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Original Article

DURATION OF VENTILATION SUPPORT USAGE AND DEVELOPMENT OF VENTILATOR-ASSOCIATED PNEUMONIA: WHEN IS THE MOST TIME AT RISK?

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ABSTRACT

Introduction: Ventilator Associated pneumonia (VAP) is pneumonia that occurs in patients who have been mechanically ventilated for a duration of more than 48 hours. The duration of ventilator use was identified as a risk factor which is trigger of VAP. **Objective:** This study aimed to determine the association between the duration of ventilator use and the incidence of VAP in patients in the Intensive Care Unit of Dr. Mohammad Hoesin General Hospital, Palembang. **Method and Material:** This study was an observational analytic study using cross sectional design. The samples were all patients who use a ventilator for more than 48 hours at the ICU room periode of July 1, 2014 to June 30, 2015. Data were obtained from patient's medical records of total 146 patients, but the number of patients who comply the criteria was 106 patients. **Result and Discussion:** Out of the 106 samples, 41 patients (38.7%) developed VAP and 65 patients (61.3%) did not develop VAP. The analysis using Chi Square test showed that patients who used ventilator for >5 days had an OR = 3.273 compared to patients using ventilator 2-5 days (p value = 0.016; 95% CI = 1.223 to 8.754). **Conclusion:** There is a significant association between the duration of ventilator use and the incidence of VAP in patients at the ICU of Dr. Mohammad Hoesin General Hospital, Palembang. Patients using ventilators for more than 5 days 3,386 times more at risk of developing VAP compared to patients using ventilators 2-5 days. The most risky time for patient using ventilator was more than 5 days of usage. And, the mortality rate of VAP patients was 63.4% from 41 patients while the mortality rate of whole ICU patients was 50.9%.

Keywords: Duration of Ventilator Use, Dr. Mohammad Hosein General Hospital, ICU's Patient, Ventilator, Ventilator Associated Pneumonia.

ABSTRAK

Pendahuluan: Ventilator Associated pneumonia (VAP) adalah pneumonia yang terjadi lebih dari 48 jam setelah pasien menggunakan bantuan alat ventilasi mekanik. Lama penggunaan ventilator diidentifikasi sebagai salah satu faktor risiko yang memicu terjadinya VAP. **Tujuan:** Penelitian ini bertujuan untuk mengetahui hubungan antara lama penggunaan ventilator dan kejadian VAP pada pasien di ICU RSUP Dr. Mohammad Hoesin Palembang. **Metode dan Bahan:** Penelitian ini merupakan penelitian observasional analitik dengan menggunakan rancangan cross sectional (potong lintang). Populasi penelitian adalah pasien yang menggunakan ventilator di ICU. Sampel penelitian adalah seluruh pasien yang menggunakan ventilator selama lebih dari 48 jam di ICU RSUP Dr. Mohammad Hoesin Palembang periode 1 Juli 2014 - 30 Juni 2015. Data pada penelitian ini diperoleh dari rekam medis pasien yang berjumlah 146 pasien, namun pasien yang memenuhi kriteria sebanyak 106 pasien. **Hasil dan Pembahadan:** Dari 106 sampel, didapatkan 41 pasien (38,7%) menderita VAP dan 65 pasien (61,3%) tidak menderita VAP. Hasil analisis menggunakan uji Chi Square menunjukkan bahwa pasien yang menggunakan ventilator selama >5 hari memiliki OR = 3,386 dibanding pasien yang menggunakan ventilator selama 2-5 hari (p value = 0,004; IK 95% = 1,452-7,893). **Kesimpulan:** Terdapat hubungan yang signifikan antara lama penggunaan ventilator dan kejadian VAP pada pasien di ICU RSUP Dr. Mohammad Hoesin Palembang. Pasien yang menggunakan ventilator selama >5 hari 3,386 kali lebih berisiko menderita VAP dibanding pasien yang menggunakan ventilator selama 2-5 hari sehingga dapat dikatakan bahwa waktu paling beresiko terkena VAP adalah pengunaan ventilator lebih dari 5 hari. Serta, angka kematian pada pasien VAP sebesar 63.4% sedangkan angka kematian total pada pasien ICU adalah sebesar 50.9%.

Kata kunci: Lama Penggunaan Ventilator, RSUP Dr. Mohammad Hosein Palembang, Pasien ICU, Ventilator, Ventilator Associated Pneumonia.

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INTRODUCTION

Ventilator is a tool used to replace or support the respiratory function which is widely used for the treatment of patients in the Intensive Care Unit (ICU). The purpose of using ventilator is to protect the airway and prevent the occurrence of breathing failure.[1]

Patients in ICU who use the mechanical venting tools have high risk of suffering from nosocomial infections called ventilator associated pneumonia. This infection occurs because of patient who use the ventilators can be easily inhale the composite microorganisms of intestinal tract or upper respiratory tract to the lower respiratory tract, so inflammation of the pulmonary parenkim occurs.[2]

Ventilator Associated Pneumonia (VAP) is part of the nosocomial infections, defined as pneumonia that occurs more than 48 hours

after the use of a ventilator with intubasi endotrakeal or tracheostomy installation. VAP divided into early onset which occured in 2-5 the first day of the use of mechanical ventilation and late onset which occurred more than 5 days after the use of mechanical ventilation.[3,14]

VAP is the most occurence nosocomial infection and has a high number of morbidity and mortality in ICU's patients. Based on United States research, VAP occurs at 9.3% of sufferers that are using mechanical venting more than 24 hours. Research in Europe concluded that mechanical ventilation may increase the risk of pneumonia 3 times higher than the patients who did not use mechanical ventilation, while the Americas reported 24 times higher.[4,15]

Table 1. *Clinical Pulmonary Infection Score* (CPIS)

Parameter		Score
Temperature (°C)	≥36.5 and≤38.4	0
	≥38.5 and≤38.9	1
	≥39 or≤36	2
Blood Leukocyte (mm^3)	≥4000 and≤11,000	0
	<4000 or>11000	1
	+ Band forms≥50%	2
Tracheal Secretion	No tracheal secretions	0
	Nonpurulent tracheal secretions	1
	Purulent tracheal secretions	2
Oxygenation: PaO_2/ FiO_2 (mm Hg)	>240 or ARDS	0
	≤240 and no ARDS	2
Pulmonary Radiograph	No infiltrate	0
	Diffuse (or patchy) infiltrate	1
	Localized infiltrate	2
Progression of Pulmonary Infiltrate	No radiographic progression	0
	Radiographic progression (after cardiac failure and ARDS excluded)	2
Culture of Tracheal Aspirate	Pathogenic bacteria present rarely or in light quantity	0
	Pathogenic bacteria present in moderate or heavy quantity	1
	Same pathogenic bacteria seen with Gram's stain	2

VAP caused by non-Multi Drug Resistance (MDR) pathogens such *as s. pneumoniae, h. Influenzae, Methicillin Sensitive Staphylococcus aureus* (MSSA) or *Pseudomonas aeruginosa* such as MDR germ, Escherichia *coli, Klebsiella pneumoniae, Acinetobacter spp* and also Gram positive such as *Methicillin Resistance Staphylococcus aureus* (MRSA). Nosocomial pneumonia which caused by fungi, anaerobic germs and viruses are rarely occurs.[5]

Suspected risk factors trigger the occurrence of VAP, such as: gender, age, patient's oral hygiene, patient's body position on his back, disease severity degree, decrease of consciousness, the use of endotracheal tube, the use of previous antibiotics, surgery, and long using of ventilator.[6,16,17,18]

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VAP is difficult to definitively diagnosed and difficult to distinguish with the the other breathing failure's causes such as *Acute Respiratory Distress Syndrome* (ARDS) and pulmonary edema. Therefore, to distinguish the VAP with other pulmonary disease can be identified with *Clinical Pulmonary Infection Score* (CPIS). If CPIS score > 6 is considered as VAP.[7]

The objective of this study is to define the duration of of ventilator usage that has the most frequent incidence of VAP in Dr. Mohammad Hosein General Hospital, Palembang, Because there is still different result between Cook et al and Putri D.Y research.

MATERIAL AND METHOD

This study was observasional analytic research with cross sectional design. The sample were all of patients who use ventilator more than 48 hours in GICU of Dr. Mohammad Husein General Hospital, Palembang from July 1st 2014 to June 30th 2015 and have to comply with the inclusion characteristics. Data collected from patient's medical records such as age, gender, disease diagnosis, record of VAP, duration of ventilator usage and the frequency of patient's mortality when they out from ICU. After the data have been collected, then it would be analyzed with *Chi Square test*.

RESULT AND DISCUSSION

The number of samples was 106 from 146 patient's medical record data that have been collected. Meanwhile the other 40 couldn't be use as sample because it didn't comply the criteria for inclusion. Sample characteristic on this research can be seen in the table 2.

The relation between duration of ventilator usage and occurence of VAP

Table 2. Characteristics of Research Subject (n=106)

Characteristics of Research Subject	Frequency (n)	Persentage (%)
Gender		
Male	50	47.2
Female	56	52,8
Total	106	100
Diagnosis group		
Pasca surgery	60	56.6
Non surgery	46	43.4
Total	106	100
Occurance of VAP		
Positive	41	38.7
Negative	65	61.3
Total	106	100
Duration of Ventilator Use		
>5 days	59	55.7
2-5 days	47	44.3
Total	106	100
Frequency of Deaths		
Death	54	50.9
Cure	52	49.1
Total	106	100

The average age of patients who use ventilators was 41.62 ± 17.54 years old. Out of 106 total of patients suffering from VAP, 8 patients or 19.5% suffered from early onset VAP and 33 patients or 80.5% suffered from late-onset VAP type.

The average duration of patients ventilator usage in ICU was 17 (2-71) days. The average duration of ventilator usage of patients who positively suffered the VAP was 8 (2-45) days while the average duration of ventilator usage in patients of non VAP was 5 (2-71) days.

Table 3. Days of Patient in ICU based on VAP(+) and VAP(-)

Days of Patient in ICU	∑ VAP (+)	%	∑ VAP (-)	%	TOTAL
2	3	33.33	6	66.67	9
3	3	30	7	70	10
4	1	14.29	6	85.71	7
5	0	0	7	100	7
6	2	25	6	75	8
7	6	46.15	7	53.85	13

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8	1	25	3	75	4
9	0	0	3	100	3
10	3	60	2	40	5
11	1	25	3	75	4
12	1	50	1	50	2
13	3	60	2	40	5
14	4	100	0	0	4
15	0	0	3	100	3
16	1	50	1	50	2
17	4	80	1	20	5
18	1	50	1	50	2
19	1	33.33	2	66.67	3
21	1	100	0	0	1
22	1	100	0	0	1
23	2	100	0	0	2
24	0	0	2	100	2
29	1	100	0	0	1
30	0	0	1	100	1
45	1	100	0	0	1
71	0	0	1	100	1

Table 3 showed the days of patients in ICU room based on the VAP (+) and VAP (-). The data analyzed with *chi square test* to define the cut off point of the most riskable days of using the ventilator. The result obtained that the most riskable days of using the ventilator was more than 5 days usage. Based on the table 4, the patients who use ventilators more than 5 days have 3.386 of OR than patients who use ventilators 2-5 days with *p* value = 0.004 and IK 95% = 1.452-7.893.

Based on the results obtained a difference of VAP sufferers number among patients who the ventilator 2-5 days and > 5 days. The analitycal results of Chi Square test shows that long usage of ventilator significantly related with VAP insident of ICU's patients in Dr. Mohammad Hoesin General Hospital, Palembang. Patients who use ventilator more than 5 days have OR = 3.386 than the patients who use ventilator for 2-5 days with p value = 0.004 and IK 95% = 1.452-7.893. It means that patients who use ventilator for more than 5 days have 3.386 times higher risk of suffering from VAP than patients who use ventilators for 2-5 days.

Table 4. Bivariate Analysis of Ventilator Usage Duration and Occurance of VAP (n=106)

Ventilator Usage Duration	Occurance of VAP		Total (n)	OR
	VAP +	VAP -		
>5 days	30	29	59	3.386
2-5 days	11	36	47	
Total	41	65	106	
P value			0.004	
IK 95%			1.452-7.893	

Cook, *et al* stated in their research that there is a significant relationship between the long usage of the ventilator with the occurance of VAP, where the VAP incidence increases according to the long usage of mechanical ventilators. According to Cook *et al*, the estimated increase of VAP insidence is 3% per day for the first 5 days of ventilator usage, 2% per day during the 6th-10th day, And then 13% per day after the day 10 of ventilator usage.

Result of this reseach compared with another research in Indonesia. Putri's research stated that there is no significant relationship between the long usage of ventilator with the the occurance of VAP in ICU's patients.[8]This differences probably occured due to VAP is not only influenced by the long usage of ventilator but it can be influenced by other risk factors such as patient's oral hygiene, the body position on their backdisease severity degree, decreased of consciousness, the use of *stress ulcer prophylaxis*, and the use of *nasogastric tube*.[3] The both research did not control the other risk factors so a difference might be occured.

The duration of mechanical ventilator usage affect the VAP incidence. In a healthy individual, the respiratory tract is sterile and has a variety of defence mechanisms against infections such as the glottis and laryngeal, cough reflex, trakeobronkial secretion, mukosilier motion, humoral immunity and cellular, and Phagocytic system to prevent the occurrence of microbial invasion into pulmonary parenkim. Saliva has an important

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role in regulating the composition of normal flora inside the mouth. The use of mechanical ventilation with endotrakeal intubasion may cause the respiratotry tract's defense disturbed, so the pathogenic microorganisms can be easily composited on the respiratory tract and then invade the parenkim. The longer duration of mechanical ventilation usage will cause the more composite bactery in respiratory tract. On the other hand, the defense of respiratory tract is not in a good condition and it keeps open during the intubasion, then the incidence of VAP increase along with the long ventilator usage.[10]

Kollef stated that VAP incidence depend on the environmental exposure duration and duration of the health tools usage.[10] Several studies had identified that the duration of ventilator usage is one of the important risk factors that triggers the VAP. Patients who use mechanical ventilation would having an improvement of VAP insidence along with the duration of ventilation and is not constantly during the ventilator usage. The highest risk of VAP occurred on the early hospital treatment. The decrease of ventilator usage duration could lower the risk of VAP, especially if the decrease of duration was conducting at the first and second week.[12,18]

The relation between the incidence of VAP and frequency of death

In this study, the VAP patients had 62.5% of mortality rate, while the non VAP patients had 47.9% of mortality rate. Safdar, *et al* stated that patients suffered from VAP has twice more risky to die than the patient who did not suffer the VAP.[12]

The deaths which caused by VAP was actually difficult to quantify because it was affected by many factors such as the patient's first diagnosis, disease severity degree, and great influence of organisms that cause VAP. Meanwhile, the VAP has a significant relation with the death (OR = 1.94; IK 95% = 1.24-3.03).[13]

CONCLUSION

Based on the result about the relation between ventilator usage duration and VAP occurance of ICU's patient in Dr. Mohammad Hosein General Hospital, Palembang, the conclusion was there is 41 (37.8%) patients who suffer VAP of 106 patients who use the ventilator. The average duration of ventilator usage in ICU of Dr. Mohammad Hosein General Hospital, Palembang was 7 (2-71) days with the average of ventilator usage duration of VAP patients was 8 (2-45) days and the average of ventilator usage duration of non VAP patients was 5 (2-71) days. Therefore, The duration of ventilator usage significantly affects to incidence of VAP in patients in the ICU of Dr. Mohammad Hoesin General Hospital, Palembang. The most affected duration was ventilator usage for more than 5 days.

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Conflict of Interest

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