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TOTAL PARENTERAL NUTRITION: AN OPTION FOR NON-FUNCTIONAL GASTRO-INTESTINAL PATIENTS

CH. B. PRAVEENA DEVI, M. RAJYALAXMI, R. SONY, K. GAYATHRI, B. KOUSIK, VSS GUPTA, B. MAHESHWARI AND SHANTI SAGAR

Department of Pharmacy, Joginpally B. R. Pharmacy College, Yenkapally, Moinabad, Hyderabad, Telangana- 500 075

*Corresponding Author: Dr. CH. B. Praveena Devi: E Mail: medicinalchemistonline123@gmail.com

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ABSTRACT

Nutrition plays a vital role in maintaining overall health, supporting growth, and preventing diseases. It involves the intake and utilization of macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals) to meet the body's metabolic needs. Proper nutrition is essential for energy production, immune function, and organ maintenance. In clinical settings, patients who cannot consume adequate nutrients orally or may require Total Parenteral Nutrition (TPN), a method of delivering essential nutrients directly into the bloodstream via intravenous infusion. TPN provides carbohydrates, amino acids, lipids, electrolytes, vitamins, and trace elements to sustain metabolic functions. It is commonly used for patients with gastrointestinal disorders, severe mal-absorption, or post-surgical complications. However, prolonged TPN use carries risks such as infections, liver dysfunction, and metabolic imbalances. This abstract highlights the importance of balanced nutrition and the role of TPN in clinical practice, emphasizing the need for careful monitoring and individualized treatment to ensure optimal patient outcomes.

Keywords: Nutrition, Feeding, Kidney, Anorexia, Osmolality, Financial, Sepsis, Micronutrients, Parenteral feeding, Nutritional deficiencies

INTRODUCTION

Patients who are unable to receive enough nutrition by oral or enteral methods can benefit from total parenteral nutrition (TPN), a medical therapy. Through the use of an intravenous (IV) catheter, TPN delivers nutrients straight into the bloodstream, avoiding the gastrointestinal (GI) system completely. For individuals with illnesses including severe gastrointestinal disorders, specific types of cancer, or major procedures that affect their capacity to consume or absorb nutrition, this approach is essential **[1]**. TPN is meticulously formulated to satisfy each patient's unique requirements and generally consists of micronutrients (vitamins and minerals) and macronutrients (proteins, lipids, and carbohydrates). Proteins are typically delivered as amino acids, whereas carbohydrates are typically supplied as dextrose. Emulsified fats can be added to lipids to supply extra calories and important fatty acids. The patient's age, weight, metabolic state, and particular dietary needs can all have a substantial impact on the precise formulation **[2-6]**. TPN has a wide range of indications, including cancer treatment where oral intake is not feasible, severe pancreatitis, short bowel syndrome, and inflammatory bowel disease. Patients recuperating from severe surgeries are also treated with it, especially if they are able to handle enteral nutrition. Parenteral nutrition (PN) was created as a result of Dudrick and colleagues' successful intravenous nutrient administration, which represented a significant breakthrough in feeding patients who couldn't be fed orally **[7]**. TPN can be administered using a variety of venous access, such as central venous catheters (CVC) or peripheral veins.

For long-term TPN, central access is frequently chosen because it allows for the administration of larger nutrient concentrations without running the risk of harming smaller peripheral veins **[8]**. A multidisciplinary strategy including doctors, dietitians, pharmacists, and nursing staff is needed to start TPN. Together, these specialists determine the patient's nutritional requirements, choose a suitable TPN formula, and track the patient's reaction to treatment. To assess liver function, electrolyte levels, and other pertinent factors, routine laboratory testing is carried out **[9, 10]**.

Table 1: A comparison of total parenteral nutrition and partial parenteral nutrition [11]

Total Parenteral Nutrition	Partial Parenteral Nutrition
Marked hypertonicity (850–2,000 mOsm/L)	Mild hypertonicity (500–600 mOsm/L)
Supplies total patient energy needs	Does not usually supply all patient energy needs
The central venous administration required	Peripheral venous administration is possible
May be deficient in total vitamin and mineral needs, depending on the formulation	Typically deficient in vitamin and mineral needs

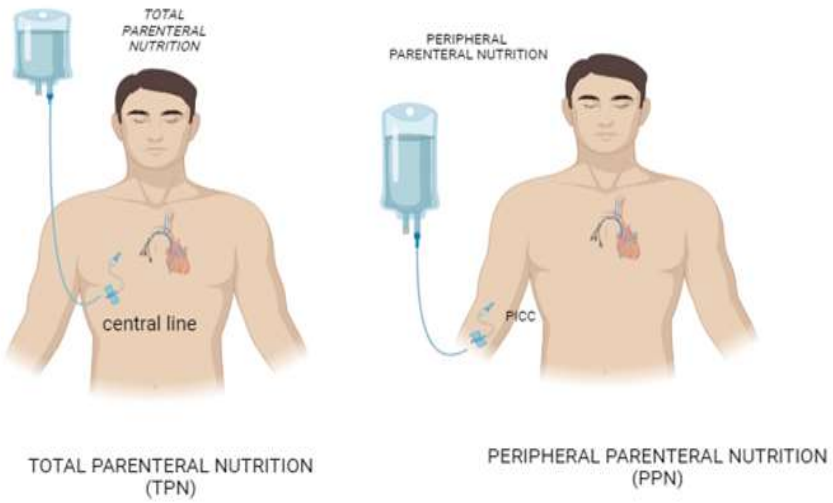

Figure 1: Representation of TPN and PPN [11]

Indications

The intravenous delivery of nourishment outside of the digestive system is known as parenteral nutrition. When the patient receives all of their nutrition via an intravenous (IV) source, this is known as total parenteral nutrition (TPN). When there are contraindications to enteral nutrition and insufficient gastrointestinal function, whole parenteral nutrition is recommended. Although enteral meal intake necessitates a functioning gastrointestinal tract, it is recommended over parenteral since it is less expensive and linked to fewer problems like infection and blood clots. In an article, the authors stated that TPN indications include **[12]**.

- Chronic intestinal obstruction as in intestinal cancer **[13]**.
- When an infant's gastrointestinal system is immature or has a congenital gastrointestinal malformation
- When there is a post-operative bowel anastomosis leak
- When the patient is unable to maintain nutritional status due to severe diarrhea or vomiting
- Hypercatabolic states due to sepsis, polytrauma, and major fractures **[14]**.
- An anticipated period of nothing by mouth (NPO) status greater than seven days as in patients with inflammatory bowel disease exacerbations as well as critically ill patients **[15]**.

Mechanism of action

Lipid emulsions, dextrose, amino acids, vitamins, electrolytes, minerals, and trace elements are all included in TPN, which is a

blend of distinct ingredients. TPN composition should be modified by clinicians to meet the needs of each patient. Proteins, dextrose, and lipid emulsions are the three primary macronutrients **[16, 17]**.

Lipid emulsion

It gives you calories and keeps you from running out of fatty acids. Within three weeks after starting fat-free TPN, essential fatty acid deficit may manifest **[12]**.

Proteins

A mixture of essential and non-essential amino acids, excluding glutamine and arginine. The patient's condition determines this modification. Patients with acute hepatic encephalopathy require temporary protein restriction to 0.8 gm/kg/day, patients on hemodialysis require 1.2 to 1.3 gm/kg/day, critically ill patients require 1.5 gm/kg/day, and patients with chronic renal failure are given 0.6 to 0.8 gm/kg/day **[18]**.

Carbohydrates

- Provided through dextrose monohydrate in a variety of concentrations, most commonly 40,50, and 70%
- Glucose utilization maximum rate is 5 to 7 mg/kg/min.
- Excess carbohydrate supplementation can result in hyperglycemia and hypertriglyceridemia.

Electrolytes trace elements and vitamins are micro -nutrients

- Trace elements and vitamins dosing can be according to recommended daily requirements.
- Electrolytes recommendation per liter of parenteral nutrition:

  Sodium: 100 to 150 mEq

  Magnesium: 8 to 24 mEq

  Calcium: 10 to 20 mEq

  Potassium: 50 to 100 mEq

  Phosphorus: 15 to 30 mEq

The three macronutrients are 3-in-1 (lipid emulsions, amino acids, and dextrose) are combined to provide total nutrition.

- A 3-in-1 solution and intravenous lipid emulsions) mixed with electrolytes, trace elements, vitamins, and water. Parenteral solution with only dextrose and amino acids with a separate intravenous lipid emulsions infusion, the 2-in-1 solution has also been previously used. **[19]**.

TPN administration

The central venous catheter must be inserted and maintained using stringent sterile procedures because it must be in place for an extended period of time. There should be no other use for the TPN line. Every 24 hours, external tubing needs to be replaced with the first the day's bag. There is no evidence that

in-line filters reduce problems. Using stringent sterile procedures, dressings should be kept sterile and typically replaced every 48 hours. Patients who get TPN outside of the hospital need to be trained to identify infection symptoms, and skilled home nursing has to be set up. Using 5% dextrose to make up the remaining fluid requirements, the PN solution is gradually begun at 50% of the determined requirements. Nitrogen and energy should be administered at the same time. The plasma glucose level determines how much regular insulin is administered (added straight to the TPN solution); if the level is normal and the final solution has 25% dextrose, then Five to ten units of normal insulin per liter of TPN fluid is the typical starting dose. If one is available, an interdisciplinary nutrition team ought to keep an eye on these patients. For inpatients, weight, CBC, electrolytes, and BUN should be measured and documented every day. Until the patient and blood glucose levels stabilize, the plasma glucose concentration should be checked every six hours. Continuous monitoring of fluid intake and output is necessary. Blood tests can be performed far less often as patients stabilize **[20]**. Due to its high osmolarity, total parenteral nutrition is not given via a peripheral intravenous catheter (also known as peripheral parenteral nutrition, or PPN). The osmolarity of PPN must be below 900 mOsm. Higher fat content and bigger volume feedings are required due to the reduced concentration. TPN is administered via central venous access because high osmolarity irritates peripheral veins. PPN is used to give patients who have enteral feedings and a functional gut extra nourishment.

Adverse effects

The main adverse effects can be due to metabolic abnormalities, infection risk, or venous access associated. Venous access: It is associated with the insertion of the central line catheter.

- Pneumothorax
- Air embolism
- Bleeding
- Venous thrombosis

Vascular injury. **[21][12]**

Catheter site infection

- Central line-associated bloodstream infection (CLABSI) **[22]**
- Bloodstream infection, known as sepsis
- Local skin infection at insertion or exit site

Metabolic abnormalities

Refeeding syndrome in chronic alcoholic patients, and in patients who have

nothingbymouth status (NPO) formore than 7 to 10 days.

- Hyperglycemia
- Sudden discontinuation can lead to hypoglycemia. Hypoglycemia is correctable with 50% dextrose.
- Serum electrolyte abnormalities
- Wernicke's encephalopathy **[23][24]**

Contraindications

According to Maudar (2017), TPN is generally contraindicated in the following conditions:

- Infants with less than 8 cm of the small bowel
- Irreversibly decerebrate patients
- Patients with critical cardiovascular instability or metabolic instabilities. Such instabilities require correction before administering intravenous nutrition.
- When gastrointestinal feeding is possible
- When the nutritional status is good and, only short-term TPN is needed
- The lack of a therapeutic goal, as TPN should not be used to prolong life when death is unescapable **[24]**.

Monitoring

Per Maudar 2017, several variables require monitoring while on TPN **[14]**

- Intake and output 12-hour charts
- Urine sugar estimate every 8 hours
- Serum electrolytes: daily sodium, potassium, bicarbonate, calcium, and chloride values
- Serum creatinine and blood urea daily values
- Serum protein levels twice daily
- Liver function tests twice daily **[26]**

Toxicity

TPN's toxicity is typically correlated with the toxicity of each of its constituent parts. Hepatic toxicity can result from increased caloric intake from TPN glucose and lipid excess; this risk can be reduced by employing higher lipid content and lower glucose content. A fatty liver may arise with a glucose infusion rate higher than 5 mg/kg/min because elevated blood glucose causes hepatic lipogenesis, which in turn causes elevated insulin levels, which further promote lipogenesis **[27]**. Decreased dextrose dosage to less than 5 g/kg day, less than 5 mg/kg min, cyclic PN for 8 hours, which reduces excessive insulin secretion, and replacing 30% of dextrose energy with lipids will prevent this impact. For pediatric patients in the pediatric intensive care unit (PICU), parenteral nutrition augmentation is more detrimental than complete parenteral feeding. Regardless of age or nutritional status,

clinicians should refrain from administering parenteral nutrition supplements during the first week in the PICU because amino acids in the PN inhibit the autophagy process, which is necessary for the elimination of cellular damage. A surplus of amino acids is transferred to the synthesis of urea. Elevated urea levels may be harmful to the liver and kidneys **[28]**. Using TPN for several weeks or months at a time can be connected to the uncommon side effect of manganese poisoning. Because manganese exposure by TPN avoids the GI tract's regulatory systems, it has a high bioavailability. Over time, manganese deposits in the liver, brain, and bone as a result of this high concentration. However, because manganese will accumulate and impact the globus pallidus and striatum of the basal ganglia, the brain is most likely to be impacted. Extrapyramidal symptoms that resemble Parkinson disease are caused by manganese's selective action on dopaminergic neurons in the basal ganglia. The substantia nigra, which is where the impacted neurons are located, can be used to distinguish between different types of idiopathic Parkinson disease **[29-40]**.

Advantages of TPN

1. Life-Saving Intervention: Ensures nutritional support in patients with non-functional GI tracts.
2. Customizable Formulations: Nutrient composition can be tailored to individual metabolic needs.
3. Prevention of Malnutrition: Prevents severe nutritional deficiencies and promotes recovery in critically ill patients.
4. Improved Quality of Life: Enables patients with chronic GI conditions to sustain adequate nutrition.
5. Versatility: Can be used in diverse clinical scenarios, including acute and chronic conditions

Disadvantages of TPN

1. Complications

Metabolic:

Hyperglycemia, hypoglycemia.

Electrolyte imbalances (e.g., hypokalemia, hypophosphatemia).

Refeeding syndrome in malnourished patients.

2. Infectious:

Central line-associated bloodstream infections (CLABSIs).

3. Hepatic:

TPN-associated liver disease (e.g., steatosis, cholestasis).

2. Logistical Challenges

Requires specialized teams for preparation and monitoring. High cost compared to enteral nutrition.

3. Reduced GI Function

Prolonged use may lead to GI mucosal atrophy and compromised gut immunity.

4. Psychological Impact

Dependency on intravenous nutrition can affect the patient's quality of life and mental health.

CONCLUSION

Proper nutrition is essential for maintaining health, preventing disease, and supporting recovery in various clinical conditions. Enteral nutrition remains the preferred route of nutrient delivery due to its physiological benefits and cost-effectiveness. However, in cases where enteral feeding is not feasible, Total Parenteral Nutrition (TPN) serves as a vital alternative, ensuring adequate nutrient intake. While TPN is a lifesaving intervention, it requires careful monitoring to prevent complications such as infections, metabolic imbalances, and liver dysfunction. Advancements in nutrition science continue to refine both enteral and parenteral approaches, emphasizing individualized care based on patient needs. A multidisciplinary approach involving dietitians, physicians, and pharmacists is crucial to optimizing nutritional support and improving patient outcomes. Future research should focus on enhancing the safety and efficacy of nutritional interventions while minimizing associated risks.

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Here's how you can convert the reference you provided to match the style of the example you gave:

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