Parenterals calculation

Part 3

Objectives

- Understanding and performing parenteral nutrition (PN) calculations.

PN

- Parenteral nutrition is the feeding of a patient by intravenous infusion.
- The general ingredients in parenteral nutrition are dextrose, amino acids, vitamins, trace elements and electrolytes.
- Additional components are added based on patient need and include fat, insulin and specific drugs as prescribed.
- Possible high **osmolarity**

How do we perform PN calculations?

- Determine the fluid requirement
- Determine the caloric requirement
- Determine the protein requirement
- find out the calories obtained from fat and protein
- Determine the calories required from dextrose

Fluid Requirements

- Adults
  - young, healthy adults 40mL/kg/day
  - all other adults 35mL/kg/day
  - elderly 25mL/kg/day
- Children
- <10 kg: 100 mL/kg/day
- 10-20 kg: 50 mL/kg/day
- >20 kg – 80 kg: 20 ml/kg/day

Caloric Requirements
Harris-Benedict Equation

- A kilocalorie is defined as the amount of heat required to raise the temperature of 1kg of water from 0^oC to 1^oC.
- The Harris-Benedict Equation is used to ***estimate the resting metabolic energy requirements*** (RME) for nonprotein calories.
- For males - ♂:
  - RME = 66 + (13.7 x W) + (5 x H) – (6.8 X A)
- For females - ♀:
  - RME = 655 + (9.6 x W) + (1.8 x H) – (4.7 x A)
- Where W is wt in kg, H is height in cm, A is age in yrs.

Caloric Requirements

- These equations are designed to maintain body weight or ideal body weight.
- **Total Daily Expenditure = RME x Stress factor x Activity factor**
- **Stress conditions**:
  - Mild: e.g. non-surgical hospitalized patients, multiply the RME x 1.2 to 1.4.
  - Moderate: e.g. patients with severe infections, multiply the RME x 1.5 to 1.75.
  - Severe: e.g. patients undergoing major surgery, multiply the RME x 1.75 to 2.0.

Stress Factors That May Increase Energy Expenditure

• fever	• 12% per degree
• cardiac failure	• 15-25%
• major surgery	• 20-30%
• severe sepsis	• 40-50%
• malnutrition	• 50-100%
• burns	• 50-100 %

Activity Factors That May Increase Energy Expenditure

- Confined to bed x 1.2
- Ambulatory x 1.3

Components of PN

Macronutrients

- Protein (amino acids)
- Carbohydrate
- Fat

Micronutrients

- Electrolytes
- Minerals
- Vitamins
- Trace elements

Components Of PN: Amino Acids

- Essential & most non-essential AA
- ***4 Kcal /gm***
- Function:

to maintain or rebuild lean body mass
support immune function.

Protein Requirements

- ***Healthy adults : 0.8 gm/kg/day***
  - critical illness: 1.2 -2.5 gm/kg/day
    moderate stress: 1-1.5 gm/kg/day
    severe stress: 1.5-2 gm/kg/day
- *15-20% calories should be protein*
- Protein for tissue growth (not energy)

Components of PN: Dextrose

- Cheap, stable, easily stored
- ***3.4 Kcal/gm***
- fuel source for CNS, RBC, renal medulla
- 10 % O.K.. for PIV
- 40 - 55 % total calories

Components of PN: IV Fat Emulsion

- 2’nd source of non-protein calories
- ***9 Kcals/gram***
- use: hormone & prostaglandin synthesis, structural component of cell membranes

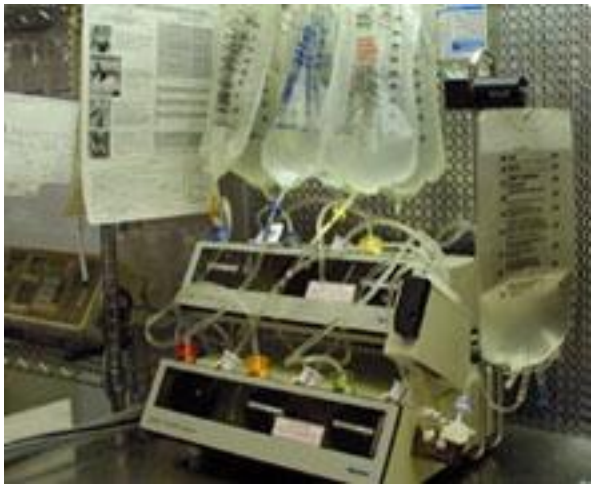
Components of PN
IV Fat Emulsion

- soybean & safflower oil LCT's
- egg yolk emulsifier
  - 10% 1 Kcal/mL
  - 20% 2Kcal/mL 30% 3Kcal/mL
- 30-40 % total calories

Determining Caloric Requirements

- To estimate the caloric needs for a patient first determine the total caloric requirements using the Harris-Benedict Equation.
- Next, calculate the amount of protein required as 0.8g/kg using 4 kcal/g of protein or amino acids.
- The remaining calories requirements are met by carbohydrate usually using dextrose at 3.4 kcal/g, and lipid emulsions using 1 kcal/mL for a 10% emulsion and 2 kcal/mL for a 20% emulsion.

Let’s make some PN’s!



Calculating PN Macronutrients

1. Calc. ***total daily calories*** required using Harris-Benedict equations and apply stress and activity factors
2. Calc. ***total protein @ 0.8 gm/kg/day***
   - Convert protein grams to Kcal
   - Calculate volume of ingredient (10%, 15%, 20%)
3. Calc. ***Kcal of fat @ 30-40% (avg. 35%)***
   - Calc. grams fat needed
   - Calculate volume of ingredient (10%, 20%)
4. Calc. ***Kcal of dextrose needed***
   - Calc. gm dextrose needed
   - Calculate volume of ingredient (50%, 70%)
5. Calc. ***total volume needed***
6. Combine volumes macro ingredients, including electrolytes, and qs with water

Sample Problem
2-1 PN

Calculate the caloric requirement for a mildly stressed 56 yr old female patient weighing 121 pounds with a height of 5ft 3in.

1. First step is to calculate the RME:

- RME = 655 + (9.6 x W) + (1.8 x H) – (4.7 x A)
- RME=655+(9.6x121/2.2)+(1.8x63x2.54)-(4.7x56)
- RME = 1208 kcal
- RME x 1.3 = *1570 kcal*

Sample Problem
2-1 PN

- How will this be supplied? Ans: 2-in-1 PN
  1. First calculate the daily quantity of protein needed:

  2. Next calc protein caloric value:

  3. Now calculate how much kcal from dextrose should be added:

Sample Problem
2-1 PN

- Dextrose 70% supplies

What about if we use 50% dextrose ?

Sample Problem
2-1 PN

- Total water volume required:

  "56 yr old female weighing 121 lbs (55 kg)"

  – all other adults 35mL/kg/day

  – ?? mL water needed?

Sample Problem
3-1 TPN

Calculate the caloric requirement for a post op surgical 46 yr old male in the ICU weighing 187 pounds with a height of 5ft 8in.

1. First step is to calculate the RME:

– RME = 66 + (13.7 x W) + (5 x H) – (6.8 X A)

– *kcal*

Sample Problem
3-1 TPN

- How will this be supplied? Ans: 3-in-1 TPN

2. Next calc protein caloric value:
    - What is the needed volume of of 20% amino acid ?

Sample Problem
3-1 TPN

3. Now calculate how much kcal from fat should be added:

– Lipids 20% supplies 20g/100mL or 0.2g/mL &

Sample Problem
3-1 TPN

4. Now calculate how much kcal from dextrose should be added:

– ……??**mL of 70% dextrose needed**

Sample Problem
3-1 TPN

- Total water volume required:

References used in preparing parenteral drugs

- Handbook of Injectable Drugs
  - Trissel, 14th ed. ASHP

- On-line sources:
- http://www.mcphs.edu/library_resources/research_db.html
    - Micromedex
    - Clinical Pharmacology
    - Clinical Reference Library