Introduction

Acinetobacter spp. is aerobic, nonfermentative, nonmotile, Gram negative, rod shape bacteria (cocobacillus), usually found in soil and water samples [1,2]. It is possible that Acinetobacter species can colonize on the skin of healthy people. However, it will frequently not result in infection [3–6]. It is occasionally isolated from skin of hospitalized patients, secretion, even through hands of medical staffs and on surface of medical equipments [1,2]. These common soil organisms can cause resistant strains of this species to antibiotics, leading to difficulties in treatment and opportunistic infections [3–6]. The ability of Acinetobacter species to form biofilms on the surface of medical equipment, implants, and catheters may contribute to the persistence of these strains in the hospital environment which makes difficult to eradicate these strains with antibiotics [3–6]. The species is also well known for its intrinsic resistance to cephalosporins and aminoglycosides, as well as its ability to develop resistance to carbapenems and quinolones [3–6]. Moreover, Acinetobacter species can cause infections ranging from mild skin infections to life-threatening septicemia, meningitis, and pneumonia [3–6]. These infections are challenging to treat due to the resistance of Acinetobacter species to multiple antibiotics [3–6]. This study is aimed to investigate the changes in antibiotic resistance profiles of Acinetobacter spp. strains isolated from blood specimens of hospitalized patients in our hospital.
severe infections in especially immunocompromised patient. Recently, it has emerged as an important nosocomial pathogen [7].

Recent surgery, catheterization, mechanical ventilation, total parenteral nutrition, trauma and use of broad spectrum antibiotics were the principal risk factors identified [8-10]. A great deal of studies have supplied the novel investigation that *Acinetobacter baumannii* is the essential genomic species associated with outbreaks of nosocomial infection. *Acinetobacter* spp. are responsible for severe hospital-acquired infections including bacteremia, urinary tract infection, meningitis. However, their superior role is as agents of nosocomial pneumonia, particularly ventilator-associated pneumonia among patients admitted to the intensive care unit [10,11]. Mortality and morbidity in patients with *Acinetobacter baumannii* infection vary according to the severity of the underlying disease [12,13].

*Acinetobacter baumannii*, which can develop resistance to antibiotics and disinfectants, can survive for long periods in the hospital environment and can cause epidemics through hospital personnel or by spreading between medical equipment and patients. Carbapenems have been widely used in the treatment of multiple drug resistant *Acinetobacter* infections. This treatment has been reported to cause resistance to many antibiotics, including carbapenems [14]. Colistin is an antimicrobial with bactericidal effectiveness against *Acinetobacter* species. However, resistance to polymyxins has been reported [15]. Tigecycline also has been found to be an effective antibiotic against MDR *Acinetobacter* species [16].

Because of the widespread resistance of these bacteria to major antibiotic groups, clinicians have difficulties in treating infections. Therefore, careful monitoring of antimicrobial resistance profiles against *Acinetobacter* spp. is important in determining empirical treatment and antibiotic usage policies.

In this study, our primary objective was to determine the frequency of *Acinetobacter* strains isolated from patients in our hospital and to evaluate the resistance status to antibiotics retrospectively.

**Materials and Methods**

**Bacterial strains**

This retrospective study was conducted at the Meram Medical Faculty, University Hospital in Konya, Turkey. We reviewed the medical records of patients admitted to the several clinics of Meram Medical Faculty between January 2014 and December 2015. The culture results of the 19244 blood samples sent to patients suspected of having bacteremia in various clinics of our hospital were evaluated and the results of in vitro antibiotic susceptibility testing of *Acinetobacter* strains isolated from blood culture were retrospectively analyzed in our study.

**Culture and Identification**

Blood specimens were cultured using BacT / Alert 3D (BioMerieux, France). Gram stain were carried out on positive bottles and followed by inoculation on to blood agar and Eosin Methylene Blue (EMB) agar. Cultured microorganisms were described by conventional methods and automated systems (VITEK 2 Compact, BioMerieux, France).

**Antimicrobial Susceptibility Testing**

Antibiotic susceptibility testing was conducted by VITEK®2 (BioMerieux, France) according to Clinical Laboratory Standards Institute (CLSI) Criteria [17] for *Acinetobacter* strains. When tigecycline resistant isolates were observed disc diffusion method was used and the results were supported by gradient test (E-test) (AB Biodisk, Sweden). Sensitivity tests of colistin resistant isolates were repeated with E-test. If the disk diffusion and E-test results are compatible with the automated system, the test result is reported.

**Results**

Bacterial growth was observed in 3347 of 19244 blood samples sent from various clinics of our hospital after incubation. Samples that were shorter than 3 days from the same patient were not included in the study.

*Acinetobacter baumannii* was isolated in 152 samples out of 3347 blood specimens (5% prevalence) from the entire hospital. The distributions of other bacterial strains isolated from blood culture are as follows: *Coagulase Negative Staphylococcus* (n=1755, 52 %), *Enterococcus* spp. (n=267, 8 %), *Klebsiella* spp. (n=182, 5%), *E.coli* (n=182, 5%), *Candida* spp. (n=153, 5%), *Pseudomonas* spp. (n=91, 3 %), *Acinetobacter* spp. (n=2, 0,1 %) and *Staphylococcus aureus* (n=72, 2 %). The distributions of bacterial strains isolated from blood culture are shown in Table 1.

All patients with *Acinetobacter* species isolated from blood culture were hospitalized and the majority of them were intensive care units patients (n=111, 72.2 %). Antibiotics with the lowest resistance to *Acinetobacter* strains were colistin (2 %) and tigecycline (6 %). A comparatively lower resistance was found when amikacin and gentamicin were compared with other antibiotics. Antibiotic resistance ratios of *Acinetobacter* species are given in Table 2.

| Name of isolates          | Number of isolates | % of isolates |
|---------------------------|--------------------|--------------|
| *Coagulase Negative Staphylococcus* | 1755               | 52           |
| *Enterococcus* spp.       | 267                | 8            |
| *Klebsiella* spp.         | 182                | 5            |
| *E.coli*                  | 182                | 5            |
| *Candida* spp.            | 153                | 5            |
| *Acinetobacter baumannii* | 152                | 5            |
| *Pseudomonas* spp.        | 91                 | 3            |
| *Staphylococcus aureus*   | 72                 | 2            |
| *Acinetobacter* spp.      | 2                  | 0.1          |
| Other bacteria            | 491                | 15           |

**Table 1: Numerical and percent distribution of bacteria isolated from blood culture (n=3347).**

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Table 2: Antibiotic resistance ratios of Acinetobacter species (n=154).

| Antimicrobial agent            | Number of susceptible strains | Number of resistant strains | Percent Resistance (%) |
|--------------------------------|--------------------------------|-----------------------------|------------------------|
| Imipenem                       | 8                              | 146                         | 95                     |
| Meropenem                      | 10                             | 144                         | 94                     |
| Tigecyclin                     | 145                            | 9                           | 6                      |
| Colistin                       | 151                            | 3                           | 2                      |
| Amicasin                       | 38                             | 116                         | 75                     |
| Gentamicin                     | 53                             | 101                         | 66                     |
| Cefepime                       | 8                              | 146                         | 95                     |
| Ceftazidime                    | 12                             | 142                         | 92                     |
| Piperacillin/ tazobactam       | 8                              | 146                         | 95                     |
| Ampicillin/ sulbactam          | 11                             | 143                         | 93                     |
| Ciprofloxacin                  | 8                              | 146                         | 95                     |
| Levofloxacin                   | 22                             | 132                         | 96                     |

Discussion

Acinetobacter species have become widespread in the past two decades and are among the major hospital pathogens. Acinetobacter baumannii has been found to have the ability to survive on abiotic surfaces in hospital environments and colonize in medical devices and on the skin of patients [10]. Acinetobacter species rarely cause community-acquired infections. However, they are often isolated from nosocomial infections and develop resistance to antibiotics [18].

Increased antibiotic resistance has been detected in Acinetobacter baumannii strains in our country, both in regional and multicentre studies [23]. According to the results of Turkey surveillance study conducted in 2000 by Eraksoy et al. [19], “Meropenem Yearly Susceptibility Test Information Collection (MYSTIC)”, it was observed that carbapenems were the antibiotics with the highest activity in Acinetobacter strains. Resistance rates of more than 90 % have been reported in many studies today for carbapenems, previously the most important treatment option in resistant Acinetobacter strains previously [20,21]. It is evident that in our country, resistance to Acinetobacter infections has increased rapidly in the short term due to possible misuse of antibiotic usage policies.

In this study, imipenem and meropenem resistance were detected at similar rates and carbapenem resistance was observed at 94 %. In a study conducted by Doğan et al. [22], in our hospital, carbapenem resistance was reported as 91% in Acinetobacter strains isolated between 2011 and 2013. In our hospital, imipenem resistance in Acinetobacter strains determined by Özdemir et al. as a nosocomial agent was observed as 70 % [24]. These resistance rates for carbapenem are lower than those in our study. Although carbapenem studies have reported lower rates for resistance, increasing rates of carbapenem resistance appear to be a serious problem. According to this information, increasing resistance to carbapenems in Acinetobacter species is noteworthy.

Resistance ratios was found to be 32–71 % for amikacin and 35–93 % for gentamicin in various studies [25–30]. In similar studies conducted in our region, Özdemir et al. [24], detected amikacin (76%) and gentamicin resistance (82%) at higher rates; In the study of Kurtoğlu et al. [31], resistance to amikacin and gentamicin were 52 %; 86 %, respectively. Resistance rates for amikacin (67.5%) and gentamicin (68.6%) are relatively low in study conducted by Doğan et al. [22]. In this study, gentamicin resistance was 66% and amikacin resistance was 75%.

In this study, ciprofloxacin resistance was 95 % and levofloxacin resistance was 96%. Özdemir and colleagues [24], reported ciprofloxacin resistance to 86% while Kurtoğlu et al. [31], reported 91 % ciprofloxacin resistance for 2010 in our region. Doğan et al. [22], found resistance in 91.7% of ciprofloxacin and 90.9 % of levofloxacin in all of the years 2011-2013. The high resistance rates in different trials in Turkey indicate that ciprofloxacin resistance is increasing and that quinolones are no longer a good choice for Acinetobacter infections [31].

The result of this study is consistent with the other studies conducted in our country. In this study was indicated that increasing resistance too many antibiotics, including carbapenems, was detected over time. Determining in vitro antibiotic susceptibility is becoming increasingly important for hospitals to predict specific empirical treatment strategies.

According to this study, considering the resistance rates to other antibiotics, it may be useful to observe the aminoglycoside group antibiotics before the last option in the empirical treatment approach.

Colistin is an important antimicrobial, especially in the treatment of carbapenem resistant A. baumannii infections [32]. The possibility of resistance is lower than that of carbapenem. However, resistance to this agent may develop over the years. In the study of Özdemir et al. [24], and in the study conducted by Öksüz et al. [33]. In 2012, no resistance to colistin was detected. Kurtoğlu et al. [31], reported 5% resistance to colistin; Dogan and his colleagues [22], reported 1.4% resistance to colistin. In this study, colistin resistance was found to be 2%.

Tigecycline, a new option in the treatment of Acinetobacter infections, has entered clinical use in Turkey in 2008 and is a broad spectrum antibiotic with tetracycline similarities [34]. Altunok et al. [35], reported a tigecycline resistance rate as high as 37.7%, while Özdem et al. [36], found tigecycline resistance as 5.5%. The studies in our region, Kurtoğlu et al. [31], reported tigecycline resistance in 2009 - 2010; 12% and 21% respectively; Özdemir et al. [21], reported that the resistance rate of tigecycline in our hospital was 1%. Dogan et al. [22], also reported tigecycline resistance ratio as 6.9 %. We found tigecycline resistance to be 6 % in our study. although tigecycline resistance is low compared to similar studies, it can be said that this resistance tends to increase over the years compared to the study of Özdemir et al. [24].

As a result, the present study showed a predominance of various A. baumannii species and high prevalence of carbapenem resistance and quinolone resistance among blood culture isolates of Acinetobacter species in our hospital.
In conclusion, the findings of this study demonstrate that colistin has the best effectiveness against A. baumannii whereas amicasin and gentamicin may be choices for the empirical treatment of A. baumannii infections. In addition, continuous monitoring of in vitro susceptibility profiles to prevent inappropriate antibiotic use and determination of rational treatment protocols is essential for effective infection control.

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