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Bacteriologic Study in Burn Patients Admitted to Burn Ward of Sina Hospital During 2012 - 2013, Tabriz, Iran: A Cross-Sectional Study

Parviz Saleh [1]; Hamidreza Afsharjoo [2]; Ali Ramouz [3,*]; Mohammad Reza Bonyadi [4]; Mahdie Hosseini [3]; Fateme Mallah [5]

[1]Infectious Diseases Department, Research Center of Infection and Tropical Diseases, Tabriz University of Medical Sciences, Tabriz, IR Iran
[2]Infectious Diseases Department, Tabriz University of Medical Sciences, Tabriz, IR Iran
[3]Student Research Committee, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, IR Iran
[4]Department of Immunology, Drug Applied Research Center, Tabriz University of Medical Sciences, Tabriz, IR Iran
[5]Gynecology and Obstetrics Department, Al Zahra Hospital, Tabriz University of Medical Sciences, Tabriz, IR Iran

*Corresponding author: Ali Ramouz, Student Research Committee, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, IR Iran. Tel: +98-9143023216, Fax: +98-4134413895, E-mail: Ali.ramouz@gmail.com

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Background: One of the important causes of mortality and morbidity in burn wards is infection. There are several reasons which make burn patients disposed to infection.

Objectives: The current study aimed to investigate the role of different factors that affect bacteremia occurrence in burn patients and factors relevant with mortality in these patients.

Patients and Methods: This cross-sectional study was performed in one year on 81 burn patients. We collected patient data regarding age, body weight and height, cause of burn, lesion color and place and percentage of burn. Then we documented all interventions, blood tests and cultures and recorded colonies criteria.

Results: Thirty-nine males (48.1%) and 42 females (51.9%) included with a mean age of 32.06 ± 17.46 years. In patients without bacteremia, 57 patients did not need catheterization (89.1%), however in patients with bacteremia, nine needed a catheter (52.9%).. In this survey, in patients with bacteremia, 12 survived (70.9%), however in those without bacteremia, 56 patients survived (92.2%). Then, the relativity between the type of burn and wound infection bacteria species was investigated, but analysis found a P value of 0.65, which was not significant.

Conclusions: Invasive interventions increased bacteremia susceptibility in burn wards. Mortality rate had a direct association with bacteremia prevalence and increased by larger burn area.

Keywords: Bacteremia; Burn; Patients; Bacteriologic Technics

1. Background

One of the important causes of mortality and morbidity in burn wards is infection (1-8). Several reasons make burn patients disposed to infection, such as wide exposed raw areas, necrotic tissue presence, immunocompromising effects of burn wound, prolonged hospitalization, patients overcrowding in wards, inability of blood to rich the affected environment and moist area in wound area (which is susceptible for proliferation and colonization) (2, 9-13). Now it has been proved that 75% of burn injury death is due to infection rather than osmotic shock or hypovolemia and most infection related burn-death is followed by septic shock with alongside bacteremia (2, 7, 14-16). Burn wound is susceptible to colonization with many microorganisms; however, bacteria play an important role leading to infection and its complications in burn patients. Type and sensitivity of bacteria in burn patients is mostly in contact with the site of injury, but as time passage predominant bacterial flora of burn wound changes, so that Gram-positive bacteria are dominant in early phase and switches to Gram-negative species in 4-10 days. In a research in Kaunsas, results proved that severe type burning which is more than 29% of body surface can cause bacteremia; however, there is controversy in time of bacteremia occurrence in different studies (13, 17-20). Prevalence of bacteria causing infection and colonies varies between developed and developing countries. This information would help health care system in every region or hospital to offer effective treatment for patients and improving the rate of recovery. There are some clues that help to identify the microorganism causing infection before paraclinic tests. One of the important facts is the color of lesion and wound, which has been confirmed by several articles. On the other hand, some studies approved that infection in burn patients with a history of important illness like hypertension can be caused by special bacteria like *Acinetobacter* (8, 12, 13, 19-25). Almost all studies approved that *Pseudomona aeruginosa* is the leading cause of infection

in burn injuries. Although Gram-positive cocci (especially MRSA) has increasing prevalence among nosocomial infections, but followed by initial management of wound area, Gram-negative species became less common in the recent years (6, 10, 13, 18, 19, 21, 26).

2. Objectives

We aimed to investigate the role of factors affecting bacteremia occurrence in burn patients and factors relevant with mortality in these patients.

3. Patients and Methods

This cross-sectional study was performed during one year from September 2012 to September 2013, at our general referral hospital (educational and governmental hospital). Of 87 patients admitted to burn ward, 81 burn patients who directly admitted to hospital burn ward were enrolled in this study and six patients who were referred, referring after 24 hours of burn incident or patients with immune system disorders (such as leukopenia or immunosuppression) were excluded. Census method was used for patients sampling. Patient demographic information such as age, body weight and height, cause of burn, lesion color and place and percentage of burn were documented completely. Interventions such as CVP (Central Vein Pressure) catheterization or intubation and their date were documented. Blood sample culture and lesion sample culture were performed in the first and seventh days of admission, although in case of any evidence of infection or sepsis (such as disorientation, hypothermia, hypotension, petechial hemorrhage, lesion color changing, increasing in peripheral edema and leukocytosis) new samples were collected. All these processes were performed by sterilized swap and incubation samples performed in a general microbiology laboratory in hospital. Since we avoided any invasive interventions, sterilized swap sampling was performed instead of wound biopsy. More than one colony in a culture proved microorganism existence in sample. Antibiotic sensitivity test was performed by disk diffusion method of Kirby-Bauer in Mueller-Hinton agar medium and outcomes interpretated due to CLSI (Clinical and Laboratory Standards Institute) suggestion. To find out antibiotic sensitivity of samples, antibiogram was performed. Blood test such as CBC (complete blood count), ABG (arterial blood gas), electrolytes, urea, creatinine and blood sugar were documented during the first days of admission and once after bacteremia in case of occurrence. Standard manometer was used to measure patients' blood pressure by physicians. Laboratory tests were performed. In addition, all clinical and physical examinations were performed by one infectious disease ward resident and laboratories tests by hospital central laboratory. Finally, the length of admission and discharge date or date of death were documented. All processes of diagnosis, treatment and study were explained to patients and no additional fee imposed to them. An informed written consent was obtained from patients before participation. This study was approved by Tabriz University of Medical Sciences ethics committee by the number of 9112. Data analysis was performed using SPSS software version 16. Qualitative variables were analyzed by Chi-square test and quantitative variables by Independent T-test and Mann-Whitney test. P value less than 0.05 interpreted as significant.

4. Results

Of 81 patients included in the study, 39 were male (48.1%) and 42 females (51.9%) with a mean age of 32.06 ± 17.46 years. The youngest patient was one year old and the oldest 78 years. Primarily, the association between age and bacteremia occurrence in burn patients was considered. There were 64 patients without bacteremia with a mean age of 33.20 ± 16.95 years and 17 patients with bacteremia with a mean age of 27.79 ± 19.19 years (P value = 0.25) (Table 1). There was no significant association between lesion color and infection onset and infectious agent, because infection occurrence and bacteria type had no effect on lesion color and lesion exudate. Regarding gender and bacteremia occurrence, in 64 patients without bacteremia 34 (53.1%) were male and in 17 patients with bacteremia, five were males (29.4%); Fischer test proved a P value of 0.07 (Table 2). Of 64 patients without bacteremia, in 57 patients catheterization was not used (89.1%) and seven patients needed catheter (10.9%), although in patients with bacteremia, nine patients needed catheter (52.9%) and eight did not (47.1%). Fischer test found P value as 0.002 (Table 3). Then, in group of patients with bacteremia, 12 patients survived (70.9%) among 17 patients; however, in 64 patients without bacteremia, 56 survived (92.2%). Fischer test analysis showed P value of 0.03 regarding the association between mortality rate and bacteremia occurrence (Table 4). The association between type of burn and wound infection bacteria species was discussed. Of study population, 40 patients infected with infectious agents; however, 17 patients infected by Gram-positive bacteria and 23 infected by Gram-negative bacteria. Burn causes were divided into three groups of hot liquids, flame and chemical materials. In patients with Gram-positive organism infection, three were affected by chemical materials (18.4%), 11 by bulla (63.2%) and three by fire flame (18.4%). On the other hand, in patients with Gram-negative organism infection, six were affected by chemical materials (25.06%), 12 by bulla (53.5%) and five fire flame (20.9%) (P value = 0.65) (Table 5). Finally, association of mortality rate and burn area in TBS (Total Body Surface) was investigated by Mann-Whitney test. Therefore, patients were divided into two groups; 71 survived patients and 10 dead patients. Mean rate of affected TBS was 56.4 in dead group, but it was 38.83 in survived group (Mean rank = 0.01).

Table 1. Results of T-test Comparing the Mean Age of Patients in the Both Groups; Bacteremia and no Bacteremia

Patients Age Range	Plentitude	With Bacteremia	Without Bacteremia
0 - 20	17	1	16
20 - 40	33	7	17
40 - 60	24	4	32
60 - 80	7	5	1

Table 2. Frequencies and Percentages of Gender and CV Line Use in the Both Groups; Bacteremia and no Bacteremia; as the Results of Fisher Exact Test [a]

Variable	Patients With Bacteremia	Patients Without Bacteremia	P Value
Gender			0.07
Male	5 (29.4)	34 (53.1)	
Female	12 (14.8)	30 (46.9)	
With catheter	9 (52.9)	8 (47.1)	
Without catheter	7 (10.9)	57 (89.1)	

[a] Data are presented as No. (%).

Table 3. Frequencies of Bacteremia and Mortality Prevalence Using Fisher Exact Test [a]

	Without Bacteremia	With Bacteremia	P Value
Variable			0.03
Survived	59 (92.2)	12 (70.6)	
Dead	5 (7.8)	5 (29.4)	

[a] Data are presented as No. (%).

Table 4. Frequencies of Organism Type Involved and Burn Types Using Chi Square Test [a]

	Gram Positive Infection	Gram Negative Infection	P Value
Variable			0.65
Scorch burn	6 (26.08)	3 (17.64)	
Flame induced burn	12 (52.17)	11 (64.7)	
Chemical material induced burn	5 (21.7)	3 (17.64)	

[a] Data are presented as No. (%).

Table 5. Association Between Burn Percentage TBS (Total Body Surface) and Mortality Prevalence Using Mann-Whitney Test

	Frequency	Mean Ranks	Mann-Whitney U	Mean Rank
Variable			201	0.01
Survived	71	38.83		
Dead	10	56.40		

5. Discussion

This study was one of the numerable reports in this field, which described the association between gender and bacteremia onset and irrelevance of bacteria species and burn cause in burn patients of an Iranian burn ward. All studies estimated infection as a major problem in burn patients and its mortality rate, which is even more important than osmotic shock and hypovolemia.

Among pathogens causing wound infection and colonization in burn patients, *Klebsiella* was the most common in this study; however, it was completely in contrast with studies performed before which confirmed *Pseudomona aeruginosa* as the most isolated agent. *Pseudomona aeruginosa* was the second most isolated microorganism from infected wounds in current records, but in other studies from Iran, they reported *Staphylococcus aurous* as the second causative agent. *Staphylococcus aurous* was the third most common microorganism among our specimens, but it was the first cause of colonization in developed

countries and as mentioned before, the second reason in studies from our region.

This study proved *P. aeruginosa* as the most common cause of bacteremia in our burn ward and this report was the same as previous researches. Association of patient age and bacteremia occurrence had not been reviewed separately in past studies, but they discussed correlation of age and infection. There was a controversy between the two reports performed before. One of the researches showed that risk of admission, length of hospitalization and risk of mortality after burn injury became more by increasing age.

This study estimated a great risk of mortality and morbidity due to nosocomial infection in elder patients. Although Oncul et al. (3) found no significant association between the mean age of both groups of patients with nosocomial infection and non-infected patients with their mortality rate. In the current study, results proved no significant correlation between age of patients and bacteremia occurrence and there was no difference in mean age of patients with bacteremia and those without it. In previous studies, the association of gender and burn accident has been discussed, but they reported no significant association between age and bacteremia prevalence.

This study showed no valuable fact in comparing bacteremia occurrence in males and females, so we can say that gender had no effect on bacteremia occurrence. In previous studies, there was no useful information about relativity of lesion color and infectious agent in infected burn patients, but in this survey, infectious agent species had no effect on the color of lesion, so lesion color cannot be diagnostic in burn wards and has no specificity for differentiating bacterial species. This is obvious that wound color is not a scientific indicator for infectious agent diagnosis.

CV line is used in some patients to perform serum therapy and preventing hypovolemia and its complications. Not much evidence are available regarding the association of CV line and bacteremia onset. Bang et al. (2) approved that IV line cannot be considered as a source of infection or sepsis and its culture sample had negative results; however, in the present study, having CV line increased the prevalence of bacteremia occurrence, so invasive interventions like CV line fixing makes patient susceptible for bacteremia. Bacteremia and mortality rate are in a close association in burn patients, as our study and most others indicated this. It is estimated that bacteremia occurrence increases mortality followed by burn traumas.

Other studies just discussed bacteremia occurrence rate in different burn patients, as Bang et al. (2) reported fire flame induced burns as most susceptible patients for sepsis. Previous studies on this field had no discussion about association of burn agent and microorganism induced infection. This study discussed different spread patterns of microorganism which cause infection in various burn agents and results proved no significant correlation between three types of burn agents and infectious microorganism. Reports about burn traumas suggested the important role of burn area on bacteremia onset and mortality rate of burn patients. Burn area extent increased mortality rate of patients in the current research, as the affected TBS enlarged, mortality rate increased as well. All patients admitted to hospital burn ward were enrolled in this study, but certainly due to lack of facilities, not all burn patients were admitted to the hospital.

This study evaluated bacteriologic factors in burn patients epidemiologically, however, in further studies larger population and more detailed information should be evaluated to achieve comprehensive results. There was no association between age of patients and bacteremia onset in burn patients and gender did not affect bacteremia occurrence. Lesion color and exudate were not diagnostic factors for infectious agent species in burn patients. However, invasive interventions like CV line increase bacteremia susceptibility in burn wards. Although, burn causing agent has no effect on infectious species, bacteremia prevalence is in a direct association with mortality rate in burn patients.

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Authors' Contributions

Parviz Saleh and Fateme Mallah developed the original idea and the protocol. Hamidreza Afsharjoo and Ali Ramouz abstracted and wrote the manuscript. Mohammad Reza Bonyadi, Ali Ramouz and Hamidreza Afsharjoo contributed to development of the protocol, abstracted data and prepared the manuscript. Mahdie Hosseini and Ali Ramouz analyzed data.

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