

## Common pathogens isolated from burn wounds and their antibiotic resistance patterns

### *Yanık yaralarından izole edilen patojenler ve antibiyotik direnç durumları*

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#### ABSTRACT

**Objective:** Burn wound infections are the most severe cause of mortality in patients in the burn units. The aim of this study is to determine the bacteriological profile and their antibiotic resistance patterns in burn unit of Dicle University Hospital.

**Methods:** Medical records of 151 burn patients admitted to the burn unit of Dicle University Hospital between June, 2008 and June 2010 were reviewed retrospectively.

**Results:** Our study included 70.2% (n=106) male and 29.8% (n=45) female patients. The mean age of cases was 10.9±14.7 years. The rate of isolated microorganisms were 62.3% (n=94) *Acinetobacter baumannii*, 25.8% (n=39) *Pseudomonas aeruginosa*, 7.3% (n=11) *Escherichia coli* and 4.6% (n=7) *Staphylococcus aureus*. The most effective antibiotic against *A. baumannii* was colistin (95%) followed by levofloxacin (84%) and trimethoprim-sulfamethoxazole (87%). The most effective antibiotics against *P. aeruginosa* were amikacin (82%), ciprofloxacin (71%) and levofloxacin (71%). The most effective antibiotics against *E. coli* were amikacin (91%), meropenem (73%) and imipenem (82%).

**Conclusion:** The prevalence of burn wound infection caused by *A. baumannii* and multiple drug resistant *A. baumannii* are increasing worldwide by time. The prevalence of multiple drug resistant *P. aeruginosa* and *E. coli* are rising also. So, new strategies of infection prevention should improve as soon as possible.

**Key words:** Burn units, wound infection, multiple drug resistance, antibiotics, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*

#### ÖZET

**Amaç:** Yanık yara enfeksiyonları yanık ünitelerindeki hastaların en sık ölüm nedenleridir. Amacımız Dicle Üniversitesi Hastanesi yanık ünitesindeki bakteri profilini ve antibiyotik direnç paternlerini belirlemektir.

**Yöntemler:** Dicle Üniversitesi Hastanesi yanık ünitesinde Haziran 2008 ve Haziran 2010 tarihleri arasında yatarak takip edilen 151 hastanın dosyaları geriye dönük olarak incelendi.

**Bulgular:** Çalışmamız 106 (%70,2) erkek ve 45 (%29,8) kadın hastadan oluşuyordu. Olguların yaş ortalaması 10.9±14.7 yıl olarak bulundu. İzole edilen mikroorganizmalar; %62,3 (n=94) *Acinetobacter baumannii*, %25,8 (n=39) *Pseudomonas aeruginosa*, %7,3 (n=11) *Escherichia coli* and %4,6 (n=7) *Staphylococcus aureus* olarak saptandı. *A. baumannii*'ye karşı en etkili antibiyotik kolistin idi, ikinci sırada levofloksasin (%84) ve üçüncü sırada trimethoprim-sülfametoksazol (%87) takip ediyordu. *P. aeruginosa*'ya karşı en etkili antibiyotikler; amikasin (%82), siprofloksasin (%71) ve levofloksasin (%71) idi. *E. coli*'ye karşı en etkili antibiyotikler ise amikasin (%91), meropenem (%73) ve imipenem (%82) idi.

**Sonuç:** *A. baumannii* nedeniyle oluşan yanık yara enfeksiyonları ve çoklu ilaç direncine sahip *A. baumannii*'nin yaygınlığı dünyada giderek artmaktadır. Çoklu ilaç direncine sahip *P. aeruginosa* ve *E. coli* patojenleri de artmaktadır. Bu nedenle en kısa zamanda yeni enfeksiyon önleme stratejileri geliştirilmelidir.

**Anahtar kelimeler:** Yanık üniteleri, yara enfeksiyonu, çoklu ilaç direnci, antibiyotikler, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*

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## INTRODUCTION

Wound infections are especially very typical in severe burns cause microbial invasion and destruction of skin, necrosis of tissues. Wound infections which are the most severe mortal cause in burn victims provide an excellent environment for proper microbial growth [1-3]. Nosocomial wound infection rate and pathogen spectrum vary with the time spent in the specialized burn units of different hospitals. In the recent years, *Acinetobacter baumannii* and *Pseudomonas aeruginosa* have emerged as important nosocomial pathogens that have intrinsic resistance against many antibiotics and gained a remarkable ability to develop novel resistance mechanisms during treatment [4,5]. Also they continue to be important pathogens in wound infections and especially lead to complications in patients with burn injuries contributing high mortality rates [6,7]. The urging challenge of antibiotic resistance has required the similar urgency for development of effective antimicrobial agents and alternative strategies for struggling with wound infections. Unfortunately, the production of new pharmaceutical antibiotic market has been insufficient.

Addition to that, extended spectrum of beta-lactamase producing strains among the clinical isolates which are *A. baumannii* and *P. aeruginosa* has further limited the therapeutic options for the increasing of the multiple drug resistance [8].

Burn wounds infected by *P. aeruginosa*, *A. baumannii* and *Escherichia coli* should be considered as a potential risk and this microorganisms' sensitivity pattern should be précised [9]. So for the preventive and therapeutic purposes, all burn units need to carry out periodic reviews about isolation patterns and the susceptibility profile of infected burn wounds. Thus, this precise study was arranged over a year to state the bacteriological profile and antibiotic resistance patterns of burn unit of Dicle University Hospital.

## METHODS

Burn unit of Dicle University Hospital which is located in Diyarbakir in the Southeast Anatolian Region of Turkey is the one and only burn unit of local area and also the largest one with a capacity of 18 beds in Turkey. Besides, it provides service approxi-

mately 6,000,000 persons from both Diyarbakir and nearby provinces like Mardin, Siirt, Batman, Sirnak, Sanliurfa, Elazig, Bitlis, Hakkari, Van.

All medical records of burn patients (range from two months to 85 years) admitted to the burn unit of Dicle University Hospital between June 2008 and June 2010 reviewed retrospectively. Patients' age, gender and infection findings were recorded. The treatment protocol of burn was established in accordance with the main international standards of treatment including antibiotherapy, daily bath wound care with topical antimicrobial such as silver sulfadiazine, fluid resuscitation, nutritional support, resuscitative regimens and surgical operations like eschar excision and grafting. Basic measures of our burn unit for burn care and infection control are staff hygiene, room isolation, periodic cultures from various parts of the ward, limitation of visitors etc.

The wound swap samples inoculated directly onto the 5% sheep blood agar and Eosine Methylene Blue agar. These agar plates are incubated at  $35\pm 2^{\circ}\text{C}$  for 18-24 hours aerobically after inoculation. The bacterial growth seen samples are recorded and the isolated bacteria identified with the conventional methods and BD Phoenix<sup>TM</sup> 100 (Becton Dickinson, MD, USA) fully automatic microbiological system.

The findings were presented as numerical and percentile. The mean age of the patients were presented as mean plus/minus the standard deviation. Data entry and analysis was made by SPSS version 16.0 (Chicago, IL, USA) statistical package program.

## RESULTS

Our study included 151 cases with positive wound culture. The mean age of cases was  $10.9\pm 14.7$  years (range from 2 months to 85 years). The age distribution of the cases were 60.3% (n=91) two months-five years, 15.2% (n=23) 6-15 years, 22.5% (n=34) 16-50 years and 2% (n=3) older than 51 years. The gender distribution of the cases was 70.2% (n=106) male and 29.8% (n=45) female.

Commonly isolated microorganisms were *A. baumannii* and *P. aeruginosa* and the least often isolated microorganisms were *E. coli* and *Staphylococcus aureus* (Table 1).

*A. baumannii*, *P. aeruginosa* and *E. coli* have very high antibiotic resistance rates (Table 2). The most effective antibiotic against *A. baumannii* was found as colistin (95%). The most effective antibiotics against *P. aeruginosa* were found as amikacine (82%) and ciprofloxacin (71%). The most effective antibiotics against *E. coli* were found as amikacine (91%) and imipenem (82%).

**Table 2.** Distribution of isolated microorganisms' antibiotic resistances

Antibiotics	<i>A. baumannii</i> n (%)	<i>P. aeruginosa</i> n (%)	<i>E. coli</i> n (%)
Amikacine	93	18	9
Ampicillin-sulbactam	96	-	100
Aztreonam	-	76	100
Cefepime	91	53	91
Cefotaxime	99	100	100
Ceftazidime	99	55	100
Ciprofloxacin	98	29	55
Colistin	5	100	-
Gentamicin	96	45	73
Imipenem	95	58	28
Levofloxacin	84	29	55
Meropenem	98	58	18
Piperacillin-tazobactam	98	40	73
Tetracycline	88	-	73
Trimethoprim-sulfa- methoxazole	87	67	91

**Table 1.** Distribution of isolated microorganisms

Microorganisms	n	%
<i>A. baumannii</i>	94	62.3
<i>P. aeruginosa</i>	39	25.8
<i>E. coli</i>	11	7.3
<i>S. aureus</i>	7	4.6
Total	151	100.0

## DISCUSSION

In the consequence, the increasing quality of burn units and improving treatment opportunities do not lead a remarkable decrease in the mortality rates. All the related causes are the combination of the rapidly changing microorganisms dominating different burn wound infections, their great antibiotic resistances and the huge cost of treatments.

One of the most capable bacteria for developing resistance is *A. baumannii* and it has become widespread in all intensive care units in a decade. If the required cautions will not be taken seriously against these microorganisms, the number of effective antibiotics will reduce dramatically and both the mortality rates and the cost of treatment will rise up worldwide by time.

The pathogen microorganisms may easily invade into the burn injury site and cause infection and

serious sepsis in the case of the injury because of degradation of the integrity of the skin tissue, dehydration and weakening of the body resistance. Type of microorganisms may change by time depending on the flora of burn unit, the type of drugs used in the care of burn wounds and hygiene compliance of health-care workers. Using effective strict isolation techniques and infection control policies may significantly decrease the occurrence of burn wound infection [10].

Interestingly a pathogen can spread between separate units, hospitals and also hospitals in the other countries. *A. baumannii* is one of the best examples for this situation. Its prevalence and the deduction of nosocomial agent have risen in the last decade. As a matter of fact, nowadays it is the most common cause of infection in the intensive care units and burn units [11,12]. The studies from different countries indicate the rate of pathogens

in burn wound infections as *P. aeruginosa* (21.6-37.5%), *A. baumannii* (0-10.4%), *Staphylococcus aureus* (8.3-30.4%), *E. coli* (2.3%) between 2003-2004 [10,13-15]. Two other studies from Turkey indicate the rate of pathogens in burn wound infections as *P. aeruginosa* (12.5-46.2%), *A. baumannii* (0.6-24.2%), *Staphylococcus aureus* (19-22%), *E. coli* (0-13%) between 1998-2007 [16,17]. A study made in our burn unit reported the rate of pathogens in burn wound infections as *P. aeruginosa* (58%), *A. baumannii* (0%), *E. coli* (22%) in 2000. In our study, the rate of pathogens in burn wound infections were found out as *A. baumannii* (62.3%), *P. aeruginosa* (25.8%), *Staphylococcus aureus* (4.6%), *E. coli* (7.3%). This result reveals that *A. baumannii* and *P. aeruginosa* have emerged as important nosocomial pathogens worldwide.

Antibiotic resistance of microorganisms isolated from burn wound infections may change from hospital to hospital, region to region and the usage pattern of antibiotics effect this situation. Especially multiple drug resistant *A. baumannii* and other Gram-negative pathogens such as *P. aeruginosa* and *E. coli* have high rates of antibiotic resistance. *A. baumannii* resistance significantly increased by time [18]. The resistance rates of *A. baumannii* against antibiotics were ampicillin-sulbactam (76%), amikacine (64-92%) and meropenem (7.7-71%), cephalosporins (3-95.9%) [17,19,20]. The resistance rates of *P. aeruginosa* against antibiotics were amikacine (57.1-68%), meropenem (18.5-54%) and cephalosporins (39.3-96.3%) [17,19].

In our study, the resistance rates of *A. baumannii* against antibiotics were colistin (5%), ampicillin-sulbactam (96%), amikacine (93%) and meropenem (98%), cephalosporins (91-99%) and the resistance rates of *P. aeruginosa* against antibiotics were amikacine (18%) and meropenem (58%), cephalosporins (53-100%). These results show that *A. baumannii* incredibly improve resistance against antibiotics. If the required cautions will not be taken seriously against these microorganisms, the number of effective antibiotics will reduce dramatically *A. baumannii* will cause serious health problems worldwide by time.

Finally, the prevalence of *A. baumannii* infections causing the majority of burn wound infections is rising and the resistance against antibiotics is unpreventable globally.

Also the prevalence of *P. aeruginosa* and *E. coli* are changing and they have high resistance against antibiotics. This case requires immediate effective measures and new efficient infection control strategies. In addition, each center should determine their patients' profile, hospital flora and their antibiotic resistance. Thus, we believe these results will contribute the prevention strategy of infection.

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