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Talking about Prevention and Control Nursing of Ventilator-Associated Pneumonia

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Abstract: Ventilator-associated pneumonia (VAP) refers to the infection of lung parenchyma in patients undergoing endotracheal intubation or tracheotomy after receiving mechanical ventilation for 48 h, which is the most common complication of patients undergoing mechanical ventilation and has a high mortality rate (21.2%-43.2%). At present, the main measures to prevent and control VAP are to strictly implement hand hygiene, strengthen oral care, raise the bedside, effectively remove secretions from the airbag, implement airbag management and ventilator circuit management, carry out enteral nutrition and cluster intervention strategies according to the actual situation of hospitals. This article reviews the characteristics, diagnosis, prevention and control of VAP, aiming to provide reference for better prevention and control of VAP.

Keywords: Ventilator-Associated Pneumonia; VAP; Prevention; Control; Nursing

Ventilator-associated pneumonia (VAP) refers to the infection of lung parenchyma in patients with endotracheal intubation or tracheotomy after 48h of mechanical ventilation and within 48 h of weaning and extubation. VAP is the most common complication of patients with mechanical ventilation and the main type of nosocomial infection in ICU. The morbidity of VAP in patients with mechanical ventilation is 9.7%-48.4%, and the fatality rate is 21.2%-43.2%. If the combined pathogenic bacteria are multi-drug resistant bacteria, the fatality rate can be as high as 38.9%-60.0%. It can be seen that the occurrence of VAP increases the fatality rate, makes it difficult to go offline, prolongs the hospital stay, increases the medical expenses, etc. It plays a key role to take effective preventive and nursing measures. This article reviews the characteristics, diagnosis, prevention and control of VAP, aiming to provide reference for better prevention and control of VAP.

1. Characteristics of VAP

1.1 Etiology and pathogenesis

1.1.1 Eharacteristics of pathogenic bacteria

Gram-negative bacilli accounted for 80% of the pathogens of VAP, and 20% were Gram-positive cocci, and many of them were complicated with drug-resistant bacteria infection and multiple infections. In 2018, “Guidelines for Diagnosis and Treatment of Acquired Pneumonia and Ventilator-associated Pneumonia in Chinese Adult Hospitals” (referred to as “Guidelines”) pointed out that the top 4 pathogens causing VAP in tertiary hospitals in China were Acinetobacter baumannii, Pseudomonas aeruginosa, Klebsiella pneumoniae and Staphylococcus aureus.

1.1.2 Route of infection

The pathogenic bacteria causing VAP mainly come from endogenous (bacteria that suck secretions in oro-

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pharynx and subglottal or reflux through gastric juice, etc.) and exogenous (hands of medical staff and medical facilities related to ventilators, etc.). Among them, the colonization and translocation of endogenous potential pathogenic bacteria are the main infection routes causing VAP, and inhalation transmission is the main transmission route.

1.1.3 Pathogenesis

The main mechanism of VAP is that oropharynx secretion and gastrointestinal reflux enter the lung, bacterial biofilm on the tracheal wall falls off, damaged oropharynx and respiratory defense system, respiratory loop bacteria and environmental pollution bacteria enter the lower respiratory tract, etc. There are two main ways for bacteria to invade the lower respiratory tract, one is endogenous VAP: Accidentally inhaled oropharyngeal secretions, gastrointestinal reflux and bacterial biofilm shedding cause VAP through endogenous ways; The other type is exogenous VAP, which is mainly triggered by the following exogenous factors, such as high bacterial concentration in ICU ward, inadequate implementation of respiratory loop management and hand hygiene of medical staff, and lax implementation of visiting system and aseptic operation technology in ICU ward.

1.2 Risk factors of VAP

VAP is caused by many factors, mainly including the following risk factors: First, the patient's own factors, such as the patient's advanced age, impaired immune function, combined with diabetes, malignant tumors and other basic diseases; The second is iatrogenic factors, such as medical operation technology, treatment and nursing methods and drug factors; Third, the mechanical ventilation time is long, the balloon pressure of balloon catheter is low, as well as the use of sedative muscle relaxants, endotracheal intubation after weaning failure, antibiotics used, nasogastric tube indwelling, long-term total parenteral nutrition, long-term supine position, etc.

2. Progress in diagnosis of VAP

2.1 Clinical diagnosis

At present, there is no clear gold standard for VAP diagnosis at home and abroad. China's 2018 guidelines point out that when mechanical ventilation is ⩾ 3 days, if imaging (including X-ray and CT) shows that the lungs have new or progressive consolidation, infiltration or ground glass-like imaging compared with the latest lung imaging and two of the following three articles are combined, the clinical diagnosis can be established: (1) Peripheral blood leukocytes > 10×109/L or < 4 ×109. (2) Body temperature > 38℃; (3) Purulent secretion.

2.2 Etiological diagnosis

On the basis of clinical diagnosis, pathogenic bacteria were cultured by bronchoscope anti-pollution brush, bronchoalveolar lavage fluid, lung tissue or sterile body fluid. There are purulent respiratory secretions from one or more samples: sputum culture ⩾ 105 cfu/ml; Bronchoalveolar lavage culture ⩾ 104 cfu/ml; Lung tissue culture ⩾ 104 cfu/ml; Protective brush culture ⩾103 CFU/ml. And it was consistent with clinical manifestations.

3. VAP prevention and control nursing

3.1 Basic measures

3.1.1 Strict hand hygiene

Hand hygiene is the most economical and convenient way to prevent VAP. Proper use of alcohol disinfectant to wash hands can reduce the incidence of nosocomial infection by 40%, and strict hand hygiene can reduce the incidence of VAP. The US Centers for Disease Control and Prevention recommends that medical staff should carry out strict hand hygiene, including hand washing and alcohol disinfection. Five opportunities for hand hygiene in clinic are: (1) Before contacting patients. (2) Before cleaning or aseptic procedure. ① Before nursing patients with oral and nasal cavity, endotracheal intubation and gas cutting sleeve (before wearing clean gloves); ② Before sputum aspiration through artificial airway or bronchoalveolar lavage (before wearing sterile gloves). (3) After contact with body fluids of patients. ① After oral and nasal care, endotracheal intubation and tracheotomy; ② After aspiration in airway, respiratory sampling or other articles contaminated by respiratory mucosa and respiratory secretions; ③ Patients were given tracheal intubation or tracheal intubation removal operation. (4) After contacting with patients. (5) After contacting the patient's surroundings (before leaving the patient bed unit).

3.1.2 Raising the head of a bed

The supine position is an independent risk factor for VAP. In the relevant guidelines, raising the bedside by 30° to 45° is regarded as a basic measure to prevent VAP. In the process of clinical implementation, we can improve the compliance of bedside elevation through standardized doctor's advice, reminding, supervision and feedback, education and training, and quality control circle.

3.1.3 Oral care

Patients after endotracheal intubation should receive oral care in time, but there is no evidence to clearly support the frequency of oral care for critically ill patients. Patients with mechanical ventilation through endotracheal intubation should be given oral care by washing and scrubbing. After oral care, they should be sucked in the mouth in time. Patients with endotracheal intubation should be given oral care by two persons. The depth of endotracheal intubation should be evaluated before and after operation. The bedside should be raised by 30° to 45° before operation, and the air bag pressure should be maintained at 25-30 cm H2O after operation. Compound chlorhexidine gargle can inhibit the adhesion and growth of bacteria in oral cavity, and reduce the formation of dental plaque. However, oral care with glucose chlorhexidine solution is still controversial, and further clinical practice and research are needed.

3.2 Effectively removal secretions from air bags

3.2.1 Aspiration of subglottic secretion

The retention in the balloon of patients with endotracheal intubation enters the lung and causes VAP. Studies have confirmed that subglottic suction can significantly reduce the occurrence of VAP. It is recommended to use a catheter with subglottic secretion drainage for patients whose expected endotracheal intubation time may exceed 48 h or 72 h. The purpose of subglottic secretion suction is to remove the retention on the balloon, which is mainly through continuous or intermittent negative pressure drainage of the retention on the balloon by using the drainage tube attached to the endotracheal tube wall. It can shorten the mechanical ventilation time and effectively reduce the occurrence of VAP. However, at present, domestic experts have not formulated standardized and unified operation procedures and standards, and have not issued relevant guidelines on the definition of negative pressure range. The greater the suction negative pressure value, the more complications such as airway mucosa damage, bleeding and even choking cough. Subglottic secretion suction includes continuous subglottic suction and intermittent subglottic suction. To prevent mucosal injury, it is recommended to use intermittent subglottic suction to intermittently suck the secretion on the balloon with constant negative pressure, which can be sucked by 10 ml syringe every hour or intermittent central negative pressure of 100~150ml every 2 hours.

3.2.2 Monitoring airbag pressure

The residue on air bag is an important source of VAP pathogen, and managing air bag is one of the important means to reduce VAP. In 2014, the expert consensus of artificial airway airbag recommended that the airbag pressure should be maintained at 25-30 cm H2O. The research shows that by comparing the finger touch method with the pressure gauge method, it is found that the finger touch method has inaccurate pressure and many complications. Therefore, it is suggested that the finger touch method based on experience should not be used to inflate the airbag in clinic, but should be monitored by pressure devices, such as hand-held manometer method, traditional pressure gauge, automatic continuous monitoring and control device, etc., especially the automatic inflator keeps the best airbag pressure. When using the balloon manometer to monitor the intermittent balloon pressure, it should be re-measured every 6-8 h, and the inflation pressure should be higher than the ideal value of 2 cm H2O every time. It should be re-measured after sputum suction with cleaning up the accumulated water in the pressure tube and changing the patient's position.

3.3 Enteral nutrition

In "Guidelines for Prevention of Ventilator-associated Pneumonia" issued by CDC in 2015, enteral nutrition is clearly regarded as one of the important measures to prevent VAP clustering strategy. Scientific and standardized enteral nutrition nursing is an important measure to prevent VAP in critically ill patients, which mainly includes: (1) Selection of feeding route. For medical institutions with high feasibility of opening small intestine access, or those with certain difficulties, it

is recommended that people with poor tolerance to stomach nutrition (such as continuous application of sedatives, anesthetics and large amount of stomach retention) and high risk of reflux (such as prone position) should first choose small intestine nutrition; In medical institutions where the opening of small intestine is not feasible, early feeding can be done through stomach. Continuous feeding can reduce the risk of gastric reflux and aspiration more than intermittent feeding. (2) Continuous feeding position. During nasal feeding, the lower bed was allowed to be raised by 30 °or higher, and the left lateral position was adopted. After nasal feeding, it was kept in the half position for 30-60 min. (3) Monitoring of gastric residual volume and gastric tolerance. For the incidence of VAP, duration of mechanical ventilation and mortality, monitoring gastric reflux and vomiting alone is as effective as monitoring gastric reflux, vomiting and residual stomach volume. Routine monitoring of gastric residual volume is not recommended for asymptomatic patients receiving enteral nutrition. Gastrointestinal tolerance should be monitored every day in critically ill patients, and attention should be paid to abdominal pain, bloating, exhaustion and defecation.

3.4 Ventilator circuit management

Respiratory circuit is an important place where bacteria inhabit and migrate, so it is particularly important to manage the ventilator circuit. The main measures are as follows: (1) The frequency of ventilator pipeline replacement. In China's Guidelines for Clinical Application of Mechanical Ventilation (2006) and the Prediction Strategy of Ventilator-associated Pneumonia in American SHEA Acute Hospital in 2014, it is recommended to replace the ventilator pipeline only when there is visible pollution or failure. (2) Condensate water management. Studies at home and abroad show that the ventilator condensed water collecting cup should be placed at the lowest point of the pipeline system, and the condensed water in the pipeline should be removed in time, when the condensed water is larger than 1/2 of the volume of the collecting cup. In addition, in order to prevent or reduce the generation of condensed water, it is suggested that patients with mechanical ventilation should be humidified by a humidifier with heating wires.

3.5 Cluster prevention and control strategies

The ventilator cluster prevention and control strategy refers to the implementation of some evidence-based treatment and nursing measures, which is the most widely used intervention strategy in clinical VAP nursing practice at present, mainly including: (1) Using non-invasive respiratory support treatment technology as much as possible; (2) Daily wake-up and offline assessment; (3) It is suggested to use a catheter with subglottic secretion suction for patients whose expected tracheal intubation time may exceed 48 h or 72 h; (4) The pressure of the airbag should be maintained at 25-30 cm H2O after inflation; (5) If there is no contraindication, the bedside is raised by 30 ° to 45 °; (6) Strengthen oral care; (7) When carrying out operations related to airway, the aseptic technical operation procedures should be strictly observed; (8) Encourage and assist patients with mechanical ventilation to take early activities and start rehabilitation exercise as soon as possible. At present, there is no standard clustering strategy. The Guidelines for Prevention, Diagnosis and Treatment of Ventilator-associated Pneumonia issued by China in 2013 recommended that all medical institutions should carry out clustering intervention nursing to prevent VAP according to their own situation on the basis of evidence.

4. Summary and prospect

In recent years, there have been more and more researches on VAP from clinical, microbiology and prevention and control measures at home and abroad, and some achievements have been made, but VAP still occurs. Therefore, medical staff at all levels of medical institutions and hospital infection professionals should pay attention to and control the management of VAP pathogenic factors, strengthen the concept of sterility of medical staff, and attach importance to the training of VAP related knowledge. Meanwhile, we should strengthen the supervision of VAP prevention and control measures and carry out continuous quality improvement, so as to promote the implementation of VAP prevention and nursing measures and reduce the occurrence of VAP.

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