Short Communication

Early enteral nutrition after total gastrectomy for gastric cancer

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Objective: To assess the difference between early enteral nutrition (EEN group) and total parenteral nutrition (TPN group) after total gastrectomy for gastric cancer. **Method:** The nutrition index, liver function, patient-generated subjective global assessment (PG-SGA) score, the post-operation complications, the hospital stay and hospitalization expense of the postoperative patient after total gastrectomy, admitted to our Department of Surgery from May 2011 to May 2013 were analyzed retrospectively. **Results:** A total of 72 patients including 37 cases in the EEN group and 35 cases in the TPN group were recruited. Hypoalbuminemia gradually improved in the EEN group about 3-5 days, but it did not increase until average 21 days in the TPN group. The body weight decreased in the EEN group during the first 2 weeks and recovered gradually in 21 days; body weight in the TPN group was significantly lower than the EEN group at 21 days (p<0.05). There were significant differences in both the groups (p<0.05) in nutrition indicators. The incidence of complications in the EEN group and TPN group were 8.1% and 25.7% respectively, with no significant differences (p>0.05). The days of hospital stays in the EEN and in the TPN group were up to 12.2±2.5 d vs 14.9±2.9 d (p<0.05) and the hospitalization expenses were 36472±4833 CNY vs 40140±3927 CNY (p<0.05), respectively. **Conclusion:** Compared with TPN, EEN was safe and well tolerated and can shorten the hospital stay as well as reduce costs incurred with total gastrectomy for gastric cancer.

Key Words: gastric cancer, enteral nutrition, parenteral nutrition, total gastrectomy, complications

INTRODUCTION

It has been an important issue for clinicians to choose a proper nutrition therapy for the patients' recovery after the gastric cancer surgery. In recent years, EEN has been recognized as the prior choice for the patients with gastro-intestinal dysfunction. Timely postoperative EEN can improve the body nutrition and the mesenteric blood flow, maintain the mesentery permeability, repair and maintain the structure and function of gastrointestinal tracts. However, up to now, there is no study indicating any differences between the clinical application of EEN and application of parenteral nutrition after total gastrectomy. In order to evaluate the difference between EEN and TPN after the gastric cancer surgery, the patients' records with total gastrectomy for gastric cancer assigned to the EEN group and the TPN group were investigated retrospectt-ively. The patients' nutrition index, indicators of liver function, patient-generated subjective global assessment (PG-SGA), complications, hospital stays and cost of hospitallization were evaluated in this study.

METHODS

Data sources

All patients who received total gastrectomy with EEN or TPN therapy at the General Surgery Department of the First Affiliated Hospital of Anhui Medical University between May 2011 and May 2013 were recruited. This study was approved by the Ethics committee of Anhui Medical University. NO20121407.

EEN preparation formula and method

Formula

1. pepTI-2000 variant (Nutricia Ltd, Holland): a bottle of 500 mL with a energy value of 4.18 kJ/mL and total energy values of 2090 KJ, each 100 mL solution containing hydrolyzed protein (4.0 g), carbohydrate (18.89 g), and fat (1.09 g) per 100 mL.
2. Enteral nutritional suspension (Total Protein, TP, Nutricia Ltd, China): a bottle of 500 mL with energy value of 0.75 kcal/mL. Each bottle contained hydro-lyzed protein (16.0 g), carbohydrate (46.2 g), and fat (14.6 g).

The method of EEN and TPN

1. EEN Group

Nasogastric and nasointestinal feeding tubes were bundled together in the stomach of patient pre-operatively.

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The Nasojejunal feeding tube was bundled with the end of the tube 30-50 cm aborally from the gastrojejunostomy anastomosis. During reconstruction of the digestive tract in gastric cancer surgery, the nasojejunal feeding tube was used for the infusion of post-operative EEN formula, and the gastric tube was pulled out. The infusion of Pep-TI was started if the patients were asymptomatic 12 hours later, the speed of infusion was increased to 20-40 mL/h (equivalent to EEN at 83.6-104.5 kJ/kg/d) at the beginning. It was increased to 104.5-125.4 kJ/kg/d with the patients' gradually increased tolerance.

2. TPN Group

The patient was offered internal jugular vein catheterization on the first post-operative day.

Nutrient solution was offered after operation routinely, the ratios of saccharides to fat and non-protein to protein calories were 2:1 and 100:1, respectively, providing the patients 104.5-125.4 kJ/kg/d energy with vitamins, electrolytes and trace elements. All operations were under sterile conditions. Enteral or parenteral infusion continued during the first 7-9 days after surgery. The supplement was not stopped until the patients reached a certain amount of oral intake.

Analysis indexes

The nutritive index, liver functions, complications, length of hospital stay, and hospitalization expenses were investigated. The nutritive index including the level of albumin, prealbumin, and PG-SGA scores on the first day before and in 1, 2, 3 weeks after surgery. Daily energy supplies, the first defecation time, the first oral intake time, the continuous artificial feeding time, length of hospital stay, hospitalization expenses, and postoperative complications were recorded.

Statistics method

All data was analyzed by SPSS 11.5 software packet. The measurement data was described in the mean ± SD form. Comparisons between the two groups were tested by t-test, count data was measured by chi-square test, and $p<0.05$ means the difference was statistically significant.

RESULTS

Baseline

A total of 74 patients were assigned into the group EEN and the group TPN. Two patients withdrew from the study owing to the shedding of nutrition tubes. Seventy-two patients (37 in EEN Group and 35 in TPN Group) completed the study. The two groups had no significant differences in age, gender (Table 1).

The general results of the patients in both groups

The time of the first defecation ($p<0.05$) and time of first soft diet intake ($p<0.05$), as well as the hospitalization time of the group EEN were shorter than the group TPN (Table 1). Complications occurred in 15 cases among these 72 cases. The incidence of complications in EEN and TPN group was 22% and 20%, respectively. There was no significant difference between groups for the complications. The most common complications were anastomotic fistula and delayed gastric emptying.

Post-operative Nutritive Index

The entire application index decreased during the first 7 days after operation, and gradually increased later. Serum albumin, total protein and PG-SGA decreased in both the two groups in the early stage of post-operation, then in EEN Group increased gradually 3-5 days later, while in TPN Group increased 7-9 days later. The weight loss of patients in EEN Group occurred in 14 days and recovered gradually within 21 days, while the body weight of patients in the TPN group was significantly lower than that of the EEN group 21 days after surgery ($p<0.05$) (Table 2).

Side effects

No stress ulcer and intestinal ischemia occurred and patients had good compliance in the EEN group, 8 of 37 patients suffered from adverse effects, including 1 case with anastomotic leakage, 4 cases with delayed gastric emptying and 3 cases with infection of the incisional wound. In the TPN group, 7 patients suffered from different adverse effects, among which anastomotic leakage, infection of incisional wound, and haemorrhage occurred in one case, and 4 cases with delayed gastric emptying and 2 cases with intra-abdominal fluid collection. All side effects were alleviated after temporary reduction in nutrition and expectant treatment. There were no significant differences in the total side effects between the two groups ($p>0.05$).

Table 1. Comparison of data between the two groups

Clinical findings	EEN Group (n=37)	TPN Group (n=35)	*p* value
Women: men	17:20	18:17	0.360
Age	59.4±8.8	61.1±7.4	0.364
Postoperative energy requirement (kcal/kg)	1282±186	1398±230	0.624
Time of the first bowel movement (days)	2.5±0.5	5.4±1.1	0.045
Time of the first soft diet (days)	6.9±3.0	8.0±3.8	0.023
Duration of artificial nutrition (days)	5.6±2.6	6.8±4.2	0.387
Hospitalization expense (CNY)	36472±4833	40140±3927	0.038
Hospital stays (days)	12.2±2.5	14.9±2.9	0.982
Postoperative complications			
Anastomotic leakage	1	1	0.485
Delayed gastric emptying	4	2	0.485
Wound infection	3	1	0.485
Postoperative bleeding	0	1	0.366
Intra-abdominal fluid collection	0	2	0.366

Table 2. Comparison of the two groups' nutrition index

	Pre Op	POD 7	POD 14	POD 21
Total protein (g/L)				
ENN	7.0±0.5	5.7±0.4	6.5±0.9	7.1±0.6
TPN	7.2±0.4	5.6±0.5	6.3±0.5	6.9±0.5
t	1.87	0.94	1.16	1.53
p	0.066	0.351	0.251	0.130
Pre-albumin (mg/L)				
ENN	231±72.5	212±30.2	226±26.7	227±63.4
TPN	236±73.4	186±29.3	198±26.9	221±46.5
t	2.39	3.65	4.40	0.43
p	0.020	0.001	0.000	0.672
Albumin (g/dL)				
ENN	3.9±0.4	3.1±0.5	3.6±0.3	3.7±0.4
TPN	4.1±0.3	3.2±0.4	3.5±0.2	3.7±0.4
t	2.39	0.93	1.65	0.00
p	0.020	0.354	0.103	1.000
BMI (kg/m^2)				
ENN	23.7±3.8	23.5±4.0	21.9±4.2	24.0±4.8
TPN	22.9±2.9	23.1±2.3	23.4±1.9	22.1±2.5
t	1.00	0.52	1.93	2.09
p	0.321	0.607	0.057	0.040
PG-SGA (score)				
ENN	5.4±3.8	7.9±2.9	8.0±3.1	5.2±1.9
TPN	4.2±2.6	8.0±3.0	8.3±2.8	5.4±3.7
t	1.56	0.14	0.43	-0.29
p	0.124	0.886	0.668	0.772

BMI was significantly recovered on postoperative day 21 in the EEN group compared with the TPN group ($p<0.05$); Pre Op: pre-operation; POD: postoperative day.

DISCUSSION

Patients with digestive tract tumour generally possess various degrees of malnutrition due to their long-time eating inability, and long-term consumption. The gastrointestinal anatomical structure and physiological normal function are abnormal because of post-traumatic stress disorder, which leads to a decreased sugar usage, increased protein and fat decomposition, and increased urinary nitrogen excretion. Widespread attention has been given on how to further improve the post-operative nutritional status and the prognosis.

The average age of gastric cancer patients was 61.0±11.9 years in our study. As the traditional nutritional supplements through peripheral or central veins usually have a big liquid volume and need a long time, heavier heart burden, which can lead to post-operative pulmonary edema and cause respiratory system infection. The intake of a large amount of exogenous sugars and post-operative insulin resistance can cause even more vital disturbance of carbohydrate metabolism and lead to stress hyperglycemia, increasing the chance of post-operative complications. Some studies have shown that the intestinal peristalsis and absorption functions were inhibited, but could return to the normal state after 6-8 hours and the gastrointestinal absorption function was enough to meet the body's needs. The gastrointestinal tract can not only absorb nutrients, but also plays an important role in immunity. Duodenal mucosal atrophy and abnormal intestinal permeability can be found after not eating for several days.[1] The structure and function of intestinal mucosa can be damaged and prevention function to bacteria is weakened.

In recent years, EEN has been widely used in the clinic as an important clinical nutrition support method after gastrointestinal surgery, and is of great significance to promote the rehabilitation of patients. The EEN is more close to the human physiological needs. The continuous enteral nutrition is more close to the natural form of enteral nutrition, causes less post-operative changes of physiological function of the digestive system, and requires less costs.[2] The results of this study showed that the ENN group did not increase the incidence of delayed gastric emptying. On the contrary, it can promote the recovery of intestinal peristalsis, shorten the postoperative exhaust and defecation time, maintain the structure and function of the intestinal epithelial cells, reduce the hypermetabolism reaction of the intestinal mucosa, correct the ischemia of the intestinal mucosa and increase the splanchnic blood flow. Therefore, it can be suggested as the first choice of early initiation nutrition for patients with trauma and operation.

The commonly used ways of EEN supply are nasojejunal tube methods (the nose duodenum tube feeding method and the nasal jejunal feeding method) and jejunostomy. Because the nasojejunal tube is convenient and has no need of the fistula except for the accidentally nasojejunal tube falling off, some jejunostomy related complications can be avoided, and secondary infection can be decreased. Thus, nasal jejunal nutrition is more desirable than jejunostomy,[3] and the jejunostomy is gradually phased out. The nasopharyngeal tube has also some disadvantages. It can induce throat discomfort, mucus hypersecretion, increase the incidence of nausea and vomiting, interfere with the patients' cough and expectoration, and increase the risk of reflux and aspiration. In this study, the occurrence rate of the

complications in the ENN group was 22% and all patients in this group reached the nutritional purposes. It may have been associated with the nutritional program that we chose. Both the slow flow rate of the nutritional infusion and gradually improved feeding quantity can avoid abdominal distension caused by early too fast and too much infusion of nutrient solution.[4] We found that some digestive symptoms (diarrhea, vomiting, abdominal distension, etc) occurred in the EEN group when the nutrient solution was injected too fast, which may be related to the high penetrant concentration of EEN liquid, the fast speed of infusion or the low temperature of the nutrient solution, etc.

There was no obvious difference in post-operative infection between the EEN group and the TPN group in this study, however Doig believed that the post-operative infection rate of the TPN group is more common than the EEN group.[5] The reason may be due to the different daily energy supply in our research from Doig's. The daily energy provided by Doig was up to 30-35 kcal/kg/d, while some studies have found that too much daily energy supply would increase the post-operative complications.[6]

The time to achieve the same nutritional index in TPN group was longer than that of the EEN group. Although prealbumin and transferrin in all patients decreased in a short-term after operation, but the EEN group had faster post-operative recovery. The EEN group was possibly more conducive to the synthesis of protein and the body immunity recovery.[7] Our study suggested that the body weight recovery in the EEN group was more obvious than that in the TPN group at 3 weeks after the surgery. The recovery of body weight may have had something to do with appetite, but the mechanism was not clear yet.

PG-SGA grading system was created by the American Dietetic Association for the nutrition of cancer patients.[8] In this study, PG-SGA score was the highest in the first 14 days after operation, while the other biochemical indexes were in the normal range. This may be related to the induction of the staff when doing questionnaire or the psychological factors of the patients undergoing. Therefore, it may be more meaningful if the PG-SGA questionnaire was given to the patients in a blinded fashion. Given the limitation of the sample size, further expanding of the sample size of EEN and TPN patients after total gastrectomy for gastric cancer is needed to approach the significance of PG-SGA score.

Conclusion

This study shows that EEN is safe, well tolerated, and has little negative effects on the rehabilitation of the patients after operation. Furthermore, EEN can improve the early and long-term post-operative nutritional status, improve the body immunity, shorten duration of hospitalization, and save the cost of hospitalization. We recommend EEN as a routine nutrition to the gastric cancer patients after total gastrectomy.

AUTHOR DISCLOSURES

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胃癌全胃切除术后早期肠内营养

目的：评价胃癌患者全胃切除术后，早期肠内营养（EEN）与全肠外营养（TPN）的差异。**方法：**收集 2011 年 5 月至 2013 年 5 月我科收治的胃癌全胃切除患者，术后随机选择 EEN 或 TPN，对 EEN 组和 TPN 组患者术前及术后的营养指标、肝功能、癌症患者营养评估标准（PG-SGA）、术后并发症、住院时间以及住院费用进行对照研究。**结果：**符合入选标准的胃癌全胃切除患者共 72 例，其中 EEN 组 37 例，TPN 组 35 例。EEN 组在术后 3～5 天低白蛋白血症逐渐改善，而 TPN 组术后 21 天才逐渐恢复。EEN 组术后 14 天体重较术前减轻，术后 21 天逐渐恢复，而 TPN 组在术后 21 天内体重无明显恢复（p<0.05）。两组营养指标有明显统计学差异（p<0.05）。ENN 组和 TPN 组并发症发生率分别为 8.1%和 25.7%，两组间无明显统计学差异（p>0.05）。ENN 组住院时间为 12.2±2.5 天，TPN 组为 14.9±2.9 天（p<0.05），ENN 组和 TPN 组住院费用分别为 36472±4833 元人民币和 40140±3927 元人民币（p<0.05）。**结论：**与 TPN 相比，胃癌全胃切除术后选择 EEN 安全、患者耐受性好，并且可以缩短住院时间，减少住院总费用。

关键词：胃癌、肠内营养、肠外营养、全胃切除术、并发症