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Effect of Sequential Early Enteral Nutrition on Postoperative Rehabilitation and Complications in Gastric Cancer Patients

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Abstract: *Objective:* To analyze the effect of sequential early enteral nutrition in patients with gastric cancer after surgery. *Methods:* A total of 139 gastric cancer patients, treated between October 2021 and October 2023, were randomly selected and divided into two groups: Group A (68 cases, receiving early enteral nutrition) and Group B (71 cases, receiving sequential early enteral nutrition), using computer randomization. The effects of the interventions on both groups were compared. *Results:* Seven days post-operation, the levels of nutritional indicators in Group B were significantly higher than those in Group A ($P < 0.05$). Group B showed significantly better levels of inflammatory factors and immune factors compared to Group A seven days post-operation ($P < 0.05$). The postoperative complication rate in Group B was 4.23%, significantly lower than that in Group A, which was 16.18% ($\chi^2 = 5.477$, $P = 0.019$). *Conclusion:* The utilization of sequential early enteral nutrition in gastric cancer patients after surgery demonstrated notable improvements in nutritional status and inflammation markers, along with enhanced immunity, effectively reducing postoperative complications.

Keywords: Sequential early enteral nutrition; Gastric cancer; Postoperative rehabilitation treatment; Complication rate

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1. Introduction

The proportion of gastric cancer patients is relatively high among those with digestive system tumors. In recent years, not only has the number of gastric cancer patients shown an upward trend, but they have also become younger. Due to the nonspecificity of early clinical symptoms of gastric cancer, most patients are diagnosed in the middle and late stages [1].

Currently, gastric cancer is primarily treated through surgery, wherein tumor tissue is removed to control disease progression and reduce metastasis rates. However, the surgical procedure itself inflicts considerable damage on the body. Post-operation, the body enters a high catabolic state, reducing metabolism and increasing the risk of malnutrition [2]. Early postoperative enteral nutrition (EEN) is a commonly employed nutritional support method for gastric cancer surgery patients. It can mitigate malnutrition incidence and shorten postoperative recovery time. Nevertheless, gastrointestinal dysfunction is prevalent in early postoperative gastric cancer patients, with EEN often leading to adverse symptoms such as abdominal pain and diarrhea [3].

Sequential early enteral nutrition (SEEN) represents a novel EEN approach. Clinicians conduct a comprehensive analysis of the patient's condition and digestive tract function, administering amino acids, peptides, and other substances in the early postoperative period, gradually transitioning to whole protein infusion. This approach not only provides adequate nutrients but aids in restoring normal gastrointestinal functions. Furthermore, incrementally increasing nutrient dosage and infusion rate promotes intestinal peristalsis and expedites the return to normal digestive tract function. Thus, SEEN's nutritional support method aligns more closely with human nutritional absorption rules and facilitates postoperative recovery while effectively reducing gastrointestinal intolerance incidence [4]. This study examines the effect of postoperative SEEN use in gastric cancer patients.

2. Materials and methods

2.1. General information

A total of 139 cases were randomly selected from gastric cancer patients treated between October 2021 and October 2023 and divided into groups using a computer randomization method. Group A comprised 68 cases with an age range of 34 to 75 years, with an average age of 59.48 ± 5.53 years and weights ranging from 45.48 to 87.53 kg, with a mean weight of 63.12 ± 6.79 kg. Thirty-seven cases were classified as stage II and 31 as stage III. Surgical methods included subtotal gastrectomy with RY anastomosis in 36 cases and total gastrectomy with RY anastomosis in 32 cases, with an average operation time of 230.12 ± 69.48 min. The gender distribution was 35 males and 33 females. Group B consisted of 71 cases, with ages ranging from 32 to 78 years and an average age of 59.12 ± 5.47 years, with weights ranging from 45.59 to 87.12 kg and a mean weight of 63.57 ± 6.84 kg. Thirty-eight cases were classified as stage II and 33 as stage III. Surgical methods included subtotal gastrectomy with RY anastomosis in 40 cases and total gastrectomy with RY anastomosis in 31 cases, with an average operation time of 230.84 ± 69.56 min. The gender distribution was 41 males and 30 females. Comparison of general data showed no significant differences ($P > 0.05$).

Inclusion criteria: (1) Patients diagnosed with gastric cancer and meeting indications for surgical treatment; (2) Patients with no history of chemotherapy; (3) Patients with no symptoms of malnutrition before surgery; (4) Patients who did not receive nutritional support or use exogenous albumin preparations before surgery; (5) Complete data and informed consent of patients.

Exclusion criteria: (1) Patients diagnosed with malnutrition before surgery; (2) Patients with severe dysfunction of major organs; (3) Patients with contraindications to enteral nutrition before surgery (intestinal obstruction, intestinal ischemia, etc.); (4) Patients with metastatic cancer lesions; (5) Patients with mental disorders.

2.2. Methods

Group A adopted EEN. Post-operation, 250 mL of glucose injection (5%) was administered through the nasoenteral feeding tube at a rate of 20 mL/h 12 hours after surgery; 500 mL of glucosamine was injected at a rate of 20–30 mL/h 24 hours after surgery; from 2 to 5 days post-operation, the amount of injected nutrients was adjusted according to the patient's needs.

Group B adopted SEEN. Twelve hours after surgery, 250 mL of glucose injection (5%) was administered through the nasoenteral nutrition tube at a rate of 20 mL/h; 24 hours after surgery, when the patient's vital signs were stable, amino acid enteral nutrition was infused at a rate of 20–30 mL/h (density 1 kcal/mL); 48 hours post-surgery, 600 mL Vivonex was infused at a rate of 40–50 mL/h; 72 hours post-surgery, 300 mL Vivonex and 500 mL short peptide enteral nutrition suspension were infused at a rate of 60–80 mL/h (density 1 kcal/mL); 4 days post-surgery, 1,000 mL of Peptison was infused at a rate of 80–100 mL/h; 5 days post-surgery, 1,000 mL of whole protein enteral nutrition was infused at 80–100 mL/h (density 1 kcal/mL).

2.3. Indicator observation

(1) Nutritional indicators: Seven days post-surgery, 5 mL of venous blood was collected, and the immunoturbidimetric method was used to detect levels of albumin (ALB) and prealbumin (PA). Hemoglobin (Hb) and total protein (TP) levels were also measured.

(2) Inflammatory factors and immune factor indicators: Seven days post-surgery, 5 mL of fasting peripheral venous blood was centrifuged at a speed of 3000 r/min for 15 minutes in the morning, with a centrifugal radius of 10 cm. The double-antibody sandwich enzyme-linked immunosorbent assay (ELISA) was utilized to measure levels of C-reactive protein (CRP) and interleukin-6 levels (IL-6) in the upper serum. An immunoturbidimetric assay was performed to assess immunoglobulin G (IgG) and immunoglobulin M (IgM) in 3 mL of fasting venous blood.

(3) Incidence of postoperative complications: The postoperative complication rate was calculated using the formula Postoperative complication rate = (Abdominal distension and diarrhea + Incision infection + Reflux esophagitis) / Total number of cases × 100%.

2.4. Statistical analysis

The data were processed using SPSS 25.0 software. Measurement data are presented as mean ± standard deviation (SD), while enumeration data are presented as %. The *t*-test and χ^2 test were applied for analysis, with statistical significance set at $P < 0.05$.

3. Results

3.1. Nutritional indicators

Table 1 shows that the ALB, PA, Hb, and TP levels in Group B were significantly higher than those in Group A 7 days after surgery ($P < 0.05$).

Table 1. Comparison of nutritional indicators (mean ± SD)

Group	*n*	ALB (g/L)	PA (ng/L)	Hb (g/L)	TP (g/L)
Group B	71	39.82 ± 2.53	182.53 ± 18.64	119.23 ± 8.46	64.92 ± 2.41
Group A	68	38.54 ± 2.46	160.23 ± 16.72	114.13 ± 9.15	63.15 ± 4.26
t	-	3.022	7.413	3.408	3.031
P	-	0.003	0.000	0.000	0.002

3.2. Inflammatory factors and immune factor indicators

As shown in **Table 2**, the CRP, IL-6, IgG, and IgM of Group B were significantly better than those in Group A 7 days after operation ($P < 0.05$).

Table 2. Comparison of inflammatory factors and immune factor indicators (mean ± SD)

Group	*n*	CRP (mg/L)	IL-6 (ng/L)	IgG (g/L)	IgM (g/L)
Group B	71	24.15 ± 2.37	31.53 ± 12.67	9.92 ± 0.85	0.96 ± 0.15
Group A	68	45.68 ± 20.12	56.31 ± 20.46	8.84 ± 0.82	0.83 ± 0.18
t	-	7.635	12.104	7.618	4.633
P	-	0.000	0.000	0.000	0.000

3.3. Incidence of postoperative complications

The postoperative complication rate in Group B was 4.23%, significantly lower than that in Group A, which was 16.18% ($P < 0.05$), as seen in **Table 3**.

Table 3. Comparison of postoperative complications incidence

Group	*n*	Abdominal distension and diarrhea	Incision infection	Reflux esophagitis	Postoperative complication rate
Group B	71	2	0	1	4.23%
Group A	68	5	3	3	16.18%
χ^2	-				5.477
P	-				0.019

4. Discussion

Gastric cancer constitutes a significant proportion of digestive system tumors and poses a considerable mortality risk. Presently, surgical intervention remains the primary clinical approach for treating gastric cancer patients. However, surgery inflicts substantial bodily damage, coupled with metabolic abnormalities and ongoing tumor cell proliferation, leading to heightened energy demands and increased postoperative complications. The risk of malnutrition escalates accordingly. Postoperative malnutrition in gastric cancer patients predominantly stems from the high catabolic state post-surgery, diminished gastric motility, reduced gastrointestinal secretions, and intolerance of protein preparations by residual gastric tissue and intestinal mucosa in the short term [5]. Malnutrition onset significantly escalates postoperative complication rates and mortality in gastric cancer patients. Hence, early postoperative nutritional support for gastric cancer patients is imperative [6]. Gastrointestinal motility function typically restores within 1–2 days post-surgery, while small intestinal motility, digestion, and absorption functions return within 6–8 hours post-surgery. Consequently, providing nutritional support to gastric cancer patients soon after surgery is deemed highly safe.

Enteral nutritional support currently serves as the primary method for postoperative nutritional supplementation in surgical patients. It not only furnishes the necessary nutrients for physical recovery but also safeguards intestinal mucosa structure, preserving cell integrity. Additionally, postoperative nutritional support accelerates intestinal immune and mechanical function restoration, increases bile secretion, enhances excretion rates, and safeguards liver function. Timely postoperative enteral nutritional support replenishes glutamine and dietary fiber essential for normal physiological activities, thus mitigating malnutrition incidence or ameliorating symptoms. With the advent of rapid surgical recovery, clinical studies corroborate that promptly initiating nutritional supplementation post-surgery effectively reduces hospitalization duration and enhances prognosis.

Currently, EEN predominates in clinical practice for postoperative gastric cancer patients. Although EEN improves patients' nutritional status, its frequent use in a single dosage form results in high intolerance rates, hindering patients' postoperative recovery [7]. To enhance postoperative nutritional status in gastric cancer patients and diminish intolerance rates, SEEN emerged as a modified nutritional support method based on EEN. This study implemented SEEN for patients in Group B and compared its efficacy with that of patients in Group A receiving EEN. Results indicated that nutritional indicators, inflammatory factors, and immune factor indicators were comparable between the two groups one day pre-surgery ($P > 0.05$). However, Group B exhibited superior indicators compared to Group A ($P < 0.05$). Furthermore, the incidence of postoperative complications in Group B was significantly lower than that in Group A ($P < 0.05$), affirming the benefits of SEEN in postoperative gastrointestinal function restoration, nutritional status improvement, inflammation reduction, and immunity enhancement.

Clinical evaluation of nutritional status predominantly relies on indicators such as ALB and PA. Post-surgery, gastric cancer patients experience heightened catabolism, leading to declining levels of these nutritional indicators. Both EEN and SEEN particularly ameliorate patients' nutritional status post-gastric cancer surgery. SEEN, however, demonstrates a superior efficacy in nutritional status improvement, likely attributed to the incomplete recovery of gastrointestinal absorptive capacity 24–48 hours post-surgery. During this period, intestinal epithelial cells are not able to absorb cellulose effectively [8]. SEEN addresses this by providing Vivonex, which bypasses digestion and better meets gastrointestinal needs within 48 hours post-surgery, facilitating optimal nutrient absorption [9]. Gastric cancer patients typically regain colon function 72 hours post-surgery, allowing for the administration of short peptides that are easily digested and absorbed. These peptides not only provide absorbable nutrients but also offer comprehensive nutrition for subsequent gastrointestinal absorption. This establishes a favorable foundation for gastrointestinal function recovery and augments postoperative nutritional status.

Surgical trauma incites inflammatory reactions and compromises immune function post-surgery in gastric cancer patients. Sole administration of EEN heightens the risk of feeding intolerance symptoms like abdominal pain and bloating, resulting in discontinuation of nutritional support, counterproductive to postoperative recovery. SEEN, by tailoring enteral nutrition preparations to patients' evolving gastrointestinal function recovery post-surgery, minimizes intolerance incidence, thereby fostering not only recovery of gastrointestinal function and nutritional status but also enhancing inflammation and immunity [10]. By furnishing adequate nutrients, SEEN ensures the immune system receives sufficient energy support, facilitating mucosal barrier repair damaged during anesthesia and surgery. This prompts intestinal mucosa repair and regeneration, reinstates immune system function, and ultimately reduces postoperative complication incidence.

In conclusion, SEEN implementation post-gastric cancer surgery enhances nutritional status, inflammation, and immunity, and effectively mitigates postoperative complications.

Disclosure statement

The authors declare no conflict of interest.

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