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Prognostic factors affecting the mortality of burn injuries patients in Dr. Sardjito General Hospital, Yogyakarta, Indonesia

Khoirul Anam, Ishandono Dachlan*
[1]Plastic and Reconstructive Surgery, Department of Surgery, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Universitas Gadjah Mada /Dr. Sardjito General Hospital, Yogyakarta

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ABSTRACT

About two million people suffer from burn injuries in the United States each year, with 100,000 hospitalized in the burn unit. Around 1000 patients suffer from severe burn injuries, with each year average of 300 deaths. Improvements in the understanding of the prognostic factors affecting burn injuries over the past decades have led to advances in medical and surgical treatment. However, comprehensive data on the factors affecting burn injuries in Indonesia have not been available, yet. The aim of the study was to investigate the prognostic factors affecting the mortality of 2nd and 3rd burn injuries patients in Dr. Sardjito General Hospital, Yogyakarta. This was a cross-sectional study conducted within the period of 2007-2011 using secondary data from the Department of Medical Records. Chi-square and logistic regression analysis were used to evaluate the correlation between the prognostic factors and the mortality. A p value < 0.05 (95% confidence interval) was considered to be significant. A significantly correlation between age, burn injuries percentage, arrival time, inhalation trauma, hemoglobin level, albumin level, creatinine level, hematocrit level and the patient's mortality was observed in this study ($p<0.05$). However, the cause of burn injuries and leukocyte count had no correlation with the patient's mortality ($p>0.05$). Furthermore, patients with albumin level < 3.5 mg/dL, burn injuries percentage $>50\%$, inhalation trauma and hospitalized in 24 hours after the incident were at 22.98, 7.65, 3.0 and 4.59 times higher risk of mortality, respectively ($p<0.05$). In conclusion, albumin level, burn injury percentage, inhalation trauma and time of arrival are prognostic factors affecting the mortality of the burn injuries patients.

ABSTRAK

Sekitar dua juta orang menderita luka bakar di Amerika Serikat setiap tahun, dengan 100.000 dirawat di unit luka bakar. Sekitar 1.000 pasien menderita luka bakar parah, dengan rerata mortalitas 300 jiwa pertahun. Perbaikan dalam pemahaman faktor prognostik mortalitas akibat luka bakar selama beberapa dekade terakhir bermanfaat memajukan perawatan medis dan bedah. Namundemikian, data komprehensif tentang faktor prognostik yang mempengaruhi mortalitas akibat luka bakar di Indonesia belum tersedia. Penelitian ini bertujuan untuk mengkaji faktor prognostik yang mempengaruhi mortalitas pasien luka bakar derajat 2 dan 3 di Rumah Sakit Umum Pusat Dr. Sardjito,

* corresponding author: ishandono@ugm.ac.id

Yogyakarta. Penelitian ini merupakan penelitian potong lintang yag dilakukan selama periode 2007-2011 menggunakan data sekunder dari Departemen Rekam Medik. Analisis Chi-kuadrat dan regresi logistik digunakan untuk mengkaji hubungan antara faktor prognostic dan mortalitas. Nilai p < 0,05 dengan taraf kepercayaan 95% dianggap berbeda nyata. Terdapat hubungan nyata antara umur, persentase luka bakar, waktu kedatangan, trauma inhalasi, kadar hemoglobin, kadar albumin, kadar kreatinin, kadar hematokrit dan mortalitas (p<0,05). Namun demikian, penyebab luka bakar dan angka leukosit tidak berhubungan mortalitas pasien (p>0,05). Selanjutnya, pasien dengan kadar albumin <3,5 mg/dL, persentase luka bakar > 50%, trauma inhalasi dan waktu kedatangan dalam 24 jam setelah kejadian mempunyai risiko mortalitas secara berturut-turut 22,98, 7,65, 3,0 dan 4,50 lebih tinggi (p<0,05). Dapat disimpulkan, kadar albumin, persentase luka bakar, trauma inhalasi dan waktu kedatangan merupakan factor prognostik yang mempengaruhi mortalitas pasien luka bakar.

Keywords : burn injuries – mortality – prognostic factors – tertiary care center - Indonesia

INTRODUCTION

Burn injuries are one of the most common traumas faced by medical professionals. Severe burn injuries show high morbidity and disability compared to other injuries.[1] In the United States, about 1.1 million people suffer from burn injuries each year and should receive emergency medical attention. About 45,000 people with the burn injuries need to be hospitalized, and around 4,500 people died. In Indonesia, a study performed in a hospital in Makassar reported that in a period of 5 years, 102 burn patients were treated at burn care, with mortality as much 9.2%. The highest degree of burns found was degree II a-b with 36 cases (46.7%). More than 90% of burn complications can be prevented, but the prevention and management of burn complications still require long-term solutions.[2]

Burn injuries might affect all aspects of the patient both physically and psychologically. Burn injuries might also affect all ages, from infants to elderly, and constitute problems in both developed and developing countries. The pain and suffering caused by burn injuries are not limited to the time it happened. Visible physical injuries and invisible psychological injuries take a long time in the healing process and often lead to chronic disability.[3] Severe burn injuries can also lead to death. A study showed that from 980 patients treated, 62 (6.3%) of them died. In addition, positive correlations between age, degree, type of burn injuries, burn injuries percentage and death were reported.[4]

In Indonesia, comprehensive studies concerning prognostic factors affecting mortality of hospitalized burn injuries patients especially who suffer 2nd and 3rd degree have not been reported, yet. The aim of this study was to investigate the prognostic factors affecting the mortality of hospitalized 2nd and 3rd-degree burn injuries patients in Dr. Sardjito General Hospital, Yogyakarta, Indonesia.

MATERIALS AND METHODS

Subjects

This was a cross-sectional study to investigate the prognostic factors affecting mortality of 2nd and 3rd-degree burn injuries

patients in Dr. Sardjito General Hospital, Yogyakarta, Indonesia within the period of 2007 to 2011. This study used a non-probability purposive or judgmental sampling method. The data were secondarily collected from the Department of Medical Records, Dr. Sardjito General Hospital, Yogyakarta, Indonesia, from November 2011 to February 2012. The population of this study were all hospitalized 2nd and 3rd degree burn injuries patients in Dr. Sardjito General Hospital, Yogyakarta, Indonesia, from January 2007 to October 2011.

Protocol of the study

One hundred and ninety eight burn injuries patients, not included burn injuries victins of mount Merapi's eruption, were selected in the study. Among them, only 119 patients met the inclusion and exclusion criteria. The inclusion criteria were all hospitalized 2nd and 3rd degree burn injuries patients in Dr. Sardjito Hospital, Yogyakarta, Indonesia, from January 2007 to October 2011. The exclusion criteria were: (a) burn injuries victims of Mount Merapi's eruption, (b) refusal of admission to inpatient treatment, (c) patients with other severe trauma, (d) patients with other serious co morbidities, (e) patient with incomplete medical records, (f) patient with medical record that did not contain the required data.

The burn injuries were classified into 1st until 3th degree based on the depth of the burn. Patients were considered suffer from 1st degree burn injury if the injury was limited to the upper layers of the epidermis. However, if the deeper dermal layers involved in the burn injury patients were considered suffer from 2nd degree burn injury. In this 2nd degree, the superficial was much more painful, while the deeper burn was less pain and has a feeling of blunt pressure. Patients were considered suffer from 3rd degree burn injury if all layers of the dermis involved, so that the skin was hard, dark, dry, painless, and had typical burn scar.[5]

All factors that might lead to mortality of the 2nd and 3rd degree burn injuries patients were evaluated such as the causes burn injuries, burn injuries percentage, time of arrival, inhalation trauma, hemoglobin level, leukocyte count, albumin level, creatinine level, and hematocrit level.

Statistical analysis

Data were presented as frequencies or percentages and analyzed using SPSS 15.0. Univariate and bivariate analysis using Chi-square test, and multivariate analysis with logistic regression equation were performed to describe and evaluate the relationship between the prognostic factors and the mortality of burn injuries patients. A p value < 0.05 (95% confidence interval or 95% CI) was considered to be significant.

RESULTS

The characteristics of the burn injuries patients are presented in TABLE 1. The highest number of burn victims was female with the ages mostly adults. Most of the patients involved in this study were live. The most common cause of burns was fire with the highest percentage of the wound was ≤ 50%. Patients came to health services within ≤ 24 hours. The majority of patients did not experience inhalation trauma. From the laboratory test, the Hb level of most patients was ≥ 10 g/dL. Most patients were having total leukocyte count ≥ 12.000/mm3, the highest albumin level > 3.4 g/dL and creatinine level in the group < 1.5 g/dL. Highest hematocrit level in the group was <41%. The academic

background, most patients were from senior high school. Most patients were referrals from other health facilities.

TABLE 1. Characteristic of the burn injuries patients

Characteristic of patients	Frequency (n)	Percentage (%)
Sex		
● Women	71	59.7
● Man	48	40.3
Total	119	100
Age		
● Infant	25	21.0
● Children	11	9.2
● Adult	75	63.0
● Elderly	8	6.7
Total	119	100
Death		
● Yes	28	23.5
● No	91	76.5
Total	119	100
Causes of burn injuries		
● Fire	47	39.5
● Hot water	27	22.7
● Electrical	34	28.6
● Hot oil	8	6.7
● Other	3	2.5
Total	119	100
Burn injuries percentage		
● > 50 %	20	16.8
● ≤ 50 %	99	83.2
Total	119	100
Time of arrival		
● > 24 hours	30	25.2
● ≤ 24 hours	89	74.8
Total	119	100
Inhalation trauma		
● Trauma +	14	11.8
● Trauma -	105	88.2
Total	19	100
Hemoglobin level		
● < 10 g/dL	11	9.2
● ≥ 10 g/dL	108	90.8
Total	119	100
Leukocyte count		
● ≥ 12.000/mm3	88	73.9
● < 12.000/mm3	31	26.1
Total	119	100
Albumin level		
● < 3.4 g/dL	43	36.1
● > 3.4 g/dL	76	63.9
Total	119	100
Creatinine level		
● > 1.5 g/dL	11	9.2
● ≤ 1.5 g/dL	108	90.8
Total	119	100
Hematocrit level		
● > 41 %	31	26.1
● ≤ 41 %	83	73.9
Total	119	100
Academic background		
● No school	28	23.5
● Elementary school	29	24.4
● Junior high school	26	21.8
● Senior high school	31	26,1
College/university	5	4.2
Total	119	100
Referral		
● Yes	78	65.5
● No	41	34.5
Total	119	100

A significantly correlation between age, burn injuries percentage, arrival time, inhalation trauma, hemoglobin level, albumin level, creatinine level, hematocrit level and the patient's mortality was observed in this study ($p<0.05$). However, the cause of burn injuries and leukocyte count had no correlation with the patient's mortality ($p>0.05$) as shown in TABLE 2.

TABLE 2. Multivariate and bivariate of variables and mortality

Variables	Mortality (+) n (%)	Mortality (-) n (%)	Total n (%)	p	RR (CI 95%)
Age					
• Infant	9 (36)	16 (64)	25 (100)		
• Children	0 (0)	11 (100)	11 (100)		
• Adult	15 (20)	60 (80)	75 (100)	0.027	
• Elderly	4 (50)	4 (50)	8 (100)		
Total	28 (8.4)	91 (91.6)	119 (100)		
Causes of burn injuries					
• Fire	17 (36.2)	30 (63.8)	47 (100)		
• Electrical	7 (20.6)	27 (79.4)	34 (100)		
• Hot water	3 (11.1)	24 (88.9)	27 (100)	0.087	
• Hot oil	1 (12.5)	7 (87.5)	8 (100)		
• Other	0 (0)	3 (100)	3 (100)		
Total	28 (23.5)	91 (76.5)	119 (100)		
Burn injuries percentage					
• > 50%	17 (85)	3 (15)	20 (100)		7.65
• ≤ 50%	11 (11.1)	88 (88.9)	99 (100)	0.001	
Total	28 (23.5)	91 (76.5)	119 (100)		(4.254-13.756)
Arrival time					
• > 24 hours	17 (56.6)	13 (43.3)	30 (100)		4.585
• ≤ 24 hours	11 (12.4)	78 (87.6)	89 (100)	0.001	
Total	28 (23.5)	91 (76.5)	119 (100)		(2.428-8.657)
Inhalation trauma					
• Yes	8 (57.1)	6 (42.9)	14 (100)		3.0
• No	20 (19.0)	85 (81)	105 (100)	0.004	
Total	28 (23.5)	91 (76.5)	119 (100)		(1.645-5.472)
Hb level					
• > 10 g/dL	6 (54.4)	5 (45.5)	11 (100)		2.678
• ≤ 10 g/dL	22 (20.4)	86 (79.6)	108 00)	0.02	
Total	28 (23.5)	91 (76.5)	119 00)		(1.390-5.159)
Leukocyte count					
• > 12x10^3/mm^3	23 (26.1)	65 (73.9)	88 (100)		1.620
• ≤ 12x10^3/mm^3	5 (16.1)	26 (83.9)	31 (100)	0.259	
Total	28 (23.5)	91 (76.5)	119 (100)		(0.675-3.892)
Albumin level					
• < 3.4 g/dL	26 (60.5)	17 (39.5)	43 (100)		22.977
• ≥ 3.4 g/dL	2 (26.3)	74 (73.7)	76 (100)	0.001	
Total	28 (23.5)	91 (76.5)	119 (100)		(5.73-92.132)
Creatinine level					
• > 1.5 g/dL	9 (81.8)	2 (18.2)	11 (100)		4.651
• ≤ 1.5 g/dL	19 (17.6)	89 (82.4)	108 (100)	0.001	
Total	28 (23.5)	91 (76.5)	119 (100)		(2.837-7.623)
Hematocrit level					
• > 41%	15 (48.4)	16 (51.6)	31 (100)		3.275
• ≤ 41%	13 (15.6)	75 (84.4)	83 (100)	0.001	
Total	28 (23.5)	91 (76.5)	119 (100)		(1.763-6.087)

A significantly correlation between albumin level [p = 0.001; Ep (B) = 22.977; 95% CI (5.73 to 92.132)], burn injuries percentage [p = 0.001; Ep (B) = 7.65; 95% CI (4.254-13.756)], inhalation trauma [p = 0.004; Ep (B) = 3.0 95% CI (1.645 to 5.472)], time of arrival [p = 0.001; Ep (B) = 4.585; CI 95% (2.428 to 8.657)] and the patient's mortality was observed in this study. Patients with albumin level < 3.5 mg/dL, burn injuries percentage >50%, inhalation trauma and who hospitalized in 24 hours after the incident of burn injury were at 22.98, 7.65, 3.0 and 4.59 times higher risk of death, respectively.

DISCUSSION

Burn injury is a major cause of morbidity and mortality compared to the other injuries. It can lead to social, physical and psychological impairment of the patients. The burn injury could be caused by thermal contact from a hot object, hot liquids (scalds) and fire, electrical burns, chemical burns and friction burns. Without prompt treatment, the burn injury results in longer length-of-stay in the hospital and a substantial cost treatment. The most common age group in the incidence of burn according to our cases is children. The child's exploratory and curious behavior and inability to understand the hazard is assumed to be the indirect cause of the cases. A pediatric burn injury can be more severe compared to adults because of their skin is thinner. They are also more vulnerable to burn injuries due to the bigger ratio of body surface area and body weight, and also the function of kidney, liver, and immune system are still immature.[6,7,8]

On the other hand, burn injury on the elderly patients who are having comorbid diseases and degenerative processes may worsen the prognosis. Our study showed no statistically significant correlation between the causes of burn injuries and mortality rate. However, prevous study showed a correlation between causes of burn injuries and mortality rate.[4] Further study with a bigger number of samples may be needed.

Patients with a larger percentage of burn injuries are less likely to survive. In this study, 17 of 20 patients with more than 50% burn injuries percentage died. Previous study showed that extensive burn injury correlated with patient mortality, where the more extensive the burn, the greater the mortality rate.[4] Initial treatment before receiving hospital care (the quality of pre-hospital care), competent team, assessment of patients with primary survey and secondary survey, management of life-threatening injuries, adequate intravenous fluid administration, adequate transportation, assessment and appropriate initial treatment will reduce the mortality in patients with burn injuries.[9] Inhalation trauma had a significant impact on patients survival in which this is one of the factors that increases the risk of mortality in burn injuries. There are three components in inhalation trauma, the edema in the upper respiratory tract, acute respiratory failure and carbon monoxide intoxication. In general, the diagnosis of inhalation trauma is based on the patient history and clinical presentation. Facial or nasal hair burns, soot deposition of the face or stridor breathing sound are possible signs of inhalation trauma. Burn injuries effect to the respiratory tract will result in the development of edema after 12 to 24 hours after injury. Inhalation trauma becomes the most common cause of death in patients with burn injuries.[10] However a study reported by Hu *et al*.[11] found no correlation between inhalation trauma and mortality. This discrepancy may be due to their low overall mortality rate and the patients having burn in a high percentage of total body surface area (%TBSA). This may have decreased the impact of inhalation injury on mortality.

Burn injuries can reduce the level of hemoglobin. Capillaries are damaged due to exposure to high temperatures. Damaged blood cells may cause anemia in burn injuries patients.[1] In the early stage of burn injuries, there is a destruction of red blood cells equal to the severity of skin damage. In extensive burn injuries, the loss of red blood cells is as much as 8-12% of the total circulating red blood cells per day in 5 to 7 days after injury. This situation is due to hemolytic process caused by heat and the presence of micro-thrombus in the area of necrosis, clearance by the reticulo-endothelial system, blood sampling for laboratory tests and wounds treatment.[12] Leukocytes help the body to fight infections and diseases as part of the immune system. An increasing number of leukocytes in the acute phase of burns is a normal reaction of the bone marrow due to the external stimulation, such as burns.[13]

Burn injury may reduce albumin levels. Burn on the skin induce a strong inflammatory response and release vaso-active substance that can increase vascular permeability, making the small molecules like water and albumin become easier to leaks. Our data showed that albumin levels may be useful in predicting mortality in burn patients. Another study was showed that overall mortality risk increased 84% on the patient which albumin level was <2 g/dL. Because the most important function of albumin is to maintain osmotic pressure of at least 80% of the normal level, and its reduction could induce another complication to the patients such as malnutrition, impaired immune response, increased risk of infection, slow wound healing, decrease in body mass and inhibition of rehabilitation. These results suggest that hypoalbuminemia has a detrimental effect on patient survival. The albumin level could be used as an indicator of mortality.[14, 8]

The mortality of burn injuries patients has also increased in the presence of acute renal failure as a complication of severe burn injuries due to decreased glomerular filtration rate (GFR). Decrease in GFR due to hypovolumia, depressed myocardium, and protein denaturation. Rhabdomyolysis and free hemoglobin may result in acute renal failure.[15] Hematocrit levels will increase due to the hemo-concentration. Increased hematocrit level indicates a decrease of intravascular fluid volume. If the intravascular space is not filled again with intravenous fluids, hypovolumic shock in patients with extensive burns may occur. Skin damage from burn injuries causes loss of fluids due to excessive evaporation, the entry of fluid into the bullae on the 2nd degree burn injuries, and the fluid loss in scar of 3rd degree burn injuries.[1]

Nevertheless, there are several limitations to this study. This was a cross-sectional study at a single center, and some data collection was incomplete that makes the samples excluded. The total numbers of patients with 2nd and 3rd degree of burn injuries were not mentioned. Despite these limitations, we believe that this study can provide important information about prognostic factors affecting the mortality of patients with 2nd and 3rd degree of burn injuries.

CONCLUSION

Albumin level, burn injury percentage, inhalation trauma and time of arrival are prognostic factors affecting the mortality of the 2nd and 3rd degree burn injuries patients in Dr. Sardjito General Hospital, Yogyakarta, Indonesia.

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