Intravenous fat emulsions: a neonatologist's point of view

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INTRODUCTION

Survival of premature neonates has increased markedly over the past 10 years. This is related to advances in knowledge as well as an increase of sophisticated equipment improving both the diagnosis and treatment of neonatal problems. The advances have improved care of respiratory failure, thermoregulation, fluid and electrolyte balance, and maintenance of energy needs. A shift in focus has occurred toward other problems of clinical concern during the neonatal period such as infections, necrotizing enterocolitis (NEC) and the consideration of how to best nourish the rapidly growing premature neonate. Last year our neonate survival for very-low-birth-weight (VLBW) infants (<1500 g) was 80%.

The average weight of a fetus reaches 1000 g around the 27th week of gestation1 and will double in the subsequent 5 weeks. During that period there will be an increase of 120 g of protein, 10 g of mineral, and 120 g of fat. The remaining weight is due to water accretion. If a neonate is born prematurely during this period of rapid growth, many argue that it should be nutritionally supported to continue this intrauterine rate of growth. Often the neonatologist is confronted with a VLBW infant who, because of extreme immaturity and serious medical problems, cannot be adequately nourished according to these standards during the first days or weeks of life. Attempts to provide nutritional support under conditions where enteral feedings may not be possible or adequate, have led to the use of either total parenteral nutrition (TPN) or parenteral supplementation in those neonates who are able to take some enteral feedings but not enough to satisfy their total requirements.

This paper will review our clinical experience with the recently released group of fat emulsions as a supplement to parenteral feedings. A recent national survey of neonatal intravenous alimentation practices revealed that...
87% or 211 of 242 responding hospitals were using fat emulsions in their neonatal nurseries³.

The risks of fluid overload and problems with infusion sites limit the quantity of solution that can be infused safely into the peripheral veins of these VLBW infants when using glucose-amino acid mixtures. A further limitation is that the VLBW infant may be intolerant of glucose⁴,⁵. The intravenous fat preparations have the highest caloric density of any nutrient and are also isotonic, exerting negligible osmotic effects. The possibility of their addition to peripheral vein regimens has made them an attractive alternative energy source for the neonate.

Despite the extensive use of these lipid emulsions over the past decade, many questions about their efficacy and potential hazards remain unanswered and led to a recent statement by the American Academy of Pediatrics about their use in paediatric patients⁶.⁷

A review of the available fat preparations and the metabolism of parenterally administered lipid is covered in other chapters. This paper will review specific considerations of fat emulsions as they apply to the neonate and include our own clinical experience with these emulsions.

**PREVENTION AND CORRECTION OF ESSENTIAL FATTY ACID DEFICIENCY (EFAD)**

There are two functions for fat as part of a total parenteral nutrition (TPN) regimen. The first is its use in small amounts as a source of linoleic acid to prevent or treat essential fatty acid deficiency (EFAD). The second is when fat is given in relatively large amounts as a partial replacement for glucose as a major source of calories.

Four decades ago Holt and co-workers demonstrated that intravenous fat emulsions had therapeutic value⁷. They observed a weight gain of 20–37 g/day in a series of malnourished infants receiving 1–2 g of lipid per kilogram bodyweight by vein. Hansen first reported human EFAD in full-term infants fed a skim milk formula containing less than 0.1 OJo of energy as linoleic acid for 6 weeks⁸. The infants developed a dry, scaly skin condition while their plasma fatty acid analysis showed a triene/tetraene (T/T) ratio of 1.55 compared to a ratio of 0.06 for control infants fed human milk. Soderhjelm and co-workers subsequently reported that when a diet was devoid of linoleic acid, the T/T ratio attained a value as high as 5.0 in 2–4-month-old infants⁹. Friedman and co-workers studied the effect of fat-free alimentation on five sick newborns, four of whom were less than 32 weeks in gestation. All of these neonates developed biochemical evidence of EFAD during the first week of life – the smallest neonate did so by the second day¹⁰.

Figure 15.1 is from a study we performed in which seven neonates were studied for a minimum of 2 weeks while they were maintained exclusively on