TPN per Pharmacy

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General Considerations

- Starting TPN is never an emergency.
- PPN may be used when needed less than 2 weeks, if patient has good veins. Max osmolality of 900 through the peripheral vein.
- Central line access needed for TPN (subclavian, PICC, IJ, I-Port, etc.)

The Basics

Who needs TPN?

Why do they need TPN?

How do I provide TPN?

What complications do I worry about?

Who needs TPN?/Why do they Need TPN?

- If the gut works, use it!!!!
- TPN is indicated in patients who can not, will not, or should not eat or receive enteral nutrition.
- Usually indicated in patients with GI abnormalities (obstruction, fistula, malabsorption, short gut, etc.)

How to provide TPN?

- 1. Calorie needs
- 2. Fluid needs
- **3**. Electrolyte needs
- 4. Special populations

Calories

- Harris Benedict Equation Men: 66+(13.7 x wt)+(5 x ht)-(6.8 x age) Women: 655+(9.6 x wt)+(1.7 x ht)-(4.7 x age)
- Indirect calorimetry
- Kcal/kg
 - Healthy, maintenance: 20-25 kcal/kg Malnourished or stressed: 25-30 kcal/kg Severe stress: 30-35 kcal/kg

Stress Factors for Harris Benedict

Condition	UAMS	Pharmacotherapy
Starvation	0.85-1	NA
Normal, nonstressed	1.2-1.3	Confined to bed 1.2
		OOB 1.3
Mild stress, Postop	1.25-1.35	Postop 1
uncomplicated		Mild trauma 1.2
Moderate Stress	1.35-1.5	1.3
Severe Stress	1.5	1.3
Burns	2 or >	Up to 2

Dextrose

- 3.4 kcal/gm
- Primary energy source for TPN.
- Dextrose is oxidized at a maximum rate of 4-7mg/kg/minute. Recommended doses rarely exceed 5mg/kg/min.
- Overfeeding with dextrose can lead to a fatty liver.
- Inexpensive
- Start low and titrate up to goal as BS tolerates.

Amino Acids

- 4 kcal/gm
- Standard amino acid products are essentially the same except electrolyte content (Cl and Acetate amounts in the base).
- Modified amino acid solutions not used much anymore (Hepatamine, NephrAmine, etc.), usually modify amounts of standard AA used.
- Can start with goal protein.

Estimated Daily Protein Needs

Condition	Daily protein need
Normal nonstressed	0.8gm/kg
Stressed, Oncology, Surgical	1.0-1.5gm/kg
Severely Stressed, Multiple Trauma, Burns	1.5-2.5gm/kg
Renal Failure (no dialysis)	0.6-0.8gm/kg
Renal Failure with dialysis	1.2-1.5gm/km
Hepatic Encephalopathy	Start with 0.4-0.5gm/kg

Lipids

- Fat = 9 kcal/gm, however, lipid emulsions also contain glycerol and egg phospholipids which contribute to the caloric amount from lipid emulsions. (10%=1.1cal/gm,20%=2cal/gm).
- Daily dosage of lipids should not exceed 2.5gm/kg/d in adults.
- ? Limiting to 1gm/kg/d in critically ill patients
- Derived from soybean oil or a combination of soybean and safflower oil.
- Propofol contains 10% lipid emulsion.

Lipids, cont.

- May be infused over 4-6 hours, however, rapid infusion may saturate the reticuloendothial system. The longer the infusion time, the less interference with the RES, therefore may infuse over 12-24 hours. CDC recommends no longer than 12 hour hang time.
- 4-10% of daily calorie requirement should be provided as essential fatty acids to prevent EFA deficiency.

Fluid Requirements

- 1500 mls per meter square per day
- Mls/kg/day method: active young adults 35 mls/kg/day, average adults 30mls/kg/day, elderly 25mls/kg/day
- Ideal weight : 1st 10kg of IBW 100mls/kg/day 2nd 10kg of IBW 50mls/kg/day weight >20kg 20mls/kg/day

Guessing (this is what is done most often!)

Usual Electrolyte Requirements

10-15

20-45

- Sodium, mEq 60-100
- Potassium, mEq 60-100
- Magnesium, mEq 12-24
- Calcium, mEq
- Phosphate, mmol
- Chloride, mEq
- Acetate, mEq
- *requirement varies with acid-base balance, in general Cl should not exceed Na to avoid metabolic acidosis.

Daily Electrolyte Requirements

Sodium	Chloride	1- 2 -3 mEq.kg/day
	Acetate	
	Phosphate	
Potassium	Chloride	0.5- 1 -2 mEq/kg/day
	Acetate	
	Phosphate	
Calcium	Gluconate	5 mEq/L
Magnesium	Sulfate	8-24 mEq/day
		12-16 mEq/day

Exceptions to the Rule

- Increased Requirements:
- 1. Na, K, Cl: vomiting, NG suction, gastrostomy output
- 2. Na, K, HCO3: diarrhea, ostomies, high output fistulas
- 3. K, PO4, Mg: Refeeding syndrome

Exceptions to the Rule, cont.

- Decreased Requirements:
- 1. Na: CHF
- 2. Na, K, Mg, PO4, Cl: renal failure

Electrolyte Content Of Body Fluids

	Na mEq/L	K mEq/L	Cl mEq/L	HCO3 mEq/L	Volume (L)/day
Diarrhea	50	35	40	45	
Ileostomy	140	20	100	25	0.5-2
Gastric	80	10	100		2
Bile	145	5	100	40	1.5
Pancreatic	140	5	75	85	0.75-1

Drug Induced Electrolyte Disorders

Drug induced renal losses:

Drug Induced Electrolye Disorders, cont.

 Drug induced transcellular shift: Albuterol – K
Sodium Bicarbonate – K
Insulin - K

Monitoring

- Fluids: Monitor weight daily, I's & O's, and what type of fluid is being lost (NG, ostomy, etc.).
- Labs: Daily BMP (Na, K, Cl, CO2, BUN, Cr, Glucose, Ca, Mg, PO4) until stable, CBC; weekly albumin, prealbumin, triglycerides, and LFT's;
- Nitrogen balance: N2 balance = N2 in -N2 out. N2 in = protein intake(gm)/6.25; N2 out = 24 hour urine urea N2 (UUN) + 4

Special Populations, Obese Patients

- Obese Critically ill patients various recommendations for feeding obese patients
- What weight do you use? Actual weight? IBW? Adjusted body weight? {(Actual–IBW) x 0.25}+IBW= adjusted body weight.
- ASPEN guidelines for critically ill adults: 11-14 kcal/day actual body weight or 22-25 kcal/day IBW. Protein >/=2gm/kg IBW if BMI is 30-40, or >/=2.5gm/kg IBW if BMI>40.

Obese Patients at UAMS

- MICU patients: 11-14 kcal/kg actual weight or 23-25 IBW, 2-2.5 gm/kg IBW
- Renal obese: Use adjusted BW for kcal and protein – if on CRRT 1.5gm/kg and up to 2.5gm/kg, if on HD 1-2-1.5 gm/kg protein
- SICU patients: 15-18 kcal/kg actual body weight (maybe up to 20). BMI 30-40 2gm/kg IBW for protein, BMI>40 2.5gm/kg protein.

Other Special Populations

- Renal Insufficiency/Failure
- Hepatic failure
- Pulmonary Failure
- Patients with high output fistulas
- Short Bowel Syndrome

Complications With TPN

- Refeeding syndrome- recognize who is at risk, start low with calories and advance as electrolyte abnormalities are corrected.
- Hyperglycemia is patient diabetic or is the hyperglycemia due to the stress response?
- Hepatic complications LFT's increased is it the TPN? What should be done?

Hepatic Abnomalities and TPN

Enzyme	Peak onset	Magnitude	Frequency
Alkaline Phosphatase	10-14 days	2-4 X	54%
SGOT	10-30 days	3 X	68%
Bilirubin	10-30 days	0.25 X	21%

Prevention of Hepatic Abnormalities with TPN

- Gut mucosal stimulation/glutamine feed the gut.
- Avoid overfeeding if abnormal LFT's, decrease calories.
- Give balanced calories (carbohydrates and fat calories to provide calories and EFA's).

Prevention of Hepatic Abnormalities with TPN, Cont.

- Look for alternative etiologies (hepatitis, obstruction, drugs, sepsis).
- **•** Rule out abscesses or other septic sources.
- In adults, ? Trial of metronidazole 260mg q6h.

