GMR Genetics and Molecular Research
Online Journal
ISSN:1676-5680

Impact of early enteral and parenteral nutrition on prealbumin and high-sensitivity C-reactive protein after gastric surgery

B. Li, H.-Y. Liu, S.-H. Guo, P. Sun, F.-M. Gong and B.-Q. Jia

Department of Surgical Oncology,
General Hospital of the People's Liberation Army, Fuxing Road, Beijing, China

Corresponding author: B.-Q. Jia
E-mail: jiabaoqing1971@126.com

Genet. Mol. Res. 14 (2): 7130-7135 (2015)
Received September 26, 2014
Accepted October 29, 2014
Published June 29, 2015
DOI http://dx.doi.org/10.4238/2015.June.29.6

ABSTRACT. We investigated the impact of early enteral nutrition (EEN) and parenteral nutrition (PN) on prealbumin (PA) and high-sensitivity C-reactive protein (hs-CRP) in patients after gastric cancer surgery. Sixty-eight selected patients undergoing gastric cancer surgery were randomly divided into the EEN (N = 34) and PN (N = 34) groups. Body weight (BW), serum albumin (ALB), transferrin (TF), PA, hs-CRP, length of hospital stay, cost of postoperative nutritional support, and incidence of complications were compared between groups. On postoperative day 7, the BW, TF, ALB, and PA for both groups were significantly decreased compared with the values obtained on preoperative day 1 ($P < 0.01$). A significant decrease was observed in TF and PA in the PN group compared with the EEN group ($P < 0.01$). There was no significant difference in BW and ALB between the two groups ($P > 0.05$). The hs-CRP level of both groups was significantly higher than on preoperative day 1. There was a significant increase in hs-CRP in the PN group compared with the EEN group ($P < 0.01$). The anal exhaust time, length of hospital stay, and nutritional support cost were significantly shorter or lower in the EEN group than in the PN group ($P < 0.01$). There was no significant difference in the incidence of complications between the two groups ($P > 0.05$). EEN helps regulate the postoperative response of patients after gastric cancer surgery, promotes rehabilitation, and accelerates the recovery of gastrointestinal function. Furthermore, EEN has the advantage of being inexpensive.

Key words: Gastric cancer; Enteral nutrition; Parenteral nutrition; Prealbumin; High-sensitivity C-reactive protein

INTRODUCTION

Elderly patients with gastric cancer often experience immune dysfunction because of the high metabolism of malignant tumors (Nakamura and Matsumoto, 2013). Perioperative fasting and surgical stress exert an important influence on the postoperative nutrition and recovery of patients, and this can significantly increase the incidence of postoperative complications and mortality (Li et al., 2014). Postoperative nutrition can significantly improve the prognosis of patients. The existing nutritional treatment includes early enteral nutrition (EEN) or parenteral nutrition (PN), and the efficacy of EEN has been gradually accepted by clinicians (Yao et al., 2013; Bowrey et al., 2014). From January 2006 to December 2013, these two nutrition therapies were provided to patients undergoing gastric cancer surgery at our hospital, and the efficacy of these treatments was investigated.

MATERIAL AND METHODS

Characteristics of participants

A total of 272 patients undergoing gastric cancer surgery from January 2006 to December 2013 were selected. None of the patients had received hormone therapy, chemotherapy, or immunotherapy, and they did not have any metabolic disorders or liver and kidney diseases such as diabetes and high cholesterol. The patients selected comprised 180 men and 92 women with an age range of 60-86 (67.7 ± 7.2) years. Among the cancer patients, 32 were in stage I, 132 were in stage II, 92 were in stage IIIa, and 16 were in stage IIIb. A total of 20 patients underwent proximal gastrectomy, 176 underwent distal gastrectomy, and 76 underwent radical total gastrectomy. The patients were randomly divided into the PN group and the EEN group, with 136 patients in each group. The two groups were comparable and showed no significant difference in age, gender, tumor staging, or surgical method ($P > 0.05$).

Nutritional treatment

After the intraoperative reconstruction of the digestive tract was completed, a Flocare nasoenteral feeding tube (Changfeng Medical Industry Co., Ltd., Jiangsu, China) was placed approximately 30 cm from the distal anastomosis of the intestine jejunum-jejunal efferent loop in patients in the EEN group. For the EEN group, a slow infusion of 250-500 mL warm saline was given through the feeding tube on postoperative postoperative day 1, followed by slow infusion of 500 mL of an enteral nutrition suspension [Nutrison (Milupa GmbH & Co., KG, Netherlands)] on postoperative day 2. A daily increment of 500 to 1000-1500 mL was subsequently provided, and the lack of fluids and nutrients was supplemented intravenously. For the PN group, nutritional support by using a self-configured 3-L bag (mainly containing amino acids, fat emulsion, glucose, vitamins, and trace elements) was commenced on postoperative day 1. For both groups, the calorie supply was 126 $kJ \cdot kg^{-1} \cdot day^{-1}$. The calorie limit was gradually increased 3-5 days after anal exhaust. A subcutaneous injection of short-acting insulin was given based on the blood glucose test results during the enteral and parenteral nutrition treatments.

Specimen collection and detection

Cubital vein blood was collected from patients in both groups on preoperative day 1 and postoperative day 7 in the morning after fasting. The blood sample was anticoagulated with EDTA, centrifuged to separate the serum, and stored at -20°C for subsequent tests. The high-sensitivity C-reactive protein (hs-CRP) level was detected by using a Wuhan Elf unknown protein analyzer. The serum albumin (ALB) and prealbumin (PA) levels were detected with a Shenzhen Mindray BC-300 automatic biochemistry analyzer (Shenzhen Mindray Biomedical Electronics Co., Ltd., Shenzhen, China). Transferrin (TF) was determined with immunoturbidimetry.

Outcome measures

The body weight (BW), ALB, TF, PA, hs-CRP, length of postoperative hospital stay, postoperative nutritional support cost, and incidence of complications were recorded for the two groups.

Statistical analysis

The study data were processed by using the SPSS 15.0 software (SPSS Inc., Chicago, IL, USA). The measurement data are reported as means ± SD. The comparison between groups was completed by using a Student t-test, and the comparison before and after treatment was carried out by using a paired Student t-test. The counting data are presented as a rate and were analyzed by using Fisher's exact test. The significance level was set as $\alpha = 0.05$.

RESULTS

Comparison of BW, TF, and ALB before and after surgery for the two groups

For both groups, BW, TF, and ALB were significantly decreased on postoperative day 7 when compared with the corresponding values on preoperative day 1 ($P < 0.01$). There was a significant decrease in the TF level in the PN group when compared with the EEN group ($P < 0.01$). There were no significant differences in BW and ALB between the two groups ($P > 0.05$). The results are shown in Table 1.

Table 1. Changes in BW, TF, and ALB after the operation.

Group	N	Preoperative day 1			Postoperative day 7		
		BW (kg)	TF (g/L)	ALB (g/L)	BW (kg)	TF (g/L)	ALB (g/L)
EEN	136	65.5 ± 5.8	2.3 ± 0.8	33.5 ± 5.2	61.4 ± 4.9*	1.8 ± 0.6*	30.5 ± 4.4*
PN	136	65.8 ± 5.5	2.4 ± 0.9	34.1 ± 5.7	61.0 ± 4.8*	1.4 ± 0.5*	30.1 ± 4.7*

BW, body weight; TF, transferrin; ALB, albumin; EEN, early enteral nutrition; PN, parenteral nutrition. *Compared with preoperative day 1, P < 0.001.

Comparison of the PA and hs-CRP levels before and after surgery for the two groups

For both groups, the levels of PA and hs-CRP were significantly different on postoperative day 7 when compared with the corresponding preoperative data. There were significant differences in the PN group when compared with the EEN group (P < 0.01). The results are shown in Table 2.

Table 2. Changes in PA and CRP after the operation.

Group	N	Preoperative day 1		Postoperative day 7	
		PA (mg/L)	CRP (mg/L)	PA (mg/L)	CRP (mg/L)
EEN	136	335.5 ± 25.8	2.8 ± 0.8*	253.2 ± 20.4	7.2 ± 1.4*
PN	136	331.3 ± 27.5	2.9 ± 0.7*	231.1 ± 21.9	11.4 ± 1.8*#

PA = prealbumin; CRP = C-reactive protein; EEN = early enteral nutrition; PN = parenteral nutrition. *Compared with preoperative day 1, P < 0.001; #Compared with EEN group, P < 0.01.

Impact of nutrition on the postoperative indicators of patients

The anal exhaust time, length of hospital stay, and nutritional support cost for the patients of the EEN group were significantly shorter or lower than those of the PN group (P < 0.01). The incidence of complications was not significantly different between the two groups (P > 0.05). The results are shown in Table 3.

Table 3. Clinical indices after the operation.

Group	N	Anal exhaust time (days)	Length of hospital stay (days)	Nutritional support cost (dollar/day)	Incidence of complications, N (%)
EEN	136	2.2 ± 0.3	16.2 ± 3.6	71.5 ± 3.8	29 (10.6)
PN	136	3.7 ± 0.5*	19.7 ± 4.5*	86.3 ± 3.5*	38 (14.0)

EEN, early enteral nutrition; PN, parenteral nutrition. *Compared with EEN, P < 0.001.

DISCUSSION

The significantly low immune function and decreased appetite of patients with gastric cancer before surgery, as well as the postoperative stress due to the surgical trauma, cause a significant decrease in the BW of patients (Kashimura et al., 2012; Rachidi et al., 2013). After a gastric cancer surgery, the conventional treatment typically consists of PN therapy with a gradually supplemented diet after anal exhaust. With the development of general surgery and postoperative nutritional science, an increased number of studies have shown that EEN helps restore the gut function and reduce the translocation of intestinal bacteria, suggesting an important role in protecting the intestinal mucosa (Delgado et al., 2011; Fujitani et al., 2012; Li et al., 2012). The present study shows that postoperative EEN or total parenteral nutrition (TPN) can reduce and restore the visceral consumption of proteins after surgical trauma and reduce *in vivo* protein catabolism. The decrease in TF in the EEN group was less than that in the PN group. Additionally, the postoperative gastrointestinal function recovery time and the length of postoperative hospital stay of the EEN group were found to be significantly shorter than those of the TPN group. There was no significant difference in the incidence of complications between the two groups, suggesting that postoperative EEN in elderly patients with gastric cancer allowed for a rapid rehabilitation and facilitated the synthesis of important proteins. These data are consistent with previous reports (Barlow et al., 2011; Mendelsohn et al., 2011). Furthermore, the treatment cost for the EEN group was significantly lower than that for the PN group, suggesting that EEN complies with the surgical concept of rapid rehabilitation, which is advantageous for the patients (Hur et al., 2011). In addition, long-term TPN can cause serious complications such as catheter-related sepsis and intestinal infections. Therefore, EEN is now accepted by most scholars and has become the preferred nutritional supplement.

PA is a negative acute-phase protein synthesized in the liver. PA levels can reflect liver function based on cell synthesis and protein secretion. With a short half-life of only 1.9 days, PA is much more sensitive than ALB. The main proteins synthesized in the liver change from structural proteins in the plasma to acute-phase proteins because of the intense stress response of the body after a gastric cancer surgery. Therefore, the determination of PA concentration in the plasma has a high sensitivity for understanding the metabolism state and immunity of the body. The dynamic observation of PA levels can also help understand changes in the disease and can be used as an indicator to determine treatment efficacy and prognosis (Hur et al., 2011; Bae et al., 2011). Serum CRP was significantly increased after 6-8 h of inflammation, which can be used as an early diagnostic marker of surgical stress (Ortega-Deballon et al., 2012). By using an ultrasensitive method, the CRP at low concentrations was measured as hs-CRP, which is a more precise indicator of vascular inflammation and a nonspecific marker of systematic stress (Ortega-Deballon et al., 2010). The present study showed that PA and hs-CRP were significantly lower or higher, respectively, on postoperative day 7 for the two groups when compared with preoperative day 1. The changes in the EEN group were more robust than those of the PN group ($P < 0.01$). This result suggests that postoperative EEN for elderly patients with gastric cancer reduces the body's response to the stress of surgical trauma. This effect of EEN support could be attributable to the effective maintenance of the intestinal mucosal barrier function, reduction of the endotoxin and bacterial translocation, and reduction of postoperative intestinal stress. Therefore, EEN better attenuates the postoperative response to stress in patients than do PN. These data highlight the significance of enhancing the body's immune function.

REFERENCES

Bae HJ, Lee HJ, Han DS, Suh YS, et al. (2011). Prealbumin levels as a useful marker for predicting infectious complications after gastric surgery. *J. Gastrointest. Surg.* 15: 2136-2144.

Barlow R, Price P, Reid TD, Hunt S, et al. (2011). Prospective multicentre randomised controlled trial of early enteral nutrition for patients undergoing major upper gastrointestinal surgical resection. *Clin. Nutr.* 30: 560-566.

Bowrey DJ, Baker M, Halliday V, Thomas AL, et al. (2014). Six weeks of home enteral nutrition versus standard care after esophagectomy or total gastrectomy for cancer: study protocol for a randomized controlled trial. *Trials* 15: 187.

Delgado Delgado RC and Luque Vásquez CE 5th (2011). Does contribute early enteral nutrition to decrease the complications of radical gastrectomy for gastric cancer? *Rev. Gastroenterol. Peru* 31: 146-150.

Fujitani K, Tsujinaka T, Fujita J, Miyashiro I, et al. (2012). Prospective randomized trial of preoperative enteral immunonutrition followed by elective total gastrectomy for gastric cancer. *Br. J. Surg.* 99: 621-629.

Hur H, Kim SG, Shim JH, Song KY, et al. (2011). Effect of early oral feeding after gastric cancer surgery: a result of randomized clinical trial. *Surgery* 149: 561-568.

Kashimura S, Saze Z, Terashima M, Soeta N, et al. (2012). CD83(+) dendritic cells and Foxp3(+) regulatory T cells in primary lesions and regional lymph nodes are inversely correlated with prognosis of gastric cancer. *Gastric Cancer* 15: 144-153.

Li G, Gu R, Wen X, Wei D, et al. (2012). The effect of early enteral nutrition on hyperthermic intraoperative intraperitoneal chemotherapy-induced mucosal permeability following gastrectomy. *JPEN J. Parenter. Enteral. Nutr.* 36: 213-218.

Li H, Han X, Su L, Zhu W, et al. (2014). Laparoscopic radical gastrectomy versus traditional open surgery in elderly patients with gastric cancer: benefits and complications. *Mol. Clin. Oncol.* 2: 530-534.

Mendelsohn RB, Gerdes H, Markowitz AJ, DiMaio CJ, et al. (2011). Carcinomatosis is not a contraindication to enteral stenting in selected patients with malignant gastric outlet obstruction. *Gastrointest. Endosc.* 73: 1135-1140.

Nakamura S and Matsumoto T. (2013). *Helicobacter pylori* and gastric mucosa-associated lymphoid tissue lymphoma: recent progress in pathogenesis and management. *World J. Gastroenterol.* 19: 8181-8187.

Ortega-Deballon P, Radais F, Facy O, d'Athis P, et al. (2010). C-reactive protein is an early predictor of septic complications after elective colorectal surgery. *World J. Surg.* 34: 808-814.

Ortega-Deballon P, Facy O and Rat P (2012). Diagnostic accuracy of C-reactive protein and white blood cell counts in the early detection of infectious complications after colorectal surgery. *Int. J. Colorectal Dis.* 27: 1237.

Rachidi SM, Qin T, Sun S, Zheng WJ, et al. (2013). Molecular profiling of multiple human cancers defines an inflammatory cancer-associated molecular pattern and uncovers KPNA2 as a uniform poor prognostic cancer marker. *PLoS One* 8: e57911.

Yao K, Zhang X, Huang Z and Li X (2013). Influence of early enteral nutrition (EEN) on insulin resistance in gastric cancer patients after surgery. *Asia Pac. J. Clin. Nutr.* 22: 537-542.

