

Nutrition Conference

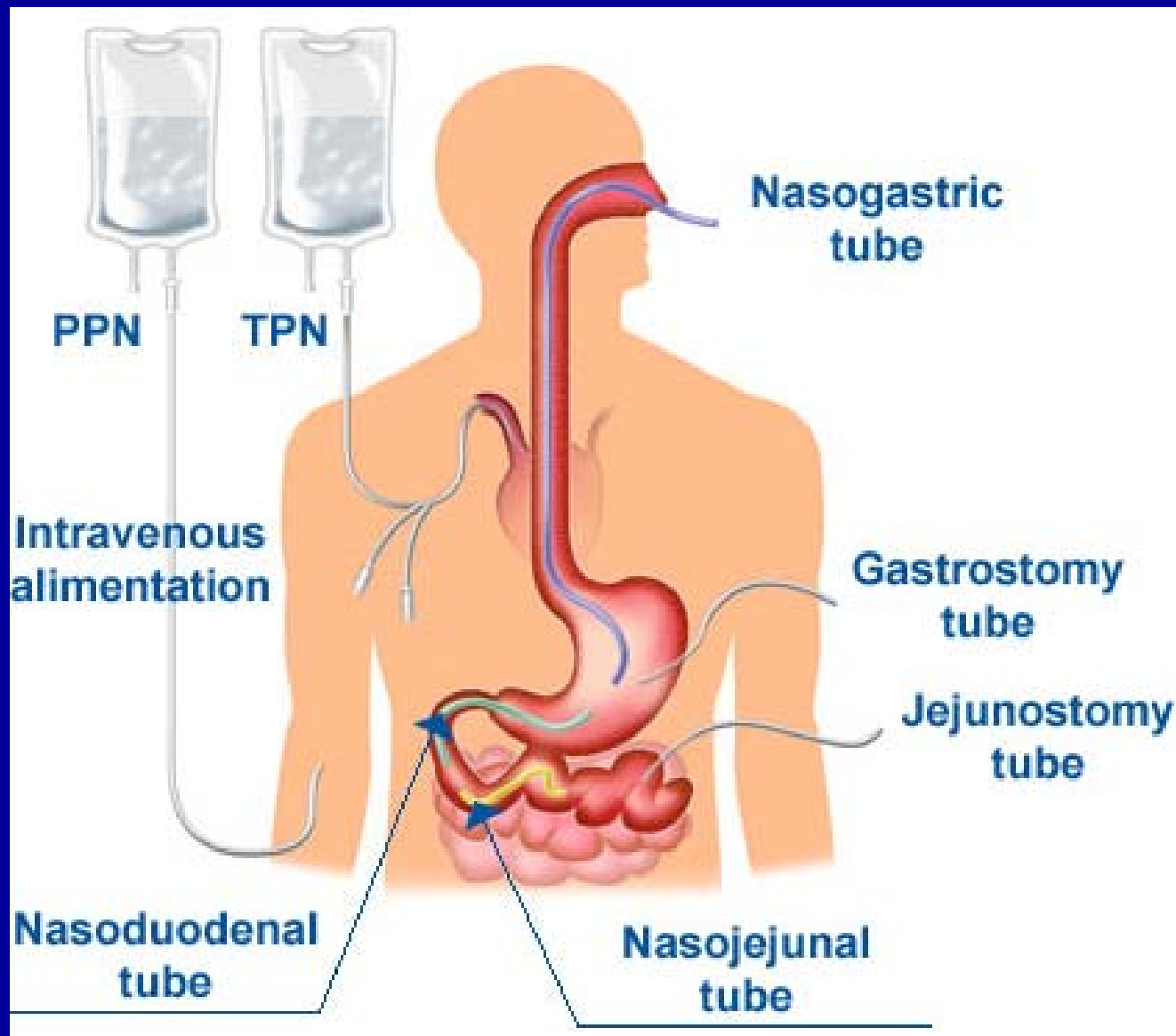
Chapter 11

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Parenteral Nutrition

- Necessary when the GI tract has insufficient function
- Enteral feeding are contraindicated
- TPN
- PPN developed in 1955-1965 side effects of Lipumol
- TPN used effectively on BEAGLES
- Later showed effectiveness with infants



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Indications for TPN

Table 11.1
Indications for Total Parenteral Nutrition

-
1. Malabsorption
 - a. Short bowel syndrome (SBS) (<150 cm small bowel in the absence of colon in continuity or <100 cm small bowel with colon in continuity)
 - b. Radiation enteritis
 - c. Other (refractory sprue, microvillus inclusion disease and others)
 2. Ileus/pseudoobstruction
 3. Small bowel or colonic obstruction
 4. High output gastrointestinal fistulas for which feeding distal to the fistula is impossible or would result in inadequate absorptive surface for adequate absorption
 5. Severe mucositis/esophagitis
 6. Intractable vomiting
-



Types of Parenteral Nutrition

- Total Parenteral Nutrition (TPN)
- Peripheral Parenteral Nutrition (PPN)
- Intradialytic Parenteral Nutrition (IDPN)



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TABLE 9-27. COMPLICATIONS ASSOCIATED WITH PARENTERAL NUTRITION

Infectious	
Sepsis, bacteremia, fungemia	Catheter site infection
Mechanical	
Venous thrombosis	Cardiac arrhythmia
Superior vena cava syndrome	Deep vein or myocardial perforation
Catheter occlusion due to Ca-P crystals	Pneumothorax
Embolism	Hydrothorax
Air embolism	Hemothorax
Hydrocephalus	Catheter dislodgement
Extravasation of solution	
Metabolic	
Fluid overload, dehydration	Vitamin or trace element deficiency
Hyperglycemia, hypoglycemia	Essential fatty acid deficiency
Hypernatremia, hyponatremia	Hyperlipidemia
Hyperkalemia, hypokalemia	Fat overload syndrome
Hyperchloremia, hypochloremia	Amino acid imbalance
Hyperphosphatemia, hypophosphatemia	Hyperammonemia
Hypercalcemia, hypocalcemia	Acidosis
Hypermagnesemia, hypomagnesemia	
Other	
Bone demineralization	Fibrosis
Rickets, Osteoporosis	Cirrhosis
Hepatobiliary dysfunction	Hepatoblastoma?
Cholestasis	Renal abnormalities (decreased GFR)?
Cholelithiasis	Psychologic (depression)
Hepatic abnormalities	Feeding problems
Steatosis	



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TPN

- Central line needed due to the hyperosmolarity usually >1600 mOsm/l
- Subclavian is Preferred
- Internal Jugular, Basilic, Saphenous and Femoral vein
- Thoracotomy with direct insertion into the right azygous vein
- PICC- lower risk for Pneumothorax, but, higher risk for thrombosis



PPN

- Short term (5-10 days)
- Patients should be able to meet some of their nutritional needs
- Thrombophlebitis: pathogenesis
 - Osmolality, pH and lipid content and particulate matter
 - Diameter, length and composition of catheter
 - Duration and rate of infusion
 - Diameter and anatomic position of the vein
 - Insertion technique



Thrombophlebitis

- 10mg hydrocortisone and 1,000 units of heparin per liter
- Avoidance of certain medications
- Avoid dextrose solutions >10%
- At least 50% of the total energy should be provided as lipid emulsion



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IDPN

- 40-70% of dialysis patients are malnourished
- Most costly and least efficient
- 2x more than dialysis



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Components of TPN

- Specific formulation prescribed for a patient depends on the patient's estimated nutrient requirements
- BEE (Basal Energy Expenditure)
- 20-25 kcal/kg/body weight/day



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Glucose/Carbs

- Dextrose predominate energy source
- Fuel for erythrocytes, WBC's, Bone marrow and renal medulla
- Providing calories as dextrose stimulates insulin secretion and decreases hepatic output
- Direct oxidation of dextrose spares the oxidation of Amino Acids



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Table 11.2
**Osmolalities and energy values of intravenous
dextrose solutions**

5	278	170
10	523	320
15	896	510
20	1,250	680
25	1,410	850
30	1,569	1,020
70	3660	2,330

Dextrose conc. (in grams) Osmolality (mOsm/kg
H₂O) kcal/l



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Lipid Emulsion

- Another energy source
- Derived from egg yolk phospholipids, soybean oil or a combination of soy bean oil and safflower oil
- Once sufficient amounts of dextrose have been provided to meet requirements of glucose dependant tissues and brain, lipid calories are effective as glucose calories in conserving body nitrogen



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Lipid Emulsion

- Lipids decrease plasma insulin, sodium, water retention and hepatic fat accumulation
- Uncommon side effects
 - Fever
 - Headache
 - Back pain
 - Dyspnea
 - Chills
 - Nausea
 - Chest pain



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Lipid Emulsion

- More serious complications:
 - Pulmonary Dysfunction
 - Hepatic Phospholipidosis
 - Impaired immune system
 - Pancreatitis
 - Decrease platelet aggregation
 - Fat overload syndrome
 - Hypersensitivity reaction



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Lipid Emulsion

- LCT have been used for decades
- Recent Studies have demonstrated that LE containing MCT may have some advantage:
 - Polymorphonuclear cells
 - Macrophages
 - Cytokine production
 - Particularly in critically ill patients



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Protein (Amino Acids)

- Maintain the nitrogen balance in the body and replete lean tissue in cachectic patients
- States that increase protein requirements:
 - Insufficient non-protein requirements
 - Catabolic illness
 - Protein losing enteropathy
 - Nephropathy
 - HD and PD
 - 0.8-1.5g/kg



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BCAA

- These have been developed for special disease states and physiologic conditions
 - Hepatic Encephalopathy 35-40% vs. 20%
- Cochrane Database
 - 556 pts with HE
 - Improvement in encephalopathy but no effect on mortality



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Others

- Fluid Volume
- Electrolytes
- Vitamins and Minerals
- Trace Elements
- Additives



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Table 1. The required trace elements and their metabolic functions

Element	Metabolic Function
Iron	Energy transfer by hemoglobin and cytochromes
Zinc	Growth, healing, immune function
Copper	Connective tissue formation and energy transfer
Manganese	Arginine, pyruvate, superoxide metabolism
Chromium	Part of insulin receptor
Selenium	Prevents peroxidation of reduced compounds such as glutathione



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Table 3. The multiple trace element formula recommended by the authors for adults on long-term parenteral nutrition*

Element	Amount/day	Comment
Zinc	3–6 mg	2 mg/kg of enteral loss for a total of 6–12 mg/day
Copper	0.3–0.5 mg	Discontinue when serum aminotransferases and alkaline phosphatase > 2x normal. Check serum Cu levels every 6–12 mo thereafter.
Manganese	30–60 mcg	Discontinue when serum aminotransferases and alkaline phosphatase > 2 x normal. Check serum Mn levels every 6–12 mo thereafter.
Chromium	5–10 mcg	Check HbA1C every 6 mo
Selenium	60–100 mcg	Higher dose in adults < 40 y.o.

*Table reprinted from “Autopsy tissue trace elements in 8 long-term parenteral nutrition patients who received the current U.S. Food and Drug Administration formulation,” *Journal of Parenteral and Enteral Nutrition* 31 (2007), 388–96, with permission.



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TPN start date for base line labs

Trace Element Monitoring Guidelines for Long Term TPN						
Element	Baseline	Weekly	Monthly	3 months	6 months	Lab Test
Manganese	x			x		whole blood
Selenium	x			x		serum
Zinc	x			x		serum
Chromium	x			x		serum
Copper	x			x		serum
Serum Fe	x			x		
Ferritin	x			x		
% Iron Saturation	x			x		
Vitamin Monitoring Guidelines for Long Term TPN						
Vitamin						
Vitamin A	x				x	
Vitamin D (1, 25)	x				x	
Vitamin D (25)	x				x	
Vitamin E	x				x	
Folate	x			x		
Vitamin B12	x			x		
Nutritional Labs for Long Term TPN						
Albumin	x	x				
Prealbumin	x		x			
CRP	x		x			
Transferrin	x			x		
Triglyceride	x	x				

*if Trig >400; will hold IL and recheck x 1 week

* May need to check trace elements more frequently if remain low and require additional supplier

Weekly Labs to also include

CMP, ion Ca, P, Mg, hepatic panel (alk phos, AST, ALT, GGT, T bili, D bili, I bili, albumin)
 CBC + Diff and Platelet. Coagulation panel if desired by MD.



Additives

- Insulin
- Heparin/Corticosteroids
- Albumin
 - Does not correct the patient nutritional status, but improves edema
 - Deficit(g) = weight(kg) x 3dl/kg x 3.5
- Acid Suppression



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Additives to TPN

- Patient has done well after surgery and is symptom free



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Writing TPN Orders

Table 11.4
Steps in Writing TPN Orders.

1. Determine ideal body weight (IBW)
2. Calculate the non-protein caloric requirement.
 $IBW = 70 \text{ kg}$
 $70 \text{ kg} \times 25 \text{ kcal} \cdot \text{kg}^{-1} \cdot \text{day}^{-1} = 1,750 \text{ kcal/day}$
3. Calculate the protein requirement
 $IBW = 70 \text{ kg}$
 $70 \text{ kg} \times 1.4 \text{ g protein} \cdot \text{kg}^{-1} \cdot \text{day}^{-1} = 98 \text{ g protein/day}$
4. Determine the optimal concentration of amino acid and carbohydrate solutions while taking volume into account. Consider an example of a 5% amino acid solution (contains 50 g of protein/l) and a 25% dextrose solution (contains 250 g of dextrose/l)
 - a. Protein requirement
 $98 \text{ g protein/day} / 50 \text{ g protein/l} = 1.96 \text{ l/day}$ OR $1,960 \text{ ml/day}$ OR 82 ml/h
 - b. Non-protein calorie requirement
 $1,960 \text{ ml/day} \times (250 \text{ g dextrose} / 1,000 \text{ ml}) \times 3.4 \text{ kcal/g dextrose} = 1,666 \text{ kcal/day}$
5. Determine the extra calories needed
 - a. $1,750 \text{ kcal} - 1,666 \text{ kcal} = 84 \text{ kcal}$
 - b. The extra calories that are needed can be delivered via lipid emulsion. Lipids are available in 10% and 20% concentrations in units of 50 ml; 50 ml of 10% lipid contains 50 kcal. Therefore, the patient can receive 84 ml of the 10% lipid emulsion in the TPN to make up the difference in caloric needs. A minimal amount of lipids needs to be given in order to prevent the development of essential fatty acid deficiency. The minimal accepted amount is 4% of the total provided calories in the form of linoleic acid.



Complications in the Hospitalized Patient Receiving Parenteral Nutrition

- Mechanical Complications
- Vascular Complications
- Infections
- Metabolic Complications



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Complications in the Hospitalized Patient Receiving Parenteral Nutrition

- Mechanical Complications
 - Pneumothorax
 - Hemothorax
 - Thoracic duct injury
 - Chylothorax
 - Brachial plexus injury
 - Subclavian and carotid artery puncture



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Complications in the Hospitalized Patient Receiving Parenteral Nutrition

- Vascular Complications
 - Thrombosis
 - 25-50% of subclavian
 - Precipitation of electrolyte salts

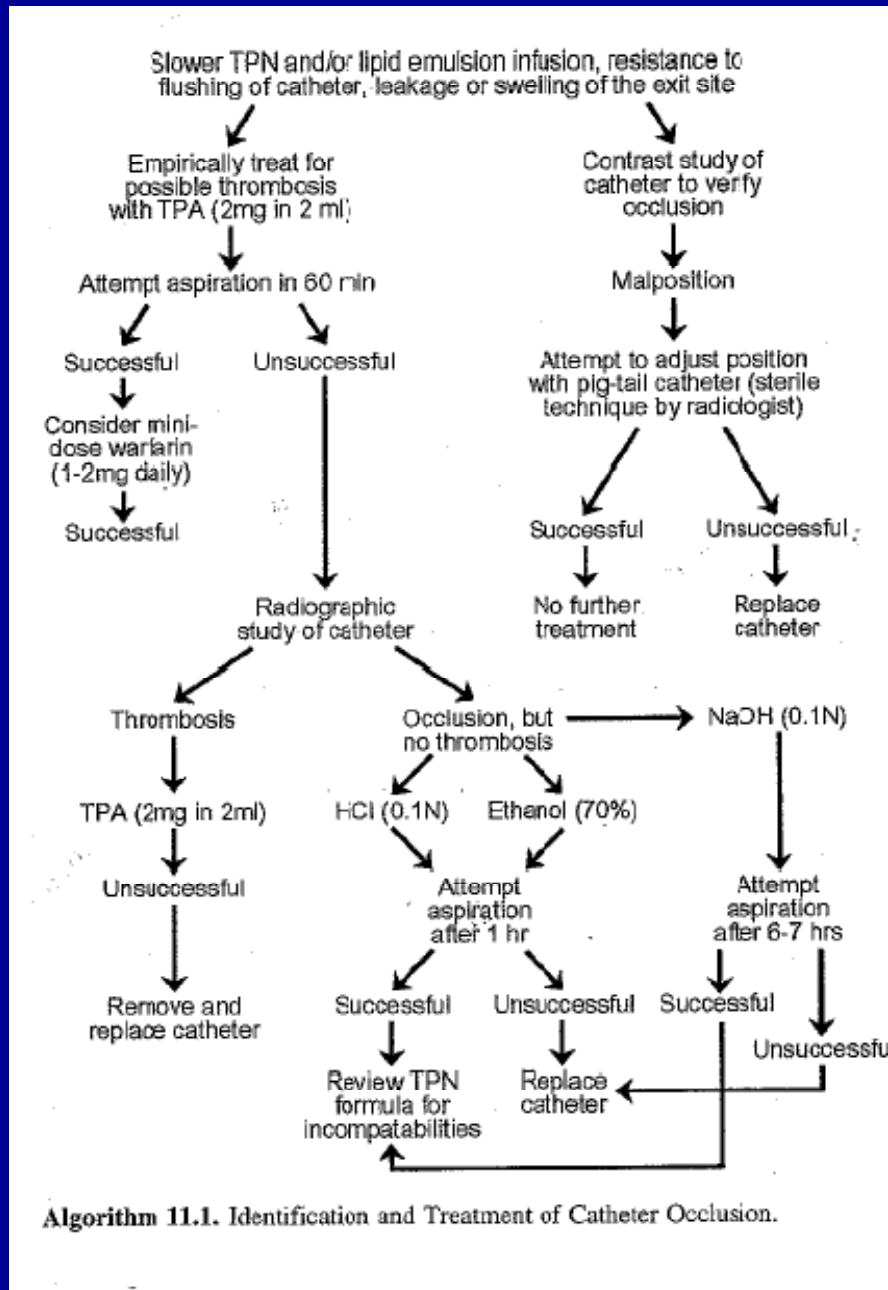


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Catheter Occlusion



Algorithm 11.1. Identification and Treatment of Catheter Occlusion.



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Table 11.5
Protocol for tPA administration

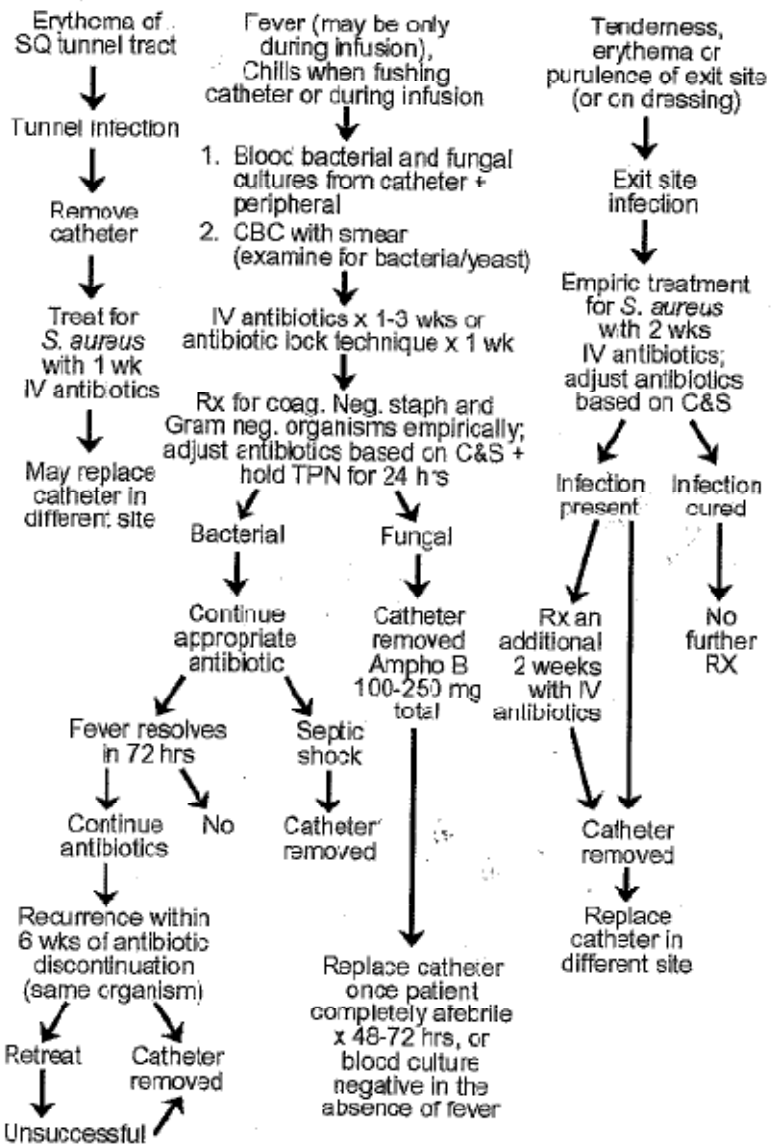
A. Preparation of enzyme:

1. Obtain tPA in a 50-mg vial.
2. Reconstitute enzyme according to instructions to provide 25 cc of enzyme at a concentration of 2 mg/ml.
3. Using sterile technique, divide the tPA into 1-cc aliquots (2 mg). Place in sterile vials suitable for freezing.
4. Store frozen at -70°C .
5. When needed, remove vials from freezer and allow to thaw at room temperature.
6. Use immediately after thawing.

B. Technique for use:

1. Attempt to aspirate the occluded catheter lumen to remove heparin.
2. Inject 2 mg (1 ml) of tPA into the occluded catheter lumen.
3. Make up the remainder of the catheter lumen fill volume with saline (e.g., for a 1.9 catheter lumen use 1 ml tPA and 0.9 ml saline).
4. Wait 15 min, then inject 0.3 ml of saline to again move the active enzyme towards the tip of the catheter.
5. After another 15 min, add another 0.3 ml to again move the active enzyme towards the tip of the catheter.
6. After a third 15-min period, try to aspirate the catheter.
7. If the catheter aspirates easily, forcefully flush several times with aspirated blood.
8. If the catheter cannot be aspirated easily, repeat the procedure.
9. If the second application of tPA is unsuccessful, refer the patient for catheter exchange.





Algorithm 11.2. Identification and Treatment of Catheter-Related infections.



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Metabolic Complications

- Innapropriate nutrient excesses or deficiencies or both
 - Fluid overload
 - Hyperglycemia
 - Nonketotic hyperosmolar coma
 - Increased ammonia
 - Hypertriglyceridemia
 - Hypercalcemia



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