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ORIGINAL RESEARCH

Impact of Intravenous Fish Oil Lipid Emulsion on Short-Term Postoperative Outcomes in Rectal Cancer Patients Following Neoadjuvant Therapy: A Propensity Score-Matched Study

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Purpose: Previous studies lack a consensus on the role of fish oil lipid emulsion in postoperative complications and recovery in rectal cancer patients post-neoadjuvant therapy. This study aimed to evaluate the impact of intravenous fish oil lipid emulsion on short-term clinical outcomes in these patients.

Patients and Methods: This retrospective study included patients who underwent radical surgery for RC after NT between November 2018 and April 2022. Patients were divided into two groups: the fish oil group (receiving fish oil treatment) and the control group (not receiving fish oil treatment). Propensity Score Matching was used to analyze and compare postoperative complications and other relevant clinical indicators between the two groups. A total of 208 patients were included, with 33 patients in each group after PSM.

Results: The results showed no significant differences between the two groups in terms of time to first flatus, time to first defecation, or time to first liquid diet intake ($p > 0.05$). However, compared to the control group, the fish oil group had significantly lower rates of postoperative complications, shorter hospital stays, and earlier tolerance to solid food ($p < 0.05$). Additionally, the fish oil group effectively suppressed the decline in postoperative albumin levels ($p < 0.05$).

Conclusion: These findings suggest that perioperative intravenous supplementation of fish oil may effectively reduce postoperative complications, accelerate recovery, and improve postoperative nutritional status in rectal cancer patients post-neoadjuvant therapy.

Keywords: postoperative complications, nutritional status, gastrointestinal recovery, propensity score matching, omega-3 polyunsaturated fatty acids, colorectal cancer

Introduction

Colorectal cancer (CRC) is the third most common cancer globally and a leading cause of cancer-related mortality.[1,2] In recent decades, the incidence of CRC has increased among individuals under 50 years of age, indicating a trend towards earlier onset.[3] The primary treatment modalities for CRC include surgery, chemotherapy, and radiotherapy. Among these, the adoption of standardized surgical techniques, such as total mesorectal excision (TME), has significantly improved outcomes for rectal cancer patients.[4] However, due to the lack of obvious symptoms in early-stage CRC, most patients are diagnosed at locally advanced stages, limiting the efficacy of surgery alone. Preoperative chemoradiotherapy has been shown to reduce tumor staging and local recurrence rates while improving radical resection rates.[5,6] Consequently, neoadjuvant chemoradiotherapy combined with TME has become the standard treatment for locally advanced rectal cancer.[7] Despite its benefits in reducing recurrence risk,[8] neoadjuvant therapy may damage local intestinal wall tissue and increase postoperative complications.[9,10] Recent studies suggest that neoadjuvant chemoradiotherapy is associated with higher rates of pelvic abscess, anastomotic leakage, and wound infections,[11] which not only increase the economic burden but may also adversely affect prognosis.[12] Therefore, reducing postoperative complications in rectal cancer patients undergoing neoadjuvant therapy has become a critical research focus.

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Fish oil, rich in long-chain omega-3 polyunsaturated fatty acids (PUFAs) such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), is known for its anti-inflammatory and health-promoting properties.[13] Studies have highlighted its potential in preventing chronic diseases, including cardiovascular diseases and cancer.[14] Specifically, short-term omega-3 PUFA supplementation has been shown to reduce postoperative infectious complications, mitigate inflammatory responses, and shorten hospital stays in CRC patients.[15] However, there is limited clinical evidence on the effects of fish oil in high-risk populations, particularly those undergoing neoadjuvant therapy. To address this gap, this study used propensity score matching (PSM) to balance baseline characteristics between groups, evaluating the impact of perioperative intravenous fish oil supplementation on postoperative complications and intestinal function recovery in rectal cancer patients receiving neoadjuvant therapy.

Materials and Methods

Patients

This retrospective cohort study was approved by the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (Approval No.: 2025–094-01). The study was exempt from informed consent. We included patients who underwent neoadjuvant chemoradiotherapy followed by radical resection for rectal cancer between November 2018 and April 2022. The fish oil group received intravenous injections of fish oil lipid emulsion (100 mL/day, containing 10 g of fish oil per 100 mL) continuously for ≥ 5 days starting from the first day after surgery, while the non-fish oil group did not receive any fish oil during hospitalization. Exclusion criteria were: (1) additional intravenous fish oil supplementation; (2) fish oil treatment for <5 days; (3) other primary malignancies; (4) liver or kidney failure; and (5) prior treatment for abdominal/pelvic malignancies, multiple organ resections, or emergency surgeries.

This study collected the following data through the hospital's electronic medical record system: (1) Demographic data: gender, age, body mass index (BMI), neoadjuvant treatment status, tumor location, and MRI staging; (2) Comorbidities: chronic pulmonary disease, hypertension, diabetes, cardiac disease, and other underlying conditions, as well as the American Society of Anesthesiologists (ASA) classification; (3) Nutritional status indicators: preoperative total protein and albumin levels; (4) Surgical-related data: surgical approach (open or laparoscopic), whether a diversion stoma was created, duration of surgery, intraoperative blood loss, amount of intraoperative transfusion, and postoperative ICU admission; (5) Postoperative outcome indicators: primarily focused on the incidence of postoperative complications, length of postoperative hospitalization, mortality rate, and recovery of intestinal function; (6) Laboratory indicators: preoperative samples collected one day before surgery for total protein, albumin, white blood cell count, percentage of neutrophils, lymphocyte, and monocyte counts; postoperative monitoring of albumin, white blood cell count, percentage of neutrophils, and monocyte count on postoperative days 1 and 3.

Preoperatively, patients received oral antibiotics (1 g streptomycin and 400 mg metronidazole at 12:00, 16:00, and 20:00). Intravenous ceftriaxone or cefoxitin was administered 30 minutes before surgery, with additional doses every 3 hours intraoperatively, and continued for 24 hours postoperatively.

The neoadjuvant treatment regimens include: (1) Solely chemotherapy: administering FOLFOX (fluorouracil + oxaliplatin), XELOX (capecitabine + oxaliplatin), or FOLFOXIRI (fluorouracil + oxaliplatin + irinotecan), completing 2 to 8 cycles preoperatively and performing surgery 1 to 2 weeks after chemotherapy; (2) Short-course radiotherapy: surgery is performed within 10 days after radiotherapy (5×5 Gy); (3) Long-course concurrent chemoradiotherapy: radiotherapy is delivered in 25 fractions (25×2 Gy), with concurrent oral capecitabine (825 mg/m², bid), and surgery is performed 6 to 8 weeks after the treatment, during which 1 to 3 cycles of XELOX chemotherapy may be selectively administered. Surgical timing and planning were determined by a multidisciplinary team (MDT) based on clinical presentation, endoscopic findings, and imaging results.

Endpoint

The primary endpoints of this study included: (1) the incidence of complications within 30 days postoperatively, focusing on surgery-related complications such as anastomotic leakage, intra-abdominal infection, surgical site infection, pneumonia, and urinary tract infection; (2) changes in postoperative infection markers (eg, white blood cell count, monocyte

count). The secondary endpoints encompassed: (1) intestinal function recovery indicators, including time to first flatus, time to first defecation, time to resume liquid diet, and time to resume solid diet; (2) nutritional status indicators, primarily observing changes in serum albumin levels; (3) clinical outcome indicators, including overall postoperative complication rate, postoperative hospital stay, and 30-day mortality rate.

Statistical Analyses

Participants were divided into omega-3 and non-omega-3 groups based on postoperative intravenous omega-3 lipid emulsion administration. Categorical variables were compared using Chi-square tests, and continuous variables were analyzed with Mann–Whitney *U*-tests. To address potential confounding biases, propensity score matching (PSM) was applied to demographic characteristics (gender, age, BMI, neoadjuvant therapy type, tumor location, and MRI staging), comorbidities (chronic obstructive pulmonary disease, hypertension, diabetes, cardiac diseases, and ASA classification), nutritional status (preoperative total protein and albumin), and inflammatory markers (preoperative white blood cell count, neutrophil percentage, lymphocyte count, and monocyte count). Surgical-related factors (surgical approach, protective stoma, surgery duration, intraoperative blood loss, and transfusion) were also compared. Nearest Neighbor Matching was used with a 1:1 ratio and a caliper of 0.02. Multivariate logistic regression identified independent risk factors for postoperative infectious complications. All analyses were performed using IBM SPSS Statistics 27.0, with significance set at $P<0.05$.

Results

Patients' Characteristics

According to the inclusion criteria, 68 patients were enrolled in the omega-3 group and 140 in the non-glutamine group (Table 1). Among them, 89 received neoadjuvant chemotherapy, 117 received neoadjuvant chemoradiotherapy, and 2 received neoadjuvant radiotherapy. Protective stomas were performed in 63.9% of cases. Before matching, stoma creation was significantly more frequent in the omega-3 group than in the non-glutamine group ($P = 0.005$). Additionally, significant differences were observed in baseline indicators, including ASA classifications ($P = 0.001$), MRI staging ($P = 0.005$), preoperative total protein ($P < 0.001$), albumin ($P < 0.001$), neutrophil percentage ($P < 0.001$), lymphocyte count ($P < 0.001$), and monocyte count ($P = 0.014$), as well as in the types of neoadjuvant therapies received ($P < 0.001$).

Table 1 Baseline Characteristics Before Propensity Score Matching

	Group Non-Fish Oil (n=140)	Group Fish Oil (n=68)	P value
Age[a]	56.5 (50–65)	56.5 (50.25–67)	0.705
Gender (%)			0.727
Male	90 (64.3)	42 (61.8)	
Female	50 (35.7)	26 (38.2)	
BMI [a]	22.82 (20.88–26.05)	23.39 (21.36–24.79)	0.838
Distance between tumor and AV (cm)[a]	6 (3.15–8)	6 (4–8)	0.173
Neoadjuvant therapy received (%)			<0.001
Neoadjuvant chemotherapy	47 (33.6)	42 (61.8)	
Neoadjuvant chemotherapy+radiotherapy	91 (65.0)	26 (38.2)	
Neoadjuvant radiotherapy	2 (1.4)	0 (0)	
MRI Stage (%)			0.005
1	7(5.0)	7(10.3)	
2	31(22.1)	21(30.9)	
3	83(59.3)	38(55.9)	
4	19(13.6)	2(2.9)	
Diabetes Mellitus (%)	17(11.4)	4(5.9)	0.119
Hypertension (%)	23 (16.4)	8 (11.8)	0.356

(*Continued*)

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Table 1 (Continued).

	Group Non-Fish Oil (n=140)	Group Fish Oil (n=68)	P value
COPD (%)	14(10.0)	4(5.9)	0.285
Coronary artery disease (%)	6 (4.3)	1 (1.5)	0.215
Hypohepatia(%)	4 (2.9)	4 (5.9)	0.347
Duration of surgery (min)[a]	232.5 (193.75–306.25)	255 (196.25–310)	0.081
Transfusion (%)	1 (0.7%)	3 (4.4)	0.345
Intraoperative blood loss (mL)[a]	55 (30–112.5)	100 (50–100)	0.365
ASA Grade (%)			0.001
I	12 (8.67)	21 (30.88)	
II	82(58.57)	32(47.06)	
III	46(32.86)	15(22.06)	
Type of operation (%)			0.429
Dixon	107(76.43)	55(80.88)	
Hartmann	3(2.14)	0(0)	
Miles	30(21.43)	13(19.12)	
Treatment modality (%)			0.273
Robotic/ Laparoscopy	138(98.6)	65(95.6)	
Conventional open	2(1.4)	3(4.4)	
Stoma (%)	99(70.71)	34(50)	0.005
Conversion (%)	0(0)	2(2.94)	0.159
Length of stay in ICU(days)[a]	0 (0–0)	0 (0–0)	0.444
Preoperative length of stay[a]	5 (4–7)	5 (4.25–7)	0.806
Preoperative total protein (g/L)[a]	65 (42–71)	41 (36–62)	<0.001
Preoperative albumin (g/L)[a]	44 (40–59)	59.5 (44.75–64.75)	<0.001
Preoperative leukocyte count ($x10^9$/L)[a]	4.21 (3.42–5.21)	4.08 (3.52–5.06)	0.282
Preoperative neutrophil(%)[a]	65.35 (56.18–71.3)	57.6 (47–66.6)	<0.001
Preoperative lymphocyte(%)[a] count($x10^9$/L)[a]	0.81 (0.58–1.28)	1.2 (0.69–1.72)	<0.001
Preoperation monocyte count($x10^9$)[a]	0.39 (0.30–0.52)	0.49 (0.36–0.59)	0.014

Notes: Values in parentheses are percentages, unless indicated otherwise; [a] values are median (interquartile range: 25–75th percentile).
Abbreviations: ASA, American Society of Anesthesiologists physical status classification; BMI, body mass index.

Propensity Score Matching Analysis

After propensity score matching, covariates were well-balanced between the two groups (Table 2). The omega-3 group had a significantly lower incidence of overall postoperative complication compared to the non-omega-3 group (1% vs 9%, P = 0.006) (Table 3). Additionally, the omega-3 group showed a significantly lower monocyte count on postoperative day 1 (P = 0.04). No significant differences were observed in pneumonia (P = 0.083), urinary tract infections (P = 0.325), intra-abdominal infections (P = 0.16), incisional dehiscence (P = 0.325), incisional infections (P = 0.16), anastomotic leaks (P = 0.325), or ICU admission rates (P = 0.562). Neither group experienced anastomotic strictures, anastomotic bleeding, postoperative bowel obstruction, unplanned reoperations, or mortality. Gastrointestinal function recovery was faster in the omega-3 group, with a significantly shorter time to first tolerance of solid food (P = 0.045). However, no significant differences were observed in time to first flatus (P = 0.132), time to first liquid diet (P = 0.063), or time to first bowel movement (P = 0.535). The incidence of abdominal distension (P = 0.325) and diarrhea (P = 0.325) also did not differ significantly. Notably, the omega-3 group had a significantly shorter hospital stay than the control group (P = 0.032) (Table 3). Both groups exhibited a postoperative decrease in serum albumin levels. However, the omega-3 group showed a significantly smaller reduction on postoperative day 1 (P = 0.01) and day 3 (P = 0.002) compared to the non-omega-3 group (Table 3).

Multivariate regression analysis showed that after propensity score matching, the risk of postoperative complications for patients receiving intravenous fish oil fat emulsion is 0.065 times that of the non-injection group. (odds ratio: 0.065, 95% CI: 0.006–0.722, p=0.026) (Table 4).

Table 2 Baseline Characteristics After Propensity Score Matching

	Group Non-Fish Oil (n=33)	Group Fish Oil (n=33)	P value
Age[a]	56 (50.5–66)	56 (48–66)	0.418
Gender (%)			0.621
Male	19 (57.6)	21 (63.6)	
Female	14 (42.4)	12 (36.4)	
BMI[a]	22.83 (20.88–26.05)	23.39 (21.36–24.79)	0.995
Distance between tumor and AV (cm)a	5.7 (2.5–9)	5 (4–7.75)	0.557
Neoadjuvant therapy (%)			0.216
Neoadjuvant chemotherapy	12 (36.4)	18 (54.5)	
Neoadjuvant chemotherapy+radiotherapy	21 (63.6)	15 (45.5))	
Neoadjuvant radiotherapy	0 (0)	0 (0)	
MRI Stage (%)			0.511
1	3 (9.1)	2 (6.1)	
2	12 (36.4)	9 (27.3)	
3	15 (45.5)	20 (60.6)	
4	3 (9.1)	2 (6.1)	
Diabetes Mellitus (%)	2 (6.1)	2 (6.1)	1
Hypertension (%)	2 (6.1))	5 (15.2)	0.238
COPD (%)	2 (6.1)	4 (12.1)	0.4
Coronary artery disease (%)	0 (0)	1 (3)	0.325
Hypohepatia (%)	1 (3)	1 (3)	1
Duration of surgery (min)[a]	230 (190–317.5)	250 (201.5–292.5)	0.882
Intraoperative blood loss (mL)[a]	50 (40–100)	100 (50–100)	0.641
Transfusion (%)	0 (0)	0 (0)	-
ASA Grade (%)			0.858
I	6 (18.2)	6 (18.2)	
II	18 (54.5)	17 (51.5)	
III	9 (27.3)	10 (30.3)	
Type of operation (%)			0.573
Dixon	23 (69.7)	26 (78.8)	
Hartmann	0 (0)	0 (0)	
Miles	10 (30.3)	7 (21.2)	
Treatment modality (%)			0.325
Robotic/ Laparoscopy	33 (100)	32 (97)	
Conventional open	0 (0)	1 (3)	
Stoma (%)	22 (66.7)	20 (60.6)	0.615
Conversion (%)	0	0	-
Length of stay in ICU(days)[a]	0 (0–0)	0 (0–0)	-
Preoperative length of stay[a]	5 (4–7)	5 (4–8)	0.416
Preoperative total protein (g/L)[a]	46 (38.5–70)	59 (41–68.5)	0.443
Preoperative albumin (g/L)[a]	56 (41–63.5)	48 (40–64)	0.374
Preoperative leukocyte count(x109/L)a	3.77 (3.04–4.98)	3.96 (3.63–5.21)	0.293
Preoperative neutrophil (%)[a]	64.2 (53.3–68.6)	60.2 (48.4–67.1)	0.453
Preoperative lymphocyte(x10^9)[a] count(x109/L)a	1.04 (0.66–1.42)	1.15 (0.63–1.68)	0.265
Preoperation monocyte count ccountcountcount(x109/L)a	0.43 (0.3–0.53)	0.43 (0.33–0.55)	0.721

Notes: Values in parentheses are percentages, unless indicated otherwise; [a] values are median (interquartile range: 25–75th percentile).
Abbreviations: ASA, American Society of Anesthesiologists physical status classification; BMI, body mass index.

Discussion

To our knowledge, this study is the first to investigate the effects of perioperative omega-3 fatty emulsion on post-operative complications and recovery in rectal cancer patients receiving neoadjuvant therapy. The results indicate that while perioperative intravenous supplementation of omega-3 fatty emulsion did not significantly reduce perioperative

Table 3 Operative Outcomes and Postoperative Complication After Propensity Score Matching

	Group Non-Fish Oil (n=33)	Group Fish Oil (n=33)	P value
Days to first flatus[a]	2 (1.5–3)	2 (1–2)	0.132
Days to first defecation[a]	3 (2–4)	2 (2–3)	0.535
Days to first fluid diet[a]	2 (1.5–3)	2 (1–3)	0.064
Days to first solid diet[a]	6 (4–7.5)	4 (4–5.5)	0.045
Abdominal distension (%)	1 (3)	0 (0)	0.325
Diarrhea (%)	1 (3)	0 (0)	0.325
Reoperation (%)	0 (0)	0 (0)	-
Ileus (%)	0 (0)	0 (0)	-
Anastomotic leakage (%)	1 (3)	0 (0)	0.325
Bleeding at anastomotic site (%)	0 (0)	0 (0)	-
Anastomotic stricture (%)	0 (0)	0 (0)	-
Wound infection (%)	2 (6.1)	0	0.16
Urinary infection (%)	1 (3)	0	0.325
Pneumonia (%)	3 (9.1)	0	0.083
Intra-abdominal infection (%)	2 (6.1)	0 (0)	0.16
Disruption of wound (%)	0 (0)	1 (3)	0.325
Others (%)	0 (0)	0 (0)	-
Overall postoperative complications (%)	9 (27.3)	1 (3)	0.006
Mortality (%)	0 (0)	0 (0)	-
Intensive care (%)	2 (6.1)	1 (3)	0.562
Hospital stay (days) [a]	9 (7–11.5)	7 (5.5–9)	0.032
Albumin on POD1(g/L) [a]	45 (35.5–53.5)	58 (35–64)	0.01
Albumin on POD3(g/L) [a]	32 (31–35)	36 (33–38)	0.002
Leukocyte count on POD1($x10^9$/L) [a]	8.38 (6.34–10.74)	9.24 (6.80–11.82)	0.332
Leukocyte count on POD3($x10^9$/L) [a]	7.93 (7.07–9.89)	6.36 (4.88–8.71)	0.122
Neutrophils on POD1(%) [a]	86.1 (81.7–88.9)	84.8 (77.85–89.8)	0.467
Neutrophils on POD3(%) [a]	79.2 (72.9–86.35)	80.6 (72.8–84.05)	0.945
Monocyte count on POD1($x10^9$/L)[a]	0.61 (0.46–0.88)	0.51 (0.4–0.69)	0.041
Monocyte count on POD3($x10^9$/L)[a]	0.5 (0.27–0.61)	0.44 (0.38–0.60)	0.954

Notes: Values in parentheses are percentages, unless indicated otherwise; [a] values are median (interquartile range: 25–75th percentile).
Abbreviations: POD1, means postoperative day 1; POD3, postoperative day 3.

Table 4 Multivariate Logistic Regression Analysis of Risk Factors for Postoperative Complications

Factor	OR	95% CI	P value
Intravenous fish oil	0.065	0.006–0.722	0.026
Surgery time	1.003	0.994–1.013	0.459
Radiotherapy	0.991	0.165–5.958	0.992
Stage>2	1.137	0.168–7.717	0.895
ASA>2	1.347	0.217–8.683	0.735
Stoma	0.743	0.096–5.771	0.777
Preoperative total protein (g/L)	0.970	0.886–1.062	0.531
Preoperative albumin (g/L)	0.952	0.854–1.062	0.380
Distance between tumor and AV (cm)	0.783	0.551–1.112	0.172

mortality and reoperation rates in rectal cancer patients undergoing neoadjuvant chemoradiotherapy, it effectively reduces the incidence of overall postoperative complication and shortens the time to tolerate solid food and length of hospital stay. Furthermore, omega-3 fatty emulsion also effectively alleviated the decrease in postoperative albumin levels and the

increase in postoperative inflammatory markers. Given the significant negative impact of postoperative complications on the short- and long-term prognosis of cancer patients, these findings hold important clinical value.

The incidence of complications after colorectal surgery is relatively high, associated with increased mortality risk, worsened oncological outcomes, and a decline in quality of life.[16] Surgical site infections (SSIs) are among the most common complications following colorectal cancer surgery, accounting for 30–40% of all complications.[17,18] Fish oil is a vital source of essential fats, rich in omega-3 polyunsaturated fatty acids (PUFAs), which possess immunomodulatory effects and anti-inflammatory properties.[19] Dan noted that EPA and DHA in fish oil protect immune function, favorably regulate the inflammatory response postoperatively, and reduce hospital and ICU stays for surgical patients.[20] Therefore, fish oil is expected to play an important role in improving surgical outcomes for colorectal cancer patients.

Notably, rectal cancer patients undergoing neoadjuvant therapy typically experience higher rates of postoperative complications than those not receiving such treatment. Thus, the findings of this study suggest that fish oil emulsion can serve as an adjunctive measure to reduce postoperative complications and promote recovery in these patients. Anastomotic leakage is the most common and devastating complication in colorectal surgery, especially for patients who have undergone neoadjuvant therapy since they are at higher risk. Immune nutritional therapies containing arginine, n-3 ω fatty acids, or glutamine have been developed and used clinically to reduce the risk of infections and overall postoperative complications, as well as to shorten hospital stays. Several studies have reported that immune nutrition can lessen the incidence of anastomotic leakage relative to standard nutritional therapy.[21] In our study, we observed that the incidence of anastomotic leakage in the fish oil group was lower than in the control group, although this difference was not statistically significant. The lack of statistical significance may be attributed to the relatively small sample size. Many surgeons tend to perform protective stomas for patients undergoing neoadjuvant therapy to prevent anastomotic leakage; in our study, the proportion of protective stomas was as high as 63.9%, which resulted in a lower overall incidence of leakage.

Colorectal cancer patients often face nutritional risks due to increased metabolism and surgical stress,[22] and the catabolic state in malignant tumor patients leads to elevated resting energy expenditure.[23] Furthermore, radiotherapy and chemotherapy can cause oral mucosal injury and taste disorders in cancer patients, leading to reduced food intake, weight loss, and decreased albumin levels, ultimately resulting in malnutrition and even cachexia.[24] The gastrointestinal side effects of chemotherapy, such as vomiting, diarrhea, and loss of appetite, may further exacerbate malnutrition.[25,26] Malnutrition significantly impacts cancer patients' quality of life and prognosis. Omega-3 PUFAs, as a nutritional support strategy, can enhance nutritional status through various mechanisms. For instance, omega-3 PUFAs can influence rest energy expenditure by modulating the inflammatory response and help prevent muscle protein loss.[27] Studies have shown that omega-3 PUFAs also positively impact gut health and microbial composition, playing a role in digestion and absorption.[28] Albumin is an essential indicator of nutritional status, and the inflammatory response from surgical stress can interfere with its synthesis. A meta-analysis by Mocellin et al showed that omega-3 PUFAs effectively elevate serum albumin levels compared to control, although specific mechanisms need further investigation.[29]

Our findings confirm the benefits of fish oil in promoting GI function recovery post-surgery, with the fish oil group taking solid food sooner than the control group. Previous studies found that DHA and EPA in fish oil possess anti-inflammatory and pro-resolving properties, especially after metabolizing into specialized pro-resolving mediators (SPMs). Moreover, DHA and EPA may promote intestinal motility.[30] Accordingly, the incidence of postoperative abdominal distension in the fish oil group was lower than in the control group, potentially linked to fish oil's effect on intestinal motility. The faster recovery and lower complication rates may explain the shorter hospital stay in the experimental group.

Our study included rectal cancer patients receiving neoadjuvant therapy, providing preliminary data in this area. The results suggest that fish oil emulsion offers short-term benefits for patients after neoadjuvant therapy and surgery. However, there is currently a lack of long-term data on fish oil's impact on survival after such treatment, and future research should explore potential long-term benefits for cancer prognosis in this population.

This study has several limitations: first, as a retrospective study, it may be influenced by unknown confounding factors, despite our efforts to minimize baseline differences through propensity score matching (PSM). Second, we did not assess changes in plasma omega-3 PUFA concentrations before and after supplementation, preventing evaluation of

fish oil absorption and metabolism. Lastly, being a single-center study, the relatively small sample size may limit the generalizability of our results.

Conclusion

In conclusion, the results of this study suggest that postoperative supplementation with fish oil emulsion may help reduce the occurrence of overall postoperative complications, promote gastrointestinal function recovery, and improve nutritional status in rectal cancer patients undergoing neoadjuvant therapy. Therefore, fish oil emulsion may offer potential benefits for postoperative rectal cancer patients who have received neoadjuvant treatment, warranting further exploration and application in clinical practice.

Ethics Approval and Informed Consent

This study is a retrospective cohort study that received approval from the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (Approval No.: 2025-094-01). This study is a retrospective study, and the ethics committee has explicitly stated that patient consent is not required for reviewing their medical records. All patient data are processed anonymously to ensure that individual identities cannot be identified, thereby protecting patient privacy and data security. In addition, we have strictly adhered to the relevant principles of the Declaration of Helsinki to ensure that patient rights and data security are fully protected.

Author Contributions

All authors made significant contributions to the reported work, including conception, study design, execution, data acquisition, analysis, and interpretation. They participated in drafting, revising, or critically reviewing the article, gave final approval of the version to be published, agreed on the journal to which the article has been submitted, and are accountable for all aspects of the work.

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Disclosure

The authors report that there are no competing interests in this work.

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