CHARACTERISTICS OF SOME BACTERIAL PATHOGENS ISOLATED FROM THE PATIENTS WITH VENTILATOR-ASSOCIATED PNEUMONIA AT THE NATIONAL HOSPITAL OF TROPICAL DISEASES IN 2023

Cam Thu Nguyen[1]*, Phuong Thoa Nguyen[1], Quoc Toan Luu[1],
Tuyet Chinh Do Thi[1], Dinh Trang Van[2], Kieu Oanh Nguyen Thi[1]

Objectives: To describe the characteristics of some bacterial pathogens isolated from patients with ventilator-associated pneumonia (VAP) at the National Hospital for Tropical Diseases (NHTD) in 2023.

Subjects and methods: A cross-sectional, retrospective study was conducted on 176 medical records of patients with ventilator-associated pneumonia at NHTD who had bacterial culture results from January 2023 to December 2023.

Results: The incidence of VAP in male patients was 56.8%, while in female patients it was 43.2%. The average age was 59.6 years. The average time to identify VAP was 7.6 days, and over 80% of patients had underlying medical conditions. The most common causative agent of VAP was Acinetobacter baumannii (40.3%), while the least common was Acinetobacter pittii (0.3%).

Conclusions: The incidence of VAP in male patients (56.8%) was higher than in female patients (43.2%). The average age of the study subjects was 59.6 years, with an average VAP identification time of 7.6 days, and over 80% of the patients had underlying medical conditions. The most common pathogens causing VAP included Acinetobacter baumannii, Pseudomonas aeruginosa, and Klebsiella pneumoniae, accounting for 40.3%, 18.4%, and 16.5%, respectively.

Keywords: Bacterial pathogens, ventilator-associated pneumonia, National Hospital for Tropical Diseases.

INTRODUCTION

Ventilator-Associated Pneumonia (VAP) or hospital-acquired pneumonia that occurs after invasive mechanical ventilation for over 48 hours is one of the serious complications and a common hospital-acquired infection in intensive care units (ICU). It affects 8 - 10% of patients treated in ICUs and 27% of those on mechanical ventilation1. Among hospital-acquired pneumonia cases, ventilator-associated pneumonia accounts for 90%[2] VAP continues to be a pressing issue for the healthcare sector due to its continuously increasing incidence rate.

The bacterial pathogens causing VAP are diverse and vary depending on the geographical region, study period, patient population, and whether the specimen collection is invasive or non-invasive. Identifying the causative agents will help hospitals proactively manage antibiotic supplies, preventing both wastage and shortages in necessary cases. As the National Hospital for Tropical Diseases is the leading specialized hospital in infectious diseases, treating severe infections, evaluating the causative agents is particularly important. Therefore, our study aims to describe the characteristics of some bacterial pathogens isolated from patients with ventilator-associated pneumonia (VAP) at the National Hospital for Tropical Diseases (NHTD) in 2023.

SUBJECTS AND METHODS

Study subjects: Medical records of 176 patients with ventilator-associated pneumonia (VAP) at the National Hospital for Tropical Diseases (NHTD), who had bacterial cultures isolated between January 2023 and December 2023.

Inclusion criteria: Patients with an ICD diagnosis code of pneumonia (J15x - J18x) and who were intubated or had a tracheostomy with mechanical ventilation for ≥ 48 hours. Patients have complete information on age, gender, treatment department, type of sample taken for culture testing for pathogenic bacteria and bacterial identification results from January 2023 to December 2023.

Exclusion criteria: Patients who met the inclusion criteria but had factors leading to bias, such as inappropriate antibiotic susceptibility test results, or inconsistencies in age or gender across different records.

Study time and location: The study was conducted at the National Hospital for Tropical Diseases from January 2023 to December 2023.

Research methodology: A cross-sectional, retrospective descriptive study.

Sampling method: Total sampling method.

Data processing and analysis: Data was entered using Excel and analyzed using SPSS 20.

RESULTS

Characteristics of study subjects

Table 1. Characteristics of the study subjects

No.	Characteristic	Classification	Quantity (n)	Percentage (%)
1	Gender	Male	100	56.8
		Female	76	43.2
2	Age	Average	59.6	
		Min - Max	12-93	
3	Age group	≤ 15 years	1	0.6
		16 - 60 years	65	36.9
		> 60 years	110	62.5
4	Underlying conditions	Number of conditions	32	
		No conditions	34	19.3
		1 condition	104	59.1
		2 or more conditions	38	21.6
5	Time of VAP onset (days)	Average	7.6	
		Min - Max	2-30	
		Early VAP	75	42.6
		Late VAP	101	57.4
6	Type of specimen (n = 258)	Sputum	61	23.6
		Tracheal aspirate	82	31.8
		Bronchial Secretions	94	36.4
		Bronchial washing	13	5.0
		Bronchial aspirate	8	3.1

Comments: The study was conducted on a total of 176 medical records from the ICU, with 258 specimens collected, isolating a total of 310 pathogens. Statistics show that the incidence of VAP in male patients (56.8%) was higher than in female patients (43.2%). The average age of patients with VAP in this

study was 59.6 years, with most patients having underlying medical conditions. The time to diagnosis of VAP ranged from 2 to 30 days, with an average of 7.6 days.

Table 2. Statistics of pathogens causing VAP

No.	Pathogen		Quantity (n)	Percentage (%)
1	Gram negativer	*Acinetobacter baumannii*	125	40.3
2		*Pseudomonas aeruginosa*	57	18.4
3		*Klebsiella pneumoniae*	51	16.5
4		*Klebsiella aerogenes*	19	6.1
5		*Stenotrophomonas maltophilia*	19	6.1
6		*Escherichia coli*	12	3.9
7		*Acinetobacter nosocomialis*	8	2.6
8		*Proteus mirabilis*	5	1.6
9		*Serratia marcescens*	2	0.6
10		*Acinetobacter pittii*	1	0.3
11	Gram positiver	*2 or more conditions*	11	3.5

Comments: Among the total of 310 isolated pathogens belonging to 11 different species, the majority were Gram-negative bacteria (10 out of 11 species), while Gram-positive bacteria were very few, only accounting for 1 out of 11 species. The most common pathogens causing infections were *Acinetobacter baumannii, Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*, which accounted for 40.3%, 18.4%, and 16.5%, respectively, with all having isolation counts greater than 30 (n > 30).

Table 3. Distribution of pathogens by age group of patients with VAP

No.		≤ 15 years		16 - 60 years		> 60 years		p
		n	%	n	%	n	%	
1	*Acinetobacter baumannii*	0	0.0		18.7	67	21.6	0.031
2	*Acinetobacter nosocomialis*	0	0.0	4	1.3	4	1.3	
3	*Acinetobacter pittii*	0	0.	1	0.3	0	0.0	
4	*Escherichia coli*	0	0.0	2	0.6	10	3.2	
5	*Klebsiella aerogenes*	0	0.0	8	2.6	11	3.5	
6	*Klebsiella pneumonia*	0	0.0	14	4.5	37	11.9	
7	*Proteus mirabilis*	0	0.0	4	1.3	1	0.3	
8	*Pseudomonas aeruginosa*	0	0.	19	6.1	38	12.3	
9	*Serratia marcescens*	0	0.0	2	0.6	0	0.	
10	*Staphylococcus aureus*	0	0.0	5	1.6	6	1.9	
11	*Stenotrophomonas maltophilia*	1	0.3	6	1.9	12	3.9	

Comments: The p-value (0.031) < 0.05 obtained from the test of the distribution of bacterial pathogens by age group indicates a significant difference in the distribution of different bacteria among age groups. It

is evident from Table 3 that in the group of patients over 60 years old, the quantity and proportion of isolated pathogens are much higher compared to the group of patients aged 16 to 60 years and those aged 15 years and younger. Specifically, in the case of Acinetobacter baumannii (the most common pathogen, accounting for 40.3% as shown in Figure 1), 67 isolates were obtained from patients over 60 years, accounting for 21.6%, while 58 isolates were obtained from the 16 to 60 years group, accounting for 18.7%. No isolates of this pathogen were found in the group aged 15 years and younger.

Table 4. Psychosocial support needs

No.	Pathogen	Early VAP		Late VAP		p
		n	%	n	%	
1	*Acinetobacter baumannii*	39	12.6	86	27.7	0.02
2	*Acinetobacter nosocomialis*	4	1.3	4	1.3	
3	*Acinetobacter pittii*	0	0.0	1	0.3	
4	*Escherichia coli*	6	1.9	6	1.9	
5	*Klebsiella aerogenes*	3	1.0	16	5.2	
6	*Klebsiella pneumonia*	22	7.1	29	9.4	
7	*Proteus mirabilis*	2	0.6		1.0	
8	*Pseudomonas aeruginosa*	32	10.3	25	8.1	
9	*Serratia marcescens*	2	0.6	0	0.0	
10	*Staphylococcus aureus*	8	2.6	3	1.0	
11	*Stenotrophomonas maltophilia*	12	3.9	7	2.3	

Comments: The p-value obtained from the test is 0.02 < 0.05, indicating a statistically significant difference between the groups of pathogenic bacteria and the classification of ventilator-associated pneumonia (VAP). Observations show that in the late VAP group, the proportion of pathogens is higher (58.1%) compared to the early VAP group (41.9%).

Table 5. Distribution of pathogens causing VAP by number of underlying diseases

No.	Pathogen	No Underlying disease		1 Underlying disease		≥ 2 Underlying diseases		p
		n	%	n	%	n	%	
1	*Acinetobacter baumannii*	31	10.0	62	20.0	3	1.0	0.011
2	*Acinetobacter nosocomialis*	3	1.0	2	0.6	-	-	
3	*Acinetobacter pittii*	1	0.3	-	-	-	-	
4	*Escherichia coli*	3	1.0	9	2.9	9	2.9	
5	*Klebsiella aerogenes*	1	0.3	9	2.9	11	3.5	
6	*Klebsiella pneumonia*	9	2.9	31	10.0	-	0.0	
7	*Proteus mirabilis*	-	-	5	1.6	11	3.5	
8	*Pseudomonas aeruginosa*	18	5.8	28	9.0	-	0.0	
9	*Serratia marcescens*	-	-	2	0.6	-	-	
10	*Staphylococcus aureus*	2	0.6	9	2.9	2	0.6	
11	*Stenotrophomonas maltophilia*	2	0.	15	4.8	-	0.0	

Comments: The distribution of pathogens causing VAP according to the number of underlying diseases has a p-value (0.011) < 0.05. This indicates that there is a different distribution of the types of bacteria

based on the number of underlying diseases that the patients have.

DISCUSSIONS

In this study, results from 176 patients diagnosed with VAP at the Central Tropical Hospital during the year 2023 show that the prevalence among male patients (56.8%) is higher than that among female patients (43.2%), with an average age of patients being 59.6 years. These findings are quite similar to those from a study at Nam Dinh Provincial General Hospital conducted by author N.T.H. Yen and a study at Huu Nghi Nghe An General Hospital by author Q.A. Tram, both indicating a higher VAP prevalence in male patients compared to female patients[8,9]. A study by Eric P. Nolley in 2023 involving 719 patients at the Johns Hopkins Healthcare system also reported an average age of VAP patients as 61.8 years, with male patients comprising 61.5%[7]. The higher incidence of ventilator-associated pneumonia (VAP) in males may be attributed to several biological, lifestyle, and environmental factors. Males generally have a different immune response compared to females. Some studies suggest that the immune response in females may be more effective at preventing infections, including those leading to VAP. Moreover, men tend to have a higher prevalence of underlying conditions such as cardiovascular diseases, diabetes, and chronic obstructive pulmonary disease (COPD). Our study also indicates that 80.7% of VAP patients had at least one underlying condition prior to hospitalization, the most common being diabetes, obesity, COVID-19, coronary artery disease, cancer, and AIDS. Underlying conditions can impair the immune system, making it more difficult for the body to fight infections, thereby significantly increasing the risk of developing VAP. Research by Laurent Papazian (2020) and Eric P. Nolley (2023) corroborates these findings, showing that individuals with underlying conditions have a 5 - 40% higher risk of developing VAP compared to those without[7,11].

The average time to diagnosis of VAP was 7.6 days, with 75 patients (42.6%) experiencing early VAP and 101 patients (57.4%) experiencing late VAP. These results are consistent with those of author N.T.H. Yen (2024), who reported an average onset time for VAP of 6.7 days. The main pathogens isolated included Acinetobacter baumannii (40.3%), Pseudomonas aeruginosa (18.4%), and *Klebsiella pneumoniae* (16.5%). This group of pathogens is also the primary cause of VAP in Asia, according to reports by Laurent Papazian (2020) and Eric P. Nolley (2023). However, in the Americas, particularly in the United States and South American countries, common pathogens include *Pseudomonas aeruginosa, Staphylococcus aureus* (especially methicillin-resistant strains - MRSA), and Enterobacter spp. In Europe, prevalent pathogens causing VAP include *Pseudomonas aeruginosa, Klebsiella pneumoniae*, and *Staphylococcus aureus*, with MRSA also being a significant issue in many European hospitals. Additionally, *Escherichia coli* and *Acinetobacter* spp have been reported, especially in Southern European countries[7,11].

CONCLUSIONS

The study reveals the characteristics of the patient group, as well as the main pathogens isolated from patients with ventilator-associated pneumonia at the Central Tropical Hospital in 2023. The prevalence among male patients (56.8%) was higher than that among female patients (43.2%). The average age of the study subjects was 59.6 years, with an average time to VAP diagnosis of 7.6 days, and over 80% of patients had underlying health conditions. The most common pathogens causing VAP were *Acinetobacter baumannii, Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*, accounting for 40.3%, 18.4%, and 16.5%, respectively. These findings provide essential data to improve prevention and antibiotic management in hospitals, aiming to reduce the risk and impact of VAP.

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