colonies at 36°C and 24 h, 1 to 1.5 mm at 25°C and 24 h, and 2 to 3 mm at 25°C and 48 h. The organism has 2 or more distinct colonial morphologies: a dry or mucoid colony with scalloped edges and a smooth-edged colony. The first colony type is rubbery when touched by a wire loop, while the second is easily removed when touched. Finally, the species has α-glucosidase activity unlike any other species of *Enterobacter*, which may be used for rapid differentiation.

The fatality rate of *E. sakazakii* sepsis has been reported previously to be as high as 40% to 80%, but has decreased to 20% in recent years.\(^2,4\) Although not uniformly fatal, 94% of infants who do survive *E. sakazakii* meningitis suffer severe neurological sequelae, including quadriplegia, developmental delay, and impaired sight and hearing.\(^3\) The organism is uniformly resistant to ampicillin, cefazolin, and extended spectrum penicillins.\(^1\) Furthermore, increasing resistance in *Enterobacter* species has led some to suggest a different therapeutic approach, including a carbapenem or newer cephalosporin along with a second agent such as an aminoglycoside. *Enterobacter sakazakii* was first classified in 1980 as an *Enterobacter*; however, recent research has suggested a new taxonomic classification in the new genus *Cronobacter*, after the Greek god Cronos, who was said to devour his young after their birth.\(^5\) Finally, further research is needed to completely understand this complex and potentially fatal organism so that we may better appreciate its pathogenicity and optimal therapeutic approaches.

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**Figure 2** Agar plates of *Enterobacter sakazakii* morphotypes from the Medical College of Georgia (MCG). Top left: chocolate agar demonstrating colony with scalloped edges (isolate 1). Top right: chocolate agar demonstrating colony with smooth edges (isolate 2). Bottom: Mueller Hinton agar demonstrating yellow pigment (isolate 1).

**Figure 3** Dendogram of *Enterobacter sakazakii* isolates in the U.S., 2001 to 2007. Medical College of Georgia (MCG) infant highlighted in blue (2 separate arterial sticks in same child). Scottish Rite (SR) highlighted in red.
Conclusion

The Centers for Disease Control (CDC) became involved in an investigation as there was a second infant, admitted to Scottish Rite, who had a positive blood culture for *E. sakazakii* on the same day as our infant. Although both infants were admitted at Scottish Rite during their neonatal intensive care unit (NICU) course, they were not admitted at the same time, nor did they receive care from common personnel, and they were housed in 2 separate rooms within the NICU. In addition, prevalence stool cultures performed at MCG and Scottish Rite of other infants housed in the NICUs were all negative, and cultures of the ready-to-feed formula administered at the NICUs failed to grow any bacteria. Further evaluation of the cases included pulsed field gel electrophoresis (PFGE) performed by the CDC for genetic fingerprinting that showed the 2 isolates (2007-17-18 from Scottish Rite and 2007-17-31 and 32 from MCG) had different genotypes and were therefore 2 distinct, albeit temporally related, cases (Figure 3).

Our patient required ventilation and multiple platelet transfusions because of thrombocytopenia secondary to disseminated intravascular coagulation. Eventually, the patient stabilized with resolution of the pneumatosis without surgical intervention for NEC. Subsequent blood cultures were all negative, and antibiotics were stopped after the completion of a 21-day course.