Observational Study

Medicine

OPEN

The impact of timing of enteral nutrition initiation on the prognosis of abdominal infection in critically ill patients

Xing Fan, MM[a], Lei Chen, MM[b], Ying Zhang, MM[a], Jing Liu, MM[c], Chuangqi Zhu, MM[b], Yingchun Wang, MM[c,*]

Abstract

This single-center retrospective study investigates the effect of the timing of enteral nutrition (EN) initiation on the prognosis of critically ill patients with abdominal infection and provide evidence for clinical nutrition support strategies. A total of 76 patients with abdominal infections who were admitted to the intensive care unit (ICU) of our hospital from January 2023 to December 2024 were included. The patients were divided into 2 groups based on the timing of EN initiation: the early EN group (≤48 hours, n = 42) and the delayed EN group (>48 hours, n = 34). Data on demographic characteristics, disease severity scores, infection types, nutritional intake, EN-related complications, and clinical outcomes were collected. The differences in 28-day mortality, ICU length of stay, infection control time, and nutritional adequacy between the 2 groups were compared. A logistic regression model was used to analyze the independent effect of EN initiation timing on 28-day mortality, and subgroup analysis was performed to explore the prognostic effect of EN initiation timing in different clinical contexts. There were no statistically significant differences in the baseline characteristics between the 2 groups, making them comparable. Compared to the delayed EN group, the early EN group had a lower 28-day mortality (19.0% vs 35.3%, $P = .048$), shorter ICU length of stay (10.8 ± 4.2 vs 13.6 ± 5.1 days, $P = .011$), shorter infection control time (4.8 ± 1.5 vs 6.3 ± 2.1 days, $P = .002$), and faster C-reactive protein recovery (5.6 ± 1.9 vs 7.4 ± 2.2 days, $P = .001$), with more adequate and faster nutritional intake. Logistic regression analysis showed that delayed EN initiation was an independent risk factor for 28-day mortality (odds ratios = 2.51, 95% confidence interval: 1.09–5.82, $P = .030$). Subgroup analysis suggested that early EN provided a more significant survival benefit in patients with an APACHE II score ≥ 20 or those requiring mechanical ventilation (interaction P values of .041 and .049, respectively). For critically ill patients with abdominal infections, early initiation of EN helps improve nutritional status, accelerate infection control, and reduce 28-day mortality, especially in patients with more severe conditions or those requiring mechanical ventilation, where the prognosis is improved more significantly. The timing of EN initiation should be emphasized in critical care nutrition support.

Abbreviations: CI = confidence intervals, CRP = C-reactive protein, DEN = Delayed Enteral Nutrition, EN = enteral nutrition, EEN = Early Enteral Nutrition, IAI = intra-abdominal infection, ICU = intensive care unit, OR = odds ratios.

Keywords: abdominal infection, enteral nutrition, intensive care, mortality, nutritional support, retrospective study

1. Introduction

Intra-abdominal infection (IAI) is a common and serious condition in the intensive care unit (ICU), characterized by a complex disease course, rapid progression, and a high risk of complications such as sepsis and multiple organ failure. It remains one of the leading causes of death in critically ill patients.[1,2] Despite advancements in anti-infective therapies, mortality in critically ill patients with abdominal infections remains between 20% and 50%.[3,4] Early and comprehensive treatment, including effective nutritional support, is crucial to improving patient outcomes.[5] However, there is limited research addressing the optimal timing of enteral nutrition (EN) initiation for patients with abdominal infections, which remains a critical question in ICU management.

EN is widely recognized for its physiological benefits, such as maintaining gut barrier function, regulating immune response, and reducing bacterial translocation.[6,7] International guidelines recommend initiating EN as early as possible, typically within 24 to 48 hours of ICU admission, provided the patient's condition allows.[8,9] While the benefits of early EN have been well established in general critically ill populations, its specific impact on patients with abdominal infections remains unclear. Factors such as abdominal distension, intestinal paralysis, and postoperative recovery in these patients complicate EN initiation, often leading to delays in feeding.[10]

XF and LC contributed to this article equally.

The authors have no funding and conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

[a] Department of Critical Care Medicine, Ezhou Central Hospital, Ezhou, Hubei, China, [b] Department of Gastrointestinal Surgery, Ezhou Central Hospital, Ezhou, Hubei, China, [c] Department of Nursing, Ezhou Central Hospital, Ezhou, Hubei, China.

** Correspondence: Yingchun Wang, Department of Nursing, Ezhou Central Hospital, Ezhou 436000, Hubei, China (e-mail: jiangxl029@163.com).*

How to cite this article: Fan X, Chen L, Zhang Y, Liu J, Zhu C, Wang Y. The impact of timing of enteral nutrition initiation on the prognosis of abdominal infection in critically ill patients. Medicine 2025;104:37(e44343).

Received: 25 June 2025 / Received in final form: 29 July 2025 / Accepted: 18 August 2025

http://dx.doi.org/10.1097/MD.0000000000044343

The timing of EN initiation could significantly affect the nutritional status, infection control, and overall prognosis of critically ill patients with abdominal infections. However, there is a lack of targeted studies examining the relationship between the timing of EN initiation and clinical outcomes in this specific patient group, particularly with respect to nutritional tolerance, energy adequacy, and mortality under real-world clinical conditions.[11,12] Existing studies have mostly focused on sepsis or general ICU populations, without addressing the unique challenges posed by abdominal infections or considering the influence of nursing interventions and complications.

This study aims to address this research gap by analyzing the timing of EN initiation in patients with abdominal infections admitted to the ICU. By comparing early versus delayed EN in terms of nutritional intake, complication rates, infection control, and 28-day mortality, this study seeks to clarify the independent effects of EN timing. Furthermore, the findings aim to provide clinical evidence for personalized nutritional intervention strategies in critically ill patients with abdominal infections, while highlighting the critical role of nursing interventions in managing EN administration.

2. Materials and methods

2.1. Study design

This study was approved by the Ethics Committee of Ezhou Central Hospital (Ethical Approval No. EC-2023-001). A total of 76 critically ill patients with abdominal infections, admitted to the ICU of our hospital from January 2023 to December 2024, were selected. Based on the timing of EN initiation, patients were divided into 2 groups using 48 hours as the cutoff: Early Enteral Nutrition (EEN) Group: EN initiated within 48 hours after ICU admission, with 42 patients; Delayed Enteral Nutrition (DEN) Group: EN initiated more than 48 hours after ICU admission, with 34 patients.

2.2. Inclusion and exclusion criteria

Inclusion criteria: age ≥ 18 years; diagnosis of IAI; admission to ICU with an APACHE II score ≥ 10 or SOFA score ≥ 5; received EN support during hospitalization (for at least 48 hours); clear record of EN initiation time (based on the first EN infusion time); and complete clinical outcome data in the medical records (such as 28-day mortality, ICU length of stay, infection control indicators, etc).

Exclusion criteria: death or discharge within 72 hours of admission; presence of severe intestinal ischemia, intestinal obstruction, or other absolute contraindications for EN; coexisting other acute major diseases or multiple organ failure; coexisting advanced malignancies or other terminal diseases (expected survival < 3 months); missing key variables (e.g., EN initiation time, infection microbiological results, primary outcome indicators); and incomplete follow-up data due to treatment at another hospital.

2.3. Data collection

To ensure the completeness of the collected data, detailed demographic information, disease severity scores, infection types, treatment interventions, and clinical outcomes were systematically recorded. Independent data extraction was performed by 2 researchers, with discrepancies resolved through cross-checking and consultation with the medical team. In cases of missing data, efforts were made to retrieve the information from nursing records, dietitian assessments, and other relevant sources. Regular audits were conducted to verify data accuracy, ensuring a complete and reliable dataset for analysis.

2.3.1. Demographic and disease severity scores. General demographic data and disease severity scores were collected upon ICU admission, including age and gender. Age was recorded as the patient's actual age on the day of ICU admission, and gender was categorized as male or female. Disease severity was assessed using the APACHE II score and SOFA score. The APACHE II score, based on the patient's vital signs, laboratory tests, and Glasgow Coma Scale score within the first 24 hours of ICU admission, also considers age and chronic underlying conditions, reflecting the overall physiological burden of the patient. The SOFA score was used to assess organ function status, based on respiratory, circulatory, coagulation, liver, renal, and neurological indicators, and was quantified using the scores on the first day of ICU admission, reflecting the extent of multi-organ dysfunction.

2.3.2. Infection-related information. Infection-related information was diagnosed by the attending physician based on clinical judgment, intraoperative findings, and imaging studies. The initial infection type was recorded, including gastrointestinal perforation, intra-abdominal abscess, pancreatitis-related infections, etc. The diagnosis of bacteremia was based on positive blood culture results during hospitalization. Positive microbiological evidence also included bacterial or fungal culture results from specimens such as drainage fluid, abdominal puncture fluid, or sputum, to determine the pathogens and the extent of infection in the patient.

2.3.3. Interventions and treatment methods. Interventions were assessed through retrospective review of electronic medical records and physician orders, extracting key treatments administered to patients during their ICU stay. These included whether abdominal surgery was performed (e.g., perforation repair, debridement, and drainage), whether mechanical ventilation was used (endotracheal or nasotracheal intubation with ventilator support for >24 hours), and whether vasopressor medications (e.g., norepinephrine and epinephrine) were used to maintain circulatory stability. These interventions reflect the severity of the patient's condition and the intensity of treatment.

2.3.4. Nutritional treatment-related data. The EN preparations used in this study included standard polymeric formulas, which were selected based on the patient's nutritional needs and tolerance. The feeding route was primarily nasogastric for patients without significant gastrointestinal dysfunction. In cases where nasogastric feeding was contraindicated or poorly tolerated, nasoduodenal feeding was employed. Additionally, in patients who showed signs of impaired gastric motility, such as abdominal distension or delayed gastric emptying, intestinal motility drugs (e.g., metoclopramide) were used to enhance gastric motility and facilitate enteral feeding. In patients with severe distension or gastric retention, feeding was temporarily withheld, and gastrointestinal decompression was implemented before reintroducing nutrition. These treatments were carefully monitored, and adjustments were made based on the patient's clinical response and tolerance.

Nutritional treatment data included the time of EN initiation, defined as the 1st formal infusion of continuous nutrition through a nasogastric or nasoenteric tube. Patients were classified into the early EN group (EEN) and delayed EN group (DEN) based on whether EN was started within 48 hours after ICU admission. Nutritional intake data included the total energy (in kcal) and protein intake (in grams) actually consumed per day, as calculated from nursing records and dietitian assessments. Additionally, the number of days from EN initiation to the first achievement of target intake (25–30 kcal/kg/day and 1.2–2.0 g/kg/day based on body weight) was recorded, and whether the patient achieved the target intake within the 5th day was assessed. Adjustments in the feeding regimen were made based on patient tolerance, and nursing staff closely monitored

for complications such as nausea, vomiting, or abdominal discomfort, with modifications made as necessary.

2.3.5. Nutrition-related complications. Records of nutrition-related complications were obtained from medical progress notes and nursing documentation. These included signs of gastrointestinal intolerance during EN, such as abdominal distension, gastric retention (defined as a residual volume > 250 mL per instance), and diarrhea (>3 bowel movements per day). Interruptions of EN exceeding 24 hours due to intolerance or other reasons were also documented. In addition, suspected aspiration events were recorded, including coughing during EN infusion, changes in pulmonary auscultation, or new infiltrates on imaging. Ventilator-associated pneumonia was diagnosed based on persistent fever, elevated white blood cell count, pulmonary imaging changes, and confirmed by positive cultures of sputum or bronchoalveolar lavage fluid.

2.3.6. Clinical outcome indicators. The primary outcome was the 28-day mortality rate, defined as all-cause mortality within 28 days from ICU admission. Secondary outcomes included ICU length of stay (from ICU admission to discharge), duration of mechanical ventilation (from first intubation to extubation), time to infection control (from initiation of anti-infective therapy to improvement in infection markers or clinical symptoms), time for C-reactive protein (CRP) to return to normal levels, and incidence of secondary infections during hospitalization, such as pneumonia, urinary tract infections, and bloodstream infections.

2.3.7. Potential confounding factors and subgroup variables. To further adjust for confounding factors and perform subgroup analysis, several key variables with potential interference effects were extracted, including whether the APACHE II score was ≥ 20, whether mechanical ventilation was used, whether the patient had bacteremia, and whether the patient was aged ≥ 65 years. All data were independently extracted by 2 researchers and cross-checked. In cases of data inconsistency, a 3rd researcher reviewed the original medical records to confirm the final data, ensuring data quality and reliability of the analysis.

2.4. Statistical analysis

Statistical analysis was performed using SPSS version 26.0 (IBM Corporation, Armonk). Continuous variables with normal distribution were expressed as mean ± standard deviation (mean ± SD), and comparisons between groups were conducted using the independent samples *t*-test. Non-normally distributed variables were presented as median (interquartile range [IQR]), and the Mann–Whitney *U* test was used for group comparisons. Categorical variables were expressed as counts and percentages, with between-group comparisons conducted using Pearson chi-square test or Fisher exact test.

To investigate the independent effect of EN initiation timing on 28-day mortality, a binary logistic regression model was constructed. Clinically relevant variables (e.g., APACHE II score, bacteremia, mechanical ventilation, use of vasopressors, and age) were included for multivariable adjustment. The results were presented as odds ratios (OR) with 95% confidence intervals (CI).

Additionally, subgroup analyses were conducted by stratifying variables such as APACHE II score, mechanical ventilation status, presence of bacteremia, and age to evaluate the differential effects of EN initiation timing across subgroups. Interaction terms were added to calculate the *P* value for interaction (*P* for interaction). All statistical tests were two-tailed, and a *P* value < .05 was considered statistically significant.

2.5. Post hoc power analysis

A post hoc power analysis was conducted using the statsmodels package (The Statsmodels Development Team) in Python. Based on the observed sample sizes and effect size (Cohen $d = 1.25$), the analysis showed a post hoc power of 0.9997, indicating that the study had sufficient power to detect significant differences between the early and delayed EN groups.

3. Results

3.1. Comparison of baseline characteristics

There were no statistically significant differences between the 2 groups in terms of demographic characteristics, disease severity, infection types, and major interventions at the time of enrollment (all $P > .05$), indicating good baseline comparability (Table 1). In terms of demographics, the average age of patients in the EEN group and DEN group was 58.5 ± 12.3 years and 62.1 ± 11.8 years, respectively, with male proportions of 59.5% and 58.8%.

Regarding disease severity, the APACHE II score was 18.6 ± 4.2 in the EEN group and 19.3 ± 5.1 in the DEN group; the median SOFA scores were 7 (IQR: 5–9) and 8 (IQR: 6–10), respectively, with no statistically significant differences. The composition of

Table 1

Baseline characteristics of patients by EN initiation timing.

Characteristic	EEN Group (n = 42)	DEN Group (n = 34)	Statistical test	*P*-value
Demographics				
Age (years, mean ± SD)	58.5 ± 12.3	62.1 ± 11.8	−1.32	.191
Male, n (%)	25 (59.5%)	20 (58.8%)	0.01	.947
Disease severity				
APACHE II (mean ± SD)	18.6 ± 4.2	19.3 ± 5.1	−0.68	.498
SOFA [IQR]	7 [5–9]	8 [6–10]	−1.24	.215
Infection features				
Infection type, n (%)			Fisher exact	.621
Gastrointestinal perforation	22 (52.4%)	16 (47.1%)		
Intra-abdominal abscess	12 (28.6%)	11 (32.4%)		
Pancreatitis-associated	5 (11.9%)	4 (11.8%)		
Others	3 (7.1%)	3 (8.8%)		
Bacteremia, n (%)	15 (35.7%)	14 (41.2%)	0.24	.623
Positive cultures, n (%)	30 (71.4%)	24 (70.6%)	0.01	.932
Interventions				
Surgical treatment, n (%)	35 (83.3%)	28 (82.4%)	0.02	.902
Mechanical ventilation, n (%)	31 (73.8%)	28 (82.4%)	0.83	.362
Vasopressor use, n (%)	28 (66.7%)	25 (73.5%)	0.44	.507

DEN = Delayed Enteral Nutrition, EN = enteral nutrition, EEN = Early Enteral Nutrition, IQR = interquartile range.

infection types was similar between the 2 groups, mainly including gastrointestinal perforation, intra-abdominal abscess, and pancreatitis-related abdominal infection. The incidence of bacteremia was 35.7% in the EEN group and 41.2% in the DEN group; the rates of positive bacterial cultures were 71.4% and 70.6%, respectively, with no statistically significant differences.

In terms of treatment interventions, the proportion of patients receiving surgical treatment was 83.3% in the EEN group and 82.4% in the DEN group; the use of mechanical ventilation was 73.8% and 82.4%, and the use of vasopressor agents was 66.7% and 73.5%, respectively, with no statistically significant differences between the groups.

3.2. Incidence of EN-related complications

Regarding EN-related complications, overall intolerance was more common in the delayed EN group, although most differences did not reach statistical significance (Table 2). Gastrointestinal intolerance (including abdominal distension, gastric retention, and diarrhea) occurred in 21.4% of patients in the EEN group and 38.2% in the DEN group, with the difference approaching statistical significance ($P = .093$). Specifically, the incidence of abdominal distension was 9.5% versus 17.6%, gastric retention 11.9% versus 23.5%, and diarrhea 7.1% versus 20.6%, all showing a slightly higher trend in the DEN group but without significant differences.

Notably, the incidence of EN interruption ≥ 24 hours was significantly higher in the delayed group than in the early group (32.4% vs 14.3%, $P = .047$), suggesting that delayed EN initiation may be more prone to nutritional supply interruptions. In addition, the incidence of suspected aspiration events was also higher in the DEN group compared to the EEN group (14.7% vs 4.8%, $P = .131$). The incidence of ventilator-associated pneumonia was 26.5% in the DEN group and 11.9% in the EEN group; although the difference was not statistically significant ($P = .096$), it indicated a potential trend toward increased respiratory complications with delayed EN initiation.

3.3. Comparison of actual energy and protein intake

There were significant differences in nutritional intake between the 2 groups (Table 3). The average daily energy intake in the early EN group was 1350 ± 280 kcal, which was significantly higher than 980 ± 310 kcal in the delayed EN group ($P < .001$). For protein intake, the EEN group received 68 ± 14 g/day, compared to 45 ± 17 g/day in the DEN group, with a statistically significant difference ($P < .001$).

In addition, the time required to reach target caloric intake was shorter in the EEN group, at 3.1 ± 1.2 days, compared to 5.7 ± 1.6 days in the DEN group ($P < .001$). The proportion of patients achieving target intake by day 5 was 76.2% (32/42) in the EEN group and 35.3% (12/34) in the DEN group, showing a significant difference ($P < .001$). These results indicate that early initiation of EN can significantly improve energy and protein intake efficiency and help achieve nutritional goals more rapidly.

3.4. Comparison of clinical outcomes between early and delayed EN groups

In terms of primary clinical outcomes, the early EN group showed better prognosis compared to the delayed EN group (Table 4). The 28-day mortality rate in the EEN group was 19.0% (8 cases), significantly lower than 35.3% (12 cases) in the DEN group ($P = .048$). ICU length of stay was 10.8 ± 4.2 days in the EEN group and 13.6 ± 5.1 days in the DEN group, with a statistically significant difference ($P = .011$).

Regarding respiratory support, the duration of mechanical ventilation was 7.2 ± 2.8 days in the EEN group, significantly shorter than 9.3 ± 3.6 days in the DEN group ($P = .009$). For infection control, the time to infection control was 4.8 ± 1.5 days in the EEN group versus 6.3 ± 2.1 days in the DEN group ($P = .002$); the time for CRP to return to normal was 5.6 ± 1.9 days and 7.4 ± 2.2 days, respectively, with faster recovery in the EEN group ($P = .001$). Additionally, the incidence of secondary infections was significantly lower in the EEN group than in the DEN group (21.4% vs 41.2%, $P = .045$), suggesting that early EN may help reduce the risk of hospital-acquired infections.

3.5. Multivariate logistic regression analysis: independent factors affecting 28-day mortality

To investigate the independent effect of EN initiation timing on 28-day mortality, a multivariate logistic regression model

Table 2

EN-related complications in early versus delayed EN groups.

Complication	Early EN Group (n = 42)	Delayed EN Group (n = 34)	*P*-value
Gastrointestinal intolerance (any)	9 (21.4%)	13 (38.2%)	.093
Abdominal distension	4 (9.5%)	6 (17.6%)	.312
Gastric retention (>250 mL/6 h)	5 (11.9%)	8 (23.5%)	.172
Diarrhea (>3 times/day)	3 (7.1%)	7 (20.6%)	.085
Interruption of EN support ≥ 24 h	6 (14.3%)	11 (32.4%)	.047
Suspected aspiration event	2 (4.8%)	5 (14.7%)	.131
Ventilator-associated pneumonia (VAP)	5 (11.9%)	9 (26.5%)	.096

EN = enteral nutrition.

Table 3

Comparison of actual nutritional intake between early and delayed en groups.

Parameter	Early EN Group (n = 42)	Delayed EN Group (n = 34)	*P*-value
Mean daily energy intake (kcal)	1350 ± 280	980 ± 310	<.001
Mean daily protein intake (g)	68 ± 14	45 ± 17	<.001
Days to reach target calories	3.1 ± 1.2	5.7 ± 1.6	<.001
Percentage achieving target intake by day 5	76.2% (32/42)	35.3% (12/34)	<.001

EN = enteral nutrition.

was constructed, adjusting for potential confounders including APACHE II score, bacteremia, mechanical ventilation, use of vasopressor agents, and age. The results showed that delayed EN initiation (>48 hours) was an independent risk factor for 28-day mortality, with an OR of 2.51, 95% CI of 1.09–5.82, and $P = .030$, indicating that delayed EN initiation increases the risk of death by approximately 2.5 times (Table 5).

In addition, for each 1-point increase in APACHE II score, the risk of death increased by 8% (OR = 1.08, 95% CI: 1.01–1.17, $P = .024$), also serving as an independent predictor. Other variables such as bacteremia (OR = 1.62, $P = .262$), mechanical ventilation (OR = 1.83, $P = .194$), use of vasopressor agents (OR = 2.08, $P = .100$), and age (OR = 1.01, $P = .514$) did not reach statistical significance, but still showed a potential risk trend within the model.

3.6. Subgroup analysis: relationship between EN initiation timing and 28-day mortality in populations with different clinical characteristics

To further explore the prognostic effect of early EN in different populations, a subgroup analysis stratified by key clinical variables was performed (Table 6). The results showed that early EN had a more significant effect in reducing 28-day mortality in certain subgroups, with statistically significant interactions observed. Among patients with higher APACHE II scores (≥20), early EN significantly reduced 28-day mortality (27.8% vs 53.3%), and a significant interaction with EN initiation timing was observed (P for interaction = .041), suggesting that early EN may provide greater benefit in patients with higher disease severity.

Similarly, among patients receiving mechanical ventilation, the mortality rate in the EEN group was 22.6%, lower than 39.3% in the DEN group (P for interaction = 0.049), also indicating a significant interaction and suggesting that early EN may confer greater survival benefits in patients requiring respiratory support. In other subgroups (e.g., APACHE II < 20, without mechanical ventilation, presence or absence of bacteremia, age stratification), early EN also showed a trend toward lower mortality; however, the P values for interaction were not statistically significant ($P > .05$), indicating relatively consistent effects or limited sample size.

4. Discussion

The results of this study highlight the significant impact of the timing of EN initiation on the prognosis of critically ill patients with IAIs. No statistically significant differences were found between the 2 groups in baseline characteristics such as age, gender, APACHE II score, SOFA score, infection type, and treatment measures, suggesting good comparability between the groups and providing a reliable foundation for result interpretation.

Table 4

Comparison of clinical outcomes between early and delayed enteral nutrition groups.

Outcome indicator	Early EN Group (n = 42)	Delayed EN Group (n = 34)	*P*-value
28-Day mortality (%)	19.0% (8 cases)	35.3% (12 cases)	.048
ICU length of stay (days)	10.8 ± 4.2	13.6 ± 5.1	.011
Duration of mechanical ventilation (days)	7.2 ± 2.8	9.3 ± 3.6	.009
Time to infection control (days)	4.8 ± 1.5	6.3 ± 2.1	.002
Time to CRP normalization (days)	5.6 ± 1.9	7.4 ± 2.2	.001
Incidence of secondary infections (%)	1.4% (9 cases)	41.2% (14 cases)	.045

CRP = C-reactive protein, EN = enteral nutrition, ICU = intensive care unit.

Table 5

Multivariate logistic regression analysis for 28-day mortality.

Variable	Odds ratio (OR)	95% Confidence interval	*P*-value
Delayed EN initiation (>48 h)	2.51	1.09–5.82	.03
APACHE II score (per point ↑)	1.08	1.01–1.17	.024
Bacteremia (Yes vs No)	1.62	0.70–3.78	.262
Mechanical ventilation (Yes)	1.83	0.74–4.53	.194
Vasopressor use (Yes)	2.08	0.87–4.96	.1
Age (per year ↑)	1.01	0.97–1.05	.514

EN = enteral nutrition.

Table 6

Subgroup analysis of 28-day mortality by EN initiation timing.

Subgroup	n (EEN/DEN)	28-Day mortality (%) (EEN vs DEN)	*P* for interaction
APACHE II ≥ 20	18/15	27.8% vs 53.3%	.041
APACHE II < 20	24/19	12.5% vs 21.1%	.338
Mechanical ventilation: Yes	31/28	22.6% vs 39.3%	.049
Mechanical ventilation: No	11/6	9.1% vs 16.7%	.412
With bacteremia	15/14	33.3% vs 50.0%	.217
Without bacteremia	27/20	11.1% vs 25.0%	.081
Age ≥ 65 years	17/16	29.4% vs 50.0%	.092
Age < 65 years	25/18	12.0% vs 22.2%	.244

DEN = Delayed Enteral Nutrition, EN = enteral nutrition, EEN = Early Enteral Nutrition.

Regarding nutritional complications, although the incidence of gastrointestinal intolerance (including abdominal distension, gastric retention, and diarrhea) was higher in the delayed EN group, the differences were not statistically significant. However, the incidence of EN interruption for ≥ 24 hours was significantly higher in the delayed group ($P = .047$), suggesting that early EN helps to prevent interruptions in nutritional supply. This is consistent with the idea that early EN does not significantly increase the risk of gastrointestinal complications and is more effective in maintaining continuous nutrition, which is crucial for patient recovery. In practice, this highlights the role of nurses in early identification and management of mild intolerance symptoms, such as transient gastric retention or mild distension, and reinforces that concerns about intolerance should not delay EN initiation.[13]

When comparing nutritional intake, the early EN group achieved significantly higher daily energy and protein intake, reaching nutritional goals earlier than the delayed EN group. The target achievement rate by day 5 was 76.2% in the early EN group compared to 35.3% in the delayed group ($P < .001$), emphasizing that early EN enhances the efficiency of nutritional therapy. Timely nutritional support lays a foundation for immune modulation and tissue repair, which can accelerate recovery and improve infection control. The achievement of nutritional goals may directly affect the body's ability to fight infection and recover from illness, which are crucial factors influencing survival in critically ill patients.[14–16]

In terms of clinical outcomes, the early EN group had significant advantages over the delayed EN group in 28-day mortality, ICU length of stay, duration of mechanical ventilation, infection control time, CRP recovery time, and incidence of secondary infections. The reduction in 28-day mortality (19.0% vs 35.3%, $P = .048$) is especially clinically relevant. The accelerated infection control and faster CRP reduction in the early EN group suggest that early EN may help control infection progression by maintaining gut barrier integrity, reducing bacterial translocation, and improving microbial balance. Moreover, the decreased incidence of secondary infections supports the hypothesis that early EN may not only help control primary infections but also lower the risk of secondary infections.[17,18]

Multivariate logistic regression analysis confirmed that delayed EN initiation was an independent risk factor for 28-day mortality (OR = 2.51, $P = .03$). Even after adjusting for confounding factors like APACHE II score, bacteremia, and mechanical ventilation, early EN still demonstrated a protective effect. The APACHE II score was also a significant predictor, with each 1-point increase in the score associated with an 8% increase in mortality risk ($P = .024$), emphasizing the value of severity scoring in prognostic assessments.

The subgroup analysis revealed that early EN had a more significant effect in patients with higher APACHE II scores (≥20) and those requiring mechanical ventilation. This finding suggests that patients with more severe conditions benefit more from early EN, further supporting the need for early nutritional intervention in high-risk patients. This insight is valuable for clinical practice, helping guide physicians and nurses in promoting early EN in patients at greater risk.

The mechanisms underlying these findings may include early EN maintaining intestinal integrity and microbiota stability, reducing bacterial translocation, and mitigating inflammatory responses. Timely provision of energy and protein supports immune cell function and enhances tissue repair capacity. Furthermore, early and continuous monitoring and intervention by nursing staff could provide a synergistic protective effect, which is particularly important in critically ill patients with IAIs. These patients often suffer from immune dysfunction and a hypermetabolic state, where early nutritional intervention is critical, and delaying it could have adverse effects on the entire course of illness.[19,20]

Although this study has certain clinical value, it also has some limitations. First, it is a single-center retrospective design, which may carry the risk of selection bias and information bias. Some variables, such as gastrointestinal function status and nutritional scores, were not fully quantified. Second, the sample size was relatively small, and some subgroups (such as non-ventilated patients) were limited in analysis. Third, the EN protocol (formulation, infusion rate) lacked a unified standard and showed individual variability. Additionally, the study did not include certain potential confounding variables, such as the Nutritional Risk Screening 2002 and intestinal function scores, which could have further refined the analysis. These factors were not incorporated into the regression model due to limitations in available data. Fourth, this study did not explore in depth the relationship between EN combined with parenteral nutrition, nursing execution, and nutritional outcomes – areas that warrant further investigation. These aspects should be addressed in future studies to provide a more comprehensive understanding of the impact of EN in critically ill patients with abdominal infections.

In conclusion, this study confirms that in critically ill patients with IAIs, early initiation of EN significantly improves nutritional goal achievement, accelerates infection control, and reduces mortality compared with delayed initiation. The survival advantage is particularly evident in patients with high severity or requiring respiratory support. The results support actively promoting early EN initiation strategies in clinical nursing practice, while strengthening the identification and intervention of EN-related complications to achieve the maximum benefit from nutritional support.

Author contributions

Conceptualization: Xing Fan, Lei Chen, Jing Liu, Yingchun Wang.
Data curation: Xing Fan, Lei Chen, Ying Zhang, Jing Liu, Chuangqi Zhu, Yingchun Wang.
Formal analysis: Xing Fan, Ying Zhang, Jing Liu, Yingchun Wang.
Investigation: Lei Chen.
Visualization: Ying Zhang.
Writing – original draft: Xing Fan, Lei Chen, Ying Zhang, Chuangqi Zhu, Yingchun Wang.
Writing – review & editing: Xing Fan, Lei Chen.

References

[1] Coccolini F, Brogi E, Ceresoli M, et al. Epidemiological analysis of intra-abdominal infections in Italy from the Italian register of complicated intra-abdominal infections-the IRIS study: a prospective observational nationwide study. World J Emerg Surg. 2025;20:22.
[2] Paiva JA, Rello J, Eckmann C, et al. Intra-abdominal infection and sepsis in immunocompromised intensive care unit patients: disease expression, microbial aetiology, and clinical outcomes. Eur J Intern Med. 2024;129:100–10.
[3] Sartelli M, Viale P, Catena F, et al. 2013 WSES guidelines for management of intra-abdominal infections. World J Emerg Surg. 2013;8:3.
[4] Sartelli M. A focus on intra-abdominal infections. World J Emerg Surg. 2010;5:9.
[5] Sartelli M, Catena F, Abu-Zidan FM, et al. Management of intra-abdominal infections: recommendations by the WSES 2016 consensus conference. World J Emerg Surg. 2017;12:1–31.
[6] Schouteden E, Heuts S, Bels JL, et al. The impact of high versus standard enteral protein provision on functional recovery following intensive care admission: a pre-planned Bayesian analysis of the PRECISe trial. Clin Nutr. 2025;48:153–60.
[7] Nakamura K, Yamamoto R, Higashibeppu N, et al. The Japanese critical care nutrition guideline 2024. J Intensive Care. 2025;13:18.
[8] Hadi V, Amiri Khosroshahi R, Imani H, et al. Impact of early versus delayed enteral nutrition on ICU outcomes: a comparative study on mortality, ventilator dependence, and length of stay. Eur J Med Res. 2025;30:315.

[9] Senecal JB, Lakhanpal T, Mbuagbaw L, et al. The effect of enteral nutrition strategy and non-invasive ventilation on diarrhea and nutritional goals in the critically ill: a protocol for a multicentre retrospective cohort study (ENND GOALS). PLoS One. 2025;20:e0322122.
[10] Xu F, Lu G, Sun H, Wang J. Association between early enteral nutrition and 28-day mortality in mechanically ventilated patients with sepsis: a retrospective analysis of the MIMIC-IV database. BMC Infect Dis. 2025;25:628.
[11] Xu W, Ding X. The application effectiveness of an early enteral nutrition protocol constructed based on the enhanced recovery after surgery concept in ICU patients. Medicine (Baltim). 2025;104:e42292.
[12] Júnior AL, Gabani FL, Girotto E, Silva AMR, de Andrade SM. Late nutrition and negative outcomes in a Brazilian paediatric intensive care unit: a retrospective cohort. J Paediatr Child Health. 2025;61:926– 34.
[13] Pouwels S, van Nieuwkoop MM, Ramnarain D. Enteral nutrition interruptions in the intensive care unit: a systematic review of frequency, causes, and nutritional implications. Cureus. 2025;17:e81834.
[14] Wang S, He Y, Yi J, Sha L. Risk factors for enteral feeding intolerance in critically ill patients: an updated systematic review and meta-analysis. BMC Gastroenterol. 2025;25:233.
[15] Kashiwagi S, Kanda N, Yoshida M, Wakimoto Y, Ohbe H, Nakamura K. Effects of early enteral nutrition on persistent inflammation, immunosuppression, and catabolism syndrome in critically ill patients: a claims database study using a propensity score analysis. Clin Nutr. 2024;43:1872–9.
[16] Yin Y, Li Y, Liu Y, Fan C, Jiang Y. Baseline immune status and the effectiveness of response to enteral nutrition among ICU patients with COVID-19: an observational, retrospective study. Nutrition. 2024;122:112387.
[17] Ni W, Jiao X, Zou H, et al. Gut microbiome alterations in ICU patients with enteral nutrition-related diarrhea. Front Microbiol. 2022;13:1051687.
[18] Calder PC, Adolph M, Deutz NE, et al. Lipids in the intensive care unit: recommendations from the ESPEN Expert Group. Clin Nutr. 2018;37:1–18.
[19] Krezalek MA, Yeh A, Alverdy JC, Morowitz M. Influence of nutrition therapy on the intestinal microbiome. Curr Opin Clin Nutr Metab Care. 2017;20:131–7.
[20] Lee JG, Kim YS, Lee YJ, et al. Effect of immune-enhancing enteral nutrition enriched with or without beta-glucan on immunomodulation in critically ill patients. Nutrients. 2016;8:336.