

Necrotizing Enterocolitis in Term Infants

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KEYWORDS

- Necrotizing enterocolitis • Term-NEC • Risk factors • Human milk
- Narcotic withdrawal

KEY POINTS

- Necrotizing enterocolitis in term neonates is not a primary diagnosis; rather, it occurs among a subset of neonates admitted to a neonatal intensive care unit for some other illness or condition.
- Features predisposing term neonates to necrotizing enterocolitis include reduced mesenteric perfusion, as occurs with polycythemia or sepsis.
- In recent years, term necrotizing enterocolitis has been recognized among neonates undergoing abstinence from maternal opioid narcotics.
- Term necrotizing enterocolitis generally occurs among those with predisposing gastrointestinal pathology who are fed cow's milk-based formulas in volumes much greater than similar-aged breast feeding neonates receive.

INTRODUCTION

Necrotizing enterocolitis (NEC) occurs primarily among prematurely delivered infants, with an incidence inversely proportionate to gestational age at birth.¹ NEC is uncommon among full-term infants, although this has been well described in multiple reports.^{2–16} Most publications of term NEC are individual case reports or small case series, owing to the rarity of this condition at individual institutions.

In 2007 the authors reported on 30 term neonates with NEC from the Intermountain Healthcare hospitals.^{17,18} This was the largest cases series of NEC in term infants of which we were aware. These 30 were born in the 5½-year period from January 1, 2001 through June 30, 2006. In this article, the authors review these 30 and summarize the

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characteristics of another 23 born in the period from July 1, 2006 through December 31, 2011. Whereas most infants in whom NEC developed during the first epoch were admitted to the neonatal intensive care unit (NICU) for another reason such as congenital heart disease, polycythemia, or sepsis, we have encountered several infants in whom NEC developed while undergoing withdrawal from maternal opioid narcotics.

FINDINGS IN THE FIRST EPOCH (2001–2006)

During the first period studied, the Intermountain Healthcare NICUs admitted 11,523 neonates, and, of these, 5877 (51%) were greater than 36 weeks' gestation at birth. Thirty of these went on to have NEC Bell's stage $\geq$ II.^{19–21} NEC was defined by the presence of one or more of the following 3 clinical signs: (1) bilious gastric aspirate or emesis, (2) abdominal distension, (3) occult or gross blood in stool (no fissure), and one or more of the following 3 radiographic findings: (1) pneumatosis intestinalis, (2) hepatobiliary gas, (3) pneumoperitoneum. If a patient had focal gastrointestinal perforation, based on visual inspection of the bowel at the time of surgery or postmortem examination, the condition was not listed as NEC but as a focal gastrointestinal perforation. In our analysis of these 30,¹⁷ we judged that 3 findings were of potential importance in identifying the pathogenic mechanism: (1) NEC occurred exclusively among neonates already admitted to the NICU for some other reason. Thus, NEC was invariably a complication of treatment as opposed to a presenting problem. (2) Certain diagnoses, at the time of admission to the NICU, were statistically more common among those who went on to have NEC. Foremost among these were congenital heart disease (particularly ductal-dependent varieties), polycythemia, and early-onset sepsis. The authors speculated that these disorders predisposed to NEC based on reduced mesenteric perfusion. (3) This variety of NEC was much more common if the neonate was fed cow's milk-based formulas, particularly if large-volume feedings were administered (compared with the amounts usually ingested by breast-feeding neonates in the first days after birth).²²

The authors proposed that these 3 features could be united into a common pathogenesis; namely, neonates admitted to an NICU with conditions involving reduced mesenteric perfusion and fed large volumes of cow's milk formulas in the first days. Clearly, NEC developed in only a minority of neonates with these features; thus, these features were not sufficient to cause the disease. However, they were so common among the 30 in whom term NEC developed as to suggest that they were necessary, although not sufficient, for causation. On this basis, we speculated that when term neonates are admitted to the NICU with conditions likely resulting in reduced mesenteric perfusion, care should be taken not to overfeed them using cow's milk-based formulas.^{17,18}

FINDINGS IN THE SECOND EPOCH (2006–2011)

During the second period studied, the Intermountain Healthcare NICUs admitted 11,504 neonates, and, of these, 5719 (50%) were greater than 36 weeks of gestation at delivery. Twenty-two of these went on to have NEC Bell's stage $\geq$ II. As in the first epoch, NEC occurred exclusively among those who had been admitted to an NICU for some other reason. Thus, in these patients too, NEC was a complication of NICU care.

Table 1 shows the diagnoses, at the time of NICU admission, for these 52 neonates. In both epochs, the most common admitting diagnoses were respiratory distress, suspected congenital heart disease, and infection/sepsis/shock. In the second epoch, 9 of the 22 were undergoing management for withdrawal from opioid narcotics during pregnancy. No similar cases were observed during the first epoch.

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