Complications Associated with Parenteral Nutrition in the Neonate

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KEYWORDS

- Parenteral nutrition • Neonates • Lipids
- Parenteral nutrition–associated liver disease • Infections

KEY POINTS

- Although parenteral nutrition (PN) is life-saving, it is associated with myriad of complications, some of which are transient and others life-threatening, including parenteral nutrition–associated liver disease (PNALD) and central line–associated bloodstream infections (CLABSIs).
- Although fish oil–based lipid emulsions can biochemically reverse PNALD, clinicians should bear in mind that the development and progression of PNALD is multifactorial.
- It remains to be determined whether dose reduction of lipid emulsions can prevent PNALD without sacrificing growth and neurodevelopment.
- The phytosterol, long-chain polyunsaturated fatty acid, and antioxidant content of intravenous lipid products seems to play an important role in the pathogenesis of PNALD.
- Research is needed with regard to optimizing the PN content for the neonatal population so as to safely promote growth and neurodevelopment.

INTRODUCTION

Parental nutrition (PN) is an essential part of the medical management of critically ill neonates. The primary goals of PN are to maintain hydration and electrolyte balance, and to promote growth and neurodevelopment without adverse complications. For a myriad of reasons, up to 70% of neonates in the neonatal intensive care unit (NICU) are prescribed PN at some point, and approximately 16,000 children receive PN in the home setting in the United States (**Box 1**).[1,2] Without PN, children who are unable to consume sufficient enteral nutrition would succumb to malnutrition, dehydration, and electrolyte derangements.

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Box 1
Neonatal populations at high risk for complications secondary to parenteral nutrition (PN)

- Premature neonates
  - Feeding intolerance
  - Necrotizing enterocolitis
- Abdominal wall defects
  - Gastroschisis and omphalocele
- Motility disorders
  - Hirschsprung disease and total aganglionosis
- Intestinal obstructions
  - Atresia
  - Pseudo-obstruction
- Malabsorption
  - Surgical short bowel syndrome (ie, necrotizing enterocolitis)
  - Enterocyte disorders (ie, tufting disorders and microvillus inclusion disease)
- Neonates with poor intestinal perfusion
  - Cyanotic congenital heart disease
- Other congenital disorders
  - Congenital diaphragmatic hernia

Although outcomes in poorly resourced countries do not mirror what has been witnessed in well-resourced countries, PN has undoubtedly contributed to the improved survival of infants with gastrointestinal disorders and premature neonates worldwide.[3–6] The survival rate of neonates born in the United States with gastroschisis is approximately 90% to 97%.[7,8] By comparison, mortality rates in poorly resourced countries vary between 40% and 100% depending on surgical and medical treatments including the availability of PN.[3,5] Despite benefits, PN does not come without complications. Whereas some of these complications are transient with recovery, others are associated with an increased risk of morbidity and mortality, specifically parenteral nutrition–associated liver disease (PNALD) and central line–associated bloodstream infections (CLABSIs) (**Fig. 1**).[2] The purpose of this review is to summarize some of the commonly encountered complications associated with PN in the neonatal population.

METABOLIC COMPLICATIONS

Lipid Intolerance

Lipid emulsions provide long-chain polyunsaturated fatty acids (LC-PUFAs), which are important for a multitude of reasons; they maintain the integrity of the cell membrane and serve as precursors to eicosanoids and prostanoids (**Fig. 2**).[9,10] The United States Food and Drug Administration (FDA)-approved and most frequently prescribed intravenous lipid product in the United States, Intralipid® 20% (Frensenius Kabi, Uppsala, Sweden), is derived entirely from soybean oil (SO), which mainly contains omega-6 fatty acids. SO contains the essential LC-PUFAs, linoleic and α-linolenic acid, but lacks the downstream products, arachidonic acid (ARA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA), which are important for cerebral and retinal