Postprint: Research Status on Aspiration Risk in Mechanically Ventilated Patients Receiving Enteral Nutrition

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Abstract

The number of critically ill patients in clinical settings is increasing. For mechanically ventilated patients, enteral nutrition is more physiologically appropriate than parenteral nutrition. Early enteral nutrition constitutes an important adjunctive therapeutic approach for critically ill patients, particularly elderly individuals requiring mechanical ventilation. These patients present with severe conditions, and combined with their stress state, exhibit substantial alterations in nutritional metabolism, fluid and electrolyte imbalances, and disturbances in protein, carbohydrate, and lipid metabolism. Although enteral nutrition can improve patients' nutritional status, complications such as diarrhea, abdominal distension, constipation, gastric content reflux, aspiration, tube obstruction, and hyperglycemia frequently occur, among which aspiration represents one of the most severe complications. Severe aspiration may lead to aspiration pneumonia, increasing patient mortality. This review examines the causes and nursing care of nasogastric feeding aspiration in mechanically ventilated patients to assist clinical healthcare professionals in preventing aspiration events.

Full Text

Preamble

Title: Research Status of Aspiration in Mechanically Ventilated Patients Receiving Enteral Nutrition
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Abstract

The number of critically ill patients in clinical settings is increasing. For mechanically ventilated patients, enteral nutrition is more physiologically appropriate than parenteral nutrition. Early enteral nutrition is an important adjunctive therapy for critically ill patients, particularly elderly patients requiring mechanical ventilation. These patients often present with severe conditions and stress states that cause significant metabolic changes, fluid and electrolyte imbalances, and disturbances in protein, carbohydrate, and fat metabolism. Although enteral nutrition can improve patients' nutritional status, complications such as diarrhea, abdominal distension, constipation, gastric content reflux, aspiration, tube blockage, and hyperglycemia frequently occur. Among these, aspiration is one of the most serious complications, potentially leading to aspiration pneumonia and increased mortality. This review summarizes the causes and nursing care of aspiration during nasogastric feeding in mechanically ventilated patients to help clinical healthcare professionals prevent aspiration events.

Keywords: mechanical ventilation; enteral nutrition; aspiration; research status

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Aspiration is a clinical adverse event in which varying amounts of fluid or small particles inadvertently pass through the glottis into the lower airway, potentially causing aspiration pneumonia, severe asphyxia, and life-threatening consequences. Mechanical ventilation maintains airway patency, improves ventilation and oxygenation, and prevents hypoxia and carbon dioxide accumulation, serving as an effective measure for critically ill patients. However, mechanical ventilation impairs swallowing and cough reflexes, preventing patients from protecting themselves through these mechanisms and making them prone to aspiration. Research indicates that mechanically ventilated patients constitute a high-risk population for aspiration.

1. Cause Analysis

Mechanical ventilation apparatus can stimulate increased respiratory secretions and raise abdominal pressure, contributing to gastric content reflux and aspiration. Before enteral nutrition administration, patients should be repositioned, receive back percussion and chest physiotherapy, and undergo thorough airway suctioning to clear secretions. This prevents post-feeding suctioning from causing coughing and breath-holding, which increase intra-abdominal pressure and trigger reflux. For tracheostomy patients, airway secretions should be cleared before feeding, and suctioning should be minimized for 30 minutes afterward to avoid stimulation-induced vomiting and reflux of gastric contents into the oropharynx and lungs.

The diameter of the gastric tube is critical: wider nasogastric tubes cause greater dilation of the lower esophageal sphincter, increasing aspiration risk.

Conversely, softer tubes improve patient comfort and reduce nasopharyngeal stimulation, decreasing reflux likelihood. Therefore, fine-bore nasogastric tubes with smaller internal diameters and greater flexibility should be used whenever possible. Tube placement depth is also important—tubes should not be inserted too shallowly. The optimal insertion length extends 10 cm beyond the conventional measurement from nose to xiphoid process, positioning the tube tip in the gastric body or pylorus where administered food is less likely to reflux. Continuous feeding methods can reduce aspiration incidence.

Gastric residual volume must be assessed before each feeding, with observations every four hours during feeding. The color and characteristics of gastric contents should be monitored to guide appropriate nursing interventions. If residual volume exceeds 200 ml, indicating gastric retention, the feeding interval should be extended or feeding paused. Alternatively, after aspirating the retained contents, feeding can resume at a reduced volume (10 ml less than the standard amount) while administering prokinetic agents such as domperidone or cisapride to promote gastric emptying.

Feeding volume, method, and temperature significantly affect aspiration risk. Clinical administration methods include bolus feeding, intermittent gravity drip, and continuous pump infusion. Controlling infusion speed prevents sudden gastric distension or pressure spikes that increase esophageal reflux and aspiration. Continuous infusion using enteral nutrition pumps has been shown to significantly reduce aspiration compared to gravity drip methods. The optimal temperature for enteral nutrition formulas is 37–40°C; temperatures that are too cold or too hot can cause gastric discomfort, abdominal pain, and diarrhea.

Insufficient tracheal tube cuff pressure allows subglottic secretions to migrate downward. During vigorous coughing episodes in ventilated patients, inadequate cuff pressure permits reflux of nutritional formula and secretions into the airway. Mechanical ventilation increases intra-abdominal pressure, and improper parameter settings or patient-ventilator asynchrony can cause gastric content reflux. While continuous and intermittent subglottic suction both reduce tracheal cuff-related injury risk and show no significant difference in aspirated secretion volume, continuous suction may increase tracheal mucosal damage. Objective measurement using automatic cuff pressure maintenance devices is recommended to maintain pressure at 25–30 cmH_2O (2.45–2.94 kPa), as subjective measurement may be inaccurate and adversely affect patients.

Micro-aspiration is a “silent” form of aspiration where oropharyngeal secretions or gastric contents pass through microscopic gaps between the cuff and tracheal wall into the lower airway. Regular oropharyngeal suctioning every 4–6 hours can reduce micro-aspiration events.

2. Nursing Care

Pre-intubation Assessment and Tube Selection: Select soft, elastic silicone nasogastric tubes with smaller diameters to improve tolerance and comfort.

Provide comfort measures including oral and nasal care and lip moisturizing to reduce discomfort from immobilization or forced positioning. Studies report that improper positioning during feeding is a risk factor for aspiration pneumonia. Continuous supine or flat positioning and low head-of-bed angles significantly increase reflux and aspiration risk. Conversely, sitting positions increase intra-abdominal pressure and aspiration danger. Research indicates that elevating the head of the bed to 30–45° effectively reduces aspiration incidence.

Sterile Technique and Formula Management: Strict aseptic technique is essential during tube placement and formula preparation. The preparation room must be disinfected, and prepared nutrition solutions should be used within the same day. Operators' hands and patients' skin must be disinfected thoroughly. Feeding pump tubing should be replaced every 24 hours.

Nutrition Selection and Infusion Control: Commonly used formulas include Nutrison, Supportan, and Peptisorb. Nutrison and Supportan are whole-protein enteral formulations with comprehensive, balanced nutrition that are well-tolerated and physiologically appropriate. Peptisorb is a short-peptide formula with lower fat content and osmolarity, offering better tolerance for patients with gastrointestinal dysfunction. X-ray confirmation of tube placement is recommended before feeding, with enteral nutrition initiated within 24–48 hours of admission. Standard gastric or nasogastric feeding is typically used initially, with post-pyloric or deep jejunal feeding considered for patients with poor gastric tolerance or high aspiration risk. After confirming initial tube position, verify correct placement before each feeding, assess feeding tolerance daily, prevent tube dislodgement, and maintain patency. Follow the principle of starting with small volumes, slow rates, and dilute concentrations. Typically begin with glucose saline at 20–30 ml/h, then advance to full-strength formula if no gastrointestinal reactions occur. Monitor bowel sounds every 4 hours to assess gastrointestinal motility. Continuous uniform infusion is preferred, with rates gradually increasing to 80–100 ml/h.

Feeding Positioning: Long-term bed rest slows gastrointestinal motility and delays gastric emptying. The stomach's horizontal position predisposes to food reflux and aspiration. Authoritative literature recommends elevating the head of the bed to 30–45° during feeding to utilize gravity in reducing reflux from the distended stomach to the esophagus. Maintain this position for 30–60 minutes post-feeding and avoid suctioning, turning, or percussion during this period to prevent stimulation-induced coughing and gastric content reflux.

Oral Care: Provide oral care twice daily with dynamic assessment of oral condition, increasing frequency as needed. Select appropriate oral solutions and ensure cotton balls are wrung dry to prevent excess fluid from entering the airway during cleaning. Maintain clean, odor-free oral cavity to prevent infection.

3. Health Education

For conscious patients, provide psychological support to alleviate fear, encourage chewing exercises, maintain communication to understand their needs, and educate them about the importance of enteral nutrition. For sedated patients with endotracheal intubation, provide psychological support during daily awakening periods.

4. Conclusion

Critically ill patients typically present with hypermetabolic states, making nutritional support crucial. Enteral nutrition offers advantages in maintaining gastrointestinal morphology and function, being physiologically appropriate, and allowing convenient administration. Standardized enteral nutrition nursing care for critically ill patients can correct malnutrition, suppress the vicious cycle of immune dysfunction and malnutrition, enhance treatment tolerance, improve immune function, and increase clinical efficacy. Research shows that aspiration, reflux, and upper respiratory infections related to enteral nutrition may prolong treatment and ventilator support duration while increasing mortality. Therefore, implementing effective nursing measures to prevent these complications is essential. Gastrointestinal complications are the most common barriers to successful enteral nutrition, related to both disease conditions and operational standardization. Nasogastric feeding is a safe and effective enteral nutrition method, but improper nursing care in mechanically ventilated patients may cause aspiration leading to asphyxia or aspiration pneumonia. During feeding, careful monitoring of gastric residual volume, positioning, tube and formula selection, infusion rate and volume, cuff pressure, oral care, and medication effects is necessary. Recognizing the relationship between nasogastric feeding and aspiration and implementing practical preventive measures can reduce aspiration incidence, lower aspiration pneumonia rates, improve patient outcomes, and shorten hospital stays.

References

[1] Mi YY, Ming YH, Zhu LQ, et al. Construction of an aspiration checklist for ICU mechanically ventilated patients receiving enteral nutrition based on evidence and evaluation of its application effect[J]. Journal of Nurses Training,
[2] Jiang J, Wang YE, Wang ZJ. Analysis of mechanical ventilation-related factors in respiratory critically ill patients of different age groups in EICU[J]. Journal of Bengbu Medical College,
[3] He B, Ruan HB, He LN. Effect analysis of a bundled comprehensive nursing care protocol in preventing aspiration during enteral nutrition in mechanically ventilated patients[J]. Modern Medicine and Health,
[4] Chen JJ. Nasogastric feeding care for paraplegic patients with tracheostomy[J]. Chinese Journal of Trauma and Disability Medicine,
[5] Shi JF. Brief discussion on cause analysis and nursing intervention of

enteral nutrition aspiration in ICU mechanically ventilated patients[J]. Medical Aesthetics and Cosmetology, Mid-month Issue,
[6] Jiang C, Chen J. Cause analysis and nursing countermeasures of nasogastric feeding reflux and aspiration in ICU mechanically ventilated patients[J]. Chinese and Foreign Health Abstracts,
[7] Wu CY. Cause analysis and nursing countermeasures of nasogastric feeding aspiration in ICU patients[J]. Heilongjiang Medicine,
[8] Tang FY. Cause analysis and nursing experience of tracheostomy nasogastric feeding aspiration[J]. Journal of Practical Traditional Chinese Medicine,
[9] Yao H. Research progress on prevention methods of nasogastric feeding reflux and aspiration in mechanically ventilated patients[J]. Chinese Journal of Modern Nursing,
[10] Zhang YX, Zhang YR, Cao JH. Clinical study on the length of indwelling gastric tube in acute stroke patients with dysphagia[J]. Chinese Journal of Modern Nursing,
[11] Wu JY, Zhu SF, Wu YN. Meta-analysis comparing the efficacy and safety of nasojejunal tube and gastric tube for enteral nutrition in mechanically ventilated patients[J]. Chinese Nursing Research,
[12] Sun C, Wang ZH, Wang X, et al. Meta-analysis of the effect of continuous nasogastric feeding on aspiration pneumonia and related symptoms in critically ill patients[J]. Chinese Journal of Modern Nursing,
[13] Zhan YX, Yang ZS, Xu NN, et al. Summary of best evidence for aspiration prevention in enteral nutrition support for neurosurgical ICU patients[J]. Journal of Nursing Science,
[14] Leng K, Luo YQ, Zeng PF. Clinical study on enteral nutrition support for severe acute pancreatitis[J]. Chinese Journal of General Surgery,
[15] Jin K, Wang YJ, Wang ZR. Observation on the efficacy of early enteral nutrition in patients with severe acute pancreatitis[J]. China Medicine,
[16] Pang XL, Cai TT, Zhu CQ. Meta-analysis of the effect of continuous versus intermittent subglottic suction on prevention of ventilator-associated pneumonia[J]. Chinese Journal of Emergency and Critical Care Nursing,
[17] SOLE ML, TALBERT S, YAN X, et al. Nursing oral suction intervention to reduce aspiration and ventilator events (NO-ASPIRATE): a randomized clinical trial[J]. J Adv Nurs,
[18] Zhang T, Ye H, Shuai QY. Analysis of related factors and nursing care of enteral nutrition aspiration in mechanically ventilated patients[J]. China Health Care & Nutrition,

Note: Figure translations are in progress. See original paper for figures.