TPN
origin and calculations

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TPN - History

- Glucose and electrolyte
- Protein hydrolysates in 30s
- Fat emulsion- Intralipid in 60s.
- Vitamins, minerals, trace elements
- Central venous catheter
- Peripheral parenteral nutrition
Indications - TPN

1. Documented inability to absorb adequate nutrients via the GI tract:
   ○ Massive small bowel resection/short bowel syndrome
   ○ Radiation enteritis
   ○ Severe diarrhea
   ○ Untreatable steatorrhea/malabsorption

2. Complete bowel obstruction or intestinal pseudo-obstruction

3. Severe catabolism with/without malnutrition when GI tract is not usable within 5-7 days

4. Inability to obtain enteral access to provide sufficient nutrients
Indications - TPN

5. Moderate to severe pancreatitis
6. Persistent GI hemorrhage
7. Acute abdomen/ileus
8. Lengthy GI work-up requiring NPO status for several days in a malnourished patient
9. High output enterocutaneous fistula and inability to gain enteral access distal to fistula site
10. Trauma requiring repeat surgical procedures
Relative Indications

- Enterocutaneous fistula
- IBD not responding to medical therapy
- Hyperemesis gravidarum
- Intractable vomiting
- Partial small bowel obstruction
- Intensive chemotherapy/severe mucositis
- Major surgery/stress when enteral nutrition not expected to resume in 7-10 days
- Chylous ascites or chylothorax when medium chain triglycerides ± enteral nutrition does not adequately decrease output
Peripheral IV Nutrition Indications

- Nutritional needs <1,800 Kcal/day
- IV nutrition requirement <10-14 days
- Peripheral venous access is available
- Requires only one IV
- Fluid restriction is not an issue
Contraindications

- Functional GI tract
- Treatment anticipated for <5 days in patients without severe malnutrition
- Inability to obtain venous access
- A prognosis that does not warrant aggressive nutrition support
- When the risks of parenteral nutrition are judged to exceed the potential benefits
Access Devices

- Peripheral Lines
  - Short
  - Midline

- Central Lines
  - PICC
  - Hickman/Broviac
  - Groshong Catheter
  - Femoral line
  - Multiple lumen acute care catheters
  - Port
Complications

- Related to access device
- Metabolic complications
Complications - Access

- **Mechanical**
  - Hemo/Pneumothorax
  - Arterial puncture
  - air embolism
  - nerve damage
  - thoracic duct damage
  - Hematoma
  - Misplaced catheter

- **Thrombotic**

- **Septic complications**
  - *When to change the line*
  - PIV- 72-96hrs (adults)
  - Midline/CVL- do not replace routinely
Metabolic Complications

- Hyper- or hypo-glycemia
- Hyperosmolar non-ketotic acidosis
- Hypertriglyceridemia
- Fat Overload Syndrome
- Essential fatty acid deficiency
- Prerenal azotemia
- Hyperammonemia
- Hyperchloremic metabolic acidosis
- Metabolic alkalosis
- Hepatic/biliary complications
- Electrolyte abnormalities
- Refeeding Syndrome
Recommendations

Preoperative TPN:
- Only to severely malnourished patients
- 7-10 days pre-op
- expected reduction of post-op complications of 10%

Postoperative TPN:
- Routine post op TPN is contraindicated
- Patients who experience complications resulting in inability to tolerate oral diet for
  - 7-10 days in previously well nourished patients
  - 5-7 days in malnourished patient
Calculating Parenteral Feeding

- Patient's energy needs (Kcal/day)
- Protein/nitrogen need/day
- Fluid need/tolerated
- Fat emulsion need/tolerated
- Dextrose need/concentration
- Electrolyte/minerals/vitamin need
- Osmolality
- Route

- TPN soln: 2 in 1, 3 in 1
Calculating Parenteral Feeding

- Formula for calculating TPN:
  - [http://health.csusb.edu/dchen/368%20stuff/TPN%20calculation.htm](http://health.csusb.edu/dchen/368%20stuff/TPN%20calculation.htm)

- Formula to calculate macronutrient content:
  - [http://clincalc.com/TPN/Macronutrients.aspx](http://clincalc.com/TPN/Macronutrients.aspx)

- Formula for calculating osmolatity:
  - [http://www.rxkinetics.com/tpnosmolcalc.html](http://www.rxkinetics.com/tpnosmolcalc.html)
Energy requirement

- Harris-Benedict + activity + infection/fever factor = Energy (Kcal)

- Scale:
  - Normal need: 25-30 kcal/kg/day
  - Elective surgery: 28-30 kcal/kg/day
  - Severe injury: 30-40 kcal/kg/day
  - Extensive trauma/burn: 45-55 kcal/kg/day
**Protein requirement**

- **Protein**: 0.83 - 2.5 gm/kg/day (typically: 1.5 gm/kg/day)
- **Nitrogen** 1 gm = 6.25 gm protein

- **Non protein energy (kcal) to nitrogen (N) ratio**:
  - 80 kcal: 1 gm N severely stressed condition
  - 100-150 kcal: 1 gm N stressful condition anabolism
  - 250-300 kcal: 1 gm N normal body maintenance

- **Prolonged TPN should contain**
  - Glutamine
  - Choline
Fluid requirement

- 30 – 50 cc fluid/kg

- 100 cc free water/gm N intake + 1cc/kcal intake

- 100 cc/kg for first 10kg
  - + 50 cc/kg for 2nd 10kg
  - + 20 cc/kg for each additional kg
Fat requirement

- Maximal tolerance level of lipids: 2.5 gm/kg body weight
- av. 30% energy should be from fat
- 60% of energy from fat is upper limit. Essential fatty acids (EFA) 2-4% Kcal
- Fat energy: 9 kcal/gm
- Fat emulsions are made isotonic by adding glycerol

- Fat emulsions:
  - 10% fat emulsion: 1.1 kcal/cc
  - 20% fat emulsion: 2.0 kcal/cc
  - 30% fat emulsion: 3.0 kcal/cc
Carbohydrate requirement

- Main source of fuel
- Min. need/ day : 100gm
- Max. rate: 5 mg/kg/min (7.2 g/kg/day)
- Max. CHO we can use : 500 g/day

- CHO given as dextrose monohydrate
- Energy: 3.4 kcal/gm
- Solutions: 50% and 70%
Vitamins/minerals

- **Include 12 vitamins except Vit K**

- **Trace elements**: iron not routinely added because it changes the pH of the solution
Osmolarity

- Dextrose: 5 mOsm/g
- Protein: 10 mOsm/g
- Lipid: Negligible

- Vitamins/minerals: 300 - 400 mOsm/L

- Peripheral TPN: <900 mOsm/L
- Central TPN: 1500 - 2800 mOsm/L
A 500ml bottle of 5% amino acid solution provides ------ grams of protein

1- 2.50 g
2- 5.00 g
3- 12.5 g
4- 25.0 g
5- none of the above
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5- none of the above
Your patient needs 92g of protein per day. remaining fluid needs are 2000cc/day. What percent AA solution will meet this patient's needs?

1- 2.3%
2- 4.6%
3- 9.2%
4- 18.4%
5- None of the above
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What is the maximum lipid tolerance (in grams) for a patient who weighs 70 kg?

1- 125 g
2- 175 g
3- 250 g
4- 370 g
5- None of the above
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2- 175 g  
3- 250 g  
4- 370 g  
5- None of the above
1500 ml of D50W provides ----- grams of dextrose and ------ kcals.

1- 500 g; 1700 kcals
2- 500 g; 2000 kcals
3- 750 g; 2550 kcals
4- 750 g; 3000 kcals
5- None of the above
1500 ml of D50W provides ------ grams of dextrose and ------ kcals.

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2- 500 g; 2000 kcals
3- 750 g; 2550 kcals
4- 750 g; 3000 kcals
5- None of the above
The maximum carbohydrate tolerance for a patient who weighs 70 kg is ----- grams per day (rounded to nearest whole number)

1- 504 g
2- 650 g
3- 703 g
4- 811 g
5- None of the above
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250 mls of a 10% lipid emulsion provides ---- kcyals

1- 250 kcals
2- 275 kcals
3- 500 kcals
4- 550 kcals
5- None of the above
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What are the fluid needs of a 75 kg man? (use ml/kg method)

1- 1875 ml/d
2- 2250 ml/d
3- 2625 ml/d
4- 3000 ml/d
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A patient receives a 1000 ml bag of TPN which contains 10% dextrose & 7% protein. In addition, this patient receives 250 ml of a 20% fat emulsion. How many calories does this approximately represent?

1- 1020 kcals
2- 1420 kcals
3- 1820 kcals
4- 2220 kcals
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4- 2220 kcals
Calculate the protein, kcals, EFA content of the following TPN prescription:
1.0 L D70W; 1.0 L 7% AA; 214 cc 20% lipid/day (50% EFA)

1- 70g protein; 2601 NP kcals/d; NPC:N 235:1; 14% EFA
2- 70g protein; 3228 NP kcals/d; NPC:N 286:1; 12% EFA
3- 70g protein; 2808 NP kcals/d; NPC:N 251:1; 7% EFA
4- 70g protein; 3228 NP kcals/d; NPC:N 286:1; 8% EFA
5- None of the above
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4- 70g protein; 3228 NP kcals/d; NPC:N 286:1; 8% EFA
5- None of the above
Your patient will receive a 3 in 1 TPN solution. Determine percent lipid, amino acid and dextrose solutions to be used, along with rate of administration. Provide 30% fat kcals from a 20% lipid emulsion. (rounded to nearest 0.1)

Nutrient needs: 2800 kcals; 100 gm protein; 2500cc fluid

1- 3.7% lipid; 23% dextrose; 4% amino acids; 104.2 cc/hr
2- 3.7% lipid; 20% dextrose; 4% amino acids; 104.2 cc/hr
3- 3.7% lipid; 23% dextrose; 8% amino acids; 104.2 cc/hr
4- 8.3% lipid; 23% dextrose; 4% amino acids; 104.2 cc/hr
5- None of the above
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http://health.csusb.edu/dchen/368%20stuff/TPN%20calculation.htm

http://www.csun.edu/~cjh78264/parenteral/calculation/index.html

http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5110a1.htm