

## Research Article

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# Nasointestinal tube in mechanical ventilation patients is more advantageous

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**Abstract:** Objective: To assess the effects of two different nutritional mode on the occurrence of ventilator-associated pneumonia (VAP) in patients on mechanical ventilation. Methods: 70 patients admitted to the ICU and under mechanical ventilation, were randomly divided into the nasointestinal tube group and nasogastric tube group. Patients from both groups received enteral nutrition, using the same nutritional agent, through intubation. The duration of stay in the ICU, duration of mechanical ventilation, incidence of VAP, nutritional state, and survival of the intestinal tract were compared between the two groups. Results: The duration of stay in the ICU, duration of mechanical ventilation and incidence of VAP in the nasointestinal tube group was lower than that in the nasogastric tube group ( $P < 0.05$ ). There was an increase in the levels of prealbumin and transferrin in the nasointestinal tube group ( $P < 0.05$ ). However, there were no obvious difference in the nasogastric tube group ( $P < 0.05$ ). The incidence of abdominal distension, diarrhea, regurgitation, aspiration, and hyperglycemia in the nasointestinal tube group was much lower than that in the nasogastric tube group ( $P < 0.05$ ). Conclusion: This study showed that enteral nutrition delivery using a nasointestinal way can effectively reduce the incidence of VAP and improve the nutritional status of patients under mechanical ventilation.

**Keywords:** Ventilator associated pneumonia; Nasogastric nutrition; Nasointestinal nutrition; Mechanical ventilation

## 1 Introduction

Nosocomial pneumonia is the second most prevalent nosocomial infection in hospital in-patients, with ventilator-associated pneumonia (VAP) being the leading nosocomial infection in patients admitted to the intensive care unit (ICU). Studies have shown that the incidence of VAP in mechanically ventilated patients is between 9% and 69%, which is four times higher than that in patients admitted to the normal ward [1]. VAP can significantly extend the duration of mechanical ventilation, is associated with increased morbidity and mortality, consumes large amounts of health care resources, and increases social and economic burden [2]. Although significant progress has been made over the past two decades in the management of VAP, several issues remain unresolved, and mortality rates continue to be high at 30-40% [3]. Therefore, VAP continues to be a disturbing problem in the care of ICU-patients under mechanical ventilation. Enteral nutrition is an important part of the treatment in patients on ventilation, and can improve the nutritional status and immune function in critically ill patients. It is also an important factor in the prevention of the occurrence of VAP. There exists a close relationship between the mode of delivery of enteral nutrition and the occurrence of VAP. Oropharyngeal secretions or reflux and aspiration of gastric contents are considered important factors in the occurrence of VAP [4]. Though numerous studies have focused on the diagnosis and treatment of VAP, few have focused on identifying routes of nutrient administration that can reduce the incidence of VAP. Therefore, the primary objective of this study was to confirm the possible differences in the incidence of VAP resulting from the use of nasogastric and nasointestinal tubes for nutrition delivery in patients under mechanical ventilation. We further

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aimed to determine the effectiveness of each of these nutritional delivery methods in reducing the incidence of VAP and mortality.

## 2 Materials and methods

### 2.1 Criteria for case selection

VAP refers to pneumonia that occurs more than 48-72 hours after intubation with no evidence of pneumonia at the time of intubation, or the diagnosis of a new pulmonary infection if the initial ICU admission was for pneumonia. Early-onset VAP is defined as the onset of VAP after 48 h but before 5 days after intubation. Late-onset VAP is defined as the onset of VAP 5 days after intubation [5].

### 2.2 Methods

70 patients (42 men, 28 women, age:  $52.9 \pm 12.4$  years, range: 35-70 years) admitted to the ICU of our hospital between January 2016 and November 2017 and who were under mechanical ventilation for more than 48 h were included in this study. The patients suffered from traumatic brain injury (22 cases), heart disease (18 cases), multiple severe combined injuries (9 cases), respiratory failure (8 cases), cerebral hemorrhage (5 cases), neoplastic disease (4 cases), and other diseases (4 cases). Signed informed consent, on behalf of the patients, was obtained from the family members. Based on the hospital admission identification number and using a pseudo-random number table, the 70 patients were randomly and equally divided into two groups: the nasointestinal and the nasogastric groups. There were no statistically significant differences between the two groups with respect to gender, age, underlying disease, severity, etc. ( $P > 0.05$ ).

The enteral nutrition administered to the patients was produced by KangYuan (Beijing) Technology Co., Ltd. The quantity of nutrition administered to the patients was calculated based on the standard formula of  $100 \text{ kJ} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$ . Enteral nutrition was delivered using a pump system. Nasointestinal tube was placed into the descending part of duodenum and the nasogastric tube was placed at the fundus of the stomach. The nutrient was delivered at a rate of  $20 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$ , six times a day. The maximum drip rate was never more than 125 ml/h.

Ethical approval: The research related to human use has been complied with all the relevant national regulations, institutional policies and in accordance the tenets

of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent committee.

### 2.3 Statistical analysis

All recorded data and results are expressed as mean  $\pm$  SD, median (interquartile range).  $P$  value  $< 0.05$  is considered significant. Statistical analyses were conducted using SPSS version 19.0 software. An independent sample  $t$  test was used to compare the data between the two groups. The count data between the two groups were compared using the  $\chi^2$  test. Logistic regression analysis was used to evaluate the correlation between the two sets of data.

## 3 Results

### 3.1 Baseline characteristics of patients from the nasogastric tube and nasointestinal tube groups (Table 1)

There were no significant differences in the basic characteristics of the two groups of patients included in the study.

### 3.2 Comparative analysis of mechanical ventilation and VAP incidence

The durations of ICU stay and mechanical ventilation were lower for the nasointestinal tube group than for the nasogastric tube group ( $P=0.036$ , Figure 1a). The incidence of VAP was significantly lower for the nasointestinal tube group than for the nasogastric tube group ( $P=0.018$ , Figure 1b).

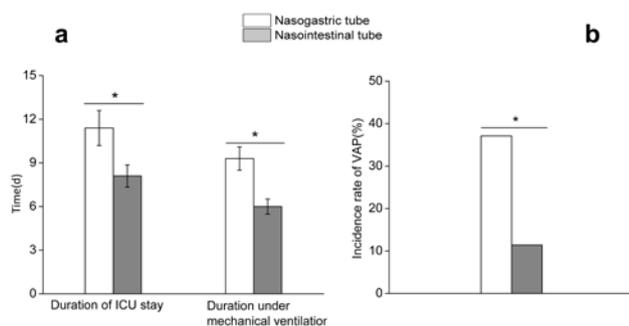
### 3.3 Comparative analysis of nutritional status

An increase in the levels of prealbumin and transferrin was observed in both the groups after the administration of enteral nutrition. At the same time, the levels of prealbumin and transferrin in the nasointestinal tube group were higher after reception of enteral nutrition than before ( $P = 0.038$ , Figure 2a). However, there was no significant difference of the level of prealbumin and transferrin

**Table 1:** Baseline characteristics of patients

	Nasogastric group	Nasointestinal group	P value
Gender (M/F)	22/13	20/15	0.625
Age (years)	54.1±12.1	51.7±12.7	0.415
Basic disease			
Brain Injury	9	13	0.302
Heart disease	11	7	0.272
Complex trauma	6	3	0.280
Respiratory failure	5	3	0.450
Cerebral hemorrhage	2	3	0.642
Malignant	1	3	0.293
Other diseases	1	3	0.293
APACHE* score	17.8 ± 1.3	18.1 ± 1.3	0.404

\*APACHE: Acute physiology and chronic health evaluation

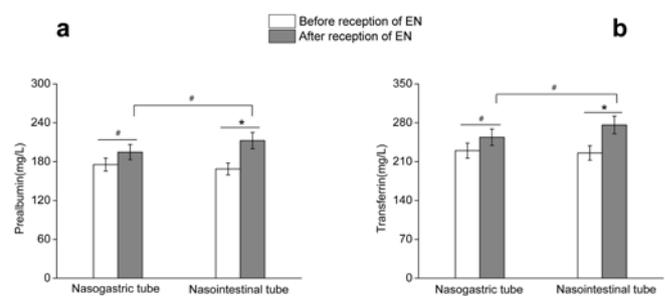


**Figure 1:** The durations of ICU stay and mechanical ventilation in the nasointestinal tube group were shorter than that in the nasogastric tube group (Fig 1a). The incidence of VAP were significantly lower for the nasointestinal tube group than for the nasogastric tube group (Fig 1b).

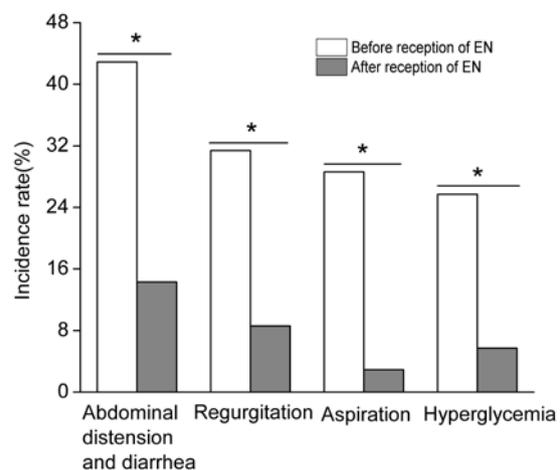
in the nasogastric tube group before reception of enteral nutrition and after it respectively ( $P=0.061$ , Figure 2 b).

### 3.4 Analysis of intestinal tolerance

The incidence of bloating & diarrhea, reflux, aspiration, and hyperglycemia in the nasointestinal tube group was significantly lower than that in the nasogastric tube group ( $P < 0.05$ , Figure 3).



**Figure 2:** The level of prealbumin and transferrin increased in both groups after the administration of enteral nutrition. There was an increase in the levels of prealbumin and transferrin in the nasointestinal tube group (Fig 2a). However, there were no obvious difference in the nasogastric tube group (Fig 2b).



**Figure 3:** The incidence of bloating & diarrhea, reflux, aspiration, and hyperglycemia in the nasointestinal tube group was significantly lower than that in the nasogastric tube group.

### 3.5 Incidence of aspiration and VAP

Of the 70 patients from the study, aspiration occurred in 11 patients and VAP in 17 patients. The incidence of VAP in patients with aspiration was significantly higher than that in patients without aspiration. This implies that aspiration can induce VAP. A significant correlation was observed between aspiration and VAP. Logistic regression analysis showed the aspiration rate to be a factor of VAP ( $B = 1.656$ ,  $p = 0.017$ ); the relative ratio was 5.236. (Table 2)

## 4 Discussion

VAP is one of the most common complications observed in patients under mechanical ventilation. It has previously been reported that the use of vasoactive drugs, nasogastric nutrition, and duration of mechanical ventilation are important causes of VAP [6]. Previously, a large number of clinical studies have focused on the diagnosis and treatment of VAP. Few studies have focused on methods to reduce the incidence of VAP by changing the route of administration of nutrients in mechanically ventilated patients.

Malnutrition and low immunity are the most common complications in critically ill patients admitted to the ICU. Mechanical ventilation increases the nutrient consumption, which leads to disease progression and further infection. Therefore, in terms of management of the disease, nutritional support is a key issue. On one hand, it can reduce the decomposition of protein and increase protein synthesis, which increases the potential and occurrence of malnutrition. On the other hand, a good nutritional status helps to increase immunity and reduce the risk of infection. At present, nasointestinal nutrition and nasogastric nutrition are the most common methods of nutritional support. Previous studies have suggested that an enteral nutrition catheter can directly damage the gastro-esophageal sphincter, lead to regurgitation, and increase the incidence of VAP [7]. At the same time, enteral nutrition increases the possibility of aspiration, and previous studies have shown that enteral nutrition is an independent factor for VAP occurrence [8]. However,

there are many benefits associated with enteral nutrition, such as nutrition being absorbed directly. The physiological effects of effective enteral nutrition include improved nutritional status in critically ill patients, protection of the gastrointestinal tract, and prevention of bacterial translocation and multiple organ failure.

However, inappropriate enteral nutrition can lead to VAP, whose mechanisms include reflux of stomach contents, bacterial colonization in the stomach, and shift of the duodenum towards the airways [1,9]. It has been demonstrated that the use of gastric mucosal protective agents that can adjust the stomach pH and prevent reflux of stomach contents is ineffective in the treatment of VAP, while the use of oral antimicrobials can prevent the occurrence of VAP [10]. In addition, positive pressure ventilation changes the chest pressure, and indirectly increases the intra-abdominal pressure, which further increases the chances of gastroesophageal reflux and the risk of VAP [11]. In our study, we observed that there exists an obvious correlation between aspiration and VAP. The incidence of VAP in patients with aspiration is about 5.2-fold higher than that in patients without aspiration. Therefore, an appropriate mode of enteral nutrition can improve the prognosis of critically ill patients. However, the reported study showed that enteral nutrition volume is not correlated with lower respiratory tract infection in patients on mechanical ventilation, which indicated the way of enteral nutrition is more closely related to ventilator-associated pneumonia [12].

A previous study showed that the rate of VAP in patients who were nasoduodenal fed was 10%, whereas the rate of VAP in patients who had nasogastric feeding was 20%, which indicated nasoduodenal feeding helped to reduce the incidence of VAP [13]. Our study shows that, compared to nasogastric enteral nutrition, nasointestinal enteral nutrition can significantly reduce the incidence of intestinal reflux, aspiration, bloating, diarrhea, high blood sugar and other complications, and enhance intestinal tolerability. Nasointestinal enteral nutrition can also significantly improve the levels of plasma prealbumin and transferrin. Prealbumin and transferrin are important indicators used to evaluate the nutritional status of the patient and the effects of nutritional support. Existing literature shows that nasointestinal nutrition can not only

**Table 2:** Incidence of aspiration and VAP

Group		VVAP incidence	VAP number	$\chi^2$	$P$
Aspiration	Yes (11)	54.5%	6	5.691	0.017
	No (59)	18.6%	11		

increase the levels of nutrition indicators, such as prealbumin and transferrin, but also reduce the production of inflammatory markers, such as interleukin-6 (IL-6) and tumor necrosis factor (TNF)- $\alpha$  [14].

Our results suggest that nasointestinal nutrition can significantly shorten the ICU stay and duration of mechanical ventilation, as well as reduce the incidence of VAP. The nasogastric nutrient solution can increase the stomach pH, which is conducive to bacterial reproduction, and consequently induce VAP [15]. In addition, nasogastric tubes are more likely to cause reflux and vomiting, which leads to colonization of bacteria in the mouth and reflux of gastric contents into the lungs, and results in VAP. Nasoduodenal feedings achieved nutritional goals earlier than those who received nasogastric feeding, and nasoduodenal feeding group has a lower rate of vomiting and VAP in the medical ICU setting [16].

In summary, nasointestinal nutrition can improve the nutritional status of patients and improve the prognosis of the patients under mechanical ventilation. Furthermore, it can reduce reflux, aspiration, and other adverse reactions, thereby decreasing the incidence of VAP. Therefore, the nasointestinal way is more effective and safer than the nasogastric tube in patients requiring enteral nutrition.

**Conflict of interest statement:** The authors confirm that this article content has no conflict of interests

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