Article

Role of Early Enteral Nutrition on Postoperative Recovery of Older Patients Undergoing Intestinal Obstruction Surgery

Ann. Ital. Chir., 2025 96, 7: 916–923
https://doi.org/10.62713/aic.4038

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AIM: This study aimed to explore the effect of early enteral nutrition on the postoperative recovery of elderly patients undergoing surgery for intestinal obstruction.

METHODS: A retrospective analysis was conducted on medical records of elderly patients (n = 100) who underwent surgery for intestinal obstruction between January 2021 and January 2024. Based on the nutritional support, patients were categorized into the enteral nutrition group (n = 43) and the control group (n = 57). The two groups were compared in terms of baseline characteristics, pain scores, nutritional status, recovery parameters, and postoperative complications.

RESULTS: Visual analogue score (VAS) pain scores were significantly lower at all postoperative time points in the enteral nutrition group compared to the control group ($p < 0.01$). By postoperative day 8, levels of total protein, albumin, prealbumin, and transferrin had remarkably increased in both groups ($p < 0.001$), with more pronounced improvements observed in the enteral nutrition group ($p < 0.001$). The time to first flatus, time of first defecation, time of gastrointestinal function recovery and length of hospital stay were all significantly shorter in the enteral nutrition group ($p < 0.001$). No significant differences were observed in the overall incidence of postoperative complications between the two groups ($p > 0.05$).

CONCLUSIONS: Early enteral nutrition support is associated with enhanced postoperative nutritional status, reduced pain, and accelerated recovery in elderly patients following surgery for intestinal obstruction without increasing the risk of complications.

Keywords: intestinal obstruction surgery; early enteral nutrition; postoperative recovery; pain; nutritional status

Introduction

Intestinal obstruction, one of the common gastrointestinal diseases in the older population, typically results from intestinal neoplasms, adhesions, intussusception, or paralytic intestinal obstruction [1,2]. Without prompt and effective treatment, intestinal obstruction is prone to serious complications and a high mortality rate. It commonly manifests as abdominal pain, acid regurgitation, abdominal distension, and cessation of defecation [3–6].

Traditionally, early postoperative feeding has been considered a trigger for abdominal discomfort, bloating, nausea, vomiting, and complications such as anastomotic fistulas and infections. However, emerging evidence suggests that appropriate nutritional support contributes to postoperative recovery in older patients undergoing intestinal obstruction surgery. For instance, administering enteral nutrition soon after intestinal obstruction surgery can enhance bowel function, stimulate bile and pancreatic enzyme secretion, and even shorten hospital stays [7–9]. Moreover, clinicians have recognized parenteral nutrition for its ability to enhance nutritional intake in patients with compromised gastrointestinal function postoperatively [10]. Yet, overreliance on parenteral nutrition following gastrointestinal surgeries may disrupt gut physiology, reduce mucosal activity, impair absorption and secretion, and destabilize the intestinal microbiota equilibrium [11,12].

Interestingly, early enteral nutrition does not elevate the risk of postoperative complications compared to parenteral nutrition [13]. In patients undergoing colorectal surgery, when early enteral nutrition is appropriately implemented, it should be emphasized as a key approach for supporting the recovery of gastrointestinal motility [14]. In neonates with congenital obstruction, the development and application of early enteral nutrition protocols have been associated with shorter hospital stays and improved outcomes [15]. A per-protocol analysis revealed that participants receiving enteral feeding had a significantly lower incidence of postoperative ileus [16]. However, data remain limited on the effects of early enteral nutrition on postoperative recovery in older patients after intestinal obstruction surgery.

This retrospective report analyzed older patients undergoing intestinal obstruction surgery, highlighting the beneficial effects of early enteral nutrition on their postoperative

Submitted: 11 March 2025 Revised: 27 May 2025 Accepted: 29 May 2025 Published: 10 July 2025

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recovery. These findings may provide valuable guidance for optimizing nutritional management in older individuals facing intestinal obstruction.

Methods

Research Design

A retrospective analysis was conducted to assess the impact of postoperative early enteral nutrition on older individuals undergoing intestinal obstruction surgery. The study received approval from the Ethical Committee of The Affiliated Jiangning Hospital of Nanjing Medical University (Approval No.2024-03-098-K01). Informed consent was obtained from all patients, and the study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Research Objects

Between January 2021 and January 2024, a total of 100 older patients who underwent surgery for intestinal obstruction were identified, and their medical records were retrospectively reviewed. Based on the postoperative nutritional strategy, patients undergoing intestinal obstruction surgery were categorized into two groups: the enteral nutrition group (n = 43) and the control group (n = 57). Patients in the enteral nutrition group received early enteral nutrition, while those in the control group were managed with parenteral nutrition.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) patients diagnosed with intestinal obstruction; (2) patients who underwent intestinal obstruction surgery; (3) patients aged over 60 years; (4) patients with complete clinical data; (5) patients with stable vital signs within 24–48 hours postoperatively.

Exclusion criteria: (1) patients with abnormal cardiac, hepatic, renal, or other major organ dysfunction; (2) patients with coagulation disorders or severe immunodeficiency; (3) patients with long-term preoperative dependence on parenteral nutrition or presence of short bowel syndrome; (4) patients with contraindications to postoperative enteral nutrition; (5) patients with other malignant tumors.

Description of Nutrition Support

Control Group

Based on patients' medical records, those in the control group received parenteral nutritional support. Uniform administration of glucose, amino acids, and trace elements began 20 hours after intestinal obstruction surgery. The daily energy provision was maintained at 125.97 kJ/kg, and nitrogen intake was controlled at 0.32 g/kg. Upon restoration of intestinal function, patients gradually transitioned from liquid and semi-liquid diets to a normal oral diet.

Enteral Nutrition Group

According to patients' medical records, warmed saline was administered 20 hours after intestinal obstruction surgery, followed by a short-peptide enteral nutrition formula (37–40 °C, Peptamen, Vevey, Switzerland). Initial infusion was delivered continuously at a rate of 20 mL/h starting 24 hours postoperatively. The concentration was gradually increased from 0.5 kcal/mL to 1.0 kcal/mL. At 48 hours after surgery, the infusion rate was incrementally increased by 10–20 mL/h every 24 hours based on patient tolerance. The target caloric intake was set at 25–30 kcal/kg/d, with priority given to protein supplementation ($\geq$1.2 g/kg/day). Once older patients voluntarily resumed oral intake of liquid meals, the feeding tube was gently withdrawn.

Collection and Analysis of Clinical Data

Clinical Characteristics

Based on medical records, baseline clinical characteristics included age, sex, body mass index (BMI), presence of diabetes, hypertension, cardiovascular disease, pulmonary disease, smoking status, drinking status, duration of obstruction, obstruction site, cause of obstruction, preoperative albumin and hemoglobin levels, operation time, and obstruction remission rate.

Pain Evaluation

Pain was assessed at specified time points (before treatment and at 6, 12, 24, and 48 hours post-treatment) using the visual analogue scale (VAS), as documented in the medical records of the patients.

Nutritional Status

Nutritional status was evaluated on postoperative days 1 and 8 using total protein, albumin, prealbumin, and transferrin levels, according to medical record data.

Recovery Parameters

Recovery was examined by measuring the time to first flatus, time to first defecation, and gastrointestinal function recovery time, defined as the time at which patients could tolerate a normal diet (consuming more than 90% of the planned dietary intake without nausea or vomiting). The length of hospital stay was also recorded.

Postoperative Complications

Postoperative complications, as documented in the patient's medical records, included incisional wound infection, respiratory tract infection, diarrhea, adhesive ileus, vomiting, cholestasis, acid regurgitation, abdominal distention, and constipation.

Statistical Analysis

Statistical analyses were performed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). All figures were generated with GraphPad Prism 8.0 software (GraphPad Soft-

Table 1. Baseline clinical characteristics of the study population.

Indicator		Enteral nutrition group (n = 43)	Control group (n = 57)	χ^2/Z/t	p-value
Age (year)		68.00 (64.50, 77.00)	73.00 (66.00, 78.00)	3.029	0.082
	≥65	29	47		
	<65	14	10		
Sex (n)	Male	27	32	0.448	0.503
	Female	16	25		
BMI (kg/m^2)		22.13 (19.76, 25.19)	21.67 (19.03, 24.68)	0.400	0.527
	≥25	13	14		
	<25	30	43		
Diabetes (n)	Yes	8	15	0.823	0.364
	No	35	42		
Hypertension (n)	Yes	9	16	0.666	0.414
	No	34	41		
Cardiovascular disease (n)	Yes	7	13	0.653	0.419
	No	36	44		
Pulmonary disease (n)	Yes	17	26	0.370	0.543
	No	26	31		
Smoking status (n)	Yes	21	31	0.302	0.582
	No	22	26		
Drinking status (n)	Yes	4	3	0.150	0.698
	No	39	54		
Duration of obstruction (days)		8.00 (7.00, 10.50)	8.00 (6.00, 11.00)	–0.631	0.540
Obstruction site (n)	High intestinal obstruction	5	12	1.543	0.214
	Low intestinal obstruction	38	45		
Cause of obstruction (n)	Neoplastic	29	35	0.388	0.533
	Non-neoplastic	14	22		
Preoperative albumin (g/L)		36.27 ± 4.87	35.27 ± 4.84	1.016	0.312
Preoperative hemoglobin (g/L)		124.33 ± 24.33	127.64 ± 24.53	–0.671	0.504
Duration of surgery (minutes)		139.02 ± 43.03	133.75 ± 43.36	0.603	0.548
Obstruction remission rate [n (%)]		40 (93.02)	54 (94.74)	<0.001	>0.999

Abbreviation: BMI, body mass index.

ware Inc., Boston, MA, USA). The Kolmogorov-Smirnov test was employed to assess the normality of data distribution. Continuous variables following a normal distribution were expressed as mean ± standard deviation. The chi-square (χ^2) test was applied to compare categorical variables (n). An independent sample *t*-test was employed to compare the differences between the two groups. A paired sample *t*-test was used to evaluate changes between two time points within the same group. Variables not conforming to a normal distribution were presented as median and interquartile range [M (P_{25}–P_{75})], and comparisons between groups were made using the Mann-Whitney *U* test. Comparisons across multiple time points were performed using repeated measures analysis of variance (ANOVA). A two-tailed $p < 0.05$ was considered statistically significant.

Table 2. Repeated-measures analysis of variance (ANOVA) for VAS scores over time.

Source	F-value	p-value
Time	350.197	0.000
Group	79.306	0.000
Time × Group Interaction	7.183	0.009

VAS, visual analogue score.

Results

Clinical Characteristics

A total of 43 older patients received early enteral nutrition, while 57 older patients were administered parenteral nutrition (Table 1). No significant differences in baseline clinical characteristics were observed between the enteral nutrition group and the control group (Table 1, $p > 0.05$).

Table 3. Comparison of postoperative complications between the two groups.

Postoperative complications (n)	Enteral nutrition group (n = 43)	Control group (n = 57)	Phi	χ^2	p-value
Incisional wound infection	1	2	–0.034		
Respiratory tract infection	1	1	0.020		
Diarrhea	3	4	–0.001		
Adhesive ileus	0	1	–0.087		
Vomiting	2	2	0.029		
Cholestasis	0	1	–0.087		
Acid regurgitation	1	1	0.020		
Abdominal distention	1	2	–0.034		
Constipation	2	1	0.084		
Total incidence	11	15	–0.008	0.007	0.934

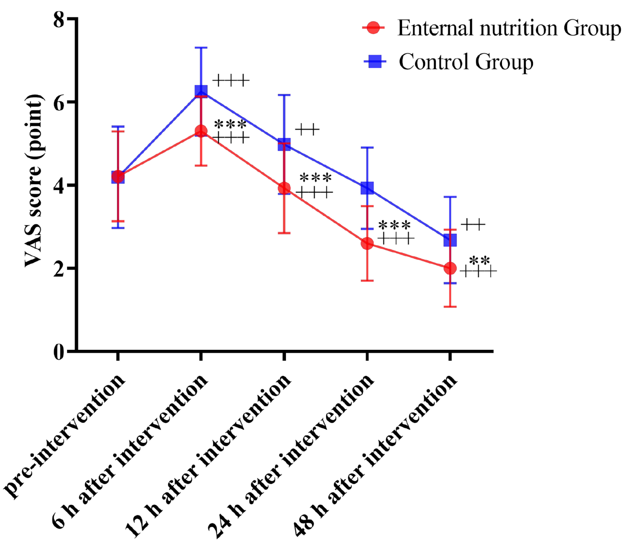

Fig. 1. Comparison of VAS scores between the two groups. $^{**}p < 0.01$, $^{***}p < 0.001$ vs. Control group; $^{++}p < 0.01$, $^{+++}p < 0.001$ vs. pre-intervention group. Abbreviation: VAS, visual analogue score.

Pain Evaluation

Pain was evaluated using the VAS score. Before treatment, no significant difference was observed in the VAS score between the enteral nutrition group and the control group (Fig. 1, Table 2, $p > 0.05$). At 6 hours after treatment, both groups exhibited an increase in VAS scores (Fig. 1, Table 2). Subsequently, VAS scores gradually declined in both groups at 12, 24, and 48 hours after treatment (Fig. 1, Table 2). At all post-treatment time points (6, 12, 24, and 48 hours), the VAS scores were significantly lower in the enteral nutrition group than in the control group (Fig. 1, Table 2, $p < 0.01$). The results of repeated measures ANOVA showed that the VAS score of the two groups was statistically significant in terms of time (F = 350.197, $p < 0.001$), group (F = 79.306, $p < 0.001$), and time $\times$ group interaction (F = 7.183, $p = 0.009$) (Table 2).

Nutritional Status

Nutritional status was evaluated at two time points (postoperative day 1 and day 8). The assessed indicators included total protein, albumin, prealbumin, and transferrin. On postoperative day 1, no significant differences were observed in these indicators between the enteral nutrition group and the control group (Fig. 2, $p > 0.05$). In both groups, the levels of these nutritional indicators were significantly elevated by postoperative day 8 compared to day 1 (Fig. 2, $p < 0.001$). Moreover, the increases were more remarkable in the enteral nutrition group than in the control group (Fig. 2, $p < 0.001$).

Recovery Situation

As shown in Fig. 3, the first flatus time, time of first defecation, gastrointestinal function recovery time, and length of hospital stay were significantly shorter in the enteral nutrition group than in the control group ($p < 0.001$).

Postoperative Complications

The postoperative complications included incisional wound infection, respiratory tract infection, diarrhea, adhesive ileus, vomiting, cholestasis, acid regurgitation, abdominal distention, and constipation (Fig. 4, Table 3). The overall incidence rate of complications showed no significant difference between the enteral nutrition group and the control group ($p > 0.05$, Fig. 5, Table 3).

Discussion

This study examined the effect of early enteral nutrition on postoperative recovery in older patients undergoing intestinal obstruction surgery. Our findings demonstrated that early enteral nutrition support can improve the nutritional status of older patients undergoing intestinal obstruction surgery and accelerate postoperative recovery, offering preliminary evidence of its beneficial impact on intestinal function restoration.

Currently, postoperative pain is commonly evaluated using the VAS score in clinical practice [17,18], where a higher VAS score indicates severe pain [19]. Previous studies have shown that early feeding may alleviate pain, as evidenced

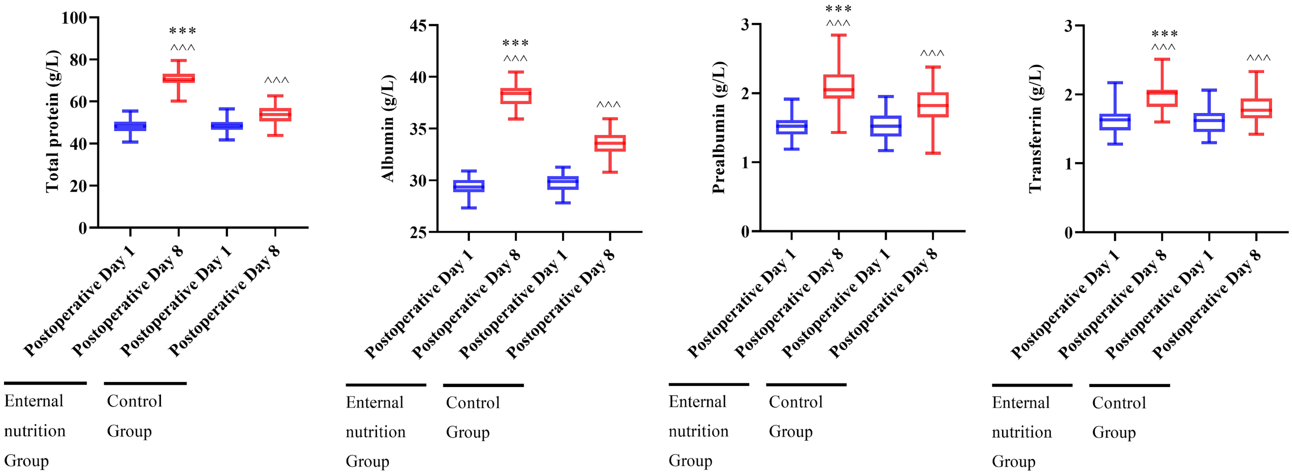

Fig. 2. Comparison of nutritional status between the two groups. $^{***}p < 0.001$ vs. Control group; $^{\wedge\wedge\wedge}p < 0.001$ vs. Postoperative day 1.

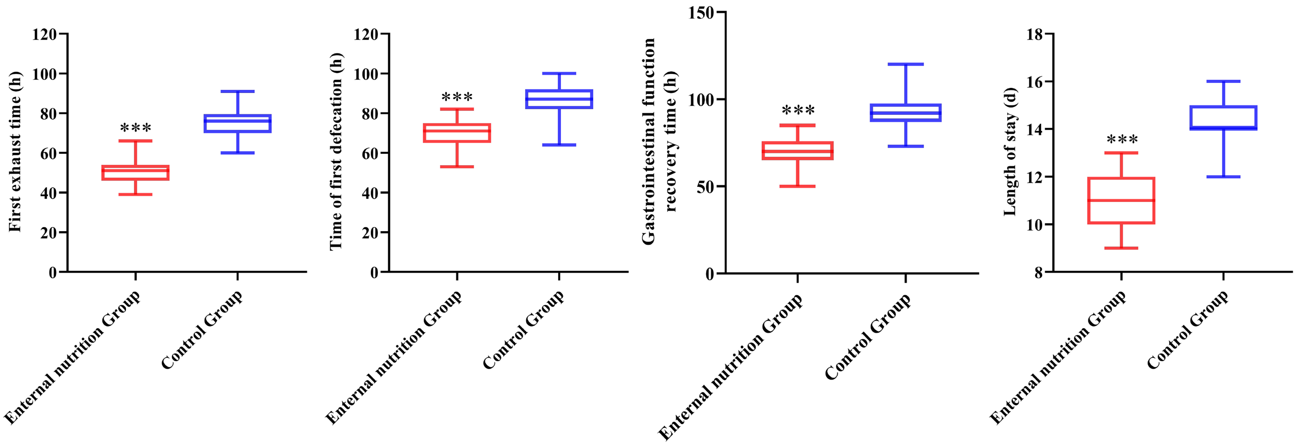

Fig. 3. Comparison of recovery parameters between the two groups. $^{***}p < 0.001$ vs. Control group.

by significant reductions in VAS scores [20]. In this study, postoperative pain in both groups was evaluated at multiple time points. Our results showed that VAS scores in both groups initially increased 6 hours after treatment and then gradually declined at 12, 24, and 48 hours. Notably, at all these time points, VAS scores were lower in the enteral nutrition group compared to the control group. These findings suggest a potential analgesic effect of early enteral nutrition in older patients following intestinal obstruction surgery. However, since the VAS score is a subjective pain assessment tool, its scores may be substantially influenced by variations in analgesic administration. Thus, the observed differences in VAS scores may not solely result from early enteral nutrition but could reflect confounding effects due to inconsistent analgesic regimens. Because we could not control for this key confounding variable, we cannot conclusively determine whether the analgesic benefit is a direct physiological outcome of early enteral nutrition or an artefact of differing pain management strategies. Future studies should systematically document perioperative analgesic use and employ multivariate regression analyses to control for confounding variables. Only then can the true impact of early enteral nutrition on postoperative pain be reliably assessed.

Malnutrition significantly affects postoperative recovery in older patients undergoing intestinal obstruction surgery and increases the risk of complications [21]. Early enteral nutrition helps restore intestinal mucosal integrity, supports cell structure, and accelerates overall recovery of the body while delivering essential nutrients [22,23]. Clinically, nutritional status is commonly assessed using biomarkers such as total protein, albumin, prealbumin, and transferrin, with higher levels indicating better nutritional status [24–27]. It has been reported that enteral nutrition enhances early nutrient absorption, including protein, and reduces the incidence of complications [28]. Furthermore, patients receiving higher protein intake during the first week of sepsis show lower hospital mortality rates. Moreover, for patients who meet more than 70% of their nutritional requirements, a combination of enteral nutrition (EN) and supplemental parenteral nutrition (PN) is superior to EN or PN alone [29]. Our study showed that levels of the nutritional indicators

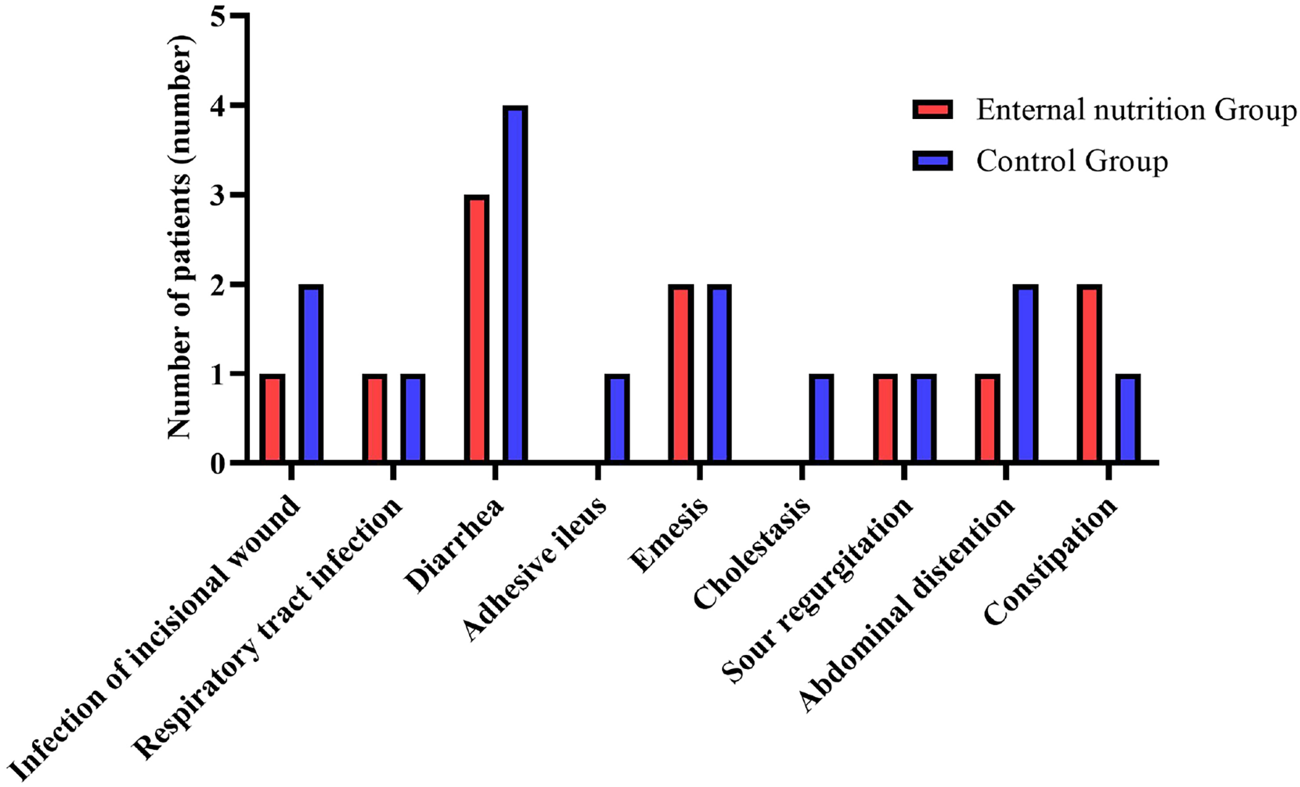

Fig. 4. Comparison of individual postoperative complications between the two groups.

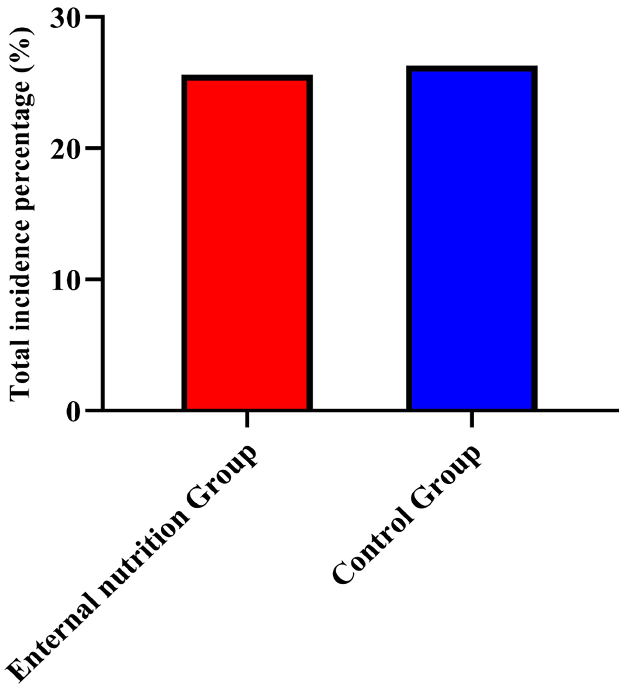

Fig. 5. Comparison of total complication incidence of postoperative complications between the two groups.

increased significantly by postoperative day 8, with more pronounced improvements in the enteral nutrition group. These findings indicate that early enteral nutrition support effectively enhances nutritional status in older patients after intestinal obstruction surgery.

The recovery situation can be evaluated using the first flatus time, time of first defecation, gastrointestinal function recovery time, and length of hospital stay, shorter durations of which are associated with better prognosis [30,31]. Previous research confirmed that, in line with Enhanced Recovery After Surgery (ERAS) principles, patients who receive enteral nutrition as early as possible postoperatively experience earlier first flatus and defecation times, thereby improving rehabilitation quality and promoting gastrointestinal functional recovery [32]. Our findings revealed that the time to first flatus, time of first defecation, time of gastrointestinal function recovery, and length of hospital stay were shorter in older patients who received early enteral nutrition support than those in the control group. These results suggest that early enteral nutrition may accelerate postoperative recovery in elderly patients by stimulating intestinal peristalsis and preserving the integrity of the intestinal mucosal barrier. Moreover, no significant differences in postoperative complications were observed between the two groups, supporting the safety of early enteral nutrition in improving clinical outcomes.

Nevertheless, it is essential to acknowledge several limitations in the present study. First, there was no sample size calculation, and the inclusion of only 100 older patients undergoing intestinal obstruction surgery may be insufficient. Second, the lack of long-term follow-up limits the ability to detect other serious adverse events. Third, the single-center, retrospective design introduces potential sources of bias (e.g., surgical type, difficulty in standardizing nutritional interventions, early postoperative activity levels, and quality of family care), which may limit the generalizability of the findings. Therefore, future studies should consider the following steps: (1) include more stratified variables, document reasons for patient exclusion, and analyze their potential impact; (2) develop detailed Standard Operating Procedures (SOP), record actual caloric intake and reasons for adjustments, and conduct sensitivity analyses; (3) collect data on potential confounding factors (such as time to postoperative ambulation and family caregiver compliance) and adjust for them in statistical analyses. To strengthen the evidence, future investigations should involve larger sample sizes and prospective study design.

Conclusions

In summary, this study demonstrates a significant association between early enteral nutrition, improved postoperative nutritional status, and accelerated recovery in elderly patients undergoing intestinal obstruction surgery. Given the favorable impact of early enteral nutrition on patient prognosis after intestinal obstruction surgery, it should be considered a valuable adjunctive strategy to accelerate postoperative recovery. However, to determine the specific role of early enteral nutrition in rehabilitation, more rigorous prospective studies are needed to control for confounding variables and verify their causal relationship.

Availability of Data and Materials

The analyzed data sets generated during the study are available from the corresponding author on reasonable request.

Author Contributions

JJN, JL and CC designed the research study. JJN and JL performed the research. CC provided help and advice on the study. CC analyzed the data. JJN drafted the manuscript. All authors contributed to important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study received approval from the Ethical Committee of The Affiliated Jiangning Hospital of Nanjing Medical University (Approval No.2024-03-098-K01). Informed consent was obtained from all patients, and the study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

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