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Original Research Article

Short-term preoperative parenteral nutrition benefits malnourished patients undergoing major gastrointestinal surgery

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ABSTRACT

Background: Pre-operative nutritional support is of paramount in malnourished patients undergoing major gastrointestinal (GI) surgery. We aimed to investigate the outcomes of short term pre-operative parenteral nutrition in nutritionally depleted patients undergoing major GI surgeries.
Methods: A retrospective study from tertiary care centre in South India, where nutritionally at risk patients undergoing major GI surgeries from 2016-2018 were identified and reviewed. Two groups –who received total or peripheral parenteral nutrition (TPN and PPN) and only enteral nutrition..
Results: Of 80 patients who were nutritionally depleted underwent major GI surgery, 38 patients received pre-operative parenteral nutrition (PN) support for mean 11 days. Patients who received pre-op PN had similar outcomes (overall complication rate n=26, 68.4% vs n=32, 76.2% p=0.43), when compared to patients who received pre-op enteral nutrition conditioning. Though a small group of patients received peripheral PN supplementation, there was no difference in overall complication rate, when compared with TPN group (n=14, 58.3% vs n=12, 85.7%, p=0.08).
Conclusions: Parenteral nutrition either total or supplemental is a useful adjunct pre-operatively for poorly nourished patients and should be utilized to build nutrition prior to major GI surgery. Pre-operative peripheral parenteral nutrition as supplement seems to be beneficial in patients undergoing GI surgery, pending large studies.

Keywords: Enteral nutrition, Gastrointestinal surgery, Malnutrition, Parenteral nutrition

INTRODUCTION

Many of the patients with gastrointestinal (GI) diseases present with poor nutrition, especially in malignancy patients. It may either be due to poor intake of calories and nutrients or due to decreased absorption in these patients.[1] These patients will have low body mass index and would suffered substantial weight loss, which was suggestive of catabolic state. These patients are more prone for infectious complications and have prolonged post-operative course and high mortality rate.[2,3] It is ideal to achieve positive nitrogen balance by enteral supplementation of adequate calories, macronutrients and micronutrients. But, more often than not, these patients will not be able to consume or maintain adequate enteral nutrition preoperatively.[4]

It is very well known that poor nutritional status is associated with increased morbidity and also mortality after the surgical procedure. Poor built and nourishment is still a common thing in India, especially in the lower economic status groups.[5] Surgery is a catabolic state, where glycogen, fat and proteins were broken down for substrates for optimal healing. A good minority of patients with GI diseases will not be able to tolerate enteral feeds completely or partially. Parenteral nutrition is a good adjunct when administered pre-operatively to augment the glycogen, protein and fat stores in these

patients.[6,7] We retrospectively review our subset of patients who were at nutritional risk and underwent major abdominal GI surgeries in the last 3 years. The aim was to assess the efficacy of the total and peripheral parenteral nutrition.

METHODS

The study design was a retrospective analysis of patients undergoing major GI surgery at our tertiary care centre in South India. The duration of study was 36 months from 2016-2018. The inclusion criteria was any patient who underwent major (>3 hours) gastrointestinal surgery and at nutritionally risk. Nutritional risk was calculated from BMI less than 20, recent weight loss (>10 % weight loss in last 3 months), unable to consume > 25% calories of the required daily intake. Our criteria to determine nutritional risk was similar to NRS 2002 score which compromised significant weight loss in the preceding 3 months, inability to tolerate oral feeds or significant reduction in the quantity of oral feeds in the preceding week, pre-operative ICU stay and BMI<20.5.[8]

In our institution, some patients received pre-operative parenteral nutrition, especially who were not able to meet their daily nutritional requirements. All these patients received nutritional conditioning before taking up for surgery. Predominantly patients, who were not able to consume enough oral nutrition, were administered parenteral nutrition. But more often, it was based on the consultant evaluation and his clinical intuition that enteral calorie could not be met.

Table 1: Composition of pre-fixed standard combinations of parenteral nutrition.

	Total parenteral nutrition				Peripheral parenteral nutrition		
Volume	1026	1540	2053	2566	1440	1920	2400
Amino acids	34	51	68	85	34	45	57
Nitrogen	5.4	8.2	10.9	13.6	5.4	7.2	9.1
Dextrose	100	150	200	250	97	130	162
Lipids	40	60	80	100	51	68	85
Calories	870	1310	1745	2180	970	1300	1620
Electrolytes							
Sodium (mEq)	32	48	64	80	32	42	53
Potassium (mEq	24	35	47	59	24	33	41
Magnesium (mEq)	8	12	16	20	8	11	13
Acetate (mEq)	39	59	78	98	39	52	65
Chloride (mEq)	46	69	92	115	46	61	77
Sulfate (mEq)	8	12	16	20	8	11	13
Calcium (mEq)	4	6	8	10	4	5	7
Phosphorus (mmol)	10	15	20	25	11	14	18
Osmolarity (mOsm/l)	1060	1060	1060	1060	750	750	750

Table 2: Multivitamins: required daily allowance.

Vitamin supplementations	Quantity
Vitamin A (retinol)	3300 IU
Vitamin D (ergocalciferol)	200 IU
Vitamin E (dl-alpha-tocopheryl acetate)	10 mg
Vitamin K (phylloquinone)	150 µg
Vitamin C (ascorbic acid)	200 mg
Niacinamide	40 mg
Vitamin B_2 (riboflavin)	3.6 mg
Vitamin B_1 (thiamine)	6 mg
Vitamin B_6 (pyridoxine HCl)	6 mg
Dexpanthenol (d-pantothenyl alcohol)	15 mg
Biotin	60 µg
Folic acid	600 µg
B_{12} (cyanocobalamin)	5 mg

All the patients meeting the inclusion criteria were included for records review. All patients were divided into two groups based on whether they received pre-operative nutritional support in the form of either parenteral nutrition or enteral nutrition. Parenteral nutrition was further sub classified into patients receiving total parenteral nutrition or peripheral parenteral nutrition.

Patients in the parenteral nutrition group were also allowed to have oral feeds as tolerated (when feasible) and TPN/ PPN was added as a supplementation because their energy needs could not be met with oral feeds alone. The energy requirements were calculated based on the weight of the patient, insensible loses and the general condition of the patient. Standard various PN regimens which were pre-fixed were used. The ideal bag was selected based on patients' weight with 50kcal/kg/day. The parenteral nutrition combinations are enlisted in Table 1. All patients received 2 vials of multivitamin

supplementation, which is double the required daily allowance.

Data was collected and tabulated. Data represents either number and frequency or mean and standard deviation. P value is calculated with wilcoxon rank sum test for continous variables and fischers exact t-test for categorical variables. Statistical analysis is performed with JMP-SAS statistical software.

RESULTS

A total of 80 patients were admitted in the Department of Surgical Gastroenterology requiring surgical intervention. All these patients were nutritionally at risk. These patients were screened for nutrition risk when they had either significant weight loss, or were unable to take adequate enteral nutrition, or had low BMI. Total of 38 patients received parenteral nutritional support in the pre-operative period; either complete or partial.

A total of 24 patients received total parenteral nutrition (TPN), and 14 patients received peripheral parenteral nutrition (PPN). These patients were compared with another group who were at risk nutritionally, but could tolerate enteral feeds, aggressively substituted with nasogastric or nasojejunal or oral or jejunostomy feeds. The pre-operative serum albumin is higher among the patients who received enteral supplementation (3.49 vs 2.85, p<0.0001). Better albumin levels are also a main reason to not give parenteral nutritional support for these patients and instead encouraged them for aggressive enteral nutrition support. Pre-operative PN was administered for mean 12 days for the patients. Patients of varied pathologies were found in both groups (Table 3).

Outcomes of both groups were compared, which includes post-operative complications, infectious complications such as respiratory tract infections and wound infections, Table 4. Mortality was noted in five patients. Causes of death were attributed to ventilator associated pneumonia (VAP) in 2 patients, abdominal sepsis in 2 patients, and advanced metastatic disease in one patient.

Another subgroup analysis was performed between patients who received TPN vs those who received PPN. Disease and patient characteristics are summarized in Table 5, and outcomes in Table 6.

Table 3: Parenteral nutrition vs enteral nutrition, patient characteristics.

Patient characteristics	PN (n=38, 47.5%)	No PN (n=42, 52.5%)	P value
	N, %	N, %	
Males	26, 68.4	30, 71.4	0.77
Mean age in years	49.52±15.4	45.76±10.9	0.14
Malignancy	61, 76.3	19, 23.7	0.05
Diagnosis			
Carcinoma colon	2, 5.3	-	
Carcinoma pancreas	8, 21.1	4, 9.5	
Carcinoma periamp	8, 21.1	14, 33.3	
Carcinoma stomach	12, 31.8	10, 23.8	
Corrosive injury	-	4, 9.5	
Entero-cutaneous fistula	6, 5.8	6, 14.3	
Other tumors¥	-	3, 7.1	
Others*	2, 5.3	1, 2.4	
Pre-op Hb (g/dl)	11.3±1.6	12±1.82	0.07
Pre-op WBC (cells/cc)	9502± 2576	9413±3921	0.81
Pre-op albumin (g/dl)	2.85±0.17	3.49±0.34	<0.0001
Surgical procedures			
Colectomy	1, 2.6	-	
Coloplasty	-	2, 4.8	
ECF takedown	2,5.3	4, 9.5	
Gastrectomy	9, 23.7	8, 19.1	
Palliative bypass	12, 31.6	5, 11.9	
Pancreatectomy	1, 2.6	2, 4.8	
Pancreaticoduodenectomy	7, 18.4	18, 42.8	
Small bowel resection	5, 13.2	1, 2.4	
Other procedures**	1, 2.6	2, 4.8	
Pre-op Hospital stay, days	11.8 +/- 2.2	12.8 +/-9.9	0.08

Foot notes ¥ - NET, SPEN, Leiomyoma* - External biliary fistula, acute necrotizing pancreatitis ** - Enucleation of tumor, Necrosectomy

Table 4: Parenteral nutrition vs enteral nutrition, outcomes.

Outcomes	PN	No PN	P value
Post -op hospital stay, days	17.1±16.3	12.9±6.8	0.58
Post-op use of parenteral nutrition	15, 39.5%	11, 26.2%	0.2
Post-op Day 7 WBC, cells /cc	12428±3802	11374±4333	0.61
Post-op Day 7 Albumin, g/dl	2.4±0.4	2.8±0.4	0.0001
Post-operative complications	26, 68.4%	32, 76.2%	0.43
Post-op infectious complications			
Respiratory infections	6, 15.8%	7, 16.7%	0.58
Wound infections	19, 50%	24, 57.1%	0.52
Post-op mortality	2, 5.3	3, 7.1	0.54

Table 5: Total parenteral nutrition vs peripheral parenteral nutrition, patient characteristics.

Patient characteristics	TPN (n=24, 63.2%)	PPN (n=14, 36.8%)	P value
	N, %	N, %	
Males	19, 79.2	7, 50	0.11
Age in years	51.9±4.3	45.4±16.8	0.07
Diagnosis			
Carcinoma colon	1, 4.2	1, 7.1	
Carcinoma pancreas	7, 29.2	1, 7.1	
Carcinoma periamp	1, 4.2	7, 50	0.02
Carcinoma stomach	10, 41.7	2, 14.3	
Enterocutaneous fistula	4, 16.7	2, 14.3	
Others	1, 4.2	1, 7.1	
Pre-op albumin	2.82	2.91	
Surgical procedures			
Colectomy	-	1, 7.1	
ECF takedown	2, 8.3	-	
Gastrectomy	9, 37.5	-	
Palliative bypass	10, 41.7	2, 14.3	
Pancreatectomy	-	1, 7.1	
Pancreaticoduodenectomy	-	7, 50	
Small bowel resection	3, 12.5	2, 14.3	
Others	-	1, 7.1	
Pre-op hospital stay, days	11.8±2.5	12±1.9	0.79

Table 6: Total parenteral nutrition vs peripheral parenteral nutrition, outcomes.

Outcomes	TPN	PPN	P value
Post-op hospital stay, days	18±18.1	15.5±12.8	0.7
Post-op use of parenteral nutrition	10, 41.7%	5, 35.7%	0.76
Post-op Day 7 WBC, cells /cc	11567±2911	13782±4690	0.28
Post-op Day 7 albumin	2.4±0.3	2.5±0.5	0.61
Post-operative complications	14, 58.3%	12, 85.7%	0.08
Post-op infectious complications			
Respiratory infections	2, 8.3%	4, 28.6%	0.12
Wound infections	11, 45.8%	8, 57.1%	0.37
Post-op organ failure			
Renal failure	3	1	
Liver failure	0	0	
Post-op mortality	1, 4.2%	1, 7.1%	0.6

DISCUSSION

Poor nutritional status secondary to greater than 20% weight loss was shown to be associated with increased mortality by Studley et al.[9] Total parenteral nutrition developed by Dr. Stanley Dudrick was intended to provide nutrition when patients are unable to tolerate enteral nutrition completely or adequate calorie intake was not achieved.[10-12] When administered for 7-10 days, parenteral nutrition can improve positive nitrogen balance, improve glycogen reserves and stabilize the catabolic state, which was induced due to the disease process.[10,13] This can be applied to patients who require a surgical procedure to cure their disease process, but were at higher mortality risk due to their malnutrition. In patients undergoing major abdominal GI surgery, pre-operative nutrition support lead to improved patient tolerance and post-operative outcomes.[1] However, an exaggerated cytokine response after administration of PN can lead to decreased immunity and increase the risk of infectious complications.[2,3]

Accurate nutrition assessment is essential to identify the patients who require pre-operative supplementation of macro and micro nutrients. Unfortunately, there is no single marker that determines malnutrition. Though albumin is a negative acute phase reactant, it is still considered a marker in the clinical practice.[14] Pre-albumin has shorter half-life (2 days) than albumin and is a more accurate marker to determine nutrition. Other markers that are seldom used are total protein and transferrin.[14] Multiple nutritional risk assessment tools are available in the literature, but the one that is validated and more widely used is 'Nutritional Risk Screening' 2002 (NRS 2002).[8] It has two components; initial screening was based on BMI < 20.5, recent weight loss, dietary intake and severity of illness. The score is based on weight loss, BMI, and disease pathology or major surgical procedure. NRS ≥ 3 is considered as nutritionally at risk and a nutrition care plan has to be started.

In the large multicentre prospective cohort study by Jie et al, pre-operative nutritional support yielded significantly lower overall complications and shorter post-operative hospital stay.[7] In our study, the differences between different modalities of nutrition supplementation ie enteral nutrition, TPN and PPN was compared and no difference in outcomes between each group suggesting that nutritional support is important than the route of nutrition administration. In our study, as the patients in the enteral group had better albumin pre-operatively, it would have been expected that they have better outcomes. But our study suggested that outcomes were similar in both enteral and parenteral nutrition groups. In our study, the infectious complications and the overall complication rates are not different from the similarly matched nutritionally risked patients who received enteral nutritional conditioning before surgery. Parenteral nutrition related complications such as venous thrombosis, pneumothorax and septicaemia were rare.

Though enteral nutrition is always preferred, many patients especially with carcinoma of upper gastrointestinal tract, enterocutaneous fistulae, will not have an option for providing jejunostomy feeds compared to corrosive stricture group patients. Even though, a nasojejunal tube placed for these patients, they will not achieve full tolerance within 7-10 days. Some of our patients with corrosive injury who were on long-standing jejunostomy feeds were also in this nutritional risk group, but they did improve with aggressive jejunostomy feeds pre-operatively, suggesting that tolerance of aggressive jejunal feeds will require long duration. Peripheral PN was predominantly administered as a supplement to enteral nutrition for patients who were not able to tolerate adequate calories in our study group. Total PN through central line was administered to patients who were not able to tolerate enteral nutrition completely or tolerating <20% of enteral feeds.

Surgeons are reluctant to use enteral nutrition in instances such as anticipated re-operation, hemodynamic instability after major GI surgery, anticipated anastomotic leak, recent gut anastomosis, and post-operative ileus. In the RCT by Braga et al, involving gastrectomy, pancreatoduodenectomy and esophagectomy patients, post-operative nutritional goals were achieved earlier (POD4) in the parenteral nutrition group.[15] A subset analysis of the malnourished patients in the group, lower overall complications was noted in the enteral group and hence they recommend early restart of enteral nutrition. In our patients, whenever possible, a feeding jejunostomy was performed and enteral nutrition is started from POD2, initially low calorie low protein diet and advance accordingly. In this study, post-operative parenteral nutrition was administered in 32.5% of patients when there was anticipated re-operation and anticipated anastomotic leak. Two large center studies investigated the time of post-operative parenteral nutrition and suggested that parenteral nutrition should be started on POD4 in the patients.[16,17] In elderly patients undergoing surgery for GI malignancy, parenteral nutrition combined with enteral nutrition is shown to be beneficial rather than enteral nutrition alone.[18] A meta-analysis of 5 RCTs suggested that hypocaloric parenteral nutrition in the post-operative period avoids hyperglycaemic status and this significantly reduces infectious complications by 5 times and shortens hospital stay by almost 2 days.[19] As low as 15 kcal/kg would be adequate to provide nutrition.

Though there are many limitations to this study such as its retrospective nature and limited number of patients in each arm, it provides insights into the various modalities to uplift the patients at nutrition risk to undergo surgical interventions successfully. This study was performed at a tertiary care centre in south India, which caters to lot of lower socio-economic strata group where malnutrition and infectious diseases are quite prevalent and which is why probably there is higher prevalence of infectious complications when compared to the studies from the developed countries.

CONCLUSION

Signs of malnutrition would necessitate delay in surgery at many times. Lower BMI, recent weight loss and reduced oral intake are suggestive of malnutrition. Enteral nutrition is ideal and if patients are not tolerating adequate enteral nutrition, parenteral nutrition either total or supplemental is a useful adjunct pre-operatively for poorly nourished patients and should be utilized to build nutrition for about 10 days prior to major GI surgery. Pre-operative peripheral parenteral nutrition as supplement seems to be beneficial in patients undergoing GI surgery, pending large studies.

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