

## Original Article

# Early enteral nutrition support for colon carcinoma patients can improve immune function and promote physical recovery

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Received July 17, 2020; Accepted November 6, 2020; Epub December 15, 2021; Published December 30, 2021

**Abstract:** Objective: To investigate the role of early enteral nutrition support (ENN) on the improvement of immune function and physical recovery of patients with colon carcinoma. Methods: The patients with colon carcinoma treated in our hospital from November 2018 to November 2019 were obtained and randomly grouped into the control group (CG) and the early enteral nutrition support group (ENN group). The changes of nutritional status and immune function related indexes, the changes of inflammatory reaction indexes, and the physical recovery and complication rate were compared between groups. Results: Before operation, there was no evident difference between the two groups in nutrition index level (serum transferrin, albumin, prealbumin and hemoglobin), immune function index level (IgA, IgG, IgM, CD4+, CD8+, CD4+/CD8+) and inflammatory reaction indices (CRP, PGE, IL-6) ( $P>0.05$ ). After operation, weight loss, incision cicatrized time, postoperative defecation time, getting up after operation and length of hospital stay of the ENN group were better than those of the CG. The change of nutritional indexes was also evidently better in the ENN group. Immune function was evidently improved compared with the CG. The level of inflammatory reaction factors was also evidently lower in the ENN group, and the incidence of postoperative complications was evidently lower than that of the CG, and the physical recovery was also better than that of the CG ( $P<0.05$ ). Conclusion: ENN for patients with colon carcinoma can improve their immune function, improve their nutritional level and promote their physical recovery.

**Keywords:** Colon carcinoma, early enteral nutrition, immune function, nutrition level, recovery

## Introduction

Colon carcinoma [1] is a common malignant tumor, and its pathogenesis is not clear, but many research reports suggest that it is related to risk factors such as high pressure in life, lack of exercise, more entertainment, lack of fresh vegetables and fruits, and eating too much fatty food [2]. It is often divided into the categories of lump, infiltration and ulcer in the clinic, and is divided into adenocarcinoma, mucinous carcinoma and undifferentiated carcinoma histologically, among which adenocarcinoma is the most common and undifferentiated carcinoma has the worst prognosis. In the clinic, the symptoms of colon carcinoma are usually dis-

tinguished by the left and right colon, and abdominal pain, abdominal mass, intestinal obstruction, and changes in stool habits and stool characteristics are common symptoms [3, 4]. The proliferation of malignant tumor cells causes the body's nutrition to be constantly consumed. In addition, anorexia, pain and other reactions can lead to different degrees of malnutrition and decreased immune function in tumor patients. Postoperative fasting further aggravates the negative nitrogen balance and affects immune function [5]. At present, the main treatment for colon carcinoma is still radical surgery [6]. Intestinal obstruction is not only a symptom of colon carcinoma patients, but is also a complication of colon carcinoma. It usu-

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ally causes poor stool discharge or inability to defecate, abdominal distension, nausea and vomiting, resulting in poor appetite or inability to eat, which will cause malnutrition and decreased immunity for a long time. In particular, intestinal obstruction caused by colon carcinoma is often complicated with chronic blood loss and anemia, thus aggravating the above symptoms and resulting in slow healing of the postoperative incision, increased incidence of anastomotic leakage and other complications, and it affects various organs of the whole body, increasing surgical risk and postoperative mortality [7, 8].

Parenteral nutrition [9] has always been used as the main nutritional method after colon carcinoma surgery. However, according to reports, long-term use of parenteral nutrition, especially during fasting after surgery, will cause intestinal mucosa atrophy and damage the intestinal mucosal barrier. In recent years, it is advocated to use enteral nutrition in the early postoperative period [10]. Early postoperative enteral nutrition for patients with gastrointestinal carcinoma is superior to parenteral nutrition in promoting the recovery of immune suppression caused by surgical stress, especially in cellular immunity [11]. Therefore, the early use of enteral nutrition combined with parenteral nutrition after colon carcinoma surgery is helpful for patients' recovery [12].

In this study, the above two methods were used after colon carcinoma surgery, and the effects of the two methods on immune function and physical recovery of patients were compared.

### Data and methods

#### *Research participants*

A total of 97 patients with colon carcinoma from November 2018 to November 2019 were randomly grouped into the control group (CG) and the early enteral nutrition support group (EEN group). There were 40 cases in the CG, including 22 men and 18 women, aged ( $58.6 \pm 5.1$ ) years. There were 57 cases in the ENN group, including 34 men and 23 women, aged ( $59.1 \pm 5.7$ ) years. Inclusion criteria were as follows: patients were diagnosed by colonoscopy before operation and confirmed by pathology after operation; patients did not receive radiotherapy and chemotherapy before operation;

no albumin or immunopotentiator was used within 2 weeks before operation; patients or their families signed the informed consent; the study was approved by the Ethics Committee. Exclusion criteria were as follows: patients with severe liver and kidney dysfunction; patients with congenital abnormal amino acid metabolism or those complicated with other metabolic diseases and allergic diseases; patients with diabetes and thyroid dysfunction; patients with pyloric obstruction or digestive tract obstruction. There was no evident difference in the general data between the two groups ( $P < 0.05$ ).

#### *Methods*

Patients in both groups were given radical operation for colon carcinoma by doctors in the same operation group. After operation, patients were given nutritional support with equal calories and nitrogen standards. Non-protein calories were  $125.5 \text{ kJ}\cdot\text{kg}^{-1}\cdot\text{d}^{-1}$ , and nitrogen was  $0.2 \text{ g}\cdot\text{kg}^{-1}\cdot\text{d}^{-1}$ .

In the ENN group, no stomach tube was placed. After 6-24 h after the operation, the patients were given 250 mL of 5% glucose saline orally. If the patients had no adverse digestive tract reactions, they were given enteral nutrition emulsion the next day, and the total amount was controlled at  $30 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{d}^{-1}$ . In the initial stage, insufficient liquid was supplemented by intravenous infusion of glucose saline.

The CG received parenteral nutrition support via the central vein, and was given 10% glucose solution (carbohydrate), 11.4% amino acid (nitrogen), 20% fat emulsion, fat-soluble vitamins, water-soluble vitamins, various trace elements, and insulin. The ratio of insulin to sugar was 1:5 to make a 3 L bag of parenteral nutrition solution, 2500 mL/d, and it was slowly infused within 24 h.

#### *Outcome measures*

(1) Clinical indicators and gastrointestinal function recovery time: weight loss, incision cicatrized time, recovery time for anal exsufflation, defecation and length of hospital stay were observed.

(2) Cellular immune function of patients: Peripheral blood of patients in each group was collected before operation, 1 day and 7 days after operation. T lymphocyte subsets ( $\text{CD4}^+$ ,  $\text{CD8}^+$ ,

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**Table 1.** General data

	CG (n=40)	EEN group (n=57)	$\chi^2/t$	P
Gender			0.2082	0.6482
Male	22 (55)	34 (59.6)		
Female	18 (45)	23 (40.4)		
Age	58.6±5.1	59.1±5.7	0.4438	0.6582
Weight (kg)	53.1±6.2	54.3±6.5	0.9121	0.3640
Dukes staging			0.9562	0.6200
A	1 (2.5)	2 (3.5)		
B	33 (82.5)	50 (87.7)		
C	6 (15)	5 (8.8)		
Tumor location			0.2599	0.8781
Sigmoid colon carcinoma	12 (30)	15 (26.3)		
Left colon carcinoma	19 (47.5)	30 (52.6)		
Right colon carcinoma	9 (22.5)	12 (21.2)		
History of alcoholism			0.0177	0.8942
Yes	23 (57.5)	32 (56.1)		
No	17 (42.5)	25 (43.9)		
History of smoking			0.1303	0.7182
Yes	26 (65)	35 (61.4)		
No	14 (35)	22 (38.6)		

difference was statistically significant with  $P < 0.05$ .

### Results

#### General information

There was no significant difference in the patients' general data such as sex, age, weight, Dukes stage, tumor location, history of alcoholism and smoking between the two groups ( $P < 0.05$ ) (**Table 1**).

#### Clinical indicators of both groups of patients

The weight loss, incision cicatrized time, postoperative defecation time, getting up and length of hospital stay in the EEN group were better than those in the CG ( $P < 0.05$ ) (**Table 2**).

#### Nutritional indicators of both groups of patients

CD4+/CD8+) in the peripheral blood of two groups were measured by flow cytometry, and immunoglobulins (IgA, IgG, IgM) were measured by immunoturbidimetry.

(3) Detection of inflammatory and stress indicators: the levels of C-reactive protein, PGE and IL-6 before and after operation in the two groups were detected.

(4) Nutritional indicators of patients: serum transferrin (TF), serum albumin (ALB), prealbumin (PAB) and hemoglobin (Hb) before and after operation in both groups were observed.

(5) Postoperative complications: The incidence of postoperative complications was observed 7 days after operation.

#### Statistical analysis

SPSS 21.0 was applied for data processing, and the measurement data were expressed as the mean (average of at least three independent experiments)  $\pm$  standard deviation. t test was applied for comparison between groups. The counting data were represented as (n, %) and analyzed by chi-square test. GraphPad Prism 6 was applied for figure illustration. The

Before operation, there was no evident difference in serum transferrin, albumin, prealbumin and hemoglobin levels between the two groups ( $P < 0.05$ ). After operation, the indexes of the EEN group were evidently higher than those of the CG ( $P < 0.05$ ) (**Table 3**).

#### Inflammation indicators of both groups of patients

There was no evident difference in CRP, PGE and IL-6 between the two groups ( $P < 0.05$ ). After operation, the indexes of patients in the two groups decreased evidently, and the decrease in the EEN group was more than that in the CG ( $P < 0.05$ ) (**Figure 1**).

#### Immunological indexes of two groups of patients

The immunological indexes of two groups before operation, 1 day after operation and 7 days after operation were compared. The results showed that there was no evident difference between the two groups before operation ( $P < 0.05$ ). One day after operation, the levels of IgA, IgM, IgG, CD4+ and CD4+/CD8+ in the EEN group were evidently better than those in the CG. Seven days after operation, all in-

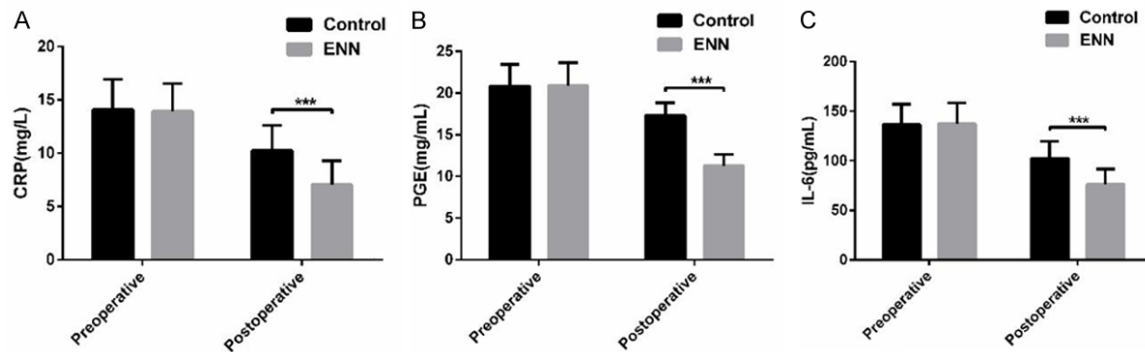
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**Table 2.** Comparison of clinical indexes between two groups

	Weight loss (kg)	Incision cicatrized time (d)	Exhaust time after operation (h)	Getting up after operation (h)	Length of hospital stay (d)
CG (n=40)	3.26±0.51	9.86±1.02	41.83±10.62	40.21±11.62	11.25±2.03
ENN group (n=57)	3.51±0.48	11.36±1.18	54.82±11.03	53.64±11.09	14.52±3.15
$\chi^2/t$	2.4608	6.5100	5.7972	5.7567	5.7733
P	0.0157	<0.0001	<0.0001	<0.0001	<0.0001

**Table 3.** Comparison of nutritional indexes between the two groups

		TF (g/L)	ALB (g/L)	PA (mg/L)	Hb (g/L)
Preoperative	CG (n=40)	1.20±0.33	35.12±3.12	129.32±9.26	105.62±3.03
	ENN group (n=57)	1.21±0.35	34.32±3.26	128.84±8.95	105.23±3.10
$\chi^2/t$		0.1418	1.2108	0.2563	0.6156
P		0.8875	0.2290	0.7982	0.5396
Postoperative	CG (n=40)	1.65±0.62	33.32±3.03	135.63±9.13	116.23±2.59
	ENN group (n=57)	1.97±0.58	37.42±3.68	153.23±10.25	125.32±2.36
$\chi^2/t$		2.5998	5.7984	8.7019	17.9364
P		0.0108	<0.0001	<0.0001	<0.0001



**Figure 1.** Comparison of inflammation indexes between two groups of patients. A: Comparison of CRP level between two groups; B: Comparison of PGE level between two groups; C: Comparison of IL-6 levels between the two groups. \*\*\* indicates compared with the CG,  $P < 0.001$ .

dexes were evidently better in the ENN group ( $P < 0.05$ ) (Table 4).

### *Incidence of postoperative complications in both groups*

Postoperative complications mainly included nausea, vomiting, abdominal pain, abdominal distension, diarrhea and constipation. The total incidence of complications in the ENN group (7%) was lower than that in the CG (22.5%) ( $P < 0.05$ ) (Table 5).

### **Discussion**

Patients with colon carcinoma often suffer from malnutrition and low immune function due

to insufficient nutrition intake before operation and metabolic disorders and energy consumption caused by the tumor itself [13]. After the operation, the metabolic disorder is further aggravated due to operative stress, protein is decomposed and the energy consumption is increased, thus causing the body to be in an immunosuppression state [14]. Perioperative high-quality nursing can reduce trauma stress and improve prognosis. Early enteral nutrition can improve overall nutrition, enhance immunity and promote rehabilitation [15].

By comparing the recovery of colon carcinoma patients with parenteral nutrition support and ENN, the results showed that there was no evi-

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**Table 4.** Comparison of immunological indexes between two groups of patients

		CG (n=40)	EEN group (n=57)	$\chi^2/t$	P
IgA (g/L)	Preoperative	1.75±0.35	1.76±0.31	0.1482	0.8825
	One day after operation	1.33±0.29	1.72±0.30	6.3892	<0.0001
	Seven days after operation	1.30±0.25	1.79±0.33	7.9253	<0.0001
IgM (g/L)	Preoperative	1.18±0.26	1.17±0.23	0.1991	0.8421
	One day after operation	1.02±0.16	1.13±0.20	2.8885	0.0047
	Seven days after operation	1.07±0.19	1.19±0.34	2.0199	0.0462
IgG (g/L)	Preoperative	10.43±1.33	10.45±1.28	0.0745	0.9407
	One day after operation	7.80±1.03	10.26±1.22	10.4088	<0.0001
	Seven days after operation	7.93±1.16	10.53±1.32	24.7633	<0.0001
CD4+ (%)	Preoperative	42.31±6.98	42.38±7.06	0.0484	0.9615
	One day after operation	35.21±6.51	40.21±7.02	3.5537	0.0005
	Seven days after operation	38.26±6.72	42.56±7.13	2.9933	0.0035
CD8+ (%)	Preoperative	22.30±2.35	22.25±2.29	0.1047	0.9168
	One day after operation	23.12±2.68	22.42±2.36	1.3595	0.1772
	Seven days after operation	20.51±3.03	17.69±3.52	4.1086	<0.0001
CD4+/CD8+ (%)	Preoperative	1.89±0.18	1.90±0.21	0.2445	0.8073
	One day after operation	1.52±0.23	1.79±0.18	6.4793	<0.0001
	Seven days after operation	1.86±0.31	2.40±0.36	7.6919	<0.0001

**Table 5.** Comparison of postoperative complications between the two groups

	Nausea	Vomiting	Abdominal pain	Abdominal distension	Diarrhea	Constipation	Total incidence rate
CG (n=40)	2 (5)	1 (2.5)	2 (5)	1 (2.5)	2 (5)	1 (2.5)	9 (22.5)
EEN group (n=57)	0	1 (1.75)	1 (1.75)	0	1 (1.75)	1 (1.75)	4 (7.0)
$\chi^2/t$							4.8551
P							0.0276

dent difference in the nutritional index level, immune function index level and inflammatory reaction index between the two groups before operation. After operation, the weight loss, incision cicatrized time, postoperative defecation time, getting up after operation and length of hospital stay of the EEN group were all better than those of the CG. Anal exhaust time and bowel sound recovery time can reflect the intestinal function recovery of patients after colon carcinoma operation. Anal exhaust indicates that the intestinal tract has recovered the functions of peristalsis, secretion and absorption, and the intestinal environment is stable. Enteral nutrition can not only stimulate the intestinal tract to promote peristalsis, but also improve the blood circulation of the intestinal mucosa, eliminate the intestinal mucosa atrophy caused by intestinal obstruction and increase the absorption of nutrients [16, 17]. The length of stay indirectly reflects the recovery

of patients. The changes of nutritional indexes (serum transferrin, albumin, prealbumin and hemoglobin) were also evidently better in the EEN group ( $P<0.05$ ). Immune function (IgA, IgG, IgM, CD4+, CD8+, CD4+/CD8+) was evidently improved compared with the CG. Serum Alb and PA are common indicators that directly reflect the nutritional status of the body [18]. These indicators are often decreased in patients with carcinoma after surgery, indicating that patients are in a state of malnutrition. Malnutrition can aggravate immune dysfunction of the body, indicating that the functions of lymphocytes and B cells are inhibited, the functions of B cells are decreased, and the synthesis of immunoglobulin is decreased due to insufficient secretion of autoantibodies, revealing that the content of IgG, IgM and IgA in peripheral blood are decreased [19]. This result is similar to the research result of Xu et al. [20], which also suggests that nutritional support plays an active



role in improving immune function and relieving inflammation after operation of colon cancer patients, and accelerates the recovery of gastrointestinal function. T lymphocyte dysfunction is characterized by CD4+, CD4+/CD8+ ratio decreasing and CD8+ increasing [21]. The results showed that CD4+ and CD4+/CD8+ ratio in the EEN group were higher than those in the CG, which indicated that early postoperative enteral nutrition could improve the immune function of colon carcinoma patients, which may be related to enteral nutrition directly providing nutrition for intestinal mucosa. More than half of human lymphoid tissues exist in the gastrointestinal mucosa, and enteral nutrient solution guarantees the energy supply of lymphoid tissues and immune cells, and promotes the recovery of postoperative immune function of patients [22]. The levels of inflammatory reaction factors (CRP, PGE, IL-6) were also evidently lower in the ENN group. C-reactive protein is an index reflecting the degree of inflammatory reaction of the body. Obvious malnutrition can aggravate the inflammation and even cause multiple organ dysfunction, which is the reason for patients undergoing early nutritional intervention after surgery [23, 24]. Long-term use of parenteral nutrition can lead to disuse atrophy of gastrointestinal function and abnormal mucosal function in patients, and even enterogenous infection in severe cases, while enteral nutrition can help patients recover gastrointestinal function, enhance the nutritional status of the body and reduce pathogenic bacteria from entering blood through intestinal mucosa [25]. The incidence of postoperative complications in the EEN group was evidently lower than that in the CG, and the physical recovery was also better in the ENN group. The most serious and complicated complication after colon carcinoma operation is anastomotic leakage. Prevention of anastomotic leakage after colon carcinoma operation is the key to treatment success. Anastomotic leakage often occurs in the 3-7 days after operation and has typical symptoms and signs, such as fever, abdominal pain, abdominal distension, abdominal tenderness and rebound pain, and coffee fecal odor drainage from the abdominal drainage tube. Studies have shown that enteral nutrition can reduce metabolic stress and lung infection. Compared with parenteral nutrition, enteral nutrition can not only reduce the mortality of patients, but also re-

duce the incidence of complications [26]. This study also has some deficiencies. For example, the early enteral nutrition support has been widely used, but the sample size we selected is too small, and the support for the conclusion is not enough. More studies and an increase of sample size will be carried out in subsequent studies.

To sum up, early postoperative enteral nutrition support for patients with colon carcinoma can improve immune function, improve nutrition level, promote the recovery of intestinal function and accelerate the recovery of patients.

### Disclosure of conflict of interest

None.

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