THE CLINICAL AND PARA CLINICAL CHARACTERISTICS OF VENTILATOR ASSOCIATED PNEUMONIA IN ADULT BURN PATIENTS

**Ngo Tuan Hung, Nguyen Hai An,
Tran Đinh Hung, Tran Thi Diu Hien**

Le Huu Trac National Burn Hospital

SUMMARY

This study assessed clinical and subclinical symptoms of ventilator-associated pneumonia (VAP) in patients with severe burns. The results showed that all patients had symptoms of increased sputum secretion, chest X-ray with infiltrates on both sides of the lungs. Many patients had a lot of sputum secretion (78.57%), the highest level of sputum secretion during 3 days after diagnosis of VAP, then gradually decreased, the difference was significant on the day seventh of diagnosing VAP (p = 0.03).

At the time of diagnosis of VAP, 96.43% of patients changed the color of sputum. Then the color of phlegm improved gradually, by day seventh after the diagnosis of VAP, there were 46.15% of patients with sputum became transparent. The ratio of PaO_2/FiO_2 decreased slowly (197.46 ± 22.79mmHg) at the time of diagnosis of VAP, then increased gradually, the difference was significant at the time after 5 days of diagnosis of VAP (p = 0.04). Bacteria grew mainly A.baumannii (53.57%). The average point of CPIS score was 7.36 ± 0.26. The mortality rate was still high with a rate of 75%.

Keywords: Ventilator-associated pneumonia (VAP), severe burns

1. INTRODUCTION

Ventilator-associated pneumonia is pneumonia that occurs after 48 hours in a patient who is ventilated through the endotracheal tube or tracheostomy, without previous evidence of pneumonia [1]. Ventilator-associated pneumonia prolongs treatment in the Intensive Care Unit, increases the time of mechanical ventilation, treatment costs and burden on the health system and patients [2]. Clinical, subclinical symptoms in patients with parallel, interleaved ventilatory-associated pneumonia, easily confused with symptoms of systemic inflammatory response syndrome already present in severe burn patients.

This study aimed to evaluate the clinical and paraclinical characteristics of VAP in severe burn patients in the burn Intensive care unit (ICU), National Burn Hospital.

2. SUBJECTS AND METHODS

- A prospective and descriptive study on 28 adult burn patients receiving invasive

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[1] *Corresponding author:* Ngo Tuan Hung, Intensive Care Unit, Le Huu Trac National Burns Hospital
Email: tuanhungvb@gmail.com

mechanical ventilation in the ICU of National Burn Hospital, from August 2019 to June 2020.

- Diagnosis of ventilator-associated pneumonia in burn patients according to the International Society for Burn Injuries (2018) [3]. Early-onset of VAP: calculated from the time of mechanical ventilation until the appearance of pneumonia <5 days. Late-onset of VAP: Calculated from the time of mechanical ventilation until the appearance of pneumonia ≥ 5 days.

- Following criteria were collected and analyzed: Age, gender, burn size, deep burn size, inhalation injury, temperature, the level of sputum secretion was monitored for 24 hours, the color of sputum, pulmonary rales, chest X-ray images, arterial blood gas, procalcitonin test: The time of mechanical ventilation (T0), the time of VAP (T1), the 3rd day after VAP (T3), the 5th day after VAP (T5), the 7th day after VAP (T7). Bacteriological characteristics.

- The level of sputum secretion was monitored during 24 hours according to Pugin J. (2002) [4]: Low degree (phlegm is sucked every > 4 hours): Point of 0; Moderate level of sputum (phlegm is sucked every 2 - 4 hours): Point 1; A lot of sputum (phlegm is sucked every < 2 hours): Points 2.

- The data was analyzed and processed by Stata software 14.0 with $p < 0.05$ is considered as statistical significance.

3. STUDY RESULTS

Table 1. Patient's characteristics

Characteristic		Mean (n = 28)	Min-Max
Age (year)		43.32 ± 2.8	25 - 86
Burn size (%)		65.96 ± 3.97	10 - 95
Deep burn area (%)		41.86 ± 3.70	10 - 74
APACHE II		12.5 ± 0.75	5 - 23
SOFA		8.46 ± 0.60	4 - 17
CPIS		7.36 ± 0.26	5 - 9
The onset of VAP after mechanical ventilation		6.36 ± 0.93	3 - 18
Time of hospital admission (hour)	Within 24 hours of the burn (%)	26 (92.86)	
	After 24 hours of burn (%)	2 (7.14)	
Inhalation injury n (%)		24 (85.71)	
Diagnosis of sepsis		16 (57.14)	
Death		21 (75%)	

CPIS: Clinical Pulmonary Infection Score - CPIS

Comment: All patients are severe with a burn surface area of 65.96 ± 3.97, deep burn area of 41.86 ± 3.70. The mean SOFA score is 8.46 ± 0.6. Of which 14 patients (50%) with a score of ≥ 9. The mean CPIS score is 7.36 ± 0.26.

Table 2. Respiratory symptoms at the time of diagnosis of VAP

Symptom		Number (n = 28)	Ratio %	
Tracheal secretions	Rate	1	3.57	
	Medium	5	17.86	96.43
	Much	22	78.57	
Color sputum	White	1	3.57	
	Opaque	26	92.86	
	Purulent sputum	1	3.57	
Lung sound		28	100	
Moist rales		28	100	
Dry rales		25	89.29	
Increased breathing frequency (> 25 cycles / minute)		17	60.71	

Comments: This mainly happens in patients with a high level of sputum secretion (78.57%) and opaque (92.86%). 100% of patients in the study have rales in the lung.

Table 3. Characteristics of chest radiograph at the time of diagnosis VAP

Lesions		Number (n = 28)	Ratio %
Infiltration site	One lung	9	32.14
	Both lungs	18	64.29
Infiltration	Diffused (or patchy)	27	96.43
	Localized	0	0
Atelectasis	one lung	1	3.57
	Lobe	0	0
Pleural effusion	One lung	0	0
	Both lungs	0	0

Comments: 96.43% of study patients have X-ray images of infiltration diffusion.
Table 4. Temperature variation over study time in patients with VAP

Time	Temperature (^{0}C)			p
	Mean	36 - 38 n (%)	> 38 or < 36 n (%)	
T1 (n = 28)	37.34 ± 0.27	17 (60.71)	11 (39.29)	
T3 (n = 21)	37.42 ± 0.32	9 (42.86)	12 (57.14)	> 0.05
T5 (n = 15)	37.6 ± 0.28	11 (73.33)	4 (26.67)	> 0.05
T7 (n = 13)	37.48 ± 0.34	8 (61.54)	5 (38.46)	> 0.05

* compare with T1

Comment: There is no difference in temperature over time of the study ($p > 0.05$).
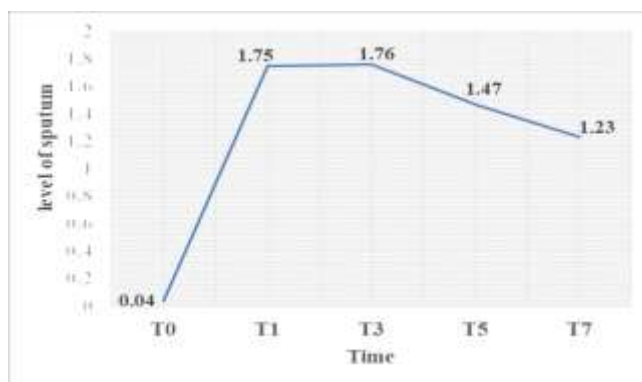
Graph 1. The change of sputum

* compare with T0; # compare with T1. 0: little; 1: mediu*m; 2: much*

Comment: The level of sputum production is increased significantly at the time of diagnosis of VAP, compare with the time of intubation (p = 0.0000). The highest increase at 3 days after diagnosis of VAP, then there is a gradual decrease, the difference significant at 7 days after diagnosis of VAP (p = 0.03).

Table 5. Sputum color change in patients with VAP

Sputum color	Time				
	T0 (n = 28)	T1 (n = 28)	T3 (n = 21)	T5 (n = 15)	T7 (n = 13)
White n (%)	28 (100)	1 (3.57)	0	3 (20)	6 (46.15)
Opaque n (%)	0	26 (92.86)	16 (76.19)	7 (46.67)	2 (15.38)
Purulent n (%)	0	1 (3.57)	5 (13.81)	5 (33.33)	5 (38.46)

Comment: At the time of intubation 100% of patients have white sputum. At the time of diagnosis of VAP, 96.43% of patients with sputum turn opaque or purulent. After that, the color of the sputum gradually improves. On the 7th day after the diagnosis of VAP, there are 46.15% of patients with white sputum.
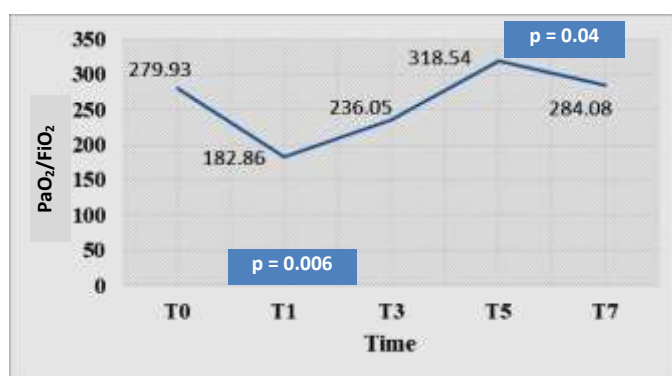
* compare with T0; # compare withT1

Graph 2. Variation of ratio PaO$_2$/FiO$_2$ in patients with VAP

Table 6. Results of bronchial fluid culture

Species	Number (%)		Total (%) (n = 28)
	Early onset VAP (n = 11)	Late onset VAP (n = 17)	
P.*aeruginosa*	3 (27.27)	7 (41.18)	10 (35.71)
A.*baumannii*	6 (54.55)	9 (52.94)	15 (53.57)
S.*aureus*	2 (18.18)	1 (5.88)	3 (10.72)

Comment: The most common bacterium was *A.baumannii (53.57%).*

4. DISCUSSION

Pneumonia and infection-related ventilator-associated complications (IVAC) is defined as a sustained increase (2 or more days) in oxygen requirement of > 20% over baseline and an increase in positive end-expiratory pressure (PEEP) > 3cm water with an associated temperature > 38^0 C or < 36^0C or a white blood cell (WBC) count > 12G/L or < 4G/L and associated administration of an antimicrobial for > 4 days. The clinical diagnosis of pneumonia in burn patients includes two of the following:

(1) Chest x-ray with new and persistent infiltrate, consolidation, or cavitation

(2) Sepsis (as defined in the section on Sepsis, p. xx).

(3) Recent change in sputum or purulence in the sputum [3].

Chest X-ray is the most important clinical diagnostic method for pneumonia. Chest X-ray helps to guide the diagnosis of pneumonia, to determine the location of lung damage, local or diffuse lesions, and severity of infection. In some cases, chest radiographs combined with clinical and epidemiological factors can help to guide treatment while waiting for bacterial cultures.

Research results of Pham Thai Dung (2013) show that all patients have lesions on radiographs at Ventilator-Associated Pneumonia. The analysis of X-ray image characteristics: indicated that the majority of the lesions encountered on both sides of the lung were 71.43%, the right accounted for 17.46%, the left accounted for 11.11%; the form of pervasive infiltrative lesions accounted for 74.6%, localized areas were 25.4%; In terms of atelectasis, it was 19.04%, in which 3 patients with 1 side collapse lung accounted for 4.76%, the 14.28% of remainings had atelectasis or lung segmentation; Pleural effusion accounts for 79.6%, of which both sides account for 50.79%, but the level is usually not much [5].

Winderink R.G. et al. found that there were 79.7% of patients with infiltrative images, of which 59.4% (equivalent to 74.54% of patients with infiltrative lesions on radiographs) were pervasive infiltration, 20.3% is localized infiltration. In addition, the authors also showed that 33.3% of patients with VAP had atelectasis images [6].

In this study, all patients with lesions on radiographs at Ventilator-Associated

Pneumonia were observed. When analyzing X-ray image characteristics, we found that: Regarding the lesion location, 64.29% was met with both sides of the lung; morphologically 96.43% of infiltrative lesions were diffuse (Table 3). This result differs from the above studies; maybe because all outpatients have suffered burn accidents, basically they are of working age, have no history of lung disease before and are hospitalized for treatment. Many studies show that the majority of patients with VAP have symptoms of increased secretion of sputum, cloudiness, or pus. Research by Pham Thai Dung (2013) found that 100% of patients had increased secretion of sputum, of which 95.24% was with large and moderate quantities; 77.78% of patients had cloudy and purulent sputum [5]. Fabregas N. found that increased secretion of purulent sputum accounted for 69% in patients with Ventilator-Associated Pneumonia [7].

In our study, all patients had increased sputum secretion, but the level of sputum secretion was high and mainly accounted for 96.43% (Table 2). In addition to the increase in the secretion of sputum, we also found that the percentage of patients with opaque and purulent nature accounted for 96.43%, of which opaque sputum accounted for 92.86%. The results were in accordance with the above studies. The index of increased sputum production reached the highest point at N3 (1.76) and decreased gradually at the time of N5 and N7, the difference was significant at 7 days after diagnosis of Ventilator-Associated Pneumonia (p = 0.03) (Figure 1). Close monitoring of the number of sputum aspirations per day can predict patients with VAP and monitor disease progression [5].

Microbiologic data may modify the diagnosis into one of three categories: (1) Confirmed: Clinical signs and pathogen isolated; (2) Probable: Clinically present without microbiologic confirmation; (3) Possible: Abnormal chest X-ray with uncertain cause and with low or moderate clinical suspicion, but microbiologic definite criteria met or pathogen identified. Positive microbiology is defined as tracheal aspirate with 10^5 organisms, bronchoalveolar lavage 10^4 organisms, and protected bronchial brush 10^3 organisms. It should be remembered that the burn wound can be the source of pathogen spread. Our study performed bronchial fluid extraction using Mini - BAL. Research results in table 6 showed that 28 samples were positive for 3 types of bacteria *P.aeruginosa, A.baumannii* and *S.aureus*. These are the bacteria commonly found in patients with severe burns [8], [9]. In which, mainly gram-negative bacteria (89.28%), *A.baumannii* accounted for the highest percentage (53.57%). That is similar to the above studies.

5. CONCLUSION

VAP was a severe complication in burn patients, increasing the mortality rate. The onset of VAP after mechanical ventilation is 6.36 ± 0.93 days. 96.43% of patients in the study had radiograph images of infiltration and diffusion. *A.baumannii* was the main bacteria (53.57%).

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