

Parenteral Nutrition

I. Nutritional Deficiencies

- o Involves protein and calories
- o Results from nonfunctioning GI tract, decreased food intake, and/ or increased metabolic need
- o Effects – reserved energy used from three sources (1) glycogen, (2) fats stored in adipose tissue and (3) essential visceral and somatic body proteins
- o **PCM = Protein-Calorie Malnutrition** – Deficiency of protein and calories caused by cancer, GI disorders, chronic CHF or alcoholism. Causes reduced enzyme and protein production, ↑ susceptibility for infection, growth deficiencies, malabsorption, and delayed wound healing
- o Forms of PCM
 - **Primary PCM** – starvation-related malnutrition, occurs when nutritional needs are not met, chronic starvation without inflammation (e.g. anorexia nervosa)
 - **Secondary PCM** – chronic disease-related malnutrition, associated with conditions that impose sustained inflammation increasing metabolic needs (e.g. cancer, organ failure, arthritis, obesity)

II. Performing a Nutritional Assessment

- o Dietary history – look for signs of ↓ food intake, ↑ metabolic requirements or a combo of both
- o Assess weight history, factors that affect food intake, food allergies or intolerances, psychosocial factors, and full physical assessment.
- o Signs of poor nutrition = dry scaly skin, brittle nails, hair loss, mouth crusting and ulceration, changes in tongue, decreased muscle mass and weakness, dental caries, ill-fitting dentures, poor skin turgor
- o **Anthropometric Measurements** – measures fat and muscle content. Height, weight, BMI. Includes skinfold thickness at various sites and midarm muscle circumference. Measurements are compared to standards for age and gender. These measurements are decreased in malnutrition

III. Detecting Deficiencies

- o **Creatinine height index** – 24 hour sample to determine adequacy of muscle mass
- o **Hematocrit** – diagnosis anemia and dehydration
- o **Hemoglobin** – assesses oxygen carrying capacity, dehydration and protein deficiency
- o **Serum Albumin** – assess visceral protein stores
- o **Serum Transferrin** – assess visceral protein stores better due to short half life
- o **Serum Triglycerides** – screens for hyperlipidemia
- o **Skin sensitivity testing** – evaluates compromise of immune response
- o **Total lymphocyte count** – low value with no other causes diagnosis PCM
- o **Total Protein screen** – detects hyper and hypo proteinemia
- o **Transthyretin** – use with albumin level and is sensitive to nutritional depletion
- o **Urine Ketone bodies** – detect carbohydrate deprivation

IV. Understanding Parenteral Nutrition Solutions

- o TPN or Total Parental Nutrition
 - Components – Dextrose, Amino Acids, Electrolytes, Vitamins, Trace Elements
 - possibly Heparin and Fat Emulsion
 - Indications
 - Long term therapy of 3 weeks or more
 - Supplies large quantities of nutrients and calories (2,000-2,500/day)
 - Promotes tissue synthesis such as wound healing
 - Allow bowel rest and healing
 - Reduces activity of pancreas

- Special Considerations
 - Requires minor surgical procedure for placement of central venous catheter
 - Is nutritionally complete
 - May result in metabolic complications – closely monitor chemistry profile
- o PPN or Peripheral Parenteral Nutrition
 - Components – same as TPN but less concentrated
 - Indications
 - Short term use of less than 3 weeks
 - Given in high volumes – patient must be able to tolerate high infusion rate
 - Provides 1,300-1,800 calories/day
 - Special Considerations
 - Nutritionally complete for short term therapy only
 - Should not be used in nutritionally depleted patients – TPN is preferred
 - Cannot be used in volume-restricted patients such as chronic heart failure pts
 - May cause phlebitis
- o Components of Parenteral Nutrition
 - **Amino Acids** = supply enough protein to replace essential amino acids and maintain protein stores
 - **Dextrose** = Provides most of the calories needed to help maintain nitrogen balance which depends on the severity of the patient's illness
 - **Electrolytes and Minerals** = Added based on an evaluation of the patient's serum chemistry profile and metabolic needs
 - **Fats** = Concentrated source of energy as lipid emulsion
 - **Trace Elements** = Promotes normal metabolism, aka micronutrients
 - **Vitamins** = Ensure normal Body Functions and optimal nutrient use for the patient
 - **Water** = Added to Parenteral nutrition solution based on the patient's fluid requirements and electrolyte balance
 - (Additional additives are ordered based on metabolic deficiencies)
- o Understanding Total Nutrient Admixture
 - A milky white solution that delivers 1 day's worth of nutrients in a single 3L bag
 - Also called a 3:1 solution
 - Advantages
 - Less time to set and prepare for administration
 - Lower cost – volume discount
 - Increased patient mobility – less interruptions for bag changes
 - Disadvantages
 - Limited amount of Calcium and Phosphorus added because of the difficulty in detecting precipitate in the milky white solution
 - Requires larger in-line filter to allow lipid molecules through
- o Understanding Lipid Emulsions
 - Major source of calories
 - Concentrations of 10-30% can be safely infused through peripheral or central veins
 - May be irritating to low volume veins

V. Managing Parenteral Nutrition

- o Maintaining TPN via central venous catheter
 - Always check the physician order against the list of components in solution bag
 - **Always use an infusion pump** – never infuse by gravity
 - **Maintain flow rates as prescribed, even if the flow falls behind schedule**
 - Don't allow TPN solution to hang for more than 24 hours
 - Assess VS frequently – monitor temperature, glucose levels and blood chemistries
- o Maintaining PPN via peripheral IV
 - Diabetic patients may require higher doses of insulin

- Hypothyroid patients may require TSH
- Pediatric and elderly patients are susceptible to fluid overload and heart failure
- Monitor the patient for S&S of sepsis
 - Chills, elevated glucose levels, elevated temperature, malaise, ↑ WBC, and altered level of consciousness
- Monitor the patient for adverse reaction to lipid emulsion
 - Chest pain, cyanosis, dyspnea, dizziness, fever
- o Managing Common Problems
 - **Clotted catheter** – alteplase as ordered
 - **Cracked or broken tubing** – clamp between patient and point of air entry
 - **Dislodged catheter** – remove catheter and apply sterile pressure dressing
 - **Infusion too rapid** – use infusion pump, check rate and check pump
- o Discontinuation of TPN or PPN
 - TPN – wean patient over 4 hours to prevent rebound hypoglycemia
 - If TPN abruptly stopped or bag runs dry administer 10-20% Dextrose at the same rate as the TPN is ordered
 - PPN – no need to wean patient due to the lower concentration of dextrose
 - If PPN abruptly stopped or bag runs dry administer 5% Dextrose at the same rate as the PPN is ordered

VI. Managing Patients with Special Needs

- o Pediatric Patients – need to maintain nutritional status and give fuel for growth, lipid emulsion may lead to lipid accumulation in the lungs of neonates
- o Elderly Patients – at risk for fluid overload with TPN and more so with PPN due to high volume, must monitor flow rates and lab work closely

VII. Managing Complications of Parenteral Therapy

- o Air Embolism
 - Caused by inadvertent disconnection of tubing or hairline cracks in tubing
 - S & S = chest pain, apprehension, cyanosis, heart murmur, cardiac arrest
 - Potentially fatal and requires quick action
 - Clamp tubing
 - Place patient on left side in Trendelenburg position and apply oxygen
 - Change IV tubing
 - Notify physician
 - Prevent by making sure all tubing connections are secure and maintain integrity of occlusive dressing
- o Extravasation
 - Can cause necrosis and sloughing of epidermis and dermis
 - S & S = pain and swelling at insertion site
 - Must immediately stop the infusion and assess for cardiopulmonary problems
- o Hyperglycemia
 - Caused by high glucose concentration, high infusion rate or glucose intolerance
 - Insulin therapy may be initiated or TPN rate adjusted
 - Monitor serum glucose every 6 hours for 24 hours, then daily or as ordered
 - Maintain serum glucose levels less than 200mg/dL
 - Initiate the infusion slowly using a pump to help prevent this complication
- o Hyperkalemia
 - S & S = decreased heart rate, irregular pulse, peaked T waves
 - Monitor serum electrolytes and notify physician of critical labs
- o Hyperosmolar Hyperglycemic Nonketonic Syndrome
 - Caused by diuresis from untreated hyperglycemia (600-4800mg/dl)
- o Hypocalcemia

- Rare complication - monitor chemistry panel
- S & S = cardiac arrhythmias, dehydration, tetany, numbing or tingling sensation
- o Hypoglycemia
 - May develop if TPN infusion is abruptly interrupted or excessive insulin given
 - Monitor serum glucose every 6 hours for 24 hours, then daily or as ordered; always wean TPN over 4 hours
- o Hypokalemia
 - Caused by little K⁺ in solution, loss from GI tract, diuretic use or large doses of insulin
 - Initiate feeding slowly and monitor electrolytes
- o Hypomagnesemia
 - Caused by insufficient magnesium in solution
 - Initiate feeding slowly and monitor electrolytes
- o Hypophosphatemia
 - Suspect if patient exhibits irritability, weakness, and paresthesia
 - Initiate feeding slowly and monitor electrolytes
- o Liver Dysfunction
 - Requires special hepatic formulations by ↓ carbohydrates and ↑ lipids
- o Metabolic Acidosis
 - Increased serum chloride level and decreased bicarbonate level
 - Must closely monitor electrolyte levels while condition is corrected
- o Phlebitis
 - Inflammation of the vein with pain, redness, tenderness and warmth at the site
 - Apply heat and assess frequently
- o Pneumothorax or hydrothorax
 - Caused by either air or fluid entering pleural cavity from central line
 - S & S = chest pain, cough, cyanosis, diminished breath sounds, unequal chest movement
 - Prepare for and assist with chest tube insertion
 - Obtain chest x-ray and monitor breath sounds
- o Sepsis
 - *Most serious catheter-related complication and can be fatal. Is preventable with meticulous and consistent catheter care
 - Remember TPN is “meals on wheels for bacteria”
 - S & S = chills, red and indurated area around catheter, unexplained fever, unexplained hyperglycemia
 - Remove catheter and culture the tip
 - Administer appropriate antibiotics
 - Prevent by maintaining aseptic technique during catheter insertion, site dressing changes and tubing changes
- o Venous thrombosis
 - Caused by vein trauma during insertion or movement of catheter against vein wall
 - Same symptoms as phlebitis plus swelling in arm neck or face
 - Remove catheter promptly and prepare for venous flow studies and Heparin infusion