

Clinical impact of early enteral nutrition support combined with comfort nursing on prognosis of critically ill ICU patients undergoing ventilator assisted ventilation

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Abstract

Objective

We aimed to clarify the impact of early enteral nutrition support combined with comfort nursing on the prognosis of critically ill patients in the intensive care unit (ICU) who received ventilator-assisted ventilation.

Methods

100 critically ill patients admitted to our ICU were selected and randomly divided into the control group (CG) and the observation group (OG). The OG initiated early enteral nutrition support within 24 h after admission to ICU and received comfort nursing. The CG initiated enteral nutrition support after admission to the ICU based on monitoring biochemical indicators and received routine ICU nursing. The nutritional status, immune function, total malnutrition rate, incidence of pulmonary infection, ventilator weaning time and ICU hospitalization time of the two groups were measured and compared.

Results

The levels of albumin (ALB), total protein (TP), and globulin (GLB) in both groups were higher than those at admission to the ICU, while OG group were higher than CG group ($P < 0.05$). The PCT levels of both groups decreased compared to the levels during the period from admission to the ICU, while OG group was greater decrease than CG group ($P < 0.05$). The overall malnutrition rate in OG group was lower than that in CG group ($P < 0.05$). The incidence of pulmonary infection in OG group was lower than that in CG group ($P < 0.05$). The time to weaning from the ventilator and the ICU stay time in OG group were shorter than those in CG group ($P < 0.05$).

Conclusion

For critically ill ICU patients undergoing ventilator assisted ventilation, early enteral nutrition support combined with comfort nursing can effectively reduce risk of malnutrition and pulmonary infection, enhance immune function, create convenient conditions for early weaning and early conversion to general wards, with broad clinical application prospects.

Keywords: ICU; ventilator assisted ventilation; early enteral nutrition support; comfort nursing

Introduction

Intensive care unit (ICU) is the most crucial component of a medical institution and is also one of the main places where patients with critical illnesses receive treatment^{1,2}. Ventilator-assisted ventilation is an important auxiliary method for alleviating ventilation disorders and establishing autonomous breathing, and it has been widely used in critically ill patients^{3,4}.

Nutritional support is the main means of life support in the ICU. Current guidelines prioritize enteral nutritional support^{5,6}. However, the medical community has not reached a consensus on when to start enteral nutritional support. According to foreign guidelines, critically ill patients can start enteral nutritional support within 24 to 48 hours after admission to the ICU, regardless of the severity of the patient's condition, and can achieve the predetermined goals within the next 48 to 72 hours^{7,8}. Chinese experts unanimously recommend that patients admitted to the ICU

with basically good nutritional status and mild conditions do not need nutritional support⁹. The contradiction in this view is related to the different purposes of enteral nutritional support. The guiding principles or consensus in foreign countries emphasize that early enteral nutritional support is to improve intestinal mucosal permeability, inhibit the synthesis and release of inflammatory cytokines, and reduce the risk of sepsis or toxic symptoms¹⁰. Chinese experts and scholars, however, regard it as a means to improve nutritional status^{11,12}. Regarding the definition of "early", previous reports suggest starting enteral nutritional support within 24 to 48 hours after admission to the ICU; however, in recent years, more and more experts and scholars have gradually accepted the view of starting enteral nutritional support within 24 hours after admission to the ICU¹³. The conditions of ICU patients present rapid changes, frequent unexpected events, and multiple complications, which bring certain risks to the care of ICU patients and pose great pressure on ICU nurses. Comfort nursing intervention can improve the

prognosis of ICU patients and enhance the quality of care¹⁴. The impact of early enteral nutrition support and comfort nursing on the prognosis of critically ill patients in the ICU who receive ventilator-assisted ventilation is highly valued, and therefore our research focuses on this theme.

Methods

Study design

This was a prospective randomized controlled study. The 100 critically ill patients admitted to the Department of Intensive Care Unit of our hospital from January 2022 to December 2023 were selected as study participants. Inclusion criteria: 1) Those complicated with severe ventilation and gas exchange dysfunction requiring artificial assisted respiration; 2) those with acute physiology and chronic health evaluation (APACHE II) scores of 15 points or higher; 3) those aged ≥ 18 years and whose hemodynamic parameters fluctuate within normal range, meeting conditions for enteral nutrition support; 4) critically ill patients and/or their families understood specific contents of research and agreed to participate in this clinical research. Exclusion criteria: 1) Those needing for enteral nutrition support combined with parenteral nutrition support or having to receive parenteral nutrition; 2) those who were already in a plant survival state upon admission to ICU; 3) those complicated with moderate to severe malnutrition or severe diarrhea without improvement after therapy; 4) those who had developed pulmonary infections; 5) those who voluntarily withdrew due to questioning effectiveness of early enteral nutrition support.

This research passed ethical review by the Ethics Committee of Huzhou Central Hospital, and the approval number was 20240301. All patients and their families signed the informed consent form.

Sample size calculation

We performed a power analysis to determine the appropriate sample size for this study. The primary outcome measure was set as the changes in albumin (ALB). Based on previous relevant studies¹⁵, we set the significance level (α) at 0.05, the power ($1-\beta$) was set at 0.8, Using G*Power analysis, we calculated the required sample size for each group was 50 cases.

Randomization

A simple random sampling method was adopted. Firstly, 100 patients were sequentially numbered from 1 to 100 based on their admission order. Then, 100 random numbers were generated using a random number table and each was matched with the patient's number. These random numbers were sorted from smallest to largest. The first 50 numbered patients were assigned to the control group (CG), and the last 50 numbered patients were assigned to the observation group (OG), ensuring that each group had 50 cases.

We prepared 100 opaque, sealed and identically-looking envelopes. Each envelope contained a piece of paper with the group information written on it, and only the patient number was marked on the envelope cover. An independent person, who was not involved in the research, sorted out the group information papers according to the randomly arranged patient numbers, placed them into the corresponding envelopes and sealed them. They were then stored in a locked filing cabinet for safekeeping. After the patients completed the baseline assessment, this independent Integrative Therapies and Translational Insights Special Issue

person retrieved the corresponding envelopes based on the patient numbers, opened them on the spot and informed the patients of their group assignments, ensuring that the researchers could not know the group information before the grouping.

The CG consisted of 34 males and 16 females, with an average age of (66.74 ± 10.32) years. The average APACHE II score at admission to the intensive care unit was (28.00 ± 3.00) points. The observation group included 37 males and 13 females, with an average age of (66.81 ± 10.38) years. The average APACHE II score at admission to the intensive care unit was (28.50 ± 3.50) points. There were no significant difference in baseline date between the two groups ($P > 0.05$), indicating comparability.

Methods

Early enteral nutrition support

Nasogastric tube insertion: For both groups, blind insertion of a nasogastric tube was the standard method. Prior to insertion, patients were required to fast for over 4 hours. Conscious critically ill patients were expected to cooperate, while the ward environment was adjusted to an appropriate temperature and humidity. Charge nurses ensured proper hand and whole-body hygiene. Restless patients were comforted by nursing staff in advance; if comforting was ineffective, the procedure could be rescheduled or sedatives administered as per doctor's instructions.

The nasal cavity was cleaned, and after secretions were removed, patients received an intramuscular injection of 10 mg of metoclopramide. Patients were assisted into a sitting or semi-reclining position. The nasogastric tube end was lubricated with sterile 0.9% sodium chloride solution or sterile water and inserted into the nasal cavity. Conscious patients were instructed to swallow when the tube reached the throat, while for comatose patients, the head was gently lifted to bring the jaw close to the sternum. The tube was advanced to different marks on the tube body to reach the duodenum, with confirmation of its position via X-ray.

Timing of initiation: The OG initiated early enteral nutrition support within 24 h after admission to ICU. The CG initiated enteral nutrition support in cases of malnutrition through monitoring biochemical indicators after admission to ICU.

Feeding protocols and nutrition formula: Both groups received infusion of the full-nutrition formula food NUTREN (Nestle Health Science; license No. SC12832127100303), a special medical-purpose food, through a nutrition pump.

The CG received infusion according to previous routine settings. The daily energy supply target was 25-35 kcal/kg·d. On the first day, the infusion volume was 30% of the total calculated volume, increased to 60% on the second day, and adjusted to complete infusion on the third day. Gastric contents of critically ill patients were evaluated every 4 hours. If the amount exceeded 250 mL (inclusive), the frequency of enteral nutrition support and/or the speed of nutrient infusion were extended.

The OG received infusion adhering to principle of individualization. For patients in acute stress period, a low-calorie feeding strategy was implemented, with an energy setting of 20-25 kcal/kg·d. After patients successfully passed the acute stress period, the infusion frequency and single-feeding amount were adjusted to ensure that the daily energy supply reached 30-35 kcal/kg.

Nursing method

The CG received routine ICU nursing.

The OG received comfort nursing, which was implemented based on well-established standardized frameworks to ensure its scientific validity and effectiveness. The specific interventions were as follows:

(1) Disease education (Informed by the health belief model): The health belief model emphasizes that individuals' health-related behaviors are influenced by their perceptions of the severity of a disease, susceptibility to it, benefits of taking preventive or treatment actions, and barriers to those actions¹⁶.

The nursing staff first introduced themselves to the patient, creating a friendly and trusting environment. Then, they explained the environment of the ICU in detail, helping patients understand the specialized care they would receive. Additionally, they informed the patient about his/her specific condition, including the nature of the illness, the treatment plan, and the expected prognosis.

(2) Psychological guidance (Based on the cognitive-behavioral theory): The cognitive-behavioral theory posits that an individual's thoughts, feelings, and behaviors are interconnected, and that changing negative thought patterns can lead to improved emotional well-being and behavioral responses¹⁷.

The nursing staff had more frequent communication with the patients. Through active listening, they identified and addressed patients' negative emotions such as anxiety, fear, and depression. By challenging and reframing negative thoughts, they alleviated these negative emotions and stimulated the patients' enthusiasm for cooperating with the treatment. The nursing staff also made every effort to meet the patients' needs as much as possible, which helped to build a positive therapeutic relationship.

Moreover, they introduced successful treatment cases to the patients. This was a form of social learning, as patients could observe and learn from the positive experiences of others, thereby boosting their confidence in their own treatment outcomes.

(3) Sleep nursing (In line with the sleep-wake cycle theory): The sleep-wake cycle theory highlights the importance of maintaining a regular sleep-wake pattern for optimal physical and mental health. Disruptions to this cycle can lead to sleep deprivation, which can have negative impacts on the body's immune function, cognitive ability, and overall recovery¹⁸.

All treatment and nursing operations were carried out during the day as much as possible and were avoided at nighttime as much as feasible. If it was necessary to perform operations at night, the nursing staff tried to be as quiet as possible to minimize disturbances to the patients' sleep.

(4) Daily routine nursing (Guided by the pressure ulcer prevention guidelines): The pressure ulcer prevention guidelines provide evidence-based recommendations for preventing pressure ulcers, which are a common complication in critically ill patients due to prolonged immobility and pressure on the skin¹⁹.

The nursing staff promptly wiped the patient's skin to keep it dry, as moisture can increase the risk of skin breakdown. At the same time, they regularly turned the patient over and provided massages to promote blood circulation. For areas that were constantly under pressure, such as the sacrum,

heels, and elbows, the nursing staff performed multiple massages to relieve pressure and prevent skin damage.

Observation indicators

(1) Blood samples were collected from the patients both when they were admitted to the ICU and when they were transferred out of the ICU to measure the levels of albumin (ALB), total protein (TP), and globulin (GLB).

(2) Blood samples were collected from the patients both when they were admitted to the ICU and when they were transferred out of the ICU to measure the level of procalcitonin (PCT).

(3) The total incidence rates of various degrees of malnutrition (mild, moderate and severe) were recorded. Based on the serum ALB test results at the time of transfer out of the ICU, the number of malnutrition cases that occurred in both groups was recorded. The specific grading standards were: 28-34 g/L, 21-27 g/L, and <21 g/L.

(4) The incidence of pulmonary infection cases was recorded when patients were transferred out of the ICU.

(5) The ventilator weaning time and ICU hospitalization time received were recorded respectively after the successful removal of the ventilator and during the transfer out of the ICU.

Statistical analysis

The collected data were processed using SPSS 27.0 statistical software. The measurement data were presented in the form of mean \pm standard deviation ($\bar{x} \pm s$), and then a t-test was conducted for comparison. The count data were presented as percentages, and then a χ^2 test was conducted for comparison. A P value < 0.05 indicated a statistically significant difference.

Results

Comparison of general data between both groups

There was no statistical significance in general data between the groups, indicating the general data of the two groups were comparable (P > 0.05; Table 1).

Comparison of nutritional status between both groups

When the patients were transferred to the ICU, there was no statistically significant difference in the levels of ALB, TP, and GLB between the two groups (P > 0.05). When they were transferred out of the ICU, the above indicators of both groups were higher than those at the time of transfer (P < 0.05, 95% CI: -4.533--3.534; P < 0.05, 95% CI: -4.428--3.252; P < 0.05, 95% CI: -0.728--0.061), and the indicators of the OG were higher than those of the CG, indicating a statistically significant difference (P < 0.05, 95% CI: -15.82--14.83; P < 0.05, 95% CI: -22.36--21.18; P < 0.05, 95% CI: -6.369--5.701; Figure 1).

Comparison of immune function between both groups

At the time of transfer to the ICU, there was no statistically significant difference in the PCT levels between the two groups (P > 0.05). When transferred out of the ICU, the PCT levels of both groups decreased compared to when they were in the ICU (P < 0.05, 95% CI: 0.149-0.341), and the decrease in the OG was greater than that in the CG group, indicating a statistically significant difference (P < 0.05, 95% CI: 6.519-6.711; Figure 2).

Table 1. General data in both groups

| Groups | N | Gender [n (%)] | | Age (years) | APACHE II scores upon admission to ICU (points) |
|------------|----|----------------|-----------|--------------|---|
| | | Male | Female | | |
| CG | 50 | 34 (68.0) | 16 (32.0) | 66.74±5.32 | 28.00±3.00 |
| OG | 50 | 37 (74.0) | 13 (26.0) | 66.81±5.38 | 28.50±3.50 |
| χ^2/t | □ | 0.437 | | 0.474 | 1.102 |
| P | □ | 0.508 | | 0.638 | 0.276 |
| 95% CI | | 0.591-1.351 | | -2.053-2.193 | -0.794-1.794 |

Table 2. Total malnutrition rate in both groups

| Groups | N | Mild malnutrition | Moderate malnutrition | Severe malnutrition | Total malnutrition rate [n (%)] |
|----------|----|-------------------|-----------------------|---------------------|---------------------------------|
| CG | 50 | 6 | 4 | 3 | 13 (26.0) |
| OG | 50 | 3 | 1 | 0 | 4 (8.0) |
| χ^2 | □ | | | | 5.741 |
| P | □ | | | | 0.016 |
| 95% CI | | | | | 1.120-2.381 |

Table 3. Incidence of pulmonary infections in both groups

| Groups | N | Incidence of pulmonary infections [n (%)] |
|----------|----|---|
| CG | 50 | 10 (20.0) |
| OG | 50 | 2 (4.0) |
| χ^2 | | 6.061 |
| P | | 0.013 |
| 95% CI | | 1.163-2.483 |

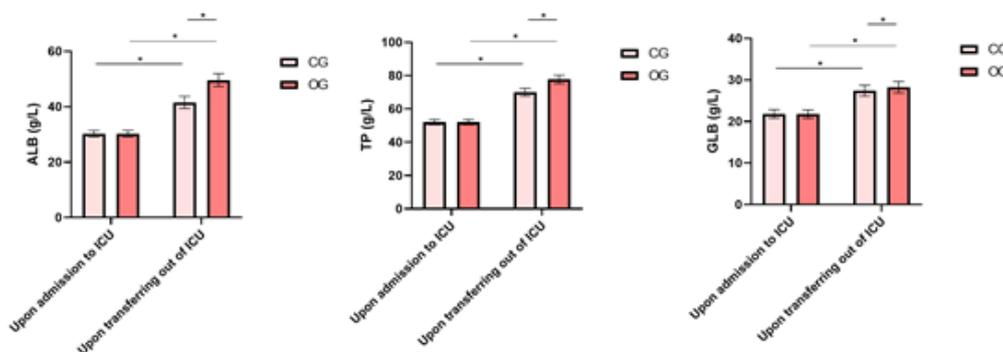


Figure 1. Nutritional status in both groups

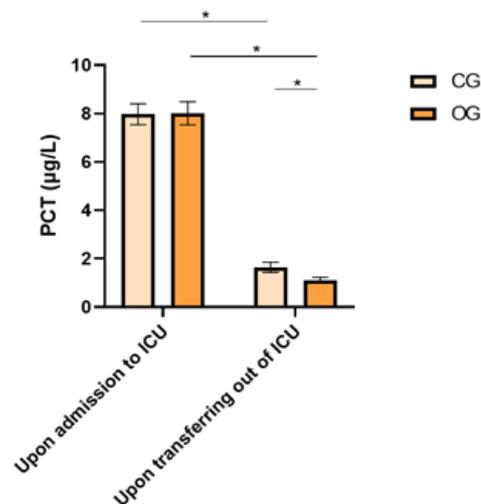


Figure 2. Immune function in both groups

Comparison of total malnutrition rate between both groups

The total malnutrition rate in the OG was lower than that in the CG, indicating a statistically significant difference (P = 0.016, 95% CI: 1.120-2.381; Table 2).

Comparison of incidence of pulmonary infections between both groups

The incidence of pulmonary infections in the OG was lower than that in the CG, indicating a statistically significant difference (P = 0.013, 95% CI: 1.163-2.483; Table 3).

Comparison of ventilator weaning time and ICU hospitalization time between both groups

The ventilator weaning time and the ICU hospitalization time in the OG were shorter than those in the CG, indicating a statistically significant difference (P < 0.05, 95% CI: -6.576--5.184; P < 0.05, 95% CI: -8.577--6.743; Figure 3).

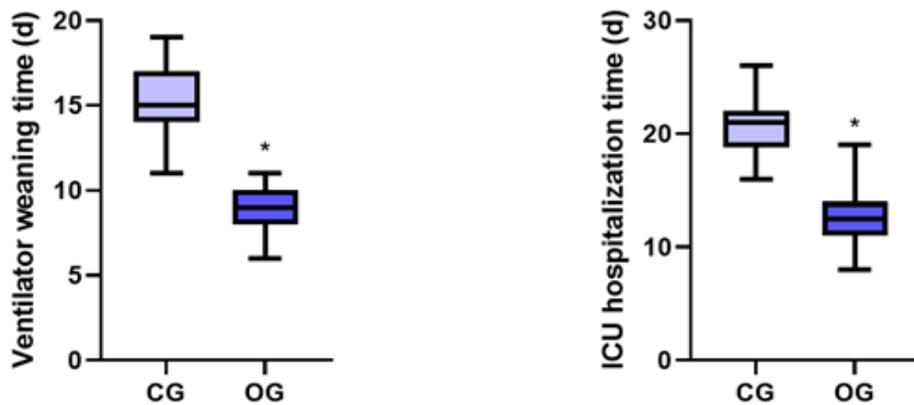


Figure 3. Ventilator weaning time and ICU hospitalization time in both groups

Discussion

Respiratory dysfunction is extremely common among critically ill patients, and mechanical ventilation is usually required to alleviate the body's hypoxia and facilitate the establishment of normal spontaneous breathing. In addition to respiratory dysfunction, critically ill patients also experience changes in nutritional metabolism, resulting in significant loss of endogenous nutrients and insufficient external nutrient intake, thereby increasing the risk of malnutrition²⁰. Clinical studies have shown that malnutrition is one of the main factors contributing to the prolonged hospital stay and increased mortality in critically ill patients²¹. After admission to the ICU, the weight of critically ill patients may decrease by 0.5 to 1.0 kg per day, which may lead to malnutrition in the short term, weaken the body's immune system, increase the risk of opportunistic infections, and raise the possibility of death²². Therefore, as long as critically ill patients still have good gastrointestinal function and there are no contraindications for enteral nutrition support, enteral nutrition support should be considered first. Only when this method fails to provide sufficient energy supply for these patients or when enteral nutrition support is unsuccessful, should parenteral nutrition support be considered²³. Regarding the timing of enteral nutrition support, foreign guidelines suggest that it should be conducted within 24-48 hrs after the patient is admitted to the ICU. However, in China, there are no clear regulations on this, and in practice, the decision and implementation are usually made by the attending physician, which increases the risk of malnutrition in critically ill patients. For critically ill patients in the ICU who receive ventilator-assisted ventilation, the harm of malnutrition is particularly serious. Therefore, providing early enteral nutrition support has become an urgent task. The existence of the ICU should not only provide standardized treatment for patients but also focus on providing high-quality life services for them. Although the ICU can improve the prognosis and quality of life of patients, due to the high hospitalization costs, it also brings certain economic pressure and burden to patients. During the treatment process, patients are prone to develop various negative emotions, and even develop intensive care unit syndrome, which poses a great safety hazard to their prognosis²⁴. Therefore, nurses not only need to provide high-quality nursing services for patients, but also need to reduce their psychological burden from a psychological perspective and improve their compliance with treatment.

After comparing the impacts of different timing of enteral nutrition support and nursing modes, this study found

that early enteral nutrition support combined with comfort nursing was more conducive to improving the prognosis of patients in the ICU patients. This is because that critically ill patients usually have metabolic disorders, which can have serious adverse effects on multiple organ systems throughout the body. The incidence of malnutrition in critically ill patients is as high as 40%, and it is closely related to the incidence of complications and the increase in mortality²⁵. Poor nutritional status will inevitably weaken the immune function, making it difficult for severe

patients to effectively resist pathogenic bacteria, thereby leading to a series of infections, such as pulmonary infections and urinary system infections. Enteral nutrition support can maintain and enhance the intestinal mucosal barrier function of patients, increase the secretion of gastrointestinal hormones, accelerate the blood circulation of the portal venous system, reduce inflammatory responses, and enhance local and systemic immune functions. The previous enteral nutrition support strategies were formulated based on the patient's nutritional status, that is, enteral nutrition support was initiated only when malnutrition occurred; however, correcting malnutrition is a long-term process, and the risks faced by severe patients are unpredictable. When these patients are admitted to the ICU, immediately starting enteral nutrition support can fully exert the positive effects of this life support method and improve the strength of respiratory muscles, providing a strong guarantee for them to establish normal spontaneous breathing as soon as possible. This is the key reason for shortening the ventilator weaning time and the length of stay in the ICU in OG. Additionally, regardless of whether critically ill patients have malnutrition or not, early enteral nutrition support is beneficial to them, improving their nutritional status, and helping them recover. However, this research also indicates that early enteral nutrition support requires clear energy supply targets based on the stage of the severe patient to avoid the occurrence of overfeeding. Comfort nursing is one of the products resulting from the continuous development of modern medicine. In the nursing process, nursing staff not only focus on the content of care but also gradually regard caring for and showing concern for patients as the core of nursing work. They effectively combine nursing operations with nursing services, no longer merely performing nursing operations for patients, but demonstrating the core value of nursing through psychological and physiological care. Through comfort care, they effectively improved the doctor-patient relationship and provided a guarantee for a harmonious medical environment. Moreover, through comfort care, the enthusiasm of patients and the participation of their families were stimulated, and patients and their families established trust in the hospital and doctors. Patients also gained confidence in overcoming diseases, effectively improving their quality of life and, to a certain extent, greatly enhancing the quality of nursing work, laying a certain foundation for the improvement of nursing work.

Limitations

This study has several limitations. Firstly, it was a single-

center design, which may limit the generalizability of the findings. The patient population and clinical practices in this single center may not be representative of those in other settings. Secondly, potential confounders such as baseline nutritional status and comorbidities were not fully controlled for, which may have influenced the observed outcomes. These factors should be considered when interpreting the results and applying them in clinical practice.

Future directions

Future research could focus on larger multicenter studies to validate the findings of this study and enhance their generalizability. Additionally, investigations into long-term outcomes after ICU discharge, such as the impact of early enteral nutrition support combined with comfort nursing on patients' quality of life, functional status, and readmission rates, would be valuable. This would provide a more comprehensive understanding of the long-term benefits of this intervention.

Conclusion

For critically ill ICU patients undergoing ventilator-assisted ventilation, early enteral nutrition support combined with comfort nursing may have potential for broader clinical application. It can effectively reduce the risk of malnutrition and pulmonary infection, enhance immune function, and create convenient conditions for early weaning and early conversion to general wards.

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