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Identification of Bacterial Growth in Patients with Endotracheal Tube (ETT) as a cause of Ventilator-Associated Pneumonia (VAP) in Intensive Care Unit Rooms

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ABSTRACT

Objective : Bacterial colonization of the airway potentially occurs in patients intubated with endotracheal tube (ETT). The most common infection is ventilator-associated pneumonia, one that occurs more than 48-72 hours after intubation. Intubation with an ETT leads to pathogenic colonization in the oral cavity and oropharynx.

Methods: The purpose of the present study was to identify bacterial growth in ETT-intubated patients as the cause of ventilator-associated pneumonia (VAP) in the ICU rooms. It was cross-sectional study with a sample of 6 patients who were intubated with an ETT, using a mechanical ventilator and suffering from a ventilator-associated pneumonia (VAP).

Results: Showed that 25% of the respondents suffered from VAP, 50% had an increase in body temperature of 37.6°C to 39°C, 25% had an increase in leukocytes of 11,000 to 20,000/mm² and decreased levels of PAO₂, 75% had an ARDS, shortness of breath and increased production of secretion. Results of identification of bacterial growth showed 5 types of gram-negative bacteria as the cause of VAP: *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *stapilococcus aureus*, *Acinetobacter baumami* (94.11%), and *Enterobacter gergoviae* (93.93%).

Conclusion: The Microbat system examination indicated a gram-negative bacterial colony containing lysine, omithine, glucose, xylose and citrate. Identification of VAP-causing bacteria can provide information and an overview of bacterial colonies in the ICU rooms to help the establishment of diagnosis, provision of nursing care and determination of pharmacological action taken.

Keywords: Bacteria, endotracheal tube (ETT), pneumonia-associated ventilator

INTRODUCTION

Infection related to health care through the placement of invasive medical devices in Intensive Care Unit (ICU) rooms is among the important factors jeopardizing patient recovery during health care. These patients have a high risk of nosocomial infection.[1] In general, patients in the ICU rooms have risk factors of underlying diseases and immune disorders, especially those patients with invasive devices such as a ventilator. A ventilator connected via an endotracheal tube to the patient constitutes the precipitating factor of infection (ventilator-associated pneumonia). Moreover, a prolonged placement of these invasive devices can facilitate nosocomial infection to the patients.[12] Bacterial colonization of the airway potentially occurs in patients intubated with an endotracheal tube (ETT). And this has a high risk of nosocomial infections. The most common infection is ventilator-associated pneumonia, one that occurs more than 48-72 hours after intubation.^{3,4} In Indonesia, a study conducted in all hospitals in Yogyakarta showed that the proportion of nosocomial infections ranged from 0% to 12% with an overall average of 4.26%. The average treatment period was 4.3 to 11.2 days, with an average of 6.7 days. However, there is no accurate data regarding the rate of nosocomial infections in Indonesia.

METHODS

The present study used the observational design with a cross-sectional approach. The sample was 6 patients intubated with an endotracheal tube, using a mechanical ventilator, and having a ventilator associated pneumonia (VAP) at an ICU room of a Hospital in Blitar. The present study was conducted at an ICU room of one of hospitals in Blitar. The study instrument used was a bacterial growth observation sheet by means of examining the culture of patients intubated with an endotracheal tube. Additionally, the study also used an observation sheet for the signs of the occurrence of ventilator-associated pneumonia (VAP) observed at <24 hours and 24-48 hours and disposable catheters. Furthermore, the signs of ventilator-associated pneumonia (VAP) were observed using a CPIS sheet, including PaO₂/FiO₂, tracheal secretions, leukocytes, temperature (Celsius) after 48 hours after the placement of a mechanical ventilator.

RESULTS

Data derived from bacterial identification using Microbact 12A/E-24E were subjected to descriptive analysis. In order to analyze pneumonic events, respondent's responses from each component were tabulated as shown in Table 1. In the event that the total CPIS score was more than or equal to 6, then the VAP diagnosis can be established. In the event that the total CPIS score was less than 6, then the VAP diagnosis was excluded. Furthermore, descriptive analysis was carried out.

The results indicated that 25% of respondents had signs of VAP, including an increase in body temperature, an increase in leukocyte count, and a decrease in PAO_2 levels, shortness of breath, and an increase in production of secretions.

Results of identification of the signs of Pneumonia

a. Identification of body temperature

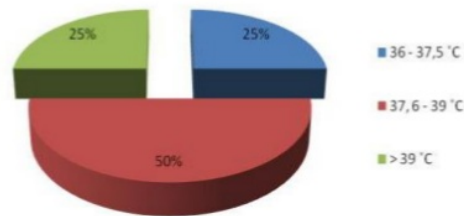


Figure 1. The pie chart of the body temperature of patients with a ventilator in the ICU room.

b. Identification of leukocyte count

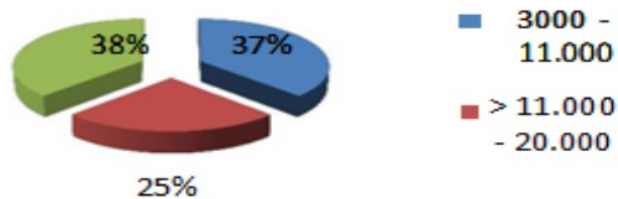


Figure 2. The pie chart of the leukocyte counts of patients with a ventilator in the ICU room.

c. Identification of PaO_2 levels

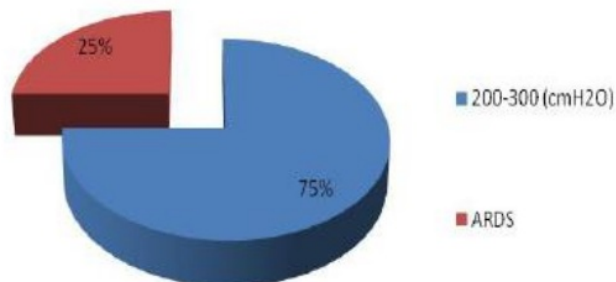
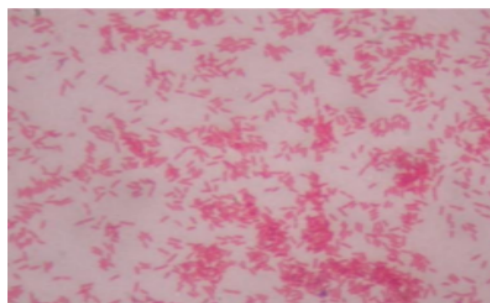


Figure 3. The pie chart of the PaO_2 levels of patients with a ventilator in the ICU room.

- d. ¹⁴ Identification of gram-negative bacteria of sample 4 (*Acinetobacter baumami*, 94.11%)



¹⁴ **Figure 4.** Identification of gram-negative bacteria of sample 4 (*Acinetobacter baumami*, 94.11%)

Identification of bacterial growth showed 5 gram-negative bacteria that caused ventilator-associated pneumonia (VAP): *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *stapilococcus aureus*, *Acinetobacter baumami* (94.11%), and *Enterobacter gergoviae* (93.93%). All of those bacteria were gram-negative after identification of gram types in bacterial colonies. The Microbat system examination indicated that those gram-negative bacterial colonies contained lysine, omithine, glucose, xylose and citrate.

DISCUSSION

¹⁸ Results of the present study showed that 25% of respondents had signs of VAP, including an increase in body temperature, an increase in leukocyte count, a decrease in PAO₂ levels, shortness of breath and an increase in production of secretions. Results of identification of pneumonic signs showed that 50% of the respondents had an increase in body temperature of 37.6°C to 39°C. Results of identification of leukocyte count showed that 25% of the respondents had a leukocyte count of 11,000 to 20,000/mm² and decreased levels of PAO₂. Additionally, 75% of the respondents had an ARDS. Results of identification of bacterial growth showed that there were 5 gram-negative bacteria that caused ventilator-associated pneumonia (VAP): *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *stapilococcus aureus*, *Acinetobacter baumami* (94.11%), and *Enterobacter gergoviae* (93.93%). All of those bacteria were gram-negative after identification of gram types in bacterial colonies.

It is known that the occurrence²¹ of ventilator-associated pneumonia (VAP) is related to bacteremia. This infection is generally the result of aspiration of potential pathogens that colonize the oropharyngeal mucosa. Intubation of patients does not only interfere with the barrier between the oropharynx and trachea, but it also facilitates the entry of bacteria into the lungs through the pools and leakage of contaminated secretions around the endotracheal tube (ETT) cuff. [6,7] This phenomenon occurs in most patients with intubation, wherein the supine position can facilitate it. In previously healthy patients and new inpatients, normal oral flora or pathogens are associated with community-acquired pneumonia. In patients treated for more than 5 days, gram-negative bacteria (GNB) and *S. aureus* often colonize the upper airways.[2,6,8]

In rare cases, VAP can occur through other pathways. Macroaspiration of gastric fluid occurs in some patients. Condensation on the ventilator tube entering the patient's airways leads to it. Fiberoptic bronchoscopy (FOB), tracheal suction, or manual ventilation with contaminated devices can also carry pathogens to the lower respiratory tract. Recently, attention is drawn to the important role of contaminated nebulizers in the occurrence of VAP; however, this device is rarely associated with VAP.[3,7,9]

¹ Other sources of VAP-causing pathogens include those of the paranasal sinuses, dental plaques, and the subglottic region between the vocal cord and the ETT cuff. The role of the gastrointestinal tract as a source of GNB colonization in the oropharynx and trachea is controversial. Several studies, using radioactive-labeled gastric fluid or several other techniques, demonstrated that gastric fluid in intubated patients was aspirated in the tracheobronchial tract within a few hours. Alkalinization of gastric fluid seems to be a prerequisite for this mechanism.[1,4,10]

Results of the present study showed that 25% of patients with an ETT and ventilator had ventilator-associated pneumonia (VAP). This can occur due to several factors, including the placement of a ventilator for more than 3 days and decreased consciousness of the patients that reduce the cough reflex and secretion discharge. Additionally, the use of a catheter section not complying with aseptic techniques leads to an increase in the incidence of VAP. Results of identification of bacterial growth indicated that all of the bacteria found were gram-negative, including *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *stapilococcus aureus*, *Acinetobacter baumami* (94.11%), and *Enterobacter gergoviae* (93.93%). Therefore, clinicians shall identify the bacteria first and then determine the appropriate antibiotics to be administered.

CONCLUSION

1. Twenty-five percent 25% of patients with a ventilator and endotracheal tube (ETT) have a ¹² risk of ventilator-associated pneumonia (VAP).
2. The signs of VAP include an increase in body temperature, an increase in leukocyte count, decreased PAO₂ levels and shortness of breath due to the buildup of secretions.
3. Results of identification of bacterial growth in patients with an ETT showed 5 bacterial colonies: *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *stapilococcus aureus*, *Acinetobacter baumami*, and *Enterobacter gergoviae*.
4. The bacteria identified as causing VAP were gram-negative.
5. Microbate system examination of the gram-negative bacteria showed that they contained lysine, omithine, glukose, xylose and citrate.

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AUTHORS' CONTRIBUTIONS

First author (Y.P) initiated and conducted the research. The second author (S.S) conducted process ⁹ and prepared the manuscript.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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