PERIPHERAL PARENTERAL NUTRITION (PPN)

I. PPN: low osmolality parenteral nutrition given via peripheral vein for up to 7 days.

II. Indications/patient selection
- A. Delayed/contraindicated enteral feedings AND delayed/contraindicated central venous access
- B. Short-term IV feedings needed (5 - 7 days maximum)
- C. Good tolerance to high rate fluid infusion; fluid restriction not needed
- D. Good tolerance to parenteral lipid infusions, TG $\leq$ 300 - 350

III. Lipid: provides bulk of calories
- A. Isotonic
- B. Protective effect on peripheral veins; reduces incidence of thrombophlebitis
- C. Plan on using a full 500 cc of 20% lipid in most cases
- D. 20% lipid has 2 kcal/cc and is the standard solution offered at Hermann
- E. 10% lipid has 1.1 kcal/cc; propofol is 10% lipid-based
- F. To calculate the grams of lipid in a defined volume of solution:
  Multiply **volume** of solution in ml X **percent** lipid in solution
  Example: 250 ml 10% IL = 250 x .10 = 25 grams lipid
  500 ml 20% IL = 500 x .20 = 100 grams lipid
- G. Limit total lipid infusions to no more than 60% total kcal or 2 grams/kg/day

IV. Protein
- A. Provision of full protein needs usually feasible
- B. Limit to 10% amino acid solution to keep osmolality of solution low
  1. Kcals: 4 per gram
  2. To calculate the grams of protein in a defined volume of solution:
     Multiply **volume** of solution in ml X **percent** AA in solution
     Example: 900 ml 10% AA = 900 x .10 = 90 grams protein

V. Dextrose: used to provide remainder of calories
- A. Per Hermann Hospital policy, use of dextrose solutions greater than 20% in a peripheral solution is prohibited.
- B. Kcalories: 3.4 per gram dextrose
- C. To calculate the grams of dextrose in a defined volume of solution:
  Multiply **volume** of solution in ml X **percent** dex in solution
  Example: 1000 ml 10% dextrose = 1000 x .10 = 100 grams dextrose
  1500 ml 20% dextrose = 1500 X .20 = 300 grams dextrose

VI. Additives
- A. Keep to a minimum to keep osmolality low
- B. Standard lytes generally acceptable
- C. Can add MVI, insulin, H2 blockers to PPN if no other access route available

WRITING PARENTERAL NUTRITION ORDERS IN THE INTENSIVE CARE UNIT

Before writing TPN orders, many questions need to be answered.

I. Is TPN appropriate for this patient?

A. **Indicated** in patients who are unable to absorb adequate nutrients via the GI tract, the severely malnourished or catabolic who cannot be fed enterally or p.o., and those requiring strict bowel rest (bowel obstruction, severe GI hemorrhage, severe short bowel syndrome, high output GI fistula)

B. **Helpful** in patients with metabolic stress, the moderately malnourished, those undergoing major surgery or multiple minor surgeries, and those able to achieve only partial enteral support

C. **Contraindicated** in patients without venous access, with functioning GI tracts, with prognoses that do not warrant aggressive nutrition support, when refused by patient or guardian, when need for TPN anticipated to be < 5 days in the non-malnourished patient, or when risks of TPN outweigh the benefits

D. Risks of TPN:
1. Metabolic
2. Mechanical
3. Infection
4. GI (fatty liver, cholestasis, gut atrophy)

II. Venous access: peripheral or central?

A. Peripheral
1. limited to high volume, high fat, low osmolality solutions for no more than 5 - 7 days
2. 1500 ml 20% dextrose + 1000 ml 10% AA + 500 ml 20% IL provides 2420 kcal & 100 grams protein in 3 liters, < 900 mOsm/liter
3. Per Hermann Hospital policy, use of dextrose solutions greater than 20% in a peripheral solution is prohibited.

B. Central
1. Concentrated, high osmolality solutions OK
2. Need sterile port for use solely for TPN

III. Standard or non-standard TPN?

A. Standard TPN solution on left side of TPN form
   1. 1 liter standard solution + 100 ml 20% IL appropriate in many cases for day 1 of TPN; provides 1250 kcal, 50 grams protein in total volume
   2. Additives : standard lytes, MVI, trace elements OK in many cases

B. Non-standard TPN solution on right side of TPN form
   1. Diabetics, the insulin-resistant, renal patients, hepatic patients, patients at risk for refeeding syndrome, and those requiring fluid restriction or non-standard electrolytes will most likely need non-standard TPN
   2. If you want to make even one change to the standard TPN solution or additives, you must write the order as non-standard TPN

IV. Determining the TPN formulation

A. Determine calorie needs*

B. Determine protein needs*

1. Kcalories: 4 per gram

2. To calculate the grams of protein in a defined volume of solution:
   Multiply **volume** of solution in ml X **percent** AA in solution
   Example: 500 ml 10% AA = 500 x .10 = 50 grams protein
   700 ml 15% AA = 700 X .15 = 105 grams protein

3. Enter volume of desired protein solution on TPN order form

C. Determine lipid needs*

1. Kcalories: 9 kcal/gram
   20% lipid has 2 kcal/cc: standard at Hermann
   10% lipid has 1.1 kcal/cc; propofol is 10% lipid-based

2. Lipid is immunosuppressive and expensive. 2-4% of total kcal as lipid prevents essential fatty acid deficiency. Use dextrose for bulk of calories.

3. Enter desired volume of 20% lipid solution on TPN order form

D. Provide remainder of caloric requirements as carbohydrate (CHO)*

1. Kcalories: 3.4 per gram dextrose
   4 per gram sucrose

*Refer to "Nutrition Assessment" handout for more information.

2. To calculate the grams of CHO in a defined volume of solution:
Multiply **volume** of solution in ml X **percent** dex in solution
Example: 500 ml 50% dextrose = 500 x .50 = 250 grams CHO
700 ml 70% dextrose = 700 X .70 = 490 grams CHO
3. Enter volume of desired dextrose solution on TPN order form

E. Determine fluid requirements*

F. Determine micronutrient requirements (See handout)

1. Refeeding syndrome: see handout
K, PO_4, Mg utilization increased in anabolism

2. Electrolytes
   a. Potassium: balance related to magnesium
   b. Sodium: consider all sources (IVF, antibiotics)
   c. Chloride/Acetate: address cause of acid/base imbalance before adjusting TPN
   d. Phosphorus/Calcium/Magnesium: amounts in excess of standard may cause precipitants to form; check with Pharmacy for compatibility
   e. Increased amounts needed with abnormal losses
   f. Decreased amounts needed with retention d/o (renal, cardiac)

3. Vitamins
   a. MVI: 10 ml/d in most cases, 5 ml/d in renal failure
   b. Ascorbic acid: 500 - 1000 mg/day may assist with healing
   c. Folate: 1 mg/day indicated in pregnancy, dialysis, EtOH abuse, burns
   d. Thiamine: 100 mg q day X 3 days in EtOH abuse
   e. Vitamin K: 2 - 4 mg q week unless on anticoagulants or thrombotic
   f. B12: may be helpful in short bowel, gastric resection, pernicious anemia 2° B12 deficiency; check labs

4. Trace Elements
   a. Zinc: increased needs with GI losses
   b. Clearance may be impaired in hepatic dysfunction

5. Additives
   a. Insulin: start sliding scale and adjust amount in TPN q am based on previous day's dosage & FSBG
   b. Stress ulcer prophylaxis: may add to TPN to provide continuous infusion and reduce cost
   c. Albumin: not stable in 3-in-1 solutions

*Refer to "Nutrition Assessment" handout for more information.

V. Initiating TPN

A. Obtain baseline lab values
B. Correct electrolyte imbalances prior to starting TPN
C. On Day 2 of TPN, recheck lab values to assess metabolic tolerance
D. Correct electrolyte abnormalities before increasing TPN
E. Increase solution to meet nutritional needs.
F. Add insulin if necessary per SS insulin dose

VI. Minimum monitoring during TPN

A. Chem 19, magnesium, ionized calcium q day until meeting 100% kcal/protein needs and lytes/BG/RFTs stable, then switch to a daily Chem 7 with a Chem 19 and Mg 1-2 times a week
B. Nitrogen balance q week until in positive balance
C. Prealbumin, transferrin q week
D. Metabolic gas analysis q week if intubated, $FIO_2 \leq 50\%$, PEEP $\leq 10\%$
E. Daily weight
F. Daily I & O's
G. Other parameters as needed

VII. A dietitian consult is automatic for all nutrition support patients.