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Original Research

Retrospective Assessment of Ventilator-Associated Pneumonias due to *Acinetobacter baumannii* in an Oncology Hospital

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Abstract

Objectives: Ventilator-associated pneumonia (VAP) is associated with significant morbidity and mortality in critically ill patients and leads to increases in health-care costs. However, it is preventable, and hospitals can decrease VAP rates. This study aims to retrospectively assess VAP rates in the intensive care unit of Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital of the University of Health Sciences, with reference to *Acinetobacter baumannii*, one of the causative organisms.

Methods: This study enrolled a total of 2277 patients hospitalized between the years of 2011 and 2015. The required data were collected by reviewing medical files of the patients through computerized hospital databases. VAP rate and ventilator utilization (VU) ratio were calculated using the United States Center for Disease Control National Healthcare Safety Network methodology.

Results: Of the study patients, 302 (13.26%) were seen to have developed VAP. Among these patients, 191 (63.25%) were microbiologically diagnosed VAP caused by *A. baumannii*. Pooled means of VU ratio and VAP rate were 0.70 and 22.91, respectively.

Conclusion: The results of this study will motivate the infection control committee of the study hospital to assess current infection control program and strategies so that high VAP rate in the study intensive care unit can be reduced to the minimum possible level.

Keywords: *Acinetobacter baumannii*; intensive care unit; oncology hospital; ventilator-associated pneumonia.

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Intensive care units (ICUs) are where devices such as central lines, ventilators, and indwelling urinary catheters are frequently used to meet the needs of critically ill patients. Although these devices are life-saving, they may be associated with significant nosocomial infections which are cause of high morbidity and mortality rates as well as increases in health-care costs.[1-3] Of nosocomial infections, pneumonia is the second most common infection in critically ill patients. The so-called ventilator-associated pneumonia (VAP) is linked with mechanical ventilation and may account for up to 60% of nosocomial infections and 86% of nosocomial pneumonias.[4,5] Beyond a mortality rate reaching up to 33–75%,[2,6] VAP represents an economic cost of $6500–$8600 estimated per incidence in Turkey.[7,8]

VAP is caused by several pathogens including both Gram-positive and -negative bacteria, and some fungi. These

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can be listed in descending order of frequency as follows: *Pseudomonas aeruginosa* (24.4%), *Staphylococcus aureus* (20.4%), *Enterobacteriaceae* (14.1%, including *Klebsiella* spp., *Escherichia coli*, *Proteus* spp., *Enterobacter* spp., *Serratia* spp., and *Citrobacter* spp.), *Streptococcus* species (12.1%, predominantly *Streptococcus pneumonia*), *Haemophilus* species (9.8%, predominantly *Haemophilus influenza*), Acinetobacter species (7.9%, predominantly *Acinetobacter baumannii*), Neisseria species (2.6%), *Stenotrophomonas maltophilia* (1.7%), coagulase-negative staphylococci (1.4%), and others (4.7%, including *Corynebacterium, Moraxella, Enterococcus*, and fungi such as *Candida*). In recent years, *A. baumannii*, a Gram-negative coccobacillus, is becoming one of the most common pathogens causing VAP, second to *P. aeruginosa*, due to its multiple drug resistance along with its ability to survive for longer periods of time under unfavorable environmental conditions such as dry surfaces.[5,9-14] Apart from higher mortality rate associated with it, emerging multidrug-resistant *A. baumannii* leads to a prolonged length of ICU and overall hospital stay, thereby increasing healthcare costs. However, various infection control and prevention strategies help decrease VAP rate, and correspondingly morbidity, mortality, and health-care costs.[11,15]

This study aims to retrospectively assess VAP infections, with a particular emphasis on *A. baumannii*, in the ICU of our hospital, Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital of the University of Health Sciences, to reinforce our existing infection control and prevention standards.

Methods

Study Design

This retrospective study was conducted in the Anesthesiology and Reanimation ICU (ARICU) which is the only ICU in our 600-bed hospital, and included the patients who were hospitalized between the years of 2011 and 2015. Our level III ICU has 12 beds and employs 22 nurses who work in two shifts, 6–7 nurses in the daytime shift and 4 nurses in the nighttime shift. The between-bed space in the ICU is only 1.5 m.

Data Collection

After the ethics committee approval was received for this study from the Clinical Research Ethics Committee of the study hospital (Approval Date: July 7, 2020; Approval Number: 2020-07/735), the required data including diagnoses of the patients on admission, duration of mechanical ventilation before VAP, length of ICU and hospital stay, laboratory results, and care bundle for each patient were retrospectively collected by reviewing all medical files of the ARICU patients through computerized hospital databases. Some data were obtained through the use of National Hospital Infection Surveillance Network (UHESA in Turkish).

Patient Selection

Pneumonia that begins within 48 h after endotracheal intubation was considered VAP if it meets the definitions implemented by the U.S. Centers for Disease Control and Prevention National Healthcare Safety Network (CDC-NHSN).[2,3,15] Patients with VAP caused by *A. baumannii* VAP (ABVAP) were determined based on microbiological results.

Microbiological Studies

The endotracheal aspirate collected from VAP patients was cultured on bloody agar and EMB agar. Bacterial identification and antibiograms were carried out using conventional methods and a VITEK-2 Compact Automated System (bioMérieux, Marcy l'Etoile, France) in the microbiology laboratory in our hospital.

Calculations

VAP rate and ventilator utilization (VU) ratio were calculated using CDC-NHSN methodology as follows:

VAP rate = (Number of VAP cases/Total ventilator days) × 1000

VU ratio = Number of ventilator days/Number of patient days.

Results

A total of 2277 patients admitted to the ARICU during the study period were enrolled in this study. Of these, 302 (13.26%) were seen to have developed VAP during their stay. Among VAP patients, 191 (63.25%) were microbiologically diagnosed ABVAP (Table 1). Table 1 also shows data given on a yearly basis. As shown in Table 1, the rates of VAP patients ranged from 10.52% to 17.47% (pooled mean: 13.26%), while the rates of ABVAP patients ranged from 54.24% to 77.19%, with a pooled mean of 63.25%.

All patients were hospitalized for 18,743 days in the course of the study period, with a total of 13,184 mechanical ventilator days. Pooled means of VU ratio and VAP rate were 0.70 and 22.91, respectively. On a yearly basis, VAP rates were fluctuating between 19.93 and 28.14, while VU ratio between 0.66 and 0.74 (Table 2).

Regarding patients' characteristics, the majority of patients were immunosuppressive, they were exposed to invasive procedures such as mechanical ventilation, and faced some risks, including longer hospital stay, ICU stay, and underlying severity of illness. On clinical examination, clinical and radiological findings (temperature, neutrophilia, purulent sputum, and PA chest film showing infiltrates) of ABVAP were similar to those of pneumonias caused by other Gram-negative bacteria.

Table 1. Rates of VAP and ABVAP infections in the ARICU

Years	Number of ICU patients	Number of VAP patients	The rate of VAP patients within the total number of ICU patients (%)	Number of ABVAP patients	The rate of ABVAP patients within the total number of VAP patients (%)
2011	428	59	13.79	32	54.24
2012	416	53	12.74	35	66.04
2013	435	76	17.47	42	55.26
2014	542	57	10.52	38	66.67
2015	456	57	12.50	44	77.19
Pooled	2277	302	13.26	191	63.25

VAP: Ventilator-associated pneumonia; ABVAP: *Acinetobacter baumannii* ventilator-associated pneumonia; ICU: Intensive care unit.

Table 2. VU ratios and VAP rates in the ARICU

Years	Number of VAP patients	Patient days	Ventilator days	VU ratio	VAP rate
2011	59	3455	2448	0.71	24.10
2012	53	3538	2599	0.74	20.39
2013	76	3927	2701	0.69	28.14
2014	57	3920	2576	0.66	22.13
2015	57	3903	2860	0.73	19.93
Pooled	302	18.743	13.184	0.70	22.91

VAP: Ventilator-associated pneumonia; VU: Ventilator utilization; ARICU: Anesthesiology and reanimation intensive care unit.

Discussion

ICU patients are at 5–10 higher risk of nosocomial infection than other hospitalized patients since they often require medical devices which can provide growth environments for infectious organisms, and approximately 10–28% of them develop VAP.[5,16,17] In our country, VAP is mostly caused by *P. aeruginosa*, *A. baumannii*, S. aureus, *Klebsiella* spp., and E. coli.[1,12,18,19] Of these, although it is endemic in countries of North Africa and the Middle East, *A. baumannii* is a growing concern in ICUs globally, as it rapidly develops resistance to the majority of antibiotics.[2,20-22] This organism can easily cause serious infections in immunosuppressive patients including cancer patients,[17] and this may explain high rate of ABVAP patients within the total number of VAP patients in the ICU of our hospital, an oncology hospital.

Overall VAP rate in ARICUs is reported to be 6.3 in 2015 throughout Turkey. This rate is 8.2 in the ARICUs of training and research hospitals, while 3.6, 11.3, and 3.3 in those of state, university, and private hospitals, respectively.[23] When compared to these values, VAP rate in our ICU is obviously quite higher both in 2015 and other study years. Regarding VU ratio in 2015, an overall VU ratio is stated as 0.62 in the ARICUs of all type of hospitals. By hospital type, VU ratios are 0.61, 0.60, 0.61, and 0.68 in the ARICUs of training and research, state, university, and private hospitals, respectively,[23] all values being slightly higher than VU ratio in our ICU. Plausible reasons for these high rates can be found in the study by Leblebicioglu et al. (2014).[24]

Among the risk factors for the development of infections in ICUs are longer ICU stay, use of medical devices, exposure to antimicrobial agents, colonization pressure, invasive procedures, underlying severity of illness, and reintubation.[3,16,17,22] Understanding these factors are an important step in taking the necessary measures to prevent and/or reduce nosocomial infections. In fact, when effective and appropriate infection control measures are implemented, nosocomial infections can be reduced by more than 30%.[18,19] Detailed information on risk factors and control measures concerning VAP can be found elsewhere.[25-27]

Conclusion

Surveillance studies guide to the basic infection control programs in a hospital setting. Data obtained from surveillance studies enable to monitor the nosocomial infection rate and any changes such as a significant increase in this rate overtime, to take preventive measures, and to assess the effectiveness of these measures. From this perspective, the results of our surveillance study will motivate the infection control committee of our hospital to assess current infection control program and strategies so that high VAP rate in our ICU can be reduced to the minimum possible level.

Disclosures

Ethics Committee Approval: Clinical Research Ethics Committee of Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital of the University of Health Sciences (Approval Number: 2020-07/735; Approval Date: July 7, 2020).

Peer-review: Externally peer-reviewed.

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