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Original Research Article

Relationship between comorbid factors and mortality of inhalation trauma patients in Wahidin Sudirohusodo Hospital, Makassar

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ABSTRACT

Background: Inhalation trauma is the leading cause of death in burn patients. Inhalation trauma is caused mainly by inhalant poisons such as smoke, gas and steam. Many patients die immediately at the scene due to inhalation trauma. The purpose of this study was to determine the relationship between comorbid factors and mortality rates in patients with inhalation trauma.
Methods: The research design was analytical research method with cross sectional design. The study sample consisted of 26 people (51.0%) inhalation trauma and 25 people (49.0%) without inhalation trauma obtained by consecutive sampling.
Results: There was a significant relationship between inhalation trauma and death outcomes ($p<0.001$). The proportion of deaths in inhalation trauma (65.4%) was significantly higher than in nonhaled trauma (16.0%). There was no significant relationship between DM and outcome ($p>0.05$). There was no significant relationship between hypertension and outcome of death ($p>0.05$). There is a significant relationship between onset and outcome ($p<0.05$). The proportion of deaths at <24 hours onset (35.6%) was significantly lower than at onset >24 hours (83.3%). The mean blood glucose level of dead patients was higher than that of alive, which was 124.4 compared to 114.9 but was not statistically significant ($p>0.05$). Both the mean systole and diastole pressures of the dead patients showed significantly lower results than that of alive, i.e., the mean systole was 101.2 compared to 114.1 ($p<0.05$) and the mean diastole was 62.2 versus 71.4 ($p<0.05$).
Conclusions: According to the results of the study, it was found that there was a relationship between the onset of more than 24 hours, high GDS levels, and lower blood pressure to mortality.

Keywords: Burn injury, Comorbid factor, Diabetes meletus, Hypertension, Inhalation Injury, Mortality

INTRODUCTION

Inhalation trauma is the leading cause of death in burn patients. Inhalation trauma is caused mainly by inhalant poisons such as smoke, gas and steam. Many patients who die immediately on the scene due to inhalation trauma. Of all burn patients admitted to hospital, inhalation injuries were seen in more than>30%.[1-3] The severity of inhalation trauma is directly proportional to the area of the burn. Deaths of patients with inhalation injuries alone are estimated to increase by a maximum of 20% and 60%. A meta-analysis of prognostic factors in inhalational trauma patients showed that mortality increased significantly with inhalation injury. Diabetes mellitus can increase the incidence of infection in patients with inhalation burns. In handling inhalational trauma patients' complications that may occur in patients are explained so that patients can cooperate to avoid

complications of inhalation burns.[2,4-6] Subjects with inhalation trauma had a greater risk of dying than subjects with no inhalation trauma. Therefore, an effort is needed to reduce the occurrence of inhalation trauma.[6]

The purpose of this study was to determine the relationship between comorbid factors and mortality rates in patients with inhalation trauma.

METHODS

Collection of samples

The study design that has been used was analytical research method with cross sectional design. The study population was inhalation trauma patients at Dr. Wahidin Sudirohusodo. Sampling was done by consecutive sampling technique, patients who met the inclusion criteria were enrolled in this study until the required number of samples was fulfilled.

The inclusion criteria were patients with inhalation trauma on the face, patients that admitted with inhalation trauma and blood samples were taken for examination, the patient's family was willing to sign the informed consent. Exclusion criteria were patients who were not included in the inclusion criteria. The number of samples is 51 subjects aged between 1-78 years.

Inhalation trauma

Inhalation trauma is the terminology used to explain changes in airway mucosa due to exposure to an irritant and cause clinical manifestations with respiratory distress symptoms, a condition of acute damage to the respiratory tract caused by inhalation of combustion smoke products and hot steam in a closed space.[4]

Signs and symptoms of someone having inhalation trauma

Signs that can direct us to act and suspect that someone has suffered for inhalation trauma include: facial burns, scorched eyebrows and nose hair, the presence of carbon deposits and signs of acute inflammation in the oropharynx, sputum containing charcoal or carbon, wheezing, tightness and hoarseness, a history of confinement in fire, and explosions that cause burn trauma to the head and body.[2,3]

Data analysis

Data management is done manually with computer by using the Statistical Package for the Social Sciences (SPSS) program version 22. Presentation of research results in the form of tables and narratives and using bivariate analysis. If it is meaningful, then it will be followed by multivariate analysis.

Ethical approval for this study was obtained from Research Ethics Committee, Faculty of Medicine, Hasanuddin University, Makassar, Indonesia. Number: 128/UN4.6.5.31/PP36/2019.

RESULTS

This study comprised of 51 subjects aged between 1-78 years, with an average of 33.0 ± 16.2 years obtained by consecutive sampling. The study sample consisted of 26 people (51.0%) suffered for inhalation trauma and 25 people (49.0%) without inhalation trauma. Most subjects did not suffer from DM (96.1%), did not suffer from hypertension (90.2%) and duration of onset <24 hours (88.2%). Mortality was found in 21 subjects (41.2%) and 30 subjects were survived (58.8%) (Table 1).

Table 1: Distribution of subject characteristics (n=51).

Variable		n	%
Inhalation trauma	Yes	26	51,0
	No	25	49,0
DM	Yes	2	3,9
	No	49	96,1
Hypertense	Yes	5	9,8
	No	46	90,2
Onset	<24 hours	45	88,2
	>=24 hours	6	11,8
Output	Dead	21	41,2
	Alive	30	58,8

Based on data analysis, there was a significant relationship between inhalation trauma and mortality rate (p<0.001). The proportion of deaths in inhalation trauma (65.4%) was significantly higher than in nonhaled trauma (16.0%) (Table 2).

Table 2: The Relationship between inhalation trauma and output.

Inhalation trauma		Output		Total	p	RR (95% CI)
		Dead	Alive			
Yes	n	17	9	26	0.000	4,1 (1,60-10,47)
	%	65.4%	34.6%	100.0%		
No	n	4	21	25		
	%	16.0%	84.0%	100.0%		
Total	n	21	30	51		
	%	41.2%	58.8%	100.0%		

RR=Relative Risk CI=Confidence Interval

Analysis of the relationship between mortality from inhalation trauma and onset shows that there is a significant relationship between onset and outcome (p <0.05). The proportion of mortality at onset <24 hours (35.6%) was significantly lower than in onset >=24 hours (83.3%). Based on RR calculations, subjects with onset

<24 hours had a smaller risk of 0.4 times to die than subjects with onset >=24 hours (Table 3).

Table 3: Relationship between onset and output.

Onset		Output		Total	P	RR (95% CI)
		Dead	Alive			
<24 hours	n	16	29	45	0.037	0.4 (0.25-0.73)
	%	35.6%	64.4%	100.0%		
≥24 hours	n	5	1	6		
	%	83.3%	16.7%	100.0%		
Total	n	21	30	51		
	%	41.2%	58.8%	100.0%		

The mean RBG level on the outside mortality higher than the survival outcome, which was 124.4 compared to 114.9 but was not statistically significant (p>0.05). The mean systolic pressure on the mortality outcome was significantly lower than that in the survival outcome, which was 101.2 compared to 114.1 (p <0.05). The mean diastole pressure at the mortality outcome was significantly lower than in the survival outcome, which was 62.2 compared to 71.4 (p<0.05) (Table 4).

Table 4. Comparison of GDS, Systole and Diastole according to output.

Variable	Output	n	Mean	SD	P
GDS	Dead	21	124.4	42.9	0.353
	Alive	30	114.9	30.0	
Systole	Dead	21	101.2	27.0	0.041
	Alive	30	114.1	17.0	
Diastole	Dead	21	62.2	15.7	0.040
	Alive	30	71.4	14.8	

DISCUSSION

Based on the results of the study, there was an association between the onset of more than 24 hours, high RBG levels, and lower blood pressure to mortality. There is a significant relationship between inhalation trauma and the mortality outcome.

The proportion of mortality rate in inhalation trauma (65.4%) was significantly higher than in nonhaled trauma (16.0%). Based on RR calculations, subjects with inhalation trauma had a greater risk of 4.1 deaths than subjects with no inhalation trauma. This is consistent with a meta-analysis of prognostic factors in smoke-induced burns that caused dramatic increase in mortality with trauma (27.6% versus 13.9%).[7] This is in accordance with the theory which states that inhalation trauma occurs directly from epithelial cells, causing a malfunction of the mucociliary apparatus which will stimulate an acute inflammatory reaction that releases macrophages and neutrophil activity in the area. Thus, the released of oxygen radicals, tissue proteases, cytokines, and smooth muscle constructors. This event causes an increase in ischemia in the damaged airways, then oedema of the airway wall and microcirculation failure will increase the resistance of the airway and pulmonary arteries. Pulmonary compliance will decrease due to interstitial pulmonary oedema resulting in oedema of the lower respiratory tract due to obstruction in the airways formed by necrotic, mucous and blood cell epithelial cells.[3,8,9]

Mecott GA, et al in his journal entitled "the Role of Hyperglycemia in Burn Patient" states that the severity of a burn is directly proportional to increased metabolism, inflammation, changes in cardio-immunological function, all of which are related to the occurrence of hyperglycemia. Hyperglycemic is currently associated with increased morbidity and mortality in critically ill patients. The limit of increased blood sugar levels in burn patients is 240 mg/dl in patients with diabetes and more than 200 mg/dl in patients without diabetes mellitus.[10,11]

Analysis of the relationship between mortality from inhalation trauma and onset shows that there is a significant relationship between onset and outcome (p<0.05). The proportion of deaths at onset <24 hours (35.6%) was significantly lower than in onset >=24 hours (83.3%). Based on RR calculations, subjects with onset <24 hours had a smaller risk of 0.4 times to die than subjects with onset >=24 hours. This can be explained based on the theory which states that at 24-48 hours from the onset of inhalation trauma, progressive airway oedema can occur.[4]

Based on the analysis of the relationship of RBG, systolic blood pressure, and diastole to mortality due to inhalation trauma, the mean RBG level on the sudden death higher than its survival rate, which was 124.4 compared to 114.9 but was not statistically significant (p>0.05). This higher increase in RBG results from a mechanism for releasing hormones such as glucagon epinephrine, glucocorticoids, and growth hormone. The release of these hormones causes gluconeogenesis, glycolysis, and lipolysis so that there is an increase in glucose levels in the blood.[10] Both the mean systole and diastole pressures at the death stage showed significantly lower results than the survival outcome, i.e. the mean systole was 101.2 compared to 114.1 (p<0.05) and the mean diastole was 62.2 versus 71.4 (p<0.05). This is caused by the presence of complex cardiovascular changes. A decrease in blood pressure can be caused by hypoxemia which causes decreased myocardial contractility or due to carbon monoxide intoxication.[12]

CONCLUSION

Comorbid factors that have a significant association with mortality in inhalation patients are more than 24 hours onset, high blood sugar levels, and lower systolic and diastolic blood pressure. However, further research is needed with more sample sizes.

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