

PARENTERAL NUTRITION

- Marasmus: simple starvation without metabolic stress (e.g. patients with short-gut syndrome who are otherwise healthy)
 - a condition of malabsorption.
 - Definition:
 - >10% loss of body weight
 - serum albumin >3.5 mg/dl
 - total protein >5.0 mg/dl
 - indicating preservation of visceral protein stores
- Kwashiorkor: a condition brought on by a diet consistently deficient of protein
 - cachexia brought on by the stress response (**much** more common in hospitalized patients)
 - Definition:
 - <10% loss of body weight, but with serum albumin <3.5 mg/dl and total protein <5.0 mg/dl.
- Mixed marasmus-kwashiorkor: >10% loss of body weight with hypoalbuminemia and hyoproteinemia. Treated like simple kwashiorkor.

The metabolic effects of kwashiorkor:

TNF, IL-1,2,6, IFN- γ stimulate:

- Hypothalamic-pituitary-adrenal axis
- Thyroidal axis
- Metabolism of hepatocyte, adipose, and muscle tissue metabolism.

Numerous futile cycles ensue that waste vital energy:

- Peripheral glycolysis with hepatic gluconeogenesis
- Fatty acid oxidation with lipogenesis (citrate from the Krebs' cycle)
- Cytokines inhibit albumin synthesis and stimulate hepatic lipid accumulation

Indications for use of parenteral nutrition:

Any patient

- with a permanently non-functional alimentary tract,
- with a non-functional alimentary tract not expected to recover for 5-7d,
- with a functional tract not able to meet energy and protein needs enterally

Although controversial, the following may also be considered:

- perioperatively in a moderately-to-severely malnourished patient,
- before BMT once oral intake is inadequate
- before or during aggressive chemotherapy
- AIDS patients with cachexia and abnormal GI function

Risks:

- Risks of central line placement
- Metabolic dysfunction (hyperglycemia, electrolyte abnormalities, fatty liver, steatosis, cholestasis)
- Liver failure

TPN Composition:

- Today's TPN is a "3 in 1" solution containing carbohydrates, proteins as well as lipids.
- Reduces the need for piggyback
- creates a hyperosmolar environment to decrease risk of bacterial infection and
- allows for safe, continuous use of lipids.
 - Calorie requirements are figured out and are then divided into nonprotein (carbohydrates and lipids) and protein.
 - Then micronutrients and other disease-specific modifications are incorporated.
 - Then, electrolytes, total volume and infusion rates are computed.
 - The average male and female require ~2300 kcal/d and 1800 kcal/d, respectively.
 - Or a formula of 20-30 kcal/kg body weight can be used.
- CARBOHYDRATES (3.4kcal/g)
 - Infuse at a rate no faster than 2-5 mg/kg per minute (otherwise the infusion rate exceeds the liver's ability to oxidize the carbohydrates.
 - Hyperglycemia is assoc with: impaired immune function, increased nosocomial infection and faster tumor growth.
 - Carbohydrate overfeeding can lead to fatty infiltration of liver.
 - Use an amount between 100 g/day (to prevent ketosis) and 200 g/day.
- LIPIDS (10 kcal/g for a 20% emulsion)
 - Essential fatty acids are contained in the lipids.
 - However, lipids cause impaired RED function and organ dysfunction
- AMINO ACIDS (4.0 kcal/day)
 - Necessary to prevent muscle-wasting states as well as substrates for IG, acute-phase reactants, and other essential products.
 - In theory, by supplying enough carbohydrates and lipids to satisfy the body's caloric need (as well as suppression of gluconeogenesis and muscle breakdown), the amino acids given via TPN can be used solely for protein synthesis and not as substrates that are used in oxidation to create energy.
 - A benign increase in BUN can be expected.

Macronutrient requirements		
	Standard Range	Maximum
Calories kcal/kg/day	Infants = 90 - 100 Children = 70 - 100 Adolecents = 40 - 55 Adults = 28 - 30	Adults = 40
Protein g/kg/day	Infants = 2.0 - 2.5 Children = 1.5 - 2.0 Adolecents = 0.8 - 2.0 Adults = 0.8 - 1.0	Adults = 2.0
Dextrose rate	4 - 5 mg/kg/min	7 mg/kg/min
Fat	15 - 30% kcal	60% kcal

Suggested Metabolic Monitoring for Patients Receiving TPN

Parameter	Initial Period	Stable Period	Long-Term
Na, K, CO ₂ , BUN, Cr	Daily	Weekly	Monthly
Ca, Phos, Mg	Daily	Weekly	Monthly
Triglyceride	Weekly	Weekly	Monthly
CBC with differential	Weekly	Weekly	Monthly
PT/PTT	Weekly	Monthly	Quarterly
Capillary glucose	3-4x day	Daily	As Needed
Weight	Daily2x	Weekly	Weekly
Intake/output	Daily	Daily	As Needed
Trace elements levels -	-	-	Quarterly

PERIPHERAL PARENTERAL NUTRITION

- The limiting factor to formulation is the osmolarity (800 mOsm/L for 2:1 and 900 mOsm/L for a 3:1) due to higher incidence of phlebitis.
- This generally creates a solution composed of 40 g (4% per volume) of amino acids and micronutrients in a D5½NS solution.

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