RESEARCH ARTICLE

Risk factors and clinical outcomes for intensive care unit patients with multidrug-resistant Acinetobacter spp. bacteremia

Đekić Malbaša J[1,2], Dugandžija T[1,3], Dragovac G[1,4], Medić D[1,5], Paut Kusturica M[6]

[1]Department of Epidemiology, Faculty of Medicine Novi Sad, University of Novi Sad, Novi Sad
[2]Department of Organization, Planning, Evaluation and Medical Informatics, Institute for Pulmonary Diseases of Vojvodina
[3]Department of Epidemiology, Oncology Institute of Vojvodina, Sremska Kamenica
[4]Center for Disease Prevention and Control
[5]Center for microbiology
Institute of Public Health of Vojvodina
[6]Department of Pharmacology and Toxicology, Faculty of Medicine Novi Sad, University of Novi Sad, Novi Sad
Serbia

Abstract

Background: Multidrug-resistant (MDR) isolates of *Acinetobacter spp*. have been reported worldwide. This study aimed to analyze clinical features and outcomes of intensive care unit (ICU) patients with MDR *Acinetobacter spp.* bacteremia and to determine factors influencing survival by using 30-day mortality as the primary endpoint**.**

Methods: A case-control study included a total of 164 patients with MDR *Acinetobacter spp.* bacteremia hospitalized in ICUs in Vojvodina Province, Serbia, from January 2013 through March 2016. Medical records were reviewed, and patients' demographic and clinical characteristics were collected. Predictors of 30-day mortality were identified by logistic regression analysis.

Results: The overall 30-day mortality rate was 48.2 % (79 of 164 patients). Multivariate logistic regression analysis revealed that independent predictors of 30-day mortality were two or more co-morbidities, diabetes mellitus, and inappropriate use of antimicrobials.

Conclusion: Early implementation of appropriate antimicrobial therapy, particularly in critically ill ICU patients with MDR *Acinetobacter spp*. bacteremia, with two or more co-morbidities and diabetes mellitus, can be crucial for survival. HIPPOKRATIA 2020, 24(1): 21-26.

Keywords: *Acinetobacter spp*., intensive care unit, multidrug-resistant, bacteremia, outcome

Corresponding author: Milica Paut Kusturica, Department of Pharmacology and Toxicology, Faculty of Medicine Novi Sad, University of Novi Sad, Novi Sad, Serbia, Hajduk Veljkova 3, Novi Sad, Serbia, tel.: +38121522172; fax: + 381216615771; e-mail: milicapaut@yahoo.com

Introduction

Acinetobacter baumannii (AB) is a strictly aerobic, opportunistic, gram-negative coccobacillus, usually ubiquitously found in the hospital environment. The combination of environmental resilience and rapid development of resistance to multiple antimicrobials classes render it a thriving nosocomial pathogen, particularly in intensive care unit (ICU) patients[1,2].

Bacteremia and ventilator-associated pneumonia are the most common infections caused by this pathogen, followed by meningitis, empyema, urinary tract, and soft tissue infections[1,2]. Bacteremia is a significant cause of mortality. Previous studies have reported that the overall mortality of AB bacteremia ranged from 29 % to 63 %[3,4]. The most common risk factors for mortality were identified as old age, neutropenia, malignancy, prior surgery, recipient at the post-transplantation period, the severity of illness defined by Pitt bacteremia score or Acute Physiology and Chronic Health Evaluation II (APACHE II) score, ICU stay, having a low level of albumin, respiratory tract as the origin of bacteremia, and inappropriate initial antimicrobial therapy[5].

Due to excessive exposure to antibiotics, multidrug-resistant (MDR) and carbapenem resistance (CR) rates have been increased worldwide. Limited treatment options for infections caused by MDR and CR AB might result in higher mortality[6-8].

However, besides the rapid growth worldwide, there are significant regional differences in the resistance rate of AB[9-11]. Information regarding the risk factors for MDR AB bacteremia mortality is limited, especially from countries with limited resources[11]. This case-control study, which analyses the clinical features and outcomes of ICU patients with MDR AB bacteremia and factors influencing survival by using 30-day mortality was performed in an eastern-European developing country.

Materials and Methods

Study Design and Population

This case-control study included adult patients (≥18 years of age) with MDR *Acinetobacter spp*. bacteremia hospitalized in the medical and surgical ICUs in the acute care hospitals in Vojvodina Province, Serbia, from 1st January 2013 to 31st March 2016. A total of eleven hospitals, of which four are tertiary and the other secondary healthcare facilities, cover the Autonomous Province of Vojvodina's population of around 1.9 million inhabitants. During the observed period, patients with MDR *Acinetobacter spp*. bacteremia were registered in the ICUs of five regional hospitals, four tertiary and one secondary, with a total capacity of 48 ICU beds.

Medical records of all patients with MDR *Acinetobacter spp.* bacteremia episodes, symptoms, and signs of infection were reviewed. Patients who stayed in ICUs for at least 48 hours before isolation of MDR *Acinetobacter spp.* from blood cultures, and had symptoms and signs of infection, were included in the study. For patients with two or more positive blood cultures, only the result of the first antimicrobial susceptibility test was included in the resistance analysis of *Acinetobacter spp*. isolates. The data of the first positive blood culture was registered as the date of bacteremia onset[5,6]. Cases were defined as patients who died within 30 days of bacteremia onset, and controls were patients who survived for more than 30 days[12-15]. The study was approved by the Ethics Committee of the University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia (decision No 01-174/1, date: 14/05/2015).

Data Collection

Medical records were reviewed, and the following data were collected: patient demographic and clinical characteristics, colonization at admission, source of bacteremia, co-morbidities, Charlson co-morbidity index (CCI) score and the patient's APACHE II score, previous invasive procedure, and previous antimicrobial use. Patients with incomplete records were excluded from the study.

Definitions

MDR *Acinetobacter spp.* bacteremia was defined as in the previous studies[5-7]. The severity of illness was assessed by using the APACHE II score within 24 hours of ICU admission[16]. Factors influencing survival were analyzed by using 30-day mortality as the primary endpoint[12-14]. Prior use of antimicrobial agents was defined as antibiotics that were administered to the patient in the 14-day period before the onset of bacteremia. Appropriate antimicrobial therapy was defined as the administration of at least one antimicrobial agent, to which a pathogen was sensitive *in vitro*, given within 72 hours after the onset of bacteremia. A therapy that did not meet these conditions was considered inappropriate[5,6]. The sources of bacteremia were classified according to the definitions of the Centre for Disease Control and Prevention[17].

Organism Identification and Susceptibility Classification

Identification of the *Acinetobacter spp*. isolates from blood cultures and antimicrobial susceptibility testing were performed by Vitek II system (bioMerieux, Marcy-lEtoile, France). Antimicrobial susceptibility results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) standards (during 2013 and 2014)[18,19], and according to guidelines and breakpoints established by the European Committee on Antimicrobial Susceptibility Testing (EUCAT) in 2015[20]. Isolate of *Acinetobacter spp*. with intermediate resistance was regarded as resistant in our study. MDR was defined as resistance to three or more classes of antimicrobials. Carbapenem resistance was defined as resistance to imipenem and meropenem.

Statistical Analysis

The IBM SPSS Statistics for Windows, Version 19.0 (IBM Corp., Armonk, NY, USA) package was used for statistical analyses. Shapiro–Wilk test was used to check the normality of the data. Student's t-test and Chi-squared test were used to analyze normally distributed data. For non-normally distributed data Mann-Whitney U test and Fisher's exact test were used. A multivariate analysis with logistic regression was performed to identify the independent risk factors for 30-day mortality. All risk factors with a p-value <0.05 in the univariate analyses were examined to assess for co-linearity, and interaction terms were tested before they were entered into the multivariate logistic regression model. The Kaplan-Meier method and log-rank test were used to compare the univariate survival distribution among patients with appropriate and inappropriate antimicrobial therapy. All analyses were two-tailed, and a p value <0.05 was considered statistically significant.

Results

From a total of 178 adult ICU patients with MDR *Acinetobacter spp*. bacteremia, 164 patients met the inclusion criteria. The overall in-hospital mortality for patients with MDR *Acinetobacter spp.* bacteremia was 51.2 % (84/164), while the 7-day mortality, 14-day mortality, and 30-day mortality rates were 32.9 %, 42.1 %, and 48.2 %, respectively.

Resistance to antimicrobials of the *Acinetobacter spp*. isolates stratified by the outcome is listed in Table 1. There was no significant difference in the antimicrobial resistance of *Acinetobacter spp*. isolates to any drug between groups of patients stratified by the outcome, except to cefepime (p =0.013).

Characteristics of patients with MDR *Acinetobacter spp.* bacteremia stratified by 30-day mortality are listed in Table 2. Of all the enrolled patients, 102 (62.2 %) were males. The median age of patients was 61 (range 18-89) years. The median ICU length of stay before bacteremia was 10.5 days, while the median ICU total stay was 21.0 days. Patients who succumbed (lethal outcome) within 30 days from bacteremia onset were older compared to survivors (62.29 ± 13.16 vs 55.49 ± 17.16, p =0.005) and had more severe illness as indicated by a higher APACHE II score at ICU admission (18.63 ± 7.06 vs 15.65 ± 6.101, p =0.012). Non-survivors had a higher co-morbidity burden, as signified by higher CCI score (3.38 ± 1.84 vs 2.46 ±

Table 1: Resistance of *Acinetobacter spp*. isolates stratified by outcome in intensive care unit patients in Vojvodina Province, Serbia, 2013-2016.

	Isolates of *Acinetobacter spp*. (n =164)		**Non-survivors (n =79)**		**Survivors (n =85)**		
Antimicrobial agents	n tested isolates	Prevalence of resistance (%)	n tested isolates	Prevalence of resistance (%)	n tested isolates	Prevalence of resistance (%)	**p**
Piperacillin-Tazobaktam	120	98.3	52	100	68	97.1	0.506
Ampicillin-Sulbactam	88	79.5	45	73.3	43	86.0	0.205
Ceftazidime	74	100	29	100	45	100.0	-
Cefepime	117	95.7	51	90.2	66	100.0	**0.013**
Gentamicin	160	98.1	79	98.7	81	97.5	1.000
Amikacin	145	96.6	69	98.6	76	94.7	0.370
Ciprofloxacin	163	100	78	100	85	100	-
Imipenem	164	97.6	79	100	85	95.3	0.122
Meropenem	164	97.6	79	100	85	95.3	0.122
Doripenem	50	100	30	100	20	100	-
Tobramycin	87	60.9	45	62.2	42	59.5	0.862
Trimethoprim-Sulfamethoxazole	32	93.8	21	90.5	11	100	0.534
Colistin	147	0,0	74	0,0	73	0,0	-

A p value <0.005 is considered significant (**bold**), n: number.

2.09, p =0.004), and more frequently had two or more co-morbidities (32.9 % vs 14.1 %, p =0.008) compared to survivors. Diabetes mellitus was more commonly recorded in the non-survivors (21.5 % vs 4.7 %, p =0.002), while trauma at admission was more frequently observed in survivors (21.2 % vs 8.9 %, p =0.048) (Table 2).

Risk factors influencing survival in the two groups of patients with MDR *Acinetobacter spp*. bacteremia stratified by 30-day mortality are summarized in Table 3. There were no significant differences between the two groups of patients regarding prior use of invasive procedures or the number of previously used antibiotics. Non-survivors were more often receiving inappropriate antimicrobial therapy than survivors (68.4 % vs 49.4 %, p =0.021).

In the multivariate regression model (Table 4), having two or more co-morbidities [Odds ratio (OR) =3.693, 95 % confidence interval (CI): 1.426-9.560, p =0.007), having diabetes mellitus (OR =3.896, 95 % CI: 1.023-14.840, p =0.046), and receiving inappropriate antibiotic therapy after the onset of bacteremia (OR =2.514, 95 % CI: 1.075-5.882, p =0.033) were independent predictors of 30-day mortality in patients with MDR *Acinetobacter spp*. bacteremia. In the univariate analysis, the variables with p <0.005, which entered the multivariate regression model, were age, APACHE II score, two or more co-morbidities, diabetes mellitus, and inappropriate antimicrobial therapy.

A significant difference in the Kaplan–Meier curves of the 30-day in-hospital mortality between patients with appropriate and in-appropriate antimicrobial therapy was found by the log-rank test (Figure 1).

Discussion

The highest MDR *Acinetobacter spp*. rates have been observed in the South and Southeast European countries' ICUs, which were associated with significant use of carbapenems[21,22]. In Vojvodina Province, Serbia, from 2002 to 2013, CR rate dramatically increased from 3.8 % to above 90 %[22].

Our data showed high resistance rates of *Acinetobacter spp*. isolates to almost all the tested antimicrobials. Resistance to carbapenems isolates of *Acinetobacter spp*. was 98 % (100 % in non-survivors vs 95 % in survivors). Also, resistance to fluoroquinolones, aminoglycosides, and carbapenems was above 95 %. During the study period, all of the tested *Acinetobacter spp*. isolates were sensitive to colistin (100 %), which is in accordance with the results of AMR surveillance at the time of our study[23].

According to a systematic review and meta-analysis of 16 observational studies, the crude mortality rates for patients with CR AB bacteremia ranged from 16 % to 76 %[9]. Our data showed high mortality of ICU patients with MDR *Acinetobacter spp*. bacteremia. The 7-day mortality, 14-day mortality, and 30-day mortality rates were 32.9 %, 42.1 %, and 48.2 %, respectively. Similar results were reported in prior studies[12,13,24,25], although mortality rates in our study were slightly higher.

Contrary to most studies' results, previous use of invasive procedures was not a risk factor for adverse outcome in our review[15,25]. Results of the univariate analysis in our study found that the older age of patients, higher APACHE II score at ICU admission, higher CCI score, having two or more co-morbidities, having diabetes mellitus, and receiving inappropriate antimicrobial therapy were associated with the increased risk for mortality in patients with MDR *Acinetobacter spp.* bacteremia. Other authors have reported similar results[12,13,15,24-26].

The results of the current study confirmed the high consumption of empirically prescribed antimicrobials. Almost all of our patients received antimicrobial therapy before the onset of MDR *Acinetobacter* spp. bacteremia, and approximately 30 % of patients had four or more classes of antimicrobials used empirically. It is known that inappropriate drug combination leads to selective pressure, which increases the risk of AB infection and promotes the emergence of drug-resistant bacteria[11,13,24-26]. In

Table 2: Demographic and clinical characteristics of the patients with multidrug-resistant (MDR) *Acinetobacter spp*. bacteremia stratified by 30-day mortality in intensive care units.

Demographical/clinical characteristics	All patients (n =164)	Non-survivors (n =79)	Survivors (n =85)	p
Male sex	102 (62.2)	46 (58.2)	56 (65.9)	0.396
Age	58.7 ± 15.7	62.29 ± 13.16	55.49 ± 17.1	**0.005**
ICU admission from other dept/hospital	122 (74.4)	59 (74.7)	63 (74.1)	1.000
Prior hospitalization in the past 6 months	114 (69.5)	58 (73.4)	56 (65.9)	0.380
MRSA colonization at admission	19 (11.6)	9 (11.4)	10 (11.8)	1.000
Immunosuppressed at admission	20 (12.2)	13 (16.5)	7 (8.3)	0.180
Charlson comorbidity index	2.91 ± 2.02	3.38 ± 1.84	2.46 ± 2.09	**0.004**
Comorbidities	100 (60.9)	56 (70.8)	44 (51.7)	**0.018**
1 co-morbidity	62 (37.8)	30 (37.9)	32 (37.6)	0.906
≥ 2 comorbidities	60 (36.6)	26 (32.9)	12 (14.1)	**0.008**
Solid organ malignancy	23 (14.0)	15 (16.8)	8 (9.4)	0.124
Hematologic malignancy	7 (4.3)	1 (1.1)	6 (7.1)	0.118
Hypertension	40 (24.4)	23 (25.8)	17 (20.0)	0.239
Peripheral blood vessel disease	15 (9.1)	9 (10.1)	6 (7.1)	0.489
Chronic heart failure	24 (14.6)	15 (18.9)	9 (10.6)	0.194
Diabetes mellitus type I	21 (12.8)	17 (21.5)	4 (4.7)	**0.002**
Peptic ulcer disease	14 (8.5)	9 (10.1)	5 (5.8)	0.326
St. post cerebrovascular infarction	8 (4.9)	6 (6.7)	2 (2.4)	0.156
Chronic kidney disease	6 (3.6)	2 (2.3)	4 (4.7)	0.683
Chronic obstructive pulmonary disease	10 (6.1)	6 (7.6)	4 (4.7)	0.524
St post myocardial infarction	4 (2.4)	3 (3.4)	1 (1.2)	0.353
Autoimmune disease	4 (2.4)	1 (1.1)	3 (3.5)	0.621
Liver cirrhosis	3 (1.8)	1 (1.1)	2 (2.4)	1.000
Anti- HCV positive	1 (0.6)	0 (0.0)	1 (1.2)	1.000
Anti- HIV positive	1 (0.6)	1 (1.1)	0 (0.0)	0.482
APACHE II score, n = 129	16.8 ± 6.63	18.63 ± 7.06	15.65 ± 6.10	**0.012**
ASA classification, n =106	3.64 ± 0.64	3.73 ± 0.638	3.56 ± 0.627	0.162
Admission diagnosis				
Burn	7 (4.3)	5 (7.2)	2 (2.1)	0.263
Trauma	25 (15.2)	7 (8.9)	18 (21.2)	**0.048**
Surgery diagnosis	64 (39.0)	31 (39.2)	33 (38.8)	0.916
Respiratory diagnosis	33 (20.1)	15 (19.0)	18 (21.2)	0.877
Cardiology diagnosis	8 (4.9)	5 (3.9)	3 (3.5)	0.484
Sepsis	27 (16.5)	16 (20.3)	11 (12.9)	0.293
Total ICU hospitalization length (days)	24.5 ± 17.4	18.23 ± 11.323	30.42 ± 19.9	<0.001
Days in ICU before bacteremia	12.7 ± 8.83	12.12 ± 9.05	13.33 ± 8.63	0.390
Prior HAI	123 (75.0)	63 (79.7)	60 (70.6)	0.176
Surgical site infection	7 (4.3)	3 (3.8)	4 (4.7)	0.921
Urinary tract infection	28 (17.1)	15 (18.9)	13 (15.3)	0.674
Pneumonia	56 (34.1)	28 (35.4)	28 (32.9)	0.863
Bloodstream infection	20 (12.2)	10 (11.2)	10 (11.7)	0.949
Central nervous system infection	2 (1.2)	1 (1.1)	0 (0.0)	0.482
Gastrointestinal infection	4 (2.4)	1 (1.1)	3 (3.5)	0.665
Skin and soft tissue infection	2 (1.2)	2 (2.5)	0 (0.0)	0.231
Systematic infection	4 (2.4)	3 (3.4)	1 (1.2)	0.337
Source of bacteremia				
Primary bacteremia	89 (54.3)	39 (49.5)	50 (54.3)	0.290
Secondary bacteremia	75 (45.7)	40 (50.6)	35 (41.2)	
Respiratory tract	66 (40.2)	33 (41.8)	33 (38.8)	0.822
Wound (skin/soft tissue)	5 (3.1)	3 (3.8)	2 (2.4)	0.673
Urinary tract	4 (2.4)	3 (3.8)	1 (0.0)	0.353

Values are reported as numbers and percentage (in brackets) or means and standard deviation (in brackets). A p value <0.005 is considered significant (bold), n: number, MRSA: methicillin resistant *Staphylococcus aureus*, APACHE II score: Acute Physiology and Chronic Health Evaluation II score, MDR: multidrug-resistant, ASA classification: American Society of Anesthesiologists, HAI: hospital acquired infection.

our study, 97.6 % of the *Acinetobacter spp*. isolates were carbapenem-resistant, and in most cases, colistin was the only appropriate antimicrobial agent to treat these severe infections. Colistin alone or used in combination with some other drugs during this study was the appropriate therapy among severely ill patients, such as ICU patients with MDR *Acinetobacter spp*. bacteremia[12,25,27].

High rates of inappropriate initial antimicrobial therapy were reported in countries with high resistance rates to multiple antimicrobials. In a Turkish study, the initial antimicrobial treatment was appropriate in only 19.7 % of patients with imipenem-resistant AB bacteremia, while in a Brazilian multi-center ICU study, only 12 % of patients with *Acinetobacter spp*. bacteremia received appropriate initial antimicrobial therapy[26].

In the current study, inappropriate antimicrobial

Table 3: Risk factors influencing survival in the observed groups of patients with multidrug-resistant (MDR) *Acinetobacter spp*. bacteremia in intensive care units in Vojvodina Province, Serbia.

Risk factors	All patients (n =164)	Non-survivors (n =79)	Survivors (n =85)	p
Invasive procedures				
Invasive procedures prior onset of bacteremia	162 (98.8)	78 (98.7)	84 (98.8)	1.000
Invasive procedure index	3.78 ± 1.1	3.81 ± 1.17	3.75 ± 1.05	0.362
Prior use of urinary catheter	162 (98.8)	78 (98.7)	84 (98.8)	1.000
Prior use of central venous catheter	152 (92.7)	73 (92.4)	79 (92.9)	1.000
Prior use of peripheral venous catheter	128 (78.0)	59 (74.7)	69 (81.2)	0.415
Prior use of dialysis catheter	31 (18.9)	18 (22.8)	13 (15.3)	0.306
Prior use of mechanical ventilation	149 (90.9)	70 (88.6)	79 (92.9)	0.490
Surgery in past 30 days	107 (66.0)	47 (59.5)	60 (72.3)	0.120
Prior antimicrobial use				
Prior antimicrobial use	158 (96.3)	66 (95.6)	92 (96.8)	0.697
Average number of antibiotics	3.1 ± 1.38	3.03±1.47	3.15 ± 1.29	0.556
1-3 classes of antibiotics	107 (65.2)	44 (63.7)	63 (66.3)	0.735
≥ 4 classes of antibiotics	51 (31.1)	22 (31.8)	29 (30.5)	0.853
Penicillines	29 (17.7)	16 (20.3)	13 (15.3)	0.531
1st generation Cephalosporin	3 (1.8)	1 (1.3)	2 (2.4)	1.000
2nd generation Cephalosporin	43 (26.2)	17 (21.5)	26 (30.6)	0.254
3th generation Cephalosporin	88 (53.7)	44 (55.7)	44 (51.8)	0.728
4th generation Cephalosporin	13 (7.9)	12 (15.2)	1 (1.2)	**0.001**
Cephalosporin	147 (89.6)	74 (93.7)	73 (85.8)	0.168
Aminoglycoside	18 (11.0)	10 (12.7)	8 (9.4)	0.678
Lincosamide	13 (7.9)	5 (6.3)	8 (9.4)	0.659
TMP-SMX	13 (7.9)	6 (7.6)	7 (8.2)	1.000
Quinolones	65 (39.6)	30 (38.0)	35 (41.2)	0.796
Imidazole Derivatives	96 (58.5)	41 (51.9)	55 (64.7)	0.132
Carbapenems	60 (36.6)	24 (30.4)	36 (42.4)	0.153
Glycopeptides	40 (24.4)	18 (22.8)	22 (25.9)	0.780
Linezolid	10 (6.1)	6 (7.6)	4 (4.7)	0.524
Azithromycine	7 (4.3)	2 (2.5)	5 (5.9)	0.445
Glycylcyclines (tigecycline)	5 (3.0)	5 (6.3)	0 (0.0)	**0.024**
Polymyxins (colistin)	4 (2.4)	2 (2.5)	2 (2.4)	1.000
Antimicrobial therapy after MDR- Acinetobacter spp. bacteremia(according to sensitivity test)				
Appropriate, n (%)	68 (41.5)	25 (31.6)	43 (50.6)	**0.021**
Inappropriate	96 (58.5)	54 (68.4)	42 (49.4)	

Values are reported as numbers and percentage (in brackets) or means and standard deviation (in brackets). A p value <0.005 is considered significant (bold), n: number, TMP-SMX: Trimethoprim-sulfamethoxazole, MDR: multidrug-resistant

therapy, having two or more co-morbidities, and diabetes mellitus were found to be independent predictors for 30-day mortality in ICU patients with MDR *Acinetobacter spp*. bacteremia. These findings are consistent with previous reports[12,13,15,24-26].

There are several limitations to this study. Firstly, molecular identification of the isolates was not performed to identify the genomic species of *Acinetobacter spp*. Secondly, most of the patients with MDR *Acinetobacter spp*. bacteremia were hospitalized in tertiary ICUs; thus, reported results might not be representative of the secondary hospitals and other hospital wards. Finally, we did not analyze the timing of adjustment of the targeted antimicrobial therapy, doses, and drug combinations after obtaining positive blood culture results, which is certainly extremely important for the outcome of critically ill patients[12,13]. However, a continuation study will soon follow. After all, there are still crucial differences between Western and developing countries that might influence MDR-AB treatment outcomes.

To summarize, in ICUs with a high prevalence rate of MDR *Acinetobacter spp*. timely application of appropriate antimicrobial therapy, especially in patients with two or more co-morbidities and diabetes mellitus, could be crucial for the survival of patients with MDR *Acinetobacter spp*. bacteremia.

Table 4: Multivariate logistic regression model of predictors of 30-day mortality in patients with multidrug-resistant (MDR) *Acinetobacter spp*. bacteremia in intensive care units in Vojvodina Province, Serbia.

Variable	aOR*	95 % CI	p
Age	1.025	0.995-1.055	0.101
APACHE II score	1.034	0.968-1.103	0.320
≥2 co-morbidities	3.693	1.426-9.560	**0.007**
Diabetes mellitus	3.896	1.023-14.840	**0.046**
Inappropriate antibiotic therapy	2.514	1.075-5.882	**0.033**

A p value <0.005 is considered significant (bold), APACHE II score: Acute Physiology and Chronic Health Evaluation II score, CI: confidence interval, aOR: adjusted odds ratio, *: Adjusted for the following variables: age, APACHE II score, ≥2 co-morbidities, diabetes mellitus and inappropriate antibiotic therapy.

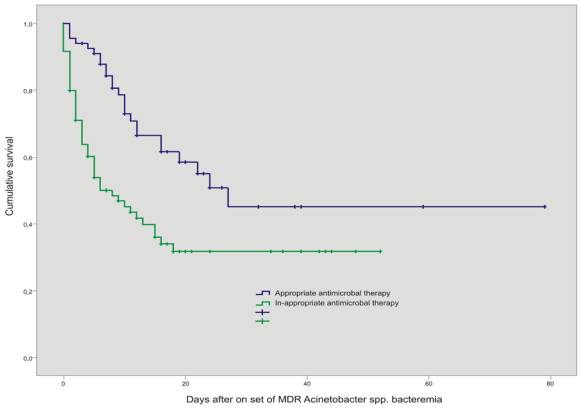

Figure 1: Cumulative survival rate after episode of multidrug-resistant (MDR) *Acinetobacter spp*. bacteremia. The curve was illustrated with the Kaplan-Meier method. The patients with inappropriate antimicrobial therapy had higher mortality rate than those with appropriate therapy (log-rank test, p <0.001).

Conflict of Interest

The authors declare no conflict of interest.

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