

Research Article

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The effects of gastrointestinal function on the incidence of ventilator-associated pneumonia in critically ill patients

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Abstract: Objective. To investigate the effect of gastrointestinal function on the incidence of ventilator-associated pneumonia (VAP) in critically ill patients. Methods. From August 2012 to June 2016, 160 critically ill patients in the ICU (Intensive Care Unit) of our hospital were selected as the research group; patients were divided equally into an observation group and a control group, 80 patients in each group, based on the random draw envelope principle. The control group was given a nasogastric tube for gastric feeding, the observation group was given a dual lumen gastrointestinal enteral device for gastric feeding; the two groups' enteral nutrition observation time was 7d; any changes in patient condition and prognosis were recorded. Results. The pH value of gastric juice in the control group and the observation group was 6.13 ± 1.38 and 4.01 ± 1.83 , respectively; the pH for the observation group was significantly lower than that of the control group ($t=4.982$, $P<0.05$). The incidence of VAP in the observation group and the control group was 2.5% and 12.5%, respectively; the VAP for the observation group was significantly lower than that of the control group ($P<0.05$). The serum levels of pre-albumin and albumin after feeding in the two groups were significantly higher than before feeding ($P<0.05$); the serum levels of pre-albumin and albumin in the observation group after feeding were significantly higher than those in the control group ($P<0.05$). The mechanical ventilation time and ICU length of stay in the observation group were 9.12 ± 2.13 days and 12.76 ± 1.98 days, respectively, significantly lower than those of the control group of 10.56 ± 2.89 days and 16.33 ± 2.11 days ($P<0.05$). Con-

clusion. Obstacles to gastrointestinal function in critically ill ICU patients are common; enteral gastric feeding by dual lumen gastrointestinal for can improve the patient's nutritional status, promote and maintain the normal pH value of gastric juice, thereby reducing the incidence of VAP through rehabilitation of patients.

Keywords: Critically ill patients; Ventilator-associated pneumonia; Gastrointestinal function; Albumin; Gastric juice pH value

1 Introduction

Ventilator-associated pneumonia (VAP) is a pulmonary infection that occurs in patients with respiratory failure after primary mechanical ventilation for 48 hours (h) or extubation within 48h [1,2]. Some studies have shown that in critically ill ICU patients account for about 1/3 of the hospital infection rate; once VAP occurs it involves difficult weaning and a prolonged hospital stay, as well as a mortality rate over 10% [3,4]. In patients with critical illness, mechanical ventilation cannot be used for oral feeding to meet their nutritional and metabolic needs, and enteral nutrition intervention is needed [5]. In most critically ill patients, the body is in a state of high stress, mostly resulting from gastrointestinal dysfunction. This makes the patient prone to local microcirculatory disturbance of the gastric mucosa, which then requires increased nutritional support. Enteral nutrition can help patients undergoing mechanical ventilation treatment: it is a part of their treatment and is closely related to prevention and treatment of ventilator-associated pneumonia. However, which method of supplying enteral nutrition can better prevent the occurrence of ventilator-associated pneumonia has become the focus of ICU ward research. Studies have shown that nutritional adjustment can reduce the changes in metabolism such as high metab-

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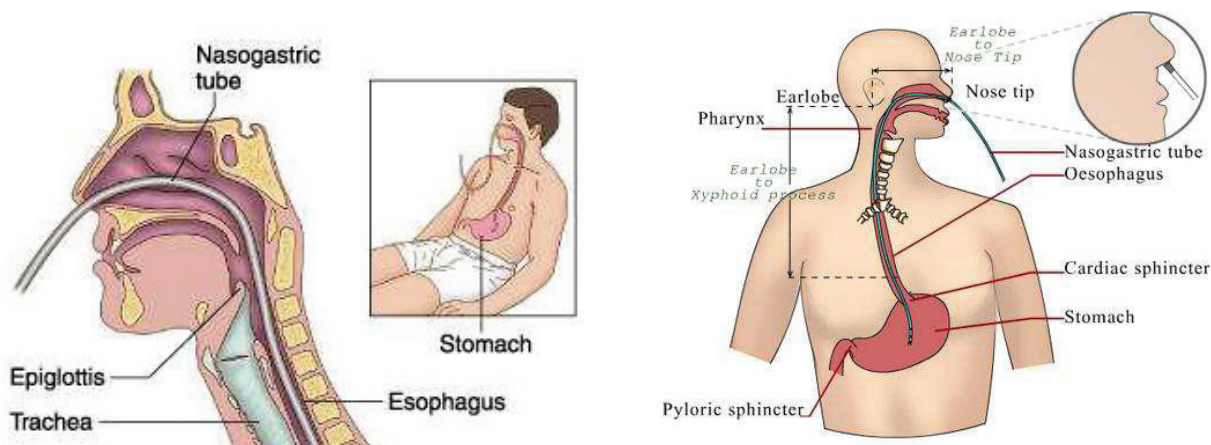


Figure 1: Left, nasogastric feeding route; Right, is gastrointestinal double lumen tube fed the intestinal tract.

juice was recorded. (2) Ventilator-associated pneumonia: judging by the diagnostic criteria of Chinese Medical Association Respiratory Disease Branch, and it will be determined at least 2 items appeared during mechanical ventilation, as following VMA: arterial oxygen partial pressure decreased unexplained during mechanical ventilation, PaO_2/FiO_2 and $>30.0\%$ decreased; the body temperature rises to more than 38 deg C; chest X-ray showed new exudative lesions; endotracheal aspirates purulent secretions, and bacterial culture (+). (3) Nutritional index test: serum prealbumin (PA) and serum albumin (ALB) were detected before and after enteral nutrition support in all patients. (4) Prognosis: observe and record the two groups of mechanical ventilation time and ICU hospitalization time.

2.4 Statistical method

SPSS20.00 software was used for statistical data analysis, measurement data using standard deviation ($\bar{x} + s$), t-test and paired t-test compared with the independent sample data, and count data expressed as a percentage, compared with the chi square analysis; $P < 0.05$ represents a significant difference.

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.

Informed consent: Informed consent has been obtained from all individuals included in this study.

3 Results

3.1 Comparison of pH values in gastric juice

The gastric juice pH values of the control group and the observation group during enteral nutrition were 6.13 ± 1.38 and 4.01 ± 1.83 respectively; the value for the observation group was lower than that for the control group ($t=4.982$, $P < 0.05$).

3.2 VAP incidence comparison

After observation, the incidence of VAP in the observation group and the control group during enteral nutrition was 2.5% and 12.5%, respectively; that for the observation group was significantly lower than that for the control group ($P < 0.05$) (Table 2).

3.3 Comparison of nutritional indexes

After testing, the two groups after nutritional support of serum prealbumin and albumin values were signifi-

Table 2: Comparison of incidence of VAP between two groups (n)

| Group | Number of cases (n) | VAP | Incidence of VAP |
|-------------------|---------------------|-----|------------------|
| Observation group | 80 | 2 | 2.5% |
| Control group | 80 | 10 | 12.5% |
| χ^2 | | | 3.878 |
| P | | | < 0.05 |

cantly higher than before nutritional support ($P < 0.05$); we observed that the serum prealbumin and albumin values the nutritional support group of were significantly higher than those in the control group ($P < 0.05$) (Table 3).

3.4 Comparison of mechanical ventilation time and ICU hospitalization time

After observation, the observation group’s mechanical ventilation time and ICU hospitalization time were $9.12 \pm 2.13d$ and $12.76 \pm 1.98d$, all significantly lower than the control group’s $10.56 \pm 2.89d$ and $16.33 \pm 2.11d$ ($P < 0.05$). (Table 4).

3.5 Discussions

VAP is the most common infectious complication in critically ill patients: the incidence rate is as high as 10%, and the fatality rate is about 20%. For this reason, we mainly strengthened the preventive support intervention in our clinic [11]. At the same time, during mechanical ventilation of critically ill patients the metabolic needs of the body must be met to ensure the intake of drugs and nutrients; to promote physical rehabilitation, increased nutrition intervention is necessary [12].

Patients undergoing mechanical ventilation who are unable to ingest food orally can have a major clinical intervention through gastrointestinal nutrition, but that also increases the risk of reflux and aspiration of gastric contents. In critically ill patients, there is often a gastrointestinal motility disorder, and reflux and inhalation of gastric contents can also cause VAP [13,14]. The occurrence of VAP causes difficulty in weaning, prolongs hospitalization time, and affects the life of patients. Therefore, corresponding preventive measures should be taken to reduce gastric reflux, avoid inhalation of oropharyngeal secretions, regularly check whether the gastric tube is properly placed and observe the intestinal motility, adjust feeding volume and speed, and avoid reflux occurs of gastric contents. In the gastrointestinal double lumen tube feeding through the intestine, food enters the intestinal tract directly, avoids food going into the stomach, stimulates the gastric acid secretion process, achieving thereby a better acid-suppression effect. The present study showed that the pH value of gastric juice during enteral nutrition in the control group and the observation group was 6.13 ± 1.38 and 4.01 ± 1.83 , respectively, and that in the observation group was significantly lower than that of the control group ($t = 4.982$, $P < 0.05$). At the same time, using a gastrointestinal double lumen tube by enteral feeding and gastrointestinal decompression residue monitor inside the stomach reduces the probability of gastric mucosal

Table 3: Comparison of nutrition index (standard plus standard deviation) between two groups before and after nutritional support

| Group | Number of cases (n) | Prealbumin (mg/L) Pre nutritional support | After nutritional support | t | P | Prealbumin (mg/L) Pre nutritional support | After nutritional support | t | P |
|-------------------|---------------------|---|---------------------------|-------|-------|---|---------------------------|--------|-------|
| Observation group | 80 | 0.11±0.06 | 0.16±0.08 | 8.348 | <0.05 | 23.49±4.22 | 29.48±3.54 | 10.584 | <0.05 |
| Control group | 80 | 0.11±0.09 | 0.14±0.10 | 5.113 | <0.05 | 23.19±5.29 | 26.11±4.28 | 5.184 | <0.05 |
| t | | 0.000 | 3.456 | | | 0.453 | 5.295 | | |
| P | | >0.05 | <0.05 | | | >0.05 | <0.05 | | |

Table 4: Contrasting mechanical ventilation time and ICU hospitalization time (D, standard + standard deviation)

| Group | Number of cases (n) | Mechanical ventilation time | ICU hospitalization time |
|-------------------|---------------------|-----------------------------|--------------------------|
| Observation group | 80 | 9.12±2.13 | 12.76±1.98 |
| Control group | 80 | 10.56±2.89 | 16.33±2.11 |
| t | | 3.224 | 4.891 |
| P | | <0.05 | <0.05 |

erosion; it can also maintain intestinal integrity, reduce bacterial translocation, and can meet the needs of enteral nutrition [15].

VAP is caused by gastric or oropharyngeal secretions with trace contamination of pathogenic bacteria in the lower respiratory tract; this can cause aspiration in critically ill patients; ventilator-dependent acid suppression therapy will increase the chance of occurrence of pneumonia [16]. Studies have shown that the gastropulmonary infection pathway plays a very important role in mechanical ventilation in patients with VAP. Routine nutritional support is prone to gastroesophageal reflux, and bacteria in the stomach enter the respiratory tract with reflux, leading to the occurrence of VAP [17]. This study showed that the incidence of VAP in the observation group and the control group during enteral nutrition was 2.5% and 12.5%, respectively, and that in the observation group was significantly lower than that in the control group ($P < 0.05$). In the observation group with gastrointestinal double lumen tube by enteral feeding in the stomach makes the solution quantity reduced, thereby reducing the reflux and bacterial growth opportunities, reduce the incidence of VAP; and its intermittent acid induced transient increase, avoid regurgitation of gastric contents into the respiratory tract and reduce the risk of VAP [18,19].

Patients with mechanical ventilation are prone to gastrointestinal disorders due to positive airway pressure, because the air shortage caused by swallowing reflex hyperfunction can also cause regurgitation and aspiration, cause or worsen lung infection, upon prolonged mechanical ventilation [20]. Dual lumen gastrointestinal after enteral feeding helps to maintain the pH value of gastric juice in the normal range, helping to inhibit the growth of digestive tract bacteria [21]; it can meet the nutritional needs of patients with a short period of time, can avoid the excessive expansion of the stomach to reflux. This study shows that two groups of nutritional support after the serum prealbumin and albumin values were significantly higher than before nutritional support ($P < 0.05$), and we observed that the nutritional support group of serum prealbumin and albumin values were significantly higher than those in control group ($P < 0.05$). That also shows that the dual lumen gastrointestinal after enteral feeding can improve the body's nutritional status. Most of the patients with mechanical ventilation are critically ill, and the operation of the endotracheal intubation puts the body in a highly stressed state. Improving the gastrointestinal function of critically ill patients can help reduce the rate of gastric reflux and lung infection [22-23]. This study shows that the mechanical ventilation time and ICU

of the observation group hospitalization time were $9.12 + 2.13d$ and $12.76 + 1.98d$, are significantly lower than the control group of $10.56 + 2.89d$ and $16.33 + 2.11d$ ($P < 0.05$), also improve the gastrointestinal motility of patients can promote the rehabilitation of patients.

In short avoiding some obstacles to gastrointestinal function in critically ill ICU patients, gastrointestinal double lumen tube enteral feeding can improve the patient's nutritional status, promote and maintain the normal pH value of gastric juice, thereby reducing the incidence of VAP and assist the patient's rehabilitation.

Declaration of conflict of interest: The authors declare that there are no conflicts of interest.

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