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Nosocomial infection characteristics in a burn intensive care unit: Analysis of an eleven-year active surveillance

Oral Öncül [a], Sinan Öksüz [b,*], Ali Acar [a], Ersin Ülkür [b], Vedat Turhan [a], Fatih Uygur [b], Asım Ulçay [a], Hakan Erdem [a], Mustafa Özyurt [c], Levent Görenek [a]

[a] Gulhane Military Medical Academy, Haydarpasa Training Hospital, Department of Infectious Disease and Clinical Microbiology, Istanbul, Turkey
[b] Gulhane Military Medical Academy, Haydarpasa Training Hospital, Department of Plastic Reconstructive and Aesthetic Surgery, Burn Unit, Istanbul, Turkey
[c] Gulhane Military Medical Academy, Haydarpasa Training Hospital, Department of Medical Microbiology, Istanbul, Turkey

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ABSTRACT

Aims: The objective of this study was to describe nosocomial infection (NI) rates, risk factors, etiologic agents, antibiotic susceptibility, invasive device utilization and invasive device associated infection rates in a burn intensive care unit (ICU) in Turkey.

Methods: Prospective surveillance of nosocomial infections was performed according to Centers for Disease Control and Prevention (CDC) and National Healthcare Safety Network (NHSN) criteria between 2001 and 2012. The data was analyzed retrospectively.

Results: During the study period 658 burn patients were admitted to our burn ICU. 469 cases acquired 602 NI for an overall NI rate of 23.1 per 1000 patient days. 109 of all the cases (16.5%) died. *Pseudomonas aeruginosa* (241), *Acinetobacter baumannii* (186) and *Staphylococcus aureus* (69) were the most common identified bacteria in 547 strains.

Conclusion: Total burn surface area, full thickness burn, older age, presence of inhalation injury were determined to be the significant risk factors for acquisition of NI. Determining the NI profile at a certain burn ICU can lead the medical staff apply the appropriate treatment regimen and limit the drug resistance. Eleven years surveillance report presented here provides a recent data about the risk factors of NI in a Turkish burn ICU.

1. Introduction

The developments in sufficient resuscitation, hemodynamic stabilization, adequate nutrition and success in treating inhalation injury has improved survival among burn patients [1–3]. Although the acute phase of the burn can be successfully managed, infection associated mortality during the hospitalization period of the burn patients is an ongoing major problem [4]. Burn patients are highly susceptible to infection due to the loss of the skin barrier, prolonged hospital stays, intensive invasive diagnostic and therapeutic procedures and immune

* Corresponding author at: Gulhane Askeri Tip Akademisi, Haydarpasa Egitim Hastanesi, Plastik Rekonstruktif ve Estetik Cerrahi Servisi, Tibbiye Cad. Uskudar, Istanbul, Turkey. Tel.: +90 533 322 90 12; fax: +90 216 348 78 80.
E-mail address: sinanoksuz@gmail.com (S. Öksüz).

deficiency caused by burn. Infections are negative predictors of clinical outcome in burn patients. Nosocomial infections (NIs) are challenging problems to treat during the long hospital stay periods of burn patients.

Centers for Disease Control and Prevention (CDC), have reported the highest rates of blood stream infection in burn patients with central venous lines, most probably originating from the burn wounds [5]. Thus determining the etiology and risk factors for NI and applying the appropriate measures for infection control is a crucial step in preventing infection related deaths among burn patients [6].

Clinical surveillance reports provide a precious source about local NI profile, antibiotic susceptibility and the risk factors for NIs among burn patients. These data lets the treatment staff employ the most convenient treatment protocol against local pathogens.

In this respect, the aim of this study was to describe NIs, investigate epidemiologic features, risk factors, infection agents, antibiotic susceptibility profile, invasive device utilization and invasive device associated infection (IDAI) rates of a burn intensive care unit (ICU) between 2001 and 2012 in Istanbul, Turkey.

2.   Materials and method

The study was conducted between the dates January 2001 and January 2012 including 11-year period at the Gulhane Military Medical Academy, Haydarpasa Training Hospital tertiary step burn ICU with nine-bed capacity in Istanbul, Turkey.

The hospitalized patients were not transferred to another center nor discharged from the burn ICU until the patients were eligible for standard clinic or outpatient care. During the 11-years period, 1062 burn patients were admitted to our burn unit and 658 of those were hospitalized and were included to the study. The patients treated in outpatient settings or the patients who died during the first 72 h of hospitalization were excluded from the study.

An established infection control surveillance program was already in place at our burn unit. Prospective surveillance data of the burn patients consecutively hospitalized at the burn unit until discharge or death were investigated according to CDC and National Healthcare Safety Network (NHSN) criteria in this retrospective database research study [5,7]. The protocol of this study was approved by the local ethical committee.

The total burn surface area (TBSA) percentage was calculated by Lund and Browder's chart, burn depth was assessed by clinical observation [8]. Any patient with 10% TBSA burn and patients with localized deep burn ≥2% TBSA were admitted to the burn unit. All the burn patients' fluid replacement was performed according to the Parkland Formula.

A protective gown and disposable gloves were used during the patient contact and infection control measures were applied to all patients. Hands were washed with conventional soap, and disinfected with 70% ethanol/glycerol before and after patient contact. Routine burn wound care consisted of daily cleansing and the daily application of a topical antimicrobial ointment (silver sulfadiazine in a 1% cream)

for the cases infected by *Pseudomonas aeruginosa* and vaseline impregnated gauze containing chlorhexidine gluconate for the cases with no evidence of infection.

Full thickness burns and inhalation injury, TBSA > 60%, and clinical infection signs were accepted as the indication of empiric antibiotic therapy. Perioperative prophylaxis was introduced to all patients. Prophylactic antibiotics were otherwise not administered to the patients. Positive culture results were considered to be the absolute indication of rational antibiotherapy. Conventional laboratory methods in addition to automated API Rapid ID 32 Staph (BioMerieux, France) system were used to identify the isolates. Antimicrobial resistance investigation of the isolates was determined by using Kirby-Bauer disk diffusion method, according to Clinical and Laboratory Standards Institute (CLSI) criteria. In cases with repetitive positive culture results of the same microorganism or positive results of more than one isolates, only one of the organisms was accepted as the infection agent in order to eliminate duplication.

A statistical package was used in statistical analysis. Student's t-test or the Mann–Whitney U-test was used for continuous variables, and chi-square test or Fisher's exact test was used to analyze categorical variables. Logistic regression model was used to identify risk factors for nosocomial infections. Clinically important variables and the variables with p value lower than 0.20 in the univariate analysis were included in the multivariate analysis as the candidate variables in order to compose the best model. Odds ratios and 95% confidence intervals were calculated using Backward LR multivariate logistic regression analysis. A p value <0.05 represented statistical significance for all statistical comparisons.

3.   Results

Among the hospitalized 658 patients, 469 cases acquired 602 NIs. The mean age of the hospitalized patients was 34.8 ± 8.6 and 392 (59.6%) were male. The mean TBSA was $32.4 \pm 8.7\%$. The mean length of hospital stay was 35.6 ± 5.8 days and the mean hospital admission day, from injury to hospitalization in our burn ICU, was 3.5 ± 0.5. The overall Acute Physiology and Chronic Health Evaluation (APACHE) II displayed a median score of 8 (IQR = 6–14). Mean Multiple Organ Dysfunction Score (MODS) was 2.6 ± 0.7.

The mean age (39.4 ± 2.7 years), the mean length of hospital stay (41.5 ± 9.3 days) and TBSA ($36.3 \pm 9.6\%$) of the patients with NI were higher than those with non-infected patients age (21.8 ± 6.4 years), length of stay (25.1 ± 7.1 days) and TBSA ($18.9 \pm 4.3\%$) ($p = 0.03$, $p = 0.01$, $p = 0.01$) respectively. The length of hospital stay for infected and non-infected cases with TBSA ≤ 40% were 31.4 ± 4.2 and 21.2 ± 3.4 days respectively ($p = 0.01$), whereas the length of hospital stay for infected and non-infected cases with TBSA > 40% were 53.8 ± 6.4 and 29.6 ± 6.7 days respectively ($p = 0.01$).

Mortality occurred in 109 (16.5%) patients and 103 of those had NI and 6 of them were non-infected. More than one NIs were observed in 62 of 103 mortality developed infected patients. Mortality was significantly higher among burn patients with NI and mix infections.