

TOTAL PARENTERAL NUTRITION

The notion that malnutrition affects outcomes in surgical patients was first reported in 1936 in a study showing that malnourished patients undergoing ulcer surgery had a 33 percent mortality compared with 3.5 percent in well nourished individuals. The stress of surgery or trauma increases protein and energy requirements by creating a hypermetabolic, catabolic state.

Malnutrition causes a number of deleterious consequences, including:

- Increased susceptibility to infection
- Poor wound healing
- Increased frequency of decubitus ulcers
- Overgrowth of bacteria in the gastrointestinal tract
- Abnormal nutrient losses through the stool.

Many animal and clinical studies have supported the adage "If the gut works, use it."

In some situations parenteral nutrition via a peripheral vein may be effective, using a solution that does not exceed 900 mosmol/kg (e.g. 10 percent dextrose, 2 percent amino acids, and electrolytes). Peripheral solutions generally provide inadequate calories unless infused at a high rate (e.g. 85 to 100 mL/h). The administration of more hyperosmolar (concentrated) solutions requires central venous access.

The initial selection of the parenteral nutrition solution should be determined by a patient's tolerance to:

- Parenteral glucose (e.g. patients with diabetes or critical illness are susceptible to hyperglycemia with exogenous dextrose infusions)
- Amino acids (e.g. renal or hepatic disease may result in intolerance to protein loads)
- Fats (e.g. critical illness or sepsis may result in hypertriglyceridemia)

Initial infusion rates of these macronutrients generally begin at 2 to 4 mg/kg per minute in adults, 0.5 to 1.0 g of protein per kg per day, and 1.0 g of lipid per kg per day. Electrolytes, minerals, trace elements and a multivitamin preparation are generally added to the parenteral solution.

Glutamine— Glutamine is an important precursor for nucleotide synthesis, and an important fuel source for rapidly dividing cells such as gastrointestinal epithelia. Animal experiments have shown that glutamine supplementation can prevent or ameliorate the gastrointestinal mucosal atrophy seen in prolonged states of parenteral nutrition.

Arginine - Arginine is an amino acid with important roles in nitrogen and ammonia metabolism, and in the generation of [nitric oxide](#). Animals subjected to wounds or fractures have improved rates of wound-healing, nitrogen retention, and growth when supplemented with dietary arginine

There are three serum measures of protein status with varying half-lives. These measures must be used in conjunction with clinical data on the duration of the current surgical illness to be useful in determining therapy.

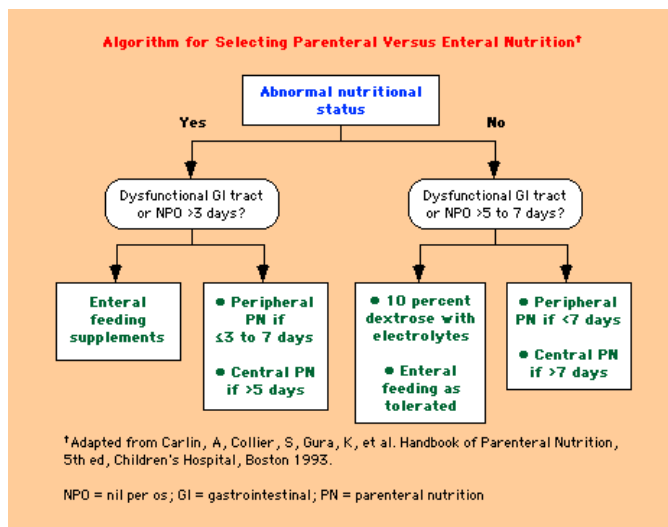
- Serum albumin has been most extensively used, as it has the longest half-life of the three (18 to 20 days).
- Serum transferrin has an intermediate half-life of eight to nine days, reflecting protein status over the past two to four weeks.
- Serum prealbumin (transthyretin) has the shortest half-life (two to three days) and is least helpful in assessing overall nutritional status since it reflects only protein status over the past days to week.

Pre and Post-op TPN-Most studies have not demonstrated a clear benefit of preoperative total parenteral nutrition (TPN) compared with untreated controls and data from studies of postoperative TPN alone are even less favorable.

SUMMARY AND RECOMMENDATIONS

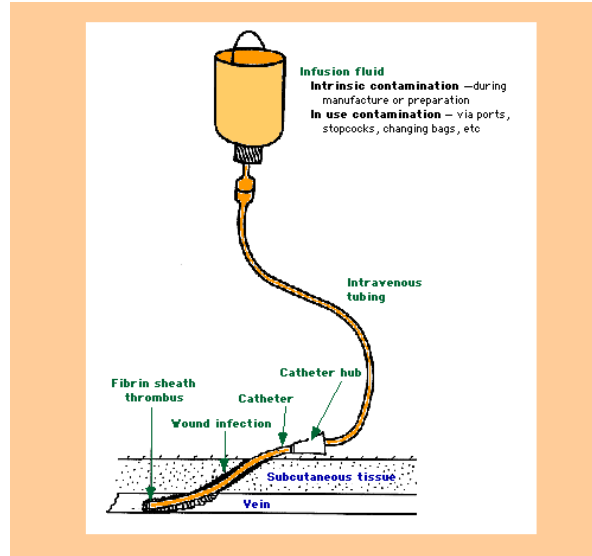
Early use of the gut is most beneficial if possible. Among patients who have had general anesthesia, resumption of oral intake is usually possible within a few days, and no supplemental nutrition is required during this time.

Given the lack of clear benefit and documented risks, patients who are not malnourished or only with mild to moderate malnutrition should not have surgery deferred for TPN or enteral feeds, and should not have routine postoperative TPN feeding unless bowel rest is anticipated for greater than 7 to 10 days. Patients with severe malnutrition may derive some benefit from delaying surgery to be fed, but are at increased risk for infectious complications if treated with TPN perioperatively. Patients may benefit more from enteral feeds when possible.



Intravascular catheter associated infections

Central venous catheters (CVCs) are increasingly used in the inpatient and outpatient setting to provide long-term venous access. Infection of CVCs remains a major problem. It is estimated, for example, that approximately 90 percent of the 50,000 to 100,000 annual catheter-related bloodstream infections in the United States occur with CVCs.



Sources of intravenous catheter-related infection. Major sources of intravenous catheter-related infection include skin colonization with migration of microorganisms along intracutaneous tract (wound infection or infection of fibrin sheath); intraluminal colonization of device or hub; hematogenous seeding from remote focus elsewhere (infection of fibrin sheath); or the delivery of contaminated infusate.

The most common source of CVC-related infections is colonization of the intracutaneous and intravascular portions of the catheter by microorganisms from the patient's skin and occasionally the hands of health care workers.

Hematogenous seeding of the device can occur during a bloodstream infection originating from another focus of infection; this is most likely to occur in critically ill patients or those with long-term catheters

Thrombosis of the CVC substantially increases the risk of colonization and infection . In addition, clot formation may occur secondarily from infection.

Administration of contaminated infusate can result in a bloodstream infection. This is now a rare source of bloodstream infection and generally causes epidemic infections.

Percutaneously inserted devices have been associated with rates of catheter-related bloodstream infection in the range of 1 to 3 percent

The following general statements apply to the risk of infection with central venous catheters:

- Internal jugular more than subclavian.
- Repeated catheterization.
- Presence of septic focus elsewhere.
- Catheter insertion using submaximal barrier precautions.
- Nontunneled more than tunneled
- Tunneled more than totally implantable device
- Lower risk with silver-chelated collagen cuff

Microbiology-Infection of CVCs is most commonly attributable to the patient's skin flora and occasionally the hands of health care workers. Gram positive cocci account for the overwhelming majority of these infections. Coagulase-negative staphylococci are a common constituent of the skin flora and have surpassed *S. aureus* as the major cause of CVC-related bloodstream infection.

- Besides the staphylococci, enterococci and other gram-positive bacilli (bacillus species or *Corynebacterium* - especially JK-1) are occasionally isolated from catheter-related bloodstream infections. Cryptogenic bacteremia due to staphylococci, enterococci or Gram positive bacilli frequently originates from an intravascular device.
- Gram negative bacilli account for up to one-third of CVC-related bloodstream infections. The most commonly isolated organisms include *K. pneumoniae*, *Enterobacter* sp., *E. coli*, *Pseudomonas* sp, *Acinetobacter* sp. and *Serratia* sp. Bloodstream infections caused by *Klebsiellae*, *Citrobacter* sp, or non-aeruginosa pseudomonads may signal infusion of contaminated infusate. A cluster of cases would mandate an immediate investigation.
- Bloodstream infection related to CVCs occasionally may be due to more than one microorganism. CVC-related infection due to anaerobic bacteria is exceedingly rare.
- Fungi, especially *Candida* species, account for up to 20 percent of systemic infections associated with CVCs. Fungal infections are a particular concern in patients receiving a high concentration of glucose in intravenous hyperalimentation. *Candida* also produce glycocalyx which enhances its ability to colonize CVCs.
- *Malassezia furfur*, a lipophilic yeast, has been associated with bloodstream infections in patients receiving intravenous lipids, especially very young infants. This may partly explain its frequency as a cause of intraluminal colonization

Prevention of Infection with Central Venous Catheters*

Replacement and relocation of catheter

- Do not routinely replace central venous catheters solely for the purpose of reducing the incidence of infection (including peripherally-inserted, nontunneled or tunneled catheters and implantable devices).

Replacement of catheter-site dressing

- Replace dressing when the catheter is removed or replaced, the dressing becomes damp, loosened, or soiled or inspection of the site is necessary.
- Replace gauze dressing every two days and transparent dressings every seven days on short-term catheters.
- Replace dressing no more than once per week until the insertion site is healed on long-term catheters. The necessity for dressing on well-healed exit sites of long-term culled and tunneled CVC is an unresolved issue.

Replacement of administration sets

- Replace administration sets, including secondary sets and add-on devices, no more frequently than at 72-hour intervals, unless clinically indicated.
- Replace tubing used to administer blood, blood products, or lipid emulsions within 24 hours of initiating the infusion. **No recommendation†** for replacement of tubing used for intermittent infusions.
- Replace tubing used to administer propofol infusions every 6 or 12 hours, depending on its use.

Hang time for parenteral fluids

- Complete infusion of lipids or lipid-containing parenteral nutrition fluids (eg, 3-in-1 solutions) within 24 hours of hanging the fluid. When lipid emulsions are given alone, complete the infusion within 12 hours of hanging the emulsion.
- Complete infusion of blood or blood products within four hours of hanging the blood.
- **No recommendation†** for the hang time of intravenous fluids, including nonlipid-containing parenteral nutrition fluids.

*Includes nontunneled catheters, tunneled catheters, and totally implanted devices.
† No recommendation is made when there is insufficient data in the literature.

Steven Schulhof, M.D.