

Research Article

Risk Factors of Mortality from *Acinetobacter Baumannii* Infection in Intensive Care Units

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Abstract

Objectives: The incidence of *Acinetobacter baumannii* pathogen is high especially among patients hospitalized in intensive care units. The objective of this study was to investigate risk factors affecting mortality in patients hospitalized in the intensive care units due to various reasons in whom AB infection was detected.

Methods: A total of 28 patients hospitalized in the intensive care units of our hospital who have AB infection detected with culture tests were included in the study. Patients' demographic data such as age and gender, admission diagnosis, duration of hospitalization, and infection types and comorbidities were obtained from the hospital records.

Results: Of all patients, 39.3% were female and 60.7% were male. The mean duration of hospitalization was found as 57.9±48.0 days. We found that previous antibiotic use, the need for mechanical aspiration, advanced age, the use of a nasogastric catheter and isolation of AB pathogen from tracheal aspirate were the risk factors for mortality from AB infection.

Conclusion: Given the high prevalence of this pathogen especially in intensive care units and its resistance against multidrug antibiotics, we believe that further studies should be continuously conducted studies on this pathogen will provide contribution to the development of new treatment strategies and antibiotics.

Keywords: *Acinetobacter baumannii*, nosocomial infection, antibiotic resistance, mortality

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A *Acinetobacter baumannii* (AB) is an aerobic, pleomorphic and non-motile nosocomial bacillus. The incidence of AB, which is an opportunistic pathogen is high in immunocompromized people, especially among persons hospitalized for a long time.^[1] AB has been described as a “red alarm” because of its wide resistance spectrum.^[2] AB usually causes hospital acquired infections. Many infections caused by this pathogen are seen in patients hospitalized in intensive care units, patients requiring mechanical ventilation, those with impaired skin integrity due to a trauma or burn and patients who underwent a

recent surgery.^[3] Although it has been formerly thought as a low-virulence pathogen, today it is considered a serious pathogen causing high mortality rates, increased hospitalization costs and prolonged hospitalization particularly in intensive care units (ICUs).^[4] It is difficult to explain the role of AB acquirement in ICUs, because AB do not always act as an infecting pathogen since it is widely distributed and has a high colonization capability. However, there are risk factors defined for colonization and infection with resistant microorganisms in ICUs.^[5]

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Especially hospital derived species isolated from patients in ICUs, AB infections may have a high resistance against antimicrobial agents. Because the resistance of AB against monotherapy with a single agent has reached 100%, multidrug antibiotherapy is used against this infection. However, antibiotic resistance of the pathogen is occurring more rapidly than the development of new antibiotics. This makes treatment decisions of clinicians difficult in patients with AB infection. Therefore, providing more result data to clinicians about risk factors causing mortality due to AB infections, would provide contribution to the management of these infections more efficiently.

The objective of this study was to investigate risk factors affecting mortality in patients hospitalized in the intensive care units due to various reasons in whom AB infection was detected.

Methods

Patients hospitalized in general intensive care, pediatric intensive care and neurology intensive care units of our hospital for at least 48 hours due to various reasons in whom AB species were isolated from the cultures in the microbiology laboratory between January 2018 and July 2019 were included in the study. Patients' demographic data such as age and gender, admission diagnosis, duration of hospitalization, and infection types and comorbidities were obtained from the hospital records and retrospectively analyzed. In addition, the samples from which AB was isolated, sensitivity of AB against antibiotics, antibiotics, cardiogenic and neurologic medications used, and mortality status were also recorded.

Patients hospitalized in the intensive care units during the study period, but had no AB pathogen isolated from blood, tracheal aspirate or urine samples and those infected with AB at the time of admission were excluded from the study. *Acinetobacter baumannii* infection was evaluated according to the Centers for Disease Control and Prevention (CDC) criteria.^[6]

CDC Definitions for Nosocomial Infections

The Centers for Disease Control and Prevention (CDC) has developed a series of definitions for the surveillance of nosocomial infections. These definitions combine specific clinical findings and outcomes of laboratory and other tests and are formulated as algorithms. Specific criteria have been included for certain infections that include different clinic and laboratory manifestations in infants compared to adults. There are criteria in the definitions for common nosocomial infections as well as rarely seen infections with serious outcomes. CDC criteria were introduced for the first time in the USA hospitals in 1988 and adopted worldwide over time.^[6]

Ethics Statement

Before the beginning of the study, the necessary ethics approval was received from the local committee of our hospital. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Statistical Analysis

Data obtained were analyzed using Statistical Package for Social Sciences (SPSS) v.21 (SPSS IBM Inc, Chicago, IL, USA) statistical software. Continuous variables were analyzed with Mann-Whitney U test and expressed as mean±standard deviation, minimum and maximum values. Categorical variables were analyzed with Chi-square test and expressed as frequency (n) and percentage (%). $P < 0.05$ values were considered statistically significant.

Results

A total of 28 patients hospitalized in the intensive care units of our hospital who have AB infection detected with culture tests were included in the study. Of all patients, 11 (39.3%) were female and 17 (60.7%) were male. Fourteen of the patients (50%) were in pediatric age group, while 14 (50%) were adult. The mean age was found as 70.8 ± 21.0 (min-max: 30-94) years in adult patients, while the mean age was found as 9.9 ± 13 (min-max: 2-48) months in pediatric patients.

When admission diagnoses of the patients were examined; the most common diagnosis was sepsis (71.4%) followed by respiratory failure (64.2%) and pneumonia (25%). Fifteen (53.6%) of the patients hospitalized in general intensive care unit, 12 (42.9%) in pediatric intensive care unit and 1 (3.6%) in neurology intensive care unit. The mean duration of hospitalization was found as 57.9 ± 48.0 (min-max: 2-252) days. The mean APACHE II score of the patients was found as 26.4 ± 3.0 (min-max: 18-32). The rate of mortality was 82.1 (n=23).

The type of infection was found as pneumonia in 19 (67.9%) patients, surgical site infection in 4 (14.3%) patients, urinary system infection in 3 (10.7%) patients, and sepsis in 2 (7.1%) patients. The samples with AB isolated were found as tracheal aspirate in 19 (67.9%) patients, wound site in 4 (14.3%) patients, urine in 3 (10.7%) patients, blood in 1 (3.6%) patient and cerebrospinal fluid (CSF) in 1 (3.7%) patient. All patients were administered colistin as antibiotherapy. Whereas 7 (25%) patients received monotherapy with colistin, 21 (75%) received multidrug antibiotherapy. Antibiotics given in addition to colistin included piperacillin-tazobactam, levofloxacin, imipenem, meropenem, sulbactam, cefoperazone and ceftipime.

According to the sensitivity tests performed, AB was found to be sensitive against colistin in all patients. Acinetobacter pathogen was sensitive against piperacillin-tazobactam in 3.6%, levofloxacin in 39.3%, imipenem in 39.3%, meropenem in 7.1%, sulbactam in 28.6%, cefoperazone in 35.7% and cefepime in 3.6% of the patients (Table 1). AB sensitivity against the medications used is shown in Table 1.

Twenty-three patients (82.1%) were using cardiogenic drugs and 18 (64.3%) neurologic drugs. Underlying diseases in patients with AB isolated were found as chronic heart disease in 7 (25%) patients, chronic pulmonary disease in 26 (92.9%) patients, chronic liver disease in 8 (28.6%) patients, chronic renal disease in 8 (28.6%) patients, diabetes mellitus in 14 (50%) patients, cerebrovascular events in 5 (17.9%), hydrocephalus in 2 (7.1%) patients and peripheral artery disease in 1 (3.6%) patient.

Whereas 47.8% of the nonsurvivors were children and 52.2% were adults. The mean age was found as 75.8 ± 21.0 years in nonsurvivor adult patients. The mean duration of stay in the intensive care unit was found as 45.0 ± 48.0 days in these patients. Of the nonsurvivors, 46.4% were male and 53.6% were female. No significant difference was found between sexes in terms of mortality ($p > 0.05$). The most common admission diagnosis was found as sepsis by 73.9% in the nonsurvivors. The mean APACHE II score was found as 27.21 in nonsurvivor and 22.7 in survivor patients. The mean APACHE II score was statistically significantly higher in nonsurvivor compared to survivor patients ($p < 0.05$). The most common type of infection was found as pneumonia in the nonsurvivors.

When the risk factors affecting mortality were examined, we found that 87% of the nonsurvivors used antibiotics previously. This rate was 20% in the survivors. 75% of the nonsurvivors were older than 75 years. Mechanical ventilation was needed in 73.9% of these patients. Again nasogastric catheter was used in 78.3% of these patients. Acinetobacter pathogen was most commonly isolated from tracheal aspirate by 73.9% in these patients. Compression wound was found in 34.8% of the nonsurvivors. The risks for mortality from AB infection is shown in Table 2. Resistance of AB against multidrug antibiotics differed between 60.9% and 95.7%.

Discussion

Acinetobacter baumannii (AB) has become a problematic nosocomial pathogen, especially in intensive care units where the pathogen widely spreads.^[7-9] It can live in moist and dry environments and found in a healthy human skin.^[10] As in many countries, in our country also AB is the most common nosocomial pathogen among gram-negative

Table 1. AB sensitivity against antibiotics

Antibiotics	n	%
Colistin	23	100
Levofloxacin	9	39.1
Imipenem	9	39.1
Cefoperazone	8	34.8
Sulbactam	6	26.1
Meropenem	2	7.1
Cefepime	1	4.3
Piperacillin-Tazobactam	1	4.3

Table 2. The risk factors affecting mortality from Acinetobacter baumannii infection

Risk Factors	n	%
Previous use of antibiotics	20	87
Mechanical ventilation	17	73.9
Nasogastric catheter	23	78.3
Isolation of pathogen from tracheal aspirate	17	73.9
Compression wound	8	34.8

bacilli, and is characterized by marked resistance against antibiotics. AB may cause nosocomial infection outbreaks such as bloodstream infection, urinary system infection, ventilator induced infection and wound site infection. The resistance of AB against multidrugs is increasing rapidly, and this pathogen is becoming further important especially in intensive care setting where patient circulation is high.

In this study, we investigated risk factors of mortality due to AB infection. In the literature, rates of mortality from AB infections widely differs among studies. Studies have reported the rate of mortality from AB infection in a wide range between 10%^[11] and 75%.^[12] In our study, the rate of mortality was 82.1%. We think that our rate of mortality lower than reported in the literature might be resulted from relatively small number of patients and inclusion of only patients hospitalized in the intensive care units in whom AB pathogen was isolated in our study.

Age has been reported as a risk factor of mortality from AB infection in the literature. In a study on AB bacteremia in adults, being older than 65 years was reported as a risk factor for mortality.^[13] In a study by Park et al. investigating risk factors of mortality from AB infection, the mean age was reported as 62.0 in nonsurvivors, but the difference between survivors and nonsurvivors was not statistically significant.^[14] In a study by Karabay et al.,^[15] the rate of mortality from AB bacteremia in patients hospitalized in the intensive care units was found as 77%. Similarly in our study the mean age of the nonsurvivors was found as 75.8 ± 21.0 years. Furthermore, 75% of these patients were older than 75 years old.

In our study, the most common type of bacteremia infection was found as pneumonia by 67.9%. Studies in the literature have reported pneumonia as the most common of AB bacteremia.^[16, 17] The most common source of AB infection has been reported as respiratory tract.^[18, 19] In addition, respiratory tract as the source of AB bacteremia has been suggested as a risk factor affecting mortality.^[14] In a study by Sahin AR, acinetobacter pathogen was most commonly isolated from tracheal aspirate by 42.3%.^[20] In our study also AB pathogen was most commonly isolated from tracheal aspirate (73.9%) in nonsurvivors.

In a study by Liu et al.,^[21] previous use of antibiotics was found to be a risk factor of mortality from AB infection. This is caused by rapidly developing resistance of this pathogen against antibiotics. In our study, 87% of the nonsurvivors used antibiotics previously. Again, mechanical ventilation also has been reported as a risk factor of mortality from AB infection in the intensive care setting.^[15, 22] In our study, mechanical ventilation was needed in 73.9% of the nonsurvivors.

APACHE II score is a widely used scoring system in predicting of prognosis in patients hospitalized in intensive care units. An APACHE II score >16 has been reported as a risk factor in predicting mortality.^[23] The mean APACHE II score was found as 21 in a study by Balci et al.^[24] and 23.3 in a study by Ozdemir et al.^[22] In our study, the mean APACHE II score was found as 27.21 in the nonsurvivors and 22.7 in the survivor patients.

The most important issue in the treatment of AB infection is multidrug antibiotic resistance, because appropriate antibiotics to be given to these patients are limited. Delay in appropriate antibiotherapy in hospital acquired infections caused by bacteria with multidrug resistance leads to increased mortality.^[20] Several studies have reported that antibiotic resistance has negative effects on mortality, length of stay in hospital and healthcare costs.^[25] When AB pathogen has multidrug resistance, hospitalization and healthcare costs increase. This is a factor increasing the rate of mortality. Different rates of the resistance of AB pathogen against antibiotics have been reported in various studies. In a study by Aygencel et al.^[26] antibiotic resistance of AB pathogen was reported as 96.3% with piperacillin-tazobactam and 94.5% with ipinepem, while antibiotic resistance was low against colistin (5%). In a study by Ozdemir et al.,^[22] sensitivity of AB against colistin was reported as 94.7%. In our study, colistin was administered in all patients and sensitivity of AB pathogen against colistin was found as 100%. AB develops resistance against antibiotics more rapidly than the development of new and potent antibiotics. Therefore it is important to continuously monitor the re-

sistance of this pathogen against multidrug antibiotics and develop treatment strategies accordingly.

This study has some limitations. The study has a retrospective design and included relatively small number of patients. In addition, we could not compare all results between the nonsurvivors and survivors because of the small number of survivors. However, given the prevalence of AB pathogen in intensive care settings and increasing resistance of the pathogen against multidrug antibiotics, it is important to conduct further studies on this pathogen and investigate risk factors affecting mortality. In this context, we believe that our results would contribute to the existing literature on this issue.

Conclusion

The results of this study showed previous antibiotic use, the need for mechanical aspiration, advanced age, the use of a nasogastric catheter and isolation of AB pathogen from tracheal aspirate as the risk factors for mortality from AB infection. Given the prevalence of this pathogen especially in intensive care units and its resistance against multidrug antibiotics, we believe that further studies should be continuously conducted studies on this pathogen will provide contribution to the development of new treatment strategies and antibiotics.

Disclosures

Ethics Committee Approval: The study was approved by the local Ethics Committee of Gaziantep Hasan Kalyoncu University.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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