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Sepsis risk factor in mount Merapi eruption victims with 2nd or 3rd degree of burn injury

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ABSTRACT

Sepsis is one of the fatal complications of burns. It is the most common cause of death from burns. Burn sepsis usually occurs after a burn injury develops into infection. This study was conducted to determine correlation between age, burn area, inhalation trauma, enteral nutrition start time, escarotomy time, and albumin level of sepsis in patients with 2nd or 3rd degree burn injury. This was a cross sectional study during May to June 2012. The subjects in this study were 39 victims of mount Merapi eruption in 2010 who suffered 2nd or 3rd degree of burns injury. The result showed the correlation between widespread burns, inhalation trauma, time of escarotomy, and albumin levels with sepsis ($p < 0.05$). In conclusion, the risk factor for sepsis in patients with 2nd or 3rd degree of burns injury are the area of burns (> 50%), inhalation trauma, time of escarotomy (> 72 hours), and albumin levels (<3.5g/dL).

ABSTRAK

Sepsis merupakan salah satu komplikasi fatal dari luka bakar. Sepsis menjadi penyebab kematian tersering dari luka bakar yang muncul setelah pasien mengalami infeksi. Peneitian ini dilakukan untuk mengkaji hubungan antara usia, luas luka bakar, trauma inhalasi, waktu memulai pemberian nutrisi enteral, waktu melakukan eskarotomi, dan kadar albumin dengan sepsis pada pasien luka bakar derajat 2 dan 3. Penelitian ini merupakan penelitian potong intang yang dilakukan pada bulan Mei sampai Juni 2012. Subjek penelitian adalah 39 korban erupsi Gunung Merapi tahun 2010 yang mengalami luka bakar derajat 2 atau 3. Hasil penelitian menunjukkan adanya hubungan antara luas luka bakar, trauma inhalasi, waktu melakukan eskarotomi, dan kadar albumin dengan sepsis ($p<0.05$). Dapat disimpulkan faktor risiko sepsis pasien luka bakar derajat 2 atau 3 adalah luas luka bakar (>50%), trauma inhalasi, waktu melakukan eskarotomi (>72 jam), dan kadar albumin (<3.5g/dL).

Keywords: sepsis - risk factor - merapi eruption - 2nd degree burn injury - 3rd degree burn injury

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INTRODUCTION

Burns are a serious cause of trauma, which causes severe morbidity and severe mortality, and has considerable economic impact. The cost of treatment of burns is very expensive due to length of stay and rehabilitation. In addition, the treatment of wounds or scars due to the burns require special handling from the beginning to the end.[1,2]

In the United States, more than 1.2 million people suffer burn injury each year, most cases are minor burn injury which only requires outpatient, however, almost 100,000 are moderate to severe and requires hospitalization, and more than 5000 die due to burn injury complications.[1] In developing countries, the incidence of burn injury is of 4-5 times the incidence in the United States. Women are considered the high-risk group for burns due to household activities such as cooking while wearing traditional flammable clothing.[3] In Indonesia, comprehensive studies on the incidence of burn injury have been conducted, yet.

Progress in the treatment of burn injury in the last three decades have led to success in reducing mortality. It also has changed the most common cause of death in burn injury. Shock due to burn injury typically occurs in burn injury of more than 20%. It was the most common cause of death between the years of 1930-1940. Experience and knowledge of resuscitation have been able to overcome these complications and reduce mortality.[4] Many deaths in burn injury can be prevented with proper airway management and adequate fluid management, however, in severe burn injury, the main cause of mortality that continue to be faced is sepsis.[5]

The number of deaths caused by sepsis in Indonesia has not much been published, yet. Based on the data in the Burn Unit of Dr. Cipto Mangunkusumo General Hospital, Jakarta during 1999-2000, burn injury with systemic inflammatory response syndrome (SIRS) and multiple organ dysfunction syndrome (MODS) caused 90% of death.[2] Although the pathophysiology of burn injury and clinical factors that predispose severe sepsis and septic shock on burn injury patients have been well understood, accurate prediction of the infection complications risk on burn injury patients has not been available, yet.[6] Several factors are reported as cause of infection and sepsis in burn injury such as age, percentage of burn injury, inhalation trauma, delay in the escharotomy and wound closing, delay in enteral feeding, diabetes mellitus, and albumin levels.[1-4,7-14]

Volcanic eruptions can cause burn injury due to the volcanic gases ejection containing harmful gas to human, such as carbon monoxide (CO), carbon dioxide (CO_2), hydrogen sulfide (H_2S), sulfur dioxide (SO_2), and nitrogen (NO_2). Most deaths in the volcanic eruptions are caused by pyroclastic flows and surges (burning clouds/*nuees ardentes*) and wet debris flows (*lahars*). Thermal injury may be the cause of asphyxia following inhalation trauma. The high temperature of the gases and entrained particles cause severe burn injury to the skin and the air passage. The presence of both types of injury in a victim may increase the delayed mortality risk from respiratory complications or from infection of burn injury.[15]

Factors that cause sepsis in burn injury due to volcanic eruptions may be similar to those in burn injury in general. However, these factors have not much been investigated, yet. This study was conducted to investigate the sepsis risk factors in mount Merapi eruption victims with 2nd or 3rd degree burns injury.

MATERIAL AND METHODS

Subjects

This was a cross-sectional study to investigate the risk factors of sepsis in patients with 2nd and 3rd degree burn injury due to mount Merapi eruption in 2010. The data of the patients were collected from the Medical Records Department (IRM), Dr. Sardjito General Hospital, Yogyakarta within the period of May to June 2012. Population in this study were all patients with 2nd or 3rd degree burn injury. This study used a total sampling method where all population was taken as samples except those who did not meet the inclusion and exclusion criteria.

Procedure

Data of the factors of sepsis such as age, burn percentage, inhalation trauma, time for starting enteral feeding, time of escharotomy being performed, albumin level were collected from medical record. Data of patients with sepsis and the outcome were also obtained from the medical record. The data collection was conducted after ethical clearance obtained from the Medical and Health Research Ethics Committee, Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta.

Statistical analysis

Data of risk factors of sepsis were presented as frequency or percentage. The correlation between the risk factors and the occurrence of sepsis was analyzed using Chi-square test. A p value < 0.05 was considered as significant.

RESULTS

Over a period of mount Merapi eruption in 2010, 39 patients with burn injury were treated at the Department of Surgery, Faculty of Medicine, Universitas Gadjah Mada /Dr. Sardjito General Hospital, Yogyakarta. Most patients were male (69.2%) and between the ages of 19-60 years old (74.4%). They had <50% (38.5%) of burn percentage and inhalation trauma (87.2%). They were given enteral feeding <24 hours (71.8%) and performed escharotomy >24 hours (82.1%). They had albumin level of <3.5g/dL (89.7%). Thirty three patients had sepsis (82.1%), and 29 patients died (74.4%). The characteristics of patients are presented in TABLE 1.

TABLE 1. Baseline characteristics of subjects

Characteristics	Frequency	Percentage (%)
Age (years)		
< 5	0	0
5 – 18	7	17.9
19– 60	27	69.2
> 60	5	12.8
Sex		
Male	27	69.2
Female	12	30.8
Burn percentage		
< 50%	15	38.5
> 50%	24	61.5
Inhalation trauma		
Yes	34	87.2
No	5	12.8
Time starting enteral feeding (hours)		
< 24	28	71.8
> 24	11	28.2
Time of escharotomy being performed (hours)		
< 72	7	17.9
> 72	32	82.1
Albumin level		
< 3.5g/dL	35	89.7
> 3.5g/dL	4	10.3
Sepsis		
Yes	32	82.1
No	7	17.9
Outcome		
Death	10	25.6
Alive	29	74.4

The correlation between the risk factors and the occurrence of sepsis is presented in TABLE 2. No correlation between age in general and sepsis (p=0.388) as well as between high risk age group (>60 years) and sepsis (p=0.169; PR=0.259; CI 95%=0.034-1.960) were observed. However, a significant correlation between burn percentage (>50%) and sepsis, as well as between inhalation trauma and sepsis (p=0.000; PR=41.33; CI 95%=3.423-499.146) were observed. A significant correlation between time of escharotomy performed and sepsis (p=0.003; PR=12.889; CI 95%=1.906-87.170), between time for starting enteral feeding and sepsis (p=0.067; PR=1.333; CI 95%=1.077-1.651), as well as between albumin level and sepsis (p=0.002; PR=23.250; CI 95%=1.925-280.770) were also oberved.

TABLE 2. Correlation between risk factors of sepsis and the occurrence of sepsis

Characteristics	Sepsis		P	PR (CI 95%)
	Yes	No		
Age (years)				
< 5	0	0	0.388	1.7268 (-0.0769–0.9259)
5 – 18	6	1		
19 – 60	23	4		
> 60	3	2		
Age group (years)				
< 60	3	2	0.169	0.259 (0.034-1960)
> 60	29	5		
Burn percentage (%)				
< 50	10	5	0.048	5.500 (0.907-33.345)
>50	22	2		
Inhalation trauma				
Yes	31	3	0.000	41.333 (3.423-499.146)
No	1	4		
Time of escharotomy being performed (hours)				
< 72	3	4	0.003	12.889 (1.906-87.170)
>72	29	3		
Time for starting enteral feeding (hours)				
< 24	21	7	0.037	1.333 (1.077-1.651)
>24	11	0		
Albumin level				
< 3.5 g/dl	31	4	0.002	23.250 (1.925-280.770)
>3/5	1	3		

DISCUSSION

This study showed that the average age of the patients was 39 years, with the most came from the age group of 19-60 years (69.7%), while there were only 5 patients came from the age group of >60 years (12.8%). The age group of >60 years is considered as a high-risk age group associated with the decline in cellular and humoral immunity.[7,16] Results of this study is different from other studies which

showed that age is not correlated with sepsis (p=0.338), whereas other studies revealed that age is correlated significantly correlated with sepsis, where the age group that has the higher risk is the age group >60 years.[8,17] This difference is probably caused by the limited number of samples that could be examined in this study.

This study also showed that most patients had >50% burn percentage (61.5%) that was caused by smoke and hot lava from Merapi eruption. We demonstrated that burn percentage was correlated with sepsis, therefore burn percentage is a risk factor in burn sepsis. Previous studies reported a significant correlation between higher burn percentage and sepsis and severe sepsis.[8,18] Therefore, this study is consistent with the findings of other studies.

The presence of inhalation trauma has a strong correlation with infections, especially pneumonia. It is generally agreed that inhalation trauma increases the risk of pneumonia. The inflammatory process due to inhalation trauma causes damage to the ciliary mucosal and airway epithelium. This result in a disruption of the cleaning process, the breakdown of the defense system in the respiratory tract, resulting in an increased risk of infection by bacteria in a couple of days and weeks.[1,4,7] The incidence of inhalation trauma reported at 0.3-43% in severe burn injury and 13-18% in elderly patients with burn injury.[17]

A study in Egypt reported 46.3% cases of inhalation trauma in all burn injury patients during 2008-2010.[19] In this study, the number of patient who suffered from inhalation trauma was 87.2%, in accordance with the possible cause of inhalation trauma which were the smoke and hot lava from Merapi eruption that contained harmful elements. From all patients who suffered from inhalation trauma, 91.17% developed sepsis. We demonstrated the correlation between inhalation trauma and sepsis (p<0.05), consequently, inhalation trauma is a risk factor for sepsis. A research that was conducted in 2009 found that from 47% death cases due to burn sepsis, 79% of them had inhalation trauma. Another study demonstrated a strong correlation between inhalation trauma and burn sepsis.[8]

Early enteral feeding (<24 hours) in patients with burn injury, lower the risk of sepsis. Early enteral feeding will maintain gastroduodenal mucosal villous function and prevent the translocation of microorganisms (bacteria, fungi) from the gastrointestinal tract.[20,21] In this study, the majority of the patients (71.8%) got early enteral feeding (<24 hours), which is adapted to the condition of the patient. However, in this study, we revealed no correlation between early enteral feeding (<24 hours) and sepsis. This finding is difference with previous studies which demonstrated significant correlation between early enteral feeding and sepsis. Those studies show that late enteral feeding is a risk factor for sepsis.[12,20] This difference is likely due to small sample size who received early enteral feeding (<24 hours) in this study, so it did not provide meaningful correlation.

Delay in performing escharotomy or debridement of the necrotic tissue lead to development of microorganism wich than result in sepsis. Skin layers demage become the entry site of the microorganisms into the deeper skin layers and systemic circulation.[1,7] In this study, there were 32 (82.1%) patients who underwent escharotomy in >72 hours and 29 (90.6%) of them developed sepsis. We analyzed the correlation between the delay in performing escharotomy and sepsis, in which we conclude that the delay in performing escharotomy correlates significantly with sepsis (p=0.03). However, other studies show different results. A study conducted by Xiao

et al shows significant correlation between the delay in performing escharotomy and sepsis, while the opposite result shows in a study conducted by Ong.[10,11]

Albumin is needed in the body's defense system, especially in the humoral response. In patients with burn injury, low albumin levels (hypoalbuminemia) increase the risk of further infection that could develop into sepsis.[14] In this study, there were 89.7% patients had albumin level <3.5g/dl, and 90.6% of them developed sepsis. We analyzed the correlation between low albumin level and sepsis and we found that low albumin level correlated with sepsis. It can be concluded that low albumin level is a risk factor for burn sepsis.

The mortality rate in the victims of mount Merapi eruption in this study reached 74.4%, while the mortality rate in patients who developed sepsis was 81.3%. This result is higher than a study by William in 2009, where the study reported the mortality rate of burn sepsis is 47%. Other study reported the mortality rate of burn sepsis is 2-14%.[17,22]

CONCLUSION

Burn percentage (>50%), inhalation trauma, time of escharotomy being performed (>72 hours), and albumin level (<3.5g/dL) are the risk factors of burn sepsis in patients with 2nd or 3rd degree burn injury.

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