Artificial Nutrition Support for Adults through the Continuum of Care: Part II- Parenteral Nutrition Webinar

Supplement: Initiating and Advancing the PN for Patient TG Case Study

Elizabeth Wall, MS, RDN-AP, CNSC

1. **Patient data and nutritional requirements**
   - 65 y/o female admitted with an enterocutaneous fistula related to Crohn's disease
   - Plan: Complete bowel rest and PN support until the fistula heals
   - Access: Left single lumen PICC (tip in the SVC)
   - Admission weight: 70 kg (stable)
   - I/O: 3200/2375 (2200 urine, 175 fistula)
   - IVF: D5W+ 0.45 NS @ 125/hr (150 g dextrose/d)
   - Medications: Vancomycin 1 g q12 hr (500 mL/d), 2 units regular insulin
   - Laboratory data:
     - Na+ 135
     - K+ 3.7
     - Cl- 99
     - CO2 23
     - BUN 10
     - Cr 0.9
     - Glucose 154↑
     - Ca++ 8.7
     - Phos 3.2
     - Mg++ 1.6

   - **Calculate nutrient requirements**
     - **Energy: 1865 kcal/d** (Harris-Benedict x 1.4)
     - **Protein: 100 g/d** (1.4 g/kg/d)
     - **Fat: ≤70 g/d** (~1g/kg/d)
     - **Fluid needs**: 2300 mL/d (30 mL/kg/d + 200 mL/d fistula output)
       - PN volume = Total daily volume - IV medication volume
         - 2300 mL total – 500 mL vancomycin = **1800 mL PN/lipids**

2. **Pre-mixed, 2 in 1 PN solutions**
   - **Determine** which of your formulary PN solutions will most closely meet your patient's energy, protein, and volume needs. In the case of TG:
     - Use a 5/15 solution (5% amino acids/15% dextrose) with standard electrolytes and 250 mL 20% intravenous lipid emulsion
     - 1 liter 5/15 provides 50 g amino acids (200 kcal) and 150 g dextrose (510 kcal) for 710 kcal/L
   - **Calculate** the goal volumes of the PN solution and lipid emulsion to meet TG's needs
     - First, subtract the lipid volume and calories from the total requirements
       - 1865 total kcals – 500 lipid kcals = **1365 kcals from PN**
       - 1800 total mL – 250 lipid mL = **1550 PN mL**
     - Second, calculate the daily calories and protein from the PN volume above - 1550 mL (1.55L) of 5/15
       - 1.55 L x 50 g amino acids/L = 77.5 g amino acids/day
       - 1.55 L x 710 kcal/L = 1,100 kcal/day
         - PN + lipid kcals = 1,100 PN + 500 lipids = 1600 kcal/d
       - This will not meet the assessed protein or energy needs of TG. You will need to choose a different pre-mixed formula or adjust the PN and lipid volumes to more closely meet the assessed needs (if the patient can handle extra volume).

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- To meet TG's calculated protein requirement, she will need 2L of 5/15 to provide 100 g amino acids and 1420 kcal/d.
- The 2L 5/15 plus the planned 250 mL 20% lipids will provide excessive calories for TG (1920 kcal/d).
- To more precisely meet TG's total calorie estimate of 1865 she will only need 445 kcal/d from lipids (1865 total kcal – 1420 PN kcal = 445 lipid kcal). Therefore, the ordered lipid volume should be ~225 mL/d (445 kcal/2 kcal/mL = 222.5 mL).

- **Initiate** the PN at a one liter rate (42 mL/hr): 5/15 PN+ 20% lipids at 9.2 mL/hr.
  - Thoughts: The patient has active inflammation, is at the low end of healthy body weight, has mild-moderate muscle and body fat losses, so she is at risk of refeeding syndrome. However, prior to starting the PN TG received IV fluids that provided 150 g dextrose/day and her electrolytes were stable, within normal limits so there is low concern for electrolyte shifting (refeeding syndrome) when starting PN. Can start the PN at a rate that matches the 150 g dextrose in the IV fluid or 1L of the 5/15 pre-mixed PN formula.

- **Day 2** – Review the labs:
  - Na^+ 140
  - K^+ 3.5
  - Cl^- 101
  - CO_2 23
  - BUN 18
  - Cr 0.9
  - Glucose 123, 143, 135, 199
  - Ca^{++} 8.6
  - Phos 2.8
  - mg^{++} 1.3 (L)
  - TG 150
  - T bili 0.5
  - Alk Phos 97
  - ALT 40
  - AST 35

  - TG had one high blood glucose level and the serum magnesium fell below normal. Keep the PN running at 42 mL/hr with the 225 mL lipids. The provider should order IV magnesium replacement to correct the level. Also, extra sliding scale insulin was needed to keep the blood glucose <180 mg/dL.

- **Day 3** – Review the labs:
  - Labs:
    - Na+ 141
    - K+ 4
    - Cl- 101
    - CO2 23
    - BUN 22
    - Cr 0.9
    - Glucose 123, 135, 100, 135
    - Ca++ 8.6
    - Phos 2.8
    - mg++ 1.6
  - Glucose is well controlled with the sliding scale insulin, magnesium is back in normal range, all other labs are normal, so can advance the PN to the goal 2L rate (83 mL/hr) and keep the lipid at 225 mL (45 g fat)/day.
  - Continue to monitor daily labs and point of care glucose for a few more days and if patient does not need additional electrolyte replacement or insulin, then TG's PN support is considered stable.

- **Cycle** the PN and lipids for transfer to LTAC.
  - Cycling just refers to incremental increase in the PN and lipid infusion rates so that the total time on PN decreased. It is typical to reduce the infusion hours by 4 hr at a time. Start by reducing from continuous to 20 hr/day. Also, must account for a one hour taper-down (50% infusion rate) at the end of the cycle to allow the pancreas time to down-regulate insulin production and the kidneys to excrete excess insulin so that the blood sugar does not drop to a dangerously low level when the patient comes off the PN (rebound hypoglycemia).
  - If pt does not complain of dyspnea with the higher infusion rate, and blood sugar and labs are stable, then the next day can go from 20 to 16 hours, and the third day can go from 16 to 12 hours, etc.
  - Generally, patients in rehab or long term care should have 12-14 hours off the PN daily, unless they are completely NPO and in that case usually give them 8-10 hours off for "fasting" time.

3. Custom 3 in 1 PN for TG

- In addition to the volume and grams of amino acids you will also need to calculate the goal grams of dextrose for the PN. The amount of lipids should meet essential fatty acid requirements, but otherwise lipids are simply a concentrated source of energy. We can plan for 50 g lipid or 500 kcal/d from lipids and 100 g amino acids. Calculate the grams of dextrose you need to order.
  - 1865 total kcals: 500 lipid kcal = 1365 kcal needed from amino acids and dextrose
  - 1365 kcal – 400 amino acid kcal = 965 kcal from dextrose
  - 965 dextrose kcal/3.4 kcal/g dextrose = 283 g dextrose
    - This is the goal dextrose to meet TG's needs. Would start PN with 150 g dextrose per day to match the previous IV fluid dextrose and watch her electrolyte and glucose for a day or two.
- Confirm your planned volume = 1800 mL (1.8L)
- Electrolyte additives
  - Sodium salt (NaCl, Na acetate, NaPhos)
    - Sodium is dosed by the volume of the PN bag – 1800 mL for TG
    - Prior to PN TG received IV fluids of D5 0.45 NaCl (77 mEq Na/L) and her serum sodium is 135 mEq/L which is low normal. This tells us that she is probably losing more sodium than she was receiving in the IV fluids. Check output of body fluids to assess for electrolyte replacement. TG's fistula is probably jejunum or ileum given Crohn's disease (sodium losses from small bowel are ~100 mEq/L). Can start the PN with 2/3 or ¾ saline (100 mEq/L or 115 mEq/L, respectively) to give more sodium than she was receiving.
    - Determine which sodium salt to give, again where are the losses? What do the labs show? Often the balance between sodium salts is 1/3 Na acetate, 2/3 NaCl.
    - We will order 2/3 saline equivalent for the 1800 mL PN or 180 mEq sodium (100 mEq Na+/L x 1.8 L = 180 mEq)

    - 1/3 Na acetate = 60 mEq
    - 2/3 NaCl = 120 mEq
  - Potassium salts (KCl, K acetate, KPhos)
    - Potassium is dosed 1-2 mEq/kg/d, 1 mEq/g amino acids, or 40-80 mEq/d. TG's potassium level is normal and she was not receiving potassium in her IV fluids, therefore will start with 1 mEq/kg/d = 70 mEq potassium
    - Since we did not give any NaPhos we will need to give at least some of the potassium as KPhos
      - The usual phosphate need is 15-30 mmol/d. TG's phosphate level is normal. Can give 20 mmol KPhos
        - Calculate how many mEq potassium are in 20 mmol KPhos; there are 1.45 mEq K+ per 1 mmol KPhos = >20 mmol KPhos x 1.45 = 29 mEq potassium
        - The remaining potassium will come from KCl or Kacetate. TG does not need extra base as CO2 is normal, therefore give 41 mEq KCl to total 70 mEq K+/d.
  - Phosphate (NaPhos or KPhos): As above 20 mmol KPhos
  - Calcium (calcium gluconate): The requirement is between 5-15 mEq/d. Will order 10 mEq/d.
  - Magnesium (magnesium sulfate): TG's magnesium level is low normal, therefore she should receive little more than would be in the pre-mixed electrolyte additives or 12 mEq magnesium.
- The PN formula
  - 1800 mL (to infuse at 75 mL/hr, continuous)
  - 150 g dextrose
  - 70 g amino acid
  - 50 g 20% lipid emulsion
  - 10 mEq calcium gluconate
  - 60 mEq sodium acetate
  - 120 mEq sodium chloride
  - 20 mmol KPHos
  - 41 mEq KCl
  - 12 mEq magnesium sulfate
  - 10 mL Adult MVI
  - 1 mL Trace minerals

- Day 2 (see slides for labs)
  - Will need to give TG magnesium supplementation outside of the PN (probably 2 g magnesium sulfate IV since she is NPO) and will increase the magnesium in the PN by 1 g magnesium (8 mEq) for 20 mEq magnesium sulfate.
  - Keep the rest of the PN the same. Would not increase the amino acids since they can be used for energy & potentially cause shifting of potassium, magnesium, and/or phosphate.
  - Discuss with the provider whether or not TG needs insulin added to the PN

- Day 3
  - Labs:
    - Na+ 141
    - K+ 4
    - Cl- 101
    - CO2 23
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- Glucose 123, 135, 100, 135
- Ca++ 8.6
- Phos 2.8
- mg++ 1.6

- Blood glucose control is improved, can go up on the dextrose to goal (283 g/d).
- Increase amino acids to goal of 100 g/d.
- Watch glucose control with added dextrose
- Final PN formula
  - 1800 mL (continuous infusion at 75 mL/hr)
  - 283 g dextrose
  - 100 g amino acid
  - 50 g 20% lipid emulsion
  - 10 mEq calcium gluconate
  - 60 mEq sodium acetate
  - 120 mEq sodium chloride
  - 20 mmol KPHos
  - 41 mEq KCl
  - 20 mEq magnesium sulfate
  - 10 mL Adult MVI
  - 1 mL Trace minerals

- Day 4 can start to cycle the infusion in preparation for transfer to LTAC.

4. Summary

- Calculate the calorie, protein and fluid needs of your patient.
- Premixed PN solutions
  - Determine which solution available will most closely meet your patient's protein needs without overfeeding calories.
  - Use IV lipid emulsions to meet essential fatty acid requirements and supplement calories to bring the total daily input to meet estimated nutrient needs.
- Custom PN solutions
  - Calculate needs: total energy, grams of protein, grams of dextrose, grams of lipid, and volume for your patient.
  - Assess the patient's response to IV fluids, recent laboratory data trends, and intake/output data to determine electrolyte contents of the PN.
  - Remember to dose sodium based on the volume of the PN bag.
- Monitor your patients and their objective clinical data daily until they are stable on a PN regimen that meets their assessed needs.
- Each day assess for ongoing PN requirement and readiness to transition to an oral diet or enteral nutrition support.