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Mortality Risk Factors of *Acinetobacter baumannii* Infections in a Medical Intensive Care Unit: A 2-Year Survey

Bir Dahili Yoğun Bakım Ünitesindeki *Acinetobacter baumannii* İnfeksiyonlarının Mortalite Risk Faktörleri: 2 Yıllık Bir Çalışma

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SUMMARY

Introduction: *Acinetobacter baumannii is considered to be a nosocomial pathogen gradually becoming more important around the world and in Turkey, particularly for patients in intensive care units (ICUs). In this study, we endeavored to overview the general characteristics of the inpatients who were treated in our ICU and diagnosed with A. baumannii infection, and particularly to determine risk factors of patients with mortal A. baumannii infection.*

Materials and Methods: *This retrospective study was conducted in the nine-bed medical ICU of a 900-bed tertiary university hospital and was designed to include a two-year period (April 2007-April 2009). Characteristics of the patients before their admission to ICU and during their stay were examined, and factors related to A. baumannii infection together with factors affecting mortality were determined.*

Results: *One hundred and twenty-nine patients were included in the study. Mean age of the patients was 63.05 (± 17.28) years, and 59.7% of the patients were males. The majority of the patients were admitted to the ICU from both emergency service and internal medicine clinics due to respiratory failure or sepsis. Forty-seven point three percent of patients (47.3%) were immunosuppressive. One hundred and sixty-three A. baumannii isolates were identified in 129 patients. A. baumannii was mostly isolated from tracheal aspirate cultures (70.5%) followed by bloodstream or central catheter cultures (16%). On average, 89% of isolates were resistant to ciprofloxacin and 94.5% to imipenem. Seventy-three percent of patients (n= 108) were diagnosed as pneumonia or ventilator-associated pneumonia (VAP), 15% (n= 22) as bloodstream infection, 8.7% (n= 13) as skin/soft tissue infection, and 3.3% (n= 5) as urinary tract infection. Ninety-eight patients (76%) who were infected by A. baumannii died. Factors affecting mortality according to univariate analysis were listed roughly in terms of Acute Physiology Assessment and Chronic Health Evaluation (APACHE) II score, length of hospital stay before ICU, the clinic from which the patient was transferred to the ICU, applied invasive procedures (mechanical ventilation, catheters, dialysis, etc.), complications in the ICU, and antibiotics used previously. According to multivariate analysis, the most significant risk factors for mortality were application of invasive mechanical ventilation, sepsis in the ICU and admission from internal medicine clinics.*

Conclusion: *Resistant A. baumannii infections are among the major medical challenges worldwide, in Turkey, and in our ICU. The mortality rate is high, and different risk factors affect the mortality rate in A. baumannii infections. According to our study, application of invasive mechanical ventilation, sepsis in the ICU and admission from internal medicine clinics were the major risk factors for mortality in our A. baumannii-infected ICU patients.*

Key Words: *Acinetobacter baumannii infection, Intensive care unit, Risk factors, Mortality*

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ÖZET

Bir Dahili Yoğun Bakım Ünitesindeki *Acinetobacter baumannii* İnfeksiyonlarının Mortalite Risk Faktörleri: 2 Yıllık Bir Çalışma

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Giriş: *Acinetobacter baumannii tüm dünyada ve Türkiye'de özellikle yoğun bakım hastaları için gittikçe önem kazanan bir nozokomiyal patojendir. Bu çalışmada, yoğun bakım ünitesi (YBÜ)'ne yatarak tedavi gören ve A. baumannii infeksiyonu tanısı alan hastaların genel özellikleri gözden geçirilmiş, özellikle mortal seyreden A. baumannii infeksiyonlu hastalardaki risk faktörleri belirlenmeye çalışılmıştır.*

Materyal ve Metod: *Bu çalışma 900 yataklı bir üniversite hastanesindeki dokuz yataklı medikal YBÜ'de, retrospektif olarak, iki yıllık periyodu (Nisan 2007-Nisan 2009) içine alacak şekilde yapılmıştır. Hastaların yoğun bakım öncesi ve yatışı sırasındaki özellikleri incelenmiş; A. baumannii infeksiyonu ile ilgili faktörler ve mortaliteye etki eden faktörler belirlenmeye çalışılmıştır.*

Bulgular: *Yüz yirmi dokuz hasta çalışmaya kabul edilmiştir. Hastaların yaş ortalaması 63.05 (± 17.28) yıldır; %59.7'si erkektir. Hastaların büyük kısmı acil servis veya iç hastalıkları servislerinden sepsis veya akut solunum yetmezliği tanısı ile kabul edilmiştir. Hastaların %47.3'ü immünsüpresiftir. Yüz yirmi dokuz hastada 163 tane A. baumannii izolatı elde edilmiştir. En sık izolatlar %70.5 ile trakeal aspirat kültüründen ve %16 ile kan/kateter kültüründen elde edilmiştir. İzolatların ortalama %89'u siprofloksasine, %94.5'i ise imipeneme dirençlidir. Hastaların %73 (n= 108)'ü pnömoni veya ventilatörle ilişkili pnömoni, %15 (n= 22)'i kan dolaşımı infeksiyonu, %8.7 (n= 13)'si deri/yumuşak doku infeksiyonu, %3.3'ü ise idrar yolu infeksiyonu tanısı almıştır. A. baumannii infeksiyonlu hastaların 98 (%76)'i ölmüştür. Mortaliteye etki eden faktörler tek değişkenli analize göre kabaca "Acute Physiology Assessment and Chronic Health Evaluation (APACHE)" II skoru, yoğun bakım öncesi hastanede yatış süresi, yoğun bakıma nereden kabul edildiği, uygulanan invaziv işlemler (mekanik ventilasyon, kateterler, diyaliz vb.), yoğun bakımda gelişen komplikasyonlar ve daha önceden kullanılan antibiyotikler olmuştur. Çok değişkenli analize göre ise invaziv mekanik ventilasyon uygulanması, YBÜ'de sepsis gelişmesi ve YBÜ'ye iç hastalıkları servislerinden kabul edilmiş olmaları mortalitede en önemli risk faktörleri olarak bulunmuştur.*

Sonuç: *Dirençli A. baumannii infeksiyonları tüm dünyada olduğu gibi Türkiye'de ve bizim hastanemizdeki YBÜ'de majör problemler arasındadır. A. baumannii infeksiyonlarında mortalite yüksektir ve mortaliteyi değişik risk faktörleri etkiler. Bizim çalışmamıza göre, YBÜ'de A. baumannii infeksiyonu gelişen hastalarda invaziv mekanik ventilasyon uygulanması, YBÜ'de sepsis gelişmesi ve hastaların iç hastalıkları servislerinden gelmiş olmaları mortaliteyi belirleyen en önemli risk faktörleridir.*

Anahtar Kelimeler: *Acinetobacter baumannii infeksiyonu, Yoğun bakım ünitesi, Risk faktörleri, Mortalite*

INTRODUCTION

Acinetobacter baumannii an aerobic, non-fermentative, gram-negative coccobacillus, has emerged as an increasingly important nosocomial pathogen. Previously considered as an organism of low virulence, most commonly capable of colonizing rather than infecting, it has become invasive, causing life-threatening infections in hospital patients, especially among the critically ill, resulting in significant morbidity and mortality. The rates of recovery of *A. baumannii* from natural environments and its incidence in the community are low, while its rate of carriage by hospitalized patients is high and its occurrence in the hospital setting is frequent. *A. baumannii* has simple growth requirements. This might contribute to the survival of *A. baumannii* in the hospital environment, which represents the main reservoir of bacterium. Treatment of this infection can be particularly difficult because of the frequency of drug resistance to multiple antibiotics, including broad-spectrum beta-lactams, aminoglycosides, quinolones, and carbapenems. Ampicillin-sulbactam, polymyxin B, colistin (polymyxin E), and tigecycline are often considered as the only drugs available to treat resistant *A. baumannii* infections[1-3].

A. baumannii is frequently encountered in hospitals in Turkey, and many isolates exhibit resistance to antimicrobials commonly used against such bacterial infections. We performed a retrospective study in our intensive care unit (ICU) to better understand the epidemiology of *A. baumannii* infections. The objectives of the study were to overview the clinical characteristics of *A. baumannii* infections, and particularly to determine the risk factors

associated with mortality in *A. baumannii*-infected patients in our medical ICU.

MATERIALS and METHODS

This study was performed in the University of Gazi, Faculty of Medicine a 900-bed tertiary university hospital located in Ankara, Turkey. The hospital provides care for all general surgical and medical conditions. Our medical ICU is a nine-bed medical unit admitting, on a non-elective basis, 400 adult patients per year. Patients were admitted after an evaluation by a physician intensivist. No specific admission criteria for the patients were required.

All consecutive patients identified in our ICU from April 2007 to April 2009 with microbiologically documented *A. baumannii* infections were eligible as potential cases. *A. baumannii* infections that developed within 48 hours of admission in the ICU were excluded. An active nosocomial infection surveillance was performed by infection control nurses during this period. The diagnosis of nosocomial infection was assessed according to Centers for Disease Control and Prevention (CDC) criteria[4]. This retrospective study was performed using prospectively collected databases. For each patient, we recorded

a. Prehospitalization characteristics (age, gender, underlying diseases, etc.),

b. Admission data [including reason for ICU admission, severity of illness on admission according to Acute Physiology Assessment and Chronic Health Evaluation (APACHE) II scoring system, source of admission, etc.],

c. Advanced life support measures taken during the ICU stay (endotracheal intubation and mechanical ventilation, central venous catheterization, arterial catheterization, blood transfusion and dialysis, etc.),

d. Data related with *A. baumannii* infections (isolation sites, susceptibility patterns, etc.),

e. Previous antibiotic treatments,

f. Length of ICU and hospital stays, and

g. ICU and hospital outcomes (mortality rates).

Microorganisms were identified by the BBL Crystal Enteric/Nonfermenter ID Kit (Becton Dickinson, USA). The in vitro activities of antimicrobial agents were tested against the clinical isolates of *A. baumannii* using the disk diffusion method according to the Clinical and Laboratory Standards Institute (CLSI) criteria[5].

Statistical Analysis

Data were analyzed using the SPSS version 11.5 statistical package (SPSS, Chicago, IL, USA). Statistical significance was set as $p< 0.05$. Normally distributed or almost-normally distributed variables were reported as means with standard deviations and were compared by Student's t test. Non-normally distributed continuous data were reported as medians with interquartile ranges and were compared by the Mann-Whitney U test. Categorical data were reported as proportions and were compared using the chi-square test (Pearson test, Fisher's exact test or Yates continuity correction test when appropriate). Multivariate analysis using the forward stepwise logistic regression method was performed, including all variables with p value ≤ 0.05 in the univariate analysis. Odds ratios (OR) and 95% confidence intervals (CI) were calculated for each variable.

RESULTS

In this two-year study period, 780 patients were admitted to our ICU. Ages ranged between 17 and 107, and mean age of the patients was 61.89 ± 18.26 years. Fifty-six point two percent (56.2%) of all patients were males. Forty-eight point two percent (48.2%) of the patients died during their stay in the ICU. The mean length of ICU stay for all inpatients was 8.61 (± 12.12) days, ranging from 1 to 102 days (median, 5 days).

Sixteen point five percent (16.5%, 129) of the inpatients were infected with *A. baumannii* while staying in our ICU. This group of patients was included in the study. In the study group, there were 52 women (40.3%) and 77 men (59.7%). The patients were aged between 19 and 90 years, and median age was 66 years. There were no significant differences between all ICU patients and the study group according to age and gender.

In the study group, the mean length of stay before ICU was 9.54 (± 16.83) days, ranging from 0 to 91 days (median, 4 days). The mean length of ICU stay was 22.92 (± 22.16) days, ranging from 2 to 107 days (median, 16 days). The mean length

of hospital stay was 35.69 (± 28.16) days, ranging from 3 to 128 days (median, 23 days). In the study group, length of ICU stay was significantly longer than for all patients (medians, 5 days vs 16 days, p< 0.05). The mean interval between admission to the ICU and identification of *A. baumannii* infections was 9.7 (± 10.36) days, ranging from 2 to 67 days (median, 8 days). APACHE II score of the patients in the study group was 23.61 (± 7.13), ranging from 9 to 47 (median, 23). Glasgow Coma Score was 14 (3-15). There were no differences between the study group and all patients according to APACHE II score (medians, 23 vs. 21, p> 0.05). Some characteristics of the study group are shown in Table 1.

Ten point one percent (10.1%, 13) of the patients were end-stage cancer patients. Twenty-six patients (20.2%) were previously admitted to our ICU during the last three months. The majority of the patients were admitted to ICU from both emergency service and internal medicine clinics. The ICU mortality rate in the study group was 76%, and the hospital mortality rate was 78.3%. This ICU mortality rate in the study group was significantly higher than the general mortality rate of our ICU (48.2% vs. 76%, p< 0.05). The other characteristics of the study group are shown in Table 2.

The majority of the study group patients were admitted to the ICU due to respiratory failure or sepsis. The main underlying diseases in the study group were cardiovascular diseases, hematologic disorders/cancers, and pulmonary diseases. Forty-seven point three percent of patients (47.3%) were immunosuppressive because of underlying diseases or drug use. Some causes of inpatient admission to the ICU and their co-morbidities are displayed in Table 2.

Mechanical ventilation was performed on 89.1% of the study group patients. While invasive mechanical ventilation was used in 109 patients, non-invasive mechanical ventilation was applied to 62 patients. During their stay in the ICU, in 121 patients, central venous catheters were placed for hemodynamic monitoring or renal replacement therapy. In 122 patients, arterial catheters were placed for invasive arterial blood pressure monitoring or arterial blood gases analysis. Renal replacement therapy was required in 61 patients due to chronic renal failure (21 patients) or newly-developed acute renal failure (40 patients). Enteral nutrition was initiated in 102 patients. Blood and blood product replacement was performed in 105 patients during their ICU stay (Table 2).

One hundred and sixty-three *A. baumannii* isolates were identified in 129 patients. *A. baumannii* was mostly isolated from tracheal aspirate cultures (115 isolates-70.5%) followed by bloodstream or central venous catheter cultures (26 isolates-16%), wound cultures (13 isolates-8%), and urinary tract cultures (5 isolates-3%). All isolates were highly resistant to carbapenems but highly susceptible to colistin and tigecycline (Table 3).

One hundred and forty-eight clinical infections were described in 129 patients during their ICU stay.

Table 1. Some characteristics of *Acinetobacter baumannii*-infected patients

Characteristics	Value Mean ± SD (median; minimum-maximum)
Age	63.05 ± 17.28 (66; 19-90)
Length of stay before ICU admission	9.54 ± 16.83 (4; 0-91)
Length of ICU stay	22.92 ± 22.16 (16; 2-107)
Length of hospital stay	35.69 ± 28.16 (23; 3-128)
Interval between admission to the ICU and identification of *A. baumannii* infections	9.7 ± 10.36 (8; 2-67)
APS (Acute Physiological Score)	13.22 ± 6.1 (13; 2-29)
APACHE II score	23.61 ± 7.13 (23; 9-47)
Glasgow Coma Score	14 (3-15)

ICU: Intensive care unit, APACHE: Acute Physiology Assessment and Chronic Health Evaluation, SD: Standard deviation.

Table 2. The other characteristics of patients who were infected by *Acinetobacter baumannii*

Characteristics	Number of patients	%
Gender		
Female	52	40.3
Male	77	59.7
ICU outcome		
Survival	31	24
Death	98	76
Hospital outcome		
Survival	28	21.7
Death	101	78.3
End-stage oncologic patients	13	10.1
Previous admission to ICU	26	20.2
Admission from*		
Emergency service (ER)	53	41.1
Internal medicine clinics	52	40.3
Hematology/BMT unit	20	15.5
Causes of admission*		
Respiratory failure	100	77.5
Sepsis	80	62
Metabolic/renal	52	40.3
Co-morbidities*		
Immunosuppression	61	47.3
Cardiovascular diseases	45	34.9
Hematologic disorders/cancer	39	30.2
Mechanical ventilation (MV)	115	89.1
Invasive MV	109	84.5
Non-invasive MV	62	48.1
Arterial line/invasive arterial blood pressure monitoring	122	94.6
Central catheter placement/ Central venous pressure monitoring	121	93.8
Hemodialysis	61	47.3
Nutrition	107	82.9
Enteral nutrition	102	79.1
Parenteral nutrition	52	40.3
Transfusion	105	81.4
Erythrocyte replacement	102	79.1

* Most important three groups (according to admission site, cause of admission and co-morbidity) are given in Table 2.
BMT: Bone marrow transplantation, ICU: Intensive care unit.

Table 3. Mean antimicrobial resistance rates of all *Acinetobacter baumannii* isolates

Antibiotic	Mean resistance rate (%)
Ampicillin-sulbactam	94.5
Ciprofloxacin	88.9
Colistin	0.6
Imipenem	94.5
Piperacillin-tazobactam	96.3
Cefoperazone-sulbactam	54
Netilmicin	31.9
Amikacin	88.3
Tigecycline*	19.5

* Only 44 strains were tested.

One hundred and eight (73%) patients were diagnosed as pneumonia or ventilator-associated pneumonia (VAP), 22 (15%) patients as blood stream infection, 13 (8.7%) patients as skin/soft tissue infection, and 5 (3.3%) patients as urinary tract infection. Nineteen patients had more than one clinical infection during the ICU stay.

Different antibiotics had been used in all study group patients before ICU admission or *A. baumannii* isolation. Previous antibiotic use was considered if the patient had received 48 hours or more of intravenous antibiotics within the previous two weeks. The most frequently used antibiotics were piperacillin/tazobactam (77.5%), imipenem (72.1%), ciprofloxacin (64.3%), and teicoplanin (64.3%).

Ultimately, 12 (9.3%) patients were discharged from the ICU, 19 (14.7%) patients were transferred to related units, and 98 (76%) patients died in the ICU. In short, 31 patients were identified as survivors and 98 patients as nonsurvivors.

A. baumannii-infected patients were grouped in two as those who survived (survivors) and those who died (nonsurvivors), and comparisons were made in terms of continuous and categorical variables. Significant continuous variables between survivors and nonsurvivors were APACHE II score, Acute Physiological Score (APS) and length of hospital stay before ICU. The APACHE II score of survivors was lower and their length of hospital stay before ICU were shorter compared to the nonsurvivors. Differen-

ces were also found between the survivors and nonsurvivors in terms of categorical variables. Significant differences were displayed in terms of clinics/units of admission, application of mechanical ventilation, placement of central venous and arterial catheterization, application of hemodialysis, replacement of blood or blood products, complications in ICU, and previous imipenem use. It was remarkably important that in the survivor group, less mechanical ventilation was applied, less invasive procedures were performed, less complications were seen, and less imipenem was used previously. Significantly different values identified in survivors and nonsurvivors are displayed in (Table 4).

When logistic regression analysis was done to identify factors independently associated with mortality in ICU, sepsis in ICU, application of invasive mechanical ventilation and admission from internal medicine clinics were significantly related with ICU mortality (Table 5).

Table 4. Significantly different values identified in survivors and nonsurvivors among *Acinetobacter baumannii*-infected patients

	Survivors (n= 31)		Non-survivors (n= 98)		
	n	%	n	%	p
Categorical Variables					
End-stage cancer patients	0	0	13	13.3	0.037
Admission from ER	18	58.1	35	35.7	0.046
Admission from internal medicine clinics	6	19.4	55	56.1	0.001
Admission from hematology/BMT unit	1	3.2	19	19.4	0.043
Mechanical ventilation (MV)	21	67.7	94	95.9	< 0.001
Invasive MV	17	54.8	92	93.9	< 0.001
Invasive blood pressure monitoring with arterial line	26	83.9	96	98	0.009
Central venous catheter	26	83.9	95	96.9	0.019
Hemodialysis	9	29	52	53.1	0.033
Blood replacement	21	67.7	84	85.7	0.048
Erythrocyte replacement	20	64.5	82	83.7	0.042
Sepsis	13	41.9	95	96.93	< 0.001
MOF (multiple organ failure)	0	0	30	30.61	< 0.001
Gastrointestinal hemorrhage	1	3.22	21	21.42	0.038
Acute renal failure	3	9.67	37	37.75	0.006
DIC (disseminated intravascular coagulation)	0	0	33	33.67	< 0.001
Previous imipenem use	17	54.83	76	77.55	0.026
Continuous Variables					p
Length of hospital stay before ICU	5.51 ± 9.68 (1; 0-43)		10.81 ± 18.38 (5; 0-91)		0.011
APS (Acute Physiological Score)	11.03 ± 5.89 (10; 3-23)		13.91 ± 6.03 (13; 2-29)		0.017
APACHE II	20.7 ± 6.51 (20; 11-37)		24.53 ± 7.1 (24; 9-47)		0.009

ER: Emergency service, BMT: Bone marrow transplantation, ICU: Intensive care unit, APACHE: Acute Physiology Assessment and Chronic Health Evaluation.

Table 5. Significantly related factors in ICU mortality of *Acinetobacter baumannii*-infected patients according to multivariate analysis

Sepsis in ICU	p< 0.001	OR= 51.53	95% CI (9.9-268.1)
Invasive MV	p= 0.002	OR= 9.84	95% CI (2.34-41.28)
Admission from internal medicine clinics	p= 0.010	OR= 6.14	95% CI (1.54-24.49)

ICU: Intensive care unit, MV: Mechanical ventilation, OR: Odds ratio.

In the study group, sepsis, application of invasive mechanical ventilation and admission from internal medicine clinics increased the ICU mortality 51.5 times, 9.8 times and 6.1 times, respectively.

DISCUSSION

The rates of nosocomial infection vary from 20% to 80% in different ICUs. Pneumonia and urinary tract and bloodstream infections constituted 68-77% of all nosocomial infections in ICUs[6,7]. During the last 40 years, *A. baumannii*, one of the bacteria from the class of *Enterobacteriaceae*, has become an increasingly important cause of NIs in many hospitals. Published data from the National Nosocomial Infections Surveillance (NNIS) System regarding ICU patients across the United States show that, in 2003, *Acinetobacter* spp. were responsible for 6.9% of pneumonias, 2.4% of bloodstream infections, 2.1% of surgical site infections, and 1.6% of urinary tract infections[8]. According to our hospital's nosocomial infections surveillance reports, in 2009, *Acinetobacter* spp. were responsible for 29% of all nosocomial infections in ICUs. Pneumonia (60%) and bloodstream infections (23%) were the most significant parts of these *Acinetobacter*-caused infections.

Nosocomial outbreaks of *A. baumannii* are a serious concern regarding their high morbidity and mortality rates, particularly in ICUs[9,10]. Therefore, in this study, we examined *A. baumannii* infections, which have gradually been gaining in importance over the last few years as a nosocomial infection agent in our ICU. We endeavored to overview general characteristics of the patients in whom *A. baumannii* infection developed, and chiefly to find whether there was a significant difference between the survivor and nonsurvivor patients following *A. baumannii* infection.

Our study was not a case control study and we did not plan particularly to determine the risk factors for the acquisition of *A. baumannii*. However, we found some similar characteristics in our *A. baumannii*-infected patients as in the literature study: longer hospitalization period, immunosuppression, application of invasive mechanical ventilation, prolonged length of ICU stay, indwelling central venous or urinary catheters, presence of invasive devices such as endotracheal and gastric tubes, and prior treatment with broad-spectrum antibiotics, etc.[11-13].

We particularly focused on determining the risk factors of mortality in this study. In the literature, age, immunosuppression, recent surgery, acute respiratory failure, septic shock, and inadequacy of initial antibiotic therapy are some factors that likely play a major role in patient outcomes.

Mortality rates of 30-75% have been reported for nosocomial pneumonia caused by *Acinetobacter* spp., with the highest rates reported in ventilator-dependent patients[14,15]. Kollef et al. and Fagon et al. found that VAP due to *A. baumannii* was an independent predictor of in-hospital mortality[16,17]. Fagon et al. confirmed in a case control study that in cases of pneumonia due to *Pseudomonas* or *Acinetobacter* spp., the mortality rate was 71.4%, the attributable mortality was 42.8% (95% CI 14.5-69.0%), and the risk ratio was 2.5 (95% CI 1.31-4.61). On the other hand, Garnacho-Montero et al. found that VAP episodes caused by *A. baumannii* had a similar prognosis to pneumonia episodes caused by other virulent pathogens. In that study, severity of illness (APACHE II score at admission), Sequential Organ Failure Assessment (SOFA) score on the day of pneumonia diagnosis, the inadequacy of initial antibiotic choice and prior use of imipenem (increases the isolation of imipenem-resistant strains) were the predictors of in-hospital

mortality[18]. In our study, factors affecting mortality in *A. baumannii*-infected patients were underlying immunosuppression (particularly for an inpatient in the hematology inpatient clinic/bone marrow transplantation unit), invasive procedures (mechanical ventilation application, central catheter placement, etc.), previous use of antibiotics (particularly imipenem), various complications (sepsis, disseminated intravascular coagulation, acute renal failure, etc.) developed during surveillance in the ICU, high APACHE II score on admission, and longer stays in the hospital prior to ICU. Yet, according to multivariate analysis results, the most important independent factors associated with mortality were found as application of invasive mechanical ventilation (increases mortality by 9.8 times), sepsis developed in the ICU (increases mortality by 51.5 times) and transfer to ICU from internal medicine clinics (increases mortality by six times). We thought that patients referred from internal medicine clinics had severe underlying diseases, the majority of which were immunosuppressive, and the majority were colonized or infected with more resistant pathogens due to long stays in hospital and frequent use of broad-spectrum antibiotics.

Our study has several limitations. First, it was a retrospective analysis, not a case control study, the sample was relatively small, and our study may have missed other important risk factors. Second, the study was performed in one of the university hospitals in Turkey. Therefore, the results may not be generalized to other hospitals, cities and countries. Third, therapies and approaches may change between centers. These differences may affect the results from one study to another. Thus, the results cannot be compared between centers. Despite all these limitations, we performed an evaluation of potential risk factors of mortality in *A. baumannii* infections, providing useful information especially for ICUs in which *A. baumanni*i represents a major infection and mortality problem.

In conclusion, resistant *A. baumannii* infections are among the major medical challenges throughout the world, in Turkey, and in our ICU. The mortality rate of *A. baumannii* infections is high and different risk factors affect the mortality rate of this infectious agent. According to our study, application of invasive mechanical ventilation, sepsis in the ICU and admission from internal medicine clinics were the major risk factors of mortality in *A. baumannii* infection.

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