Review Article

A Study on the Effect of Total Parenteral Nutrition Compared to Crystalloids with Colloids Alone Given Preoperatively or, Post-Operatively in Patients with Type II Intestinal Failure Affecting the Outcome in a Tertiary Care Hospital in Bengaluru, India

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Abstract

Background & Objectives: Intestinal Failure is where patient is not able to maintain normal gut functions due to various reasons. Most of the reasons patients developed intestinal failure is due to Surgical reasons and best countered by bowel rest, early surgical intervention and Parenteral Nutrition. Here we are studying 2 parenteral nutrition modalities namely TPN compared to crystalloids and colloids alone with or without surgery affecting the overall outcome of the patient's intestinal failure, with or without surgery.

Methods: Sample size for the study was n=50 in each group with age being matched and the patient condition and complexity of surgery not matched for both groups between June 2017 to November2019. Using convenient sampling technique, all patients with intestinal failure as identified over the past 2 ½ years admitted in our hospital in various departments, were included in the study.

Results: Outcome with respect to enteral autonomy after surgery among the two nutritional modules, those on TPN was statistically significant.

Summary: This study meant TPN with surgery in cases of Type II intestinal failure was found to be beneficial in the group which were studied with respect to various aspects like achieving enteral autonomy, decrease in length of hospital stay and overall outcome of the patient.

Interpretation & Conclusion: The need for TPN to be standardized across the ICUs and ITUs in all patients who need parenteral support either pro or post – op especially in cases of Type II intestinal Failure. The more the adherence to previously laid protocol earlier the patient reached enteral autonomy and lesser the days of hospital stay.

Keywords: Parenteral nutrition; Intravenous hyperalimentation; Parenteral hyperalimentation

Introduction

Intestinal Failure (IF) especially type II is a well-established clinical entity but the nomenclature is not included in PubMed MeSH search terms until recently.

IF may be due to acquired or congenital, gastrointestinal or systemic, benign or malignant diseases, which affect all age groups.

It may be of abrupt onset, or may be the slow, progressive evolution of a chronic disease, may be self-limiting short term, or a long term condition (Chronic Intestinal failure, CIF).[1] It results from obstruction, abnormal motility, major surgical resection, congenital disease or defect-associated loss of absorption.

It is characterized by not only maintaining, protein-energy, but also difficulties in maintaining water, electrolyte or micronutrient balance, particularly when there is loss of a major length of the small bowel.

If it persists for more than few days, it demands intravenous delivery of nutrition and water-parenteral nutrition.[2] Type II IF occurs in metabolically unstable patients in hospital and

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requires prolonged parenteral nutrition over periods of weeks or months. It is often associated with sepsis, and may be associated with renal impairment.

These patients often need the facilities of an Intensive Care or High Dependency (Intensive Treatment) Unit for some or much of the stay in the hospital.

This type of IF is rarer and needs to be managed by multi-professional intestinal failure team. Effective management of type II IF(including early return of Enteral autonomy, early corrective surgery) can reduce the likelihood of type III IF.

Here TPN is compared with Crystalloids with Colloids including complete substitution or partial replacement in patients admitted with resected bowel due to any reason, needing parenteral support for more than a week.[3]

Objectives of study

Primary Objectives:

I. To compare TPN with Surgery compared to Crystalloids and colloids with surgery in similar cases of Type II IF affecting the outcome with respect to discharged to home or death / moribund.

II. To compare outcome of patients treated primarily with TPN with Crystalloids and colloids alone affecting irrespective of surgery in case of Type II IF as to whether they were discharged or died.[4]

Secondary Objectives:

- To assess the current practice of TPN in patients with IF type II
- To assess the return of enteral autonomy of patients with IF type II
- To determine the association of current practice of TPN use in Type II IF with return of enteral autonomy in this subset of patients.
- To determine the correlation between current practice of TPN along with its complication in Type II IF and return of enteral autonomy and health hazards when it was not used and only Crystalloids with Colloids were used in these patients.

Total Parenteral Nutrition (TPN), also known as Parenteral Nutrition (PN) is a form of nutritional support given completely via the bloodstream, intravenously with an IV pump. TPN administers proteins, carbohydrates, fats, vitamins, and minerals. It aims to prevent and restore nutritional deficits, allowing bowel rest while supplying adequate caloric intake and essential nutrients, and removing antigenic mucosal stimuli.[5]

TPN may be short-term or long-term nutritional therapy, and may be administered on acute medical floors as well as in critical care areas. The caloric requirements of each patient are individualized according to the degree of stress, organ failure, and percentage of ideal body weight. TPN is used with patients who cannot orally ingest or digest nutrition. TPN may be administered as peripheral parenteral nutrition (PPN) or via a central line, depending on the components and osmolality. Central veins are usually the veins of choice because there is less risk of thrombophlebitis and vessel damage.

- Short
- Non-functioning
- Obstructed
- Leaking
- Mucosal disease

Typical type Intestinal Failure

- 0 - 6 months post laparotomy
- Enterocutaneous fistula / wound dehiscence

Parenteral Nutrition (PN) is life-sustaining therapy for patients who have Intestinal Failure (IF). This includes not only the traditional Short Bowel Syndrome (SBS) patients, who have IF on the basis of anatomic loss (congenital or acquired), but also those patients with functional impairment in motility or absorptive capacity. The condition is clinically characterized by the inability to maintain fluid, energy, protein, electrolyte, or micronutrient balance when on a conventionally accepted, normal diet. A functional definition of IF, which is also the basis for reimbursement, arbitrarily requires PN dependence.[2]

There are multiple etiologies of IF; however, for the majority of patients, the final common pathway is massive bowel resection. Consequently, the goal of IF management is to support the patient's physiologic needs during this acute period of stress and to attempt to achieve enteral autonomy, if feasible. PN is the primary modality of support until intestinal absorptive function is restored. This process of intestinal adaptation is impacted by the residual intestinal length and motility of the intestine and the patient's tolerance for and adherence to dietary and pharmacologic therapies.4 An understanding of normal physiology is fundamental to providing care to these complex patients.5 Surgical interventions to restore intestinal continuity and improve function are requisite components of any comprehensive intestinal rehabilitation program. Parenteral Nutrition (PN) is the cornerstone of management until adaptation returns the patient to PN-Independent state, While IF is a consequence of surgical resection resulting in anatomical loss and or functional impairment in motility or absorptive capacity. This condition is characterized by the inability to maintain fluid, energy, protein, electrolyte, or micronutrient balance when on a conventionally accepted, regular diet[Table 1].

Table 1: Age of the Respondents (N = 50)

Age at	Minimum	Maximum	Mean	Std. Deviation
TPN	18	60	39.6	12.755
C/C	22	60	43.36	9.308

Etiology of intestinal failure

IF as the consequence of surgical resection most commonly occurs in adults after injury to the intestine (ischemic or traumatic), Inflammatory Bowel Disease (IBD), malignancy, and radiation therapy. IF may also be a consequence of complications following bariatric surgery.7,8 Motility disorders, such as chronic intestinal pseudo-obstruction, constitute the remainder of cases. Knowledge of the incidence of IF is hampered by the lack of reliable data, but this is considered to be a rare condition on the basis of estimates of PN-dependent individuals.[6] The North American Home Parenteral and Enteral Nutrition registry reported 5,481 patients on PN between 1985 and 1992. Some of the leading conditions at the time included Crohn's disease, malignancy, congenital disorders, dysmotility, acquired immunodeficiency syndrome, and intestinal ischemia. Attempts to delineate the extent of the current use of PN in the US are under way via the Sustain Patient Care Registry. The majority (42%) of the 1,250 registry patients enrolled in the first 2.5 years received PN because of SBS.[5]

Indication for parenteral nutrition

Intestinal length and site of resection will impact absorption and motility, and influence an individual's need for intravenous (IV) fluid and PN support. Greater absorption occurs with more remaining bowel, which is directly related to the potential for becoming PN-independent. The residual anatomic segment of the intestine impacts the potential for adaptation, and may preserve vital functions, such as vitamin B_{12} absorption. The presence of the ileocecal valve (ICV) suggests that much of the colon is present, adding valuable mucosal surface area for water and nutrient assimilation. It not only provides a brake for intestinal transit but also protects the ileum from the high microbial content of the colon[Table 2].

Table 2: Gender of the Respondents

Gender	TPN		C/C	
	Number of Respondents	Percent (%)	Number of Respondents	Percent (%)
Male	28	56	38	76
Female	22	44	12	24
Total	50	100	50	100

According to Chowdary & Reddy (2010), candidates for TPN are: Patients with paralyzed or nonfunctional GI tract, or conditions that require bowel rest, such as small bowel obstruction, ulcerative colitis, or pancreatitis. Patients who have had nothing by mouth (NPO) for seven days or longer.

Critically ill patients: Patients with chronic or extreme malnutrition, or chronic diarrhea or vomiting with a need for surgery or chemotherapy. The nutritional goals for patients with IF are to provide adequate fluid, macronutrients, and micronutrients and to prevent dehydration and nutrient deficiencies. Patients may present with premorbid malnutrition attributed to chronic disease (IBD, malignancy) or treatment (radiation enteritis), or they may be previously healthy individuals who have sustained an acute intestinal injury (mesenteric ischemia, trauma). Energy and nutrient goals are determined by assessment of nutrition status, activity level, and ongoing metabolic demands for recovery, growth, and development. Individuals with IF may experience initial gastric hypersecretion and rapid gastric emptying, resulting in the need to compensate for substantial fluid, electrolyte, and micronutrient deficits. Osmotic diarrhea may also result from carbohydrate (CHO) malabsorption and colonic fermentation of unabsorbed CHO. Steatorrhea occurs due to unabsorbed bile salts and fat, and is accompanied by fat-soluble vitamin deficiencies and may also be complicated by excess oxalate absorption from the colon resulting in calcium oxalate kidney stones.[4]

- Contraindications for TPN
- Cardiac failure
- Severe liver disease
- Disorders of fat metabolism
- Uncontrolled diabetes
- Shock
- Severe blood dyscrasias
- Inexperienced hands
- Intravenous Hyperalimentation;
- Parenteral Hyperalimentation

PN is typically infused over a 24 hour period in the postoperative period. However in our setting after a major surgery or when prolonged ICU stay is anticipated, TPN is

initiated from 3rd or 4th day post-operatively typically in our ICUs and around 5-6 days in ITU setting, when patient can't be initiated to enteral autonomy by then. Glycemic control and fluid tolerance are important considerations in determining the length of infusion. An added benefit from cycled PN is the prevention of hepatobiliary complications by promoting mobilization of fat and fatty-acid oxidation during the time PN is not infusing.[1]

Routine monitoring and Infusion control: Prevention of fluid overload because of excessive infusion and trying high flow rate at the beginning of initiation of TPN was avoided meticulously in ward and less often in ICU, by starting at 30%, later graduating to make it complete replacement, barring episodes of occasional hypoglycemia in ICUs managed by infusion of 25% Dextrose, which is monitored by daily morning sugars, when patient showed hypoglycemic symptoms. Infusion control was done using specialized machines to check the flow rate of TPN almost always across all wards to prevent overload.

Blood investigations aimed at monitoring the electrolytes especially potassium, in the presence of insensitive losses, stomal losses etc., was carried daily, while the calcium, BUN and Creatinine is monitored up to once in 3 days, while Liver function Test to look for cholestasis, elevated liver enzymes was carried once in a week. Other investigations like total leucocyte counts were repeated in the event of hyperpyrexia or a new complication during the course of the infusion.[3]

Literature

Complications of TPN:

- CLABSI- Though infections in an ICU setting were more common, they were managed by changing the central line often used for administration of PN.
- Pneumothroax - Due to improper central line insertion, not common in teaching hospital set up as ours.
- Air Embolism- Reflecting on the bedside care by flushing out the air before reconnecting the IV lines are more common with IV fluids than TPN.
- Hyperglycemia- Related to sudden increase in glucose after recent malnourished state. Often noted as a stress response to sepsis, pancreas damage in pancreatitis, pancreatic surgeries and associated with poor response for fistulated gut postoperatively, especially in diabetics.

Refeeding syndrome is caused by rapid refeeding after a period of malnutrition, which leads to metabolic and hormonal changes characterized by electrolyte shifts (decreased phosphate, magnesium, and potassium in serum levels) that may lead to widespread cellular dysfunction. High risk patients include those who are starved over last 10 days, with dysphagia. It was manifested about 24-48 hours of starting TPN in these patients, hence, they have to slowly graduated compared to the well-nourished patients pre- or post-operatively. Fluid excess or pulmonary edema evidenced by fluid overload with elevated JVP, hypoxia, bilateral crackles on auscultation. Hepatic dysfunction is a feared PN complication, and used to be primarily attributed to the formulation. However sepsis causing cholestasis, hepatotoxic drugs have to be ruled out and avoided too. Repeated episodes of CLABSI or other infections requiring repeated operative and non-operative interventions subject the liver and other organs to stresses from the microbe as well as the medications employed to treat the infection.

Both types of TPN (3 in 1 or 2 in 1) formulations may be used in the immediate postoperative period, but a total nutrient admixture is more convenient for the stable home patient. The lipid emulsion is provided separately in this instance.

Return of Enteral Autonomy: An aggressive attempt to wean PN and promote enteral autonomy should be undertaken in all patients. Some patients will be able to achieve nutritional adequacy with oral or enteral feeding, while others may be partially or totally PN-dependent. Encouragement of an oral diet is essential to promote intestinal adaptation; a condition in which the intestine undergoes hypertrophy and nutrient absorption is improved.

Pharmacological management

Medication management is frequently necessary to control GI symptoms and maximize absorption. Antacids (hydrogen antagonists or proton-pump inhibitors) are necessary to reduce gastric hypersecretion within the first 6 months following massive small-bowel resection. Antidiarrheal medications, taken 30–60 minutes prior to meals, are used to slow transit. The Food and Drug Administration in the US has recently approved the use of teduglutide for the treatment of PN-dependent adult patients with SBS who are clinically stable with non-obstructive and non-malignant disease. The goal of this therapy is to reduce the volume and frequency of PN infusions in the setting of optimization of diet, hydration, and antidiarrheal medications.

Surgical interventions determining the outcome

There are literature-based estimates of minimal residual length of the intestine in Small Bowel Syndrome patients associated with achievement of enteral autonomy. This has been a moving target; however, it is generally accepted that the adult with 60–90 cm of small intestine and the Ileo-cecal valve (ICV) have the potential to become PN-independent. This depends not only on the length but also on the nature of the retained intestinal segment and whether it is in continuity with the colon. The presence of the ICV probably is a surrogate for the most adaptive segment, the terminal ileum being present, and suggests that the full length of the colon is present to participate in the management of fluid absorption. Since the length of the residual intestine correlates with PN dependence, surgeons make every effort to conserve length. Although enterostomy may be necessary, it should be reversed to optimize functional outcome and allow for colonic involvement in the absorptive process. It later followed by stoma reversal was the most commonly carried out surgery in our setting. Secondary operations are intended

to address the natural consequences of intestinal adaptation. These include progressive dilation of the intestine to increase the absorptive surface area and prolongation of the transit time. Other methods include small intestinal transplantation with or without liver transplant which was not being carried out in our hospital set up.

Methodology

Method of Sample collection

It included access to hospital data (including files and MRD records, discharge summaries) regarding the Intestinal Failure patients admitted under our Hospital either in ICU, ITU or Wards and following their treatment choice and eventual outcome in patients admitted from June 2017 to November 2019.

- **Sampling procedure:** The sampling procedure used in this study was random, convenience based sampling.
- **Sampling size:** The sample size for the study was 100 patients with type II IF admitted in our Hospital, 50 who were on TPN + Crystalloids, Colloids, 50 who are on Crystalloids and Colloids only.
- **Inclusion criteria for sampling:** All the adult patients aged >18 years and <60 years of age (inclusive of both) with type II Intestinal Failure on Parenteral Nutrition.
- **Exclusion criteria For sampling:** Patients who are <18 years and >60 years of age, Not having Intestinal Failure, or Not on Parenteral Nutrition.
- **Instrument used:** Observational checklist to access the current status of TPN patients with type II IF. A structured protocol based assess to use of TPN/ Crystalloids with Colloids in IF.
- **Data collection method:** After obtaining Hospital and Departments permission, based on the inclusion, exclusion criteria, 100 patients were selected, through convenience sampling technique, 50 each of TPN + Crystalloid and Colloids, and Crystalloids and Colloids alone. After obtaining permission, the investigator did rate an observation checklist regarding current practice of use of TPN and schedule baseline variables, return of enteral autonomy and the health hazard when crystalloids with colloids alone were used in Type II IF will be analyzed. Approximately a week's follow up per patient were required, daily 5-10 minutes each.

Conclusion

The test result variable(s): Disease condition - TPN, Surgery - TPN, Final Outcome TPN, Enteral Autonomy achieved TPN, Days of Hospital stay - TPN , Date of Starting TPN - Date of Admission TP has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

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