Chapter 2
Nutrition and Caloric Requirements for Infants and Children

Nutrition Requirements

- Nutrient requirements for infants and children include the following:
  - Energy (measured as cal/kg/d)
  - Carbohydrates
  - Water
  - Minerals and trace elements
  - Protein
  - Vitamins
  - Fat
- The ideal energy ratio provides:
  - 65% of the energy as carbohydrates
  - 35% as lipids
- Most infants need 100–120 cal/kg/d for adequate growth. Some need up to 160–180 cal/kg/d.
- The primary goal in total parenteral nutrition (TPN) is to provide energy and nutrients in sufficient quantities to allow normal growth and development.
- The maximum dextrose concentration that can be delivered safely through a peripheral vein is 12.5%.
- A 15–20% dextrose concentration can be used in the presence of central venous line.
- At least 3% of the total energy should be supplied as essential fatty acids. This can be accomplished by providing a fat emulsion (e.g., Intralipid, Liposyn), 0.5 g/kg/day, 3 times per week.
- Fat emulsions provide about 37.8–42 kJ/g.
- Parenteral fat emulsion is usually provided as a 20% lipid emulsion made from soybeans (e.g., Intralipid).
- Intralipid is a concentrated source of energy with a caloric density of 8.4 kJ/mL (for 20% Intralipid).
- Lipids play a primary role in supporting gluconeogenesis in parenterally fed preterm infants.
- Most practitioners start with 0.5–1.5 g/kg/d on the first day and increase steadily to 3–3.5 g/kg/d.
  - Term infants need 1.8–2.2 g/kg/d along with adequate nonprotein energy for growth.
  - Preterm very low birth weight (VLBW) infants need 3–3.5 g/kg/d along with adequate nonprotein energy for growth.
  - Once protein intake has been started, calcium and phosphorous should be added to TPN.
  - Calcium and phosphorous need to be concurrently administered for proper accretion.

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- Take care to ensure that solubility is not exceeded; if this happens, calcium and phosphorous may spontaneously precipitate.
- Supplemental magnesium should be added to TPN once protein has been added.

Caloric Requirements

- Carbohydrates: 45%
- Lipids: 40%
- Proteins: 15%
  - 0–1 years→90–120 kcal/kg/day
  - 1–7 years→75–90 kcal/kg/day
  - 7–12 years→60–75 kcal/kg/day
  - 12–18 years→30–60 kcal/kg/day

Carbohydrates

The caloric density of carbohydrates in a solution is 3.4 kcal/g glucose.

D10%W solution has 10 g glucose/100 mL and provides (10 gm × 3.4 kcal/g) 100 mL = 0.34 kcal/ml. (D12.5% can be given through a peripheral line and D20% should be given through a central line.)

Fat

- Fat is used as an energy source and to provide essential fatty acids (linoleic and linoleic acid).
- The caloric density of fat in a solution is 9 kcal/g.
- 20% intralipids (20 g fat/100 ml fluid) solution has a caloric density of 2 kcal/ml.

Guidelines for infusion of 20% intralipids (g/kg/day) are provided in Table 2.1.

- Monitor the effect of infusion by measuring the serum triglyceride level. The goal is < 200 mg%.
- Caution should be used in infusing fat emulsion in premature infants with pulmonary insufficiency, liver failure, jaundice, and coagulation disorders.

Protein

- The amino acid compositions for neonates, children, and adult TPN differ as there are some amino acids that are essential during the early phases of life.
- Protein requirements for growth and repair are age dependent.
- Protein requirement (q/kg/day):
  - Premature-term neonate 0–1 month 3.0–3.5
  - Infant (1–12 months) 2.5–3.0
  - Children 1.5–2.5
  - Adolescents 1.0–1.5

Table 2.1 Guidelines for infusion of 20% intralipids (g/kg/day)

Initial	0.5	1	1
Increase daily by	0.25	0.5	0.5
Maximum dose	3	4	2

- The total calories to nitrogen ratio of the TPN formulation has a great impact on the optimal utilization of the carbohydrate calories and potentially on the incidence of TPN-associated liver disease.
- Ideally, it ranges from 150 to 180:1.

Electrolytes

Na^+	3–4 mmol/kg/day.
K^+	2–3 mmol/kg/day.
Ca^+	0.5–1.5 mmol/kg/day.
Mg^+	0.5 mmol/kg/day.
Cl^-	3–4 mmol/kg/day.
Phosphate	0.5 mmol/kg/day.

Vitamins and trace elements

- Vitamins A, D, E, and K are fat soluble.
- Vitamins B-1, B-2, B-6, B-12, C, biotin, niacin, pantothenate, and folic acid are water soluble.
- Vitamin supplementation should be started as soon as protein is added to TPN.
- Trace elements: zinc, copper, and chromium.

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