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Three Years Retrospective Study of Electrical Burns in Dr. Soetomo General Hospital Surabaya



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Abstract— Introduction: Electrical injury is cause of burns that continues to be one of the most distressing trauma injuries in highly industrialized countries. In Indonesia, the number of electrical burns is still underreported. The purpose of this study is to evaluate the profile of electrical burn patients in Department of Plastic Surgery Dr. Soetomo General Hospital Surabaya period of 2014 – 2016. **Methods:** This research was a descriptive observational study by evaluating medical record with the number of samples was 19 electrical burn patients. The variables were etiology, gender, age, history of disease, degree, percentage, type of electrical burns, complications and comorbidities, amputation rate, and Length of Stay (LOS). **Results:** All patients with electrical burns were male with high voltage injuries, 7 (36.8%) patients were 26-35 years old, and respectively 1 (5.3%) patient had a history of pulmonary disease and Type 2 Diabetes Mellitus. Electrical burns with mixed II-III degrees were found in 16 (84.2%) patients, percentage of burn 0-10% in 10 (52.6%), and LOS 11-20 days in 9 (47.4%) patients. There was complication of increasing transaminase serum in 6 (31.6%) patients. The number of patients who were not amputated was 14 (73.7%). **Conclusion:** This study revealed the most frequent electrical burns are encountered in male workers, reflecting the inefficiency of the electric energy system. It can be caused by the fact of the population's low social and economic level.

Keywords— Burn injury, electrical burn, burn incidence

1. Introduction

One of the global health problems is burns, each year's mortality can reach 265,000 people. The majority of cases occur in middle and lower income countries and almost half occur in the Southeast Asian region. [1] Based on the results of Riset Kesehatan Dasar Republik Indonesia 2013 conducted by Departemen Kesehatan Republik Indonesia, the number of national injury prevalences experienced by Indonesian people was 8.2%, and the cause of injury due to burns was 0.7% of total national injury prevalences in Indonesia. [2]

Burns are a common form of trauma. Patients with serious injuries need special treatment quickly and accurately to minimize morbidity and mortality. If burn injuries are categorized as moderate to severe, hospitalization will be required. [3] Burns can occur in both men and women regardless of age, especially children under five years. Most burns occur in households due to hot water, fire, and electricity. In addition,

burns also can be caused by industrial work accidents. [4]

According to statistics from WHO, there are more than 300,000 deaths per year due to fire only. Meanwhile, there are more due to hot liquids (scalds), electricity (electrical burns), and various other sources. However, until now there is still no accurate global quantitative data regarding the case. [5] Approximately 500-1000 deaths per year in the United States are the result of electrical injuries with a mortality rate of 3-5%. In the era of robots and laparoscopes nowadays, various types of electrical equipment can cause accidents. This is several times caused by negligence in assembly construction, but sometimes also due to the development of defective insulation that results in frayed cables resulting in short-circuiting. [6] Although in fact electrical burns are far less than other forms of burns, this type of injury has a high rate of morbidity and mortality, which is one of the most severe injuries. In addition, high costs and long-term hospitalization are needed as well as the need for several surgical procedures. Thus, specific management considerations are important for this type of injury. [7]

In the beginning of the management of severe burn patients, many difficult decisions are faced. One of them is to amputate extremities of the body. With amputation, the morbidity rate can be reduced and increase the survival of burn patients. Winkley et al. compared survival rates in patients with single extremity burns who undergo amputation and not. He stated that 78% of patients who experienced amputation survived, while only 11% survived without amputation. Haberal also reported a series of 65 major amputations in electrical burn patients. The mortality rate reached 20%, there were also some things which could aggravate. For examples like delayed referrals, inadequate decompression, and high incidence of kidney failure. [8]

In 2014 – 2016, the profile of electrical burn patients in Department of Plastic Surgery Dr. Soetomo General Hospital Surabaya had not been studied and analyzed. Therefore, research needs to be done as a strategy for burn care management in the future. The purpose of this study is to evaluate the profile of electrical burn patients in Department of Plastic Surgery Dr. Soetomo General Hospital Surabaya period of 2014 – 2016.

2. Methods

This research was a descriptive observational study. The variables were burn wound etiology, gender, age, history of disease, degree of burn, percentage of burn, type of electrical burns, complications and comorbidities, amputation rate, and LOS. The population was inpatients' medical record data in Burn Center and ROI Dr. Soetomo General Hospital Surabaya in the period of 2014 – 2016 with electrical burn diagnosis and had received approval of ethical clearance from ethics commission of Faculty of Medicine Universitas Airlangga and Dr. Soetomo General Hospital Surabaya. Samples were obtained using consecutive sampling technique based on inclusion criteria that was patient who had complete data according to variables and went to Burn Center and ROI Dr. Soetomo General Hospital Surabaya in 2014 – 2016 with a diagnosis of electrical burns. The data obtained will be analyzed and presented in the form of tables.

3. Result

Table 1. Burn wound etiology distribution in Dr. Soetomo General Hospital

Causes	Year			Total
	2014	2015	2016	
Flame	42 (47.7%)	35 (70%)	46 (60.5%)	123 (57.5%)
Scald	30 (34.1%)	7 (14%)	18 (23.7%)	55 (25.7%)

Electric	15 (17%)	8 (16%)	12 (15.8%)	35 (16.4%)
Chemical	3 (3.4%)	0 (0%)	0 (0%)	3 (1.4%)
Total	88 (100%)	50 (100%)	76 (100%)	214 (100%)

The results of this study revealed that from 214 patients, flame is the most common factor in burn wound, affecting 123 (57.5%) patients, followed by scald 55 (25.7%) patients, electricity 35 (16.4%) patients, and chemical agent 3 (1.4%) patients (Table 1). Based on inclusion criteria, only 19 electrical burn patients were suitable for this study.

Table 2. The characteristics of subjects

Independent Variable	N (%)
Gender	
Male	19 (100%)
Female	0 (0%)
Age	
<5	0 (0%)
5-11	0 (0%)
12-16	1 (5.3%)
17-25	4 (21.1%)
26-35	7 (36.8%)
36-45	2 (10.5%)
46-55	4 (21.1%)
56-65	1 (5.3%)
>65	0 (0%)
History of disease	
Pulmonary disease	1 (5.3%)
Type 2 Diabetes Mellitus	1 (5.3%)
No data	17 (89.5%)

Results revealed 19 electrical burn patients who were treated, all patients were male (100%), the majority of age is 26-35 years old (36.8%), and respectively 1 (5.3%) patient had a history of pulmonary disease and Type 2 Diabetes Mellitus (Table 2).

Table 3. The characteristics of electrical burns

Variable	N (%)
Degree of burn	
II degree only	3 (15.8%)
III degree only	0 (0%)
II-III degree mixture	16 (84.2%)
Percentage of burn	
0-10%	10 (52.6%)
11-20%	7 (36.8%)
21-30%	1 (5.26%)
31-40%	0 (0%)
41-50%	1 (5.26%)
51-60%	0 (0%)
61-70%	0 (0%)

71-80%	0 (0%)
81-90%	0 (0%)
91-100%	0 (0%)
Type of electrical injury	
High voltage injuries	19 (100%)
Low voltage injuries	0 (0%)
Lightning injuries	0 (0%)
Other electrical injuries	0 (0%)
LOS	
<10 days	4 (21.1%)
11-20 days	9 (47.4%)
21-30 days	4 (21.1%)
31-40 days	1 (5.26%)
41-50 days	1 (5.26%)
51-60 days	0 (0%)
>60 days	0 (0%)
Amputation rate	
Amputation	5 (26.3%)
Not amputation	14 (73.7%)
Amputation location	5 (26.3%)
Lower limb	2 (40%)
Upper limb	3 (60%)

Results revealed electrical burns with mixed II-III degrees were found in 16 (84.2%) patients, percentage of burn 0-10% in 10 (52.6%), all patients were high voltage injuries (100%), and Length of Stay (LOS) 11-20 days in 9 (47.4%) patients. The number of patients who were not amputated was 14 (73.7%) with the location of the upper limb as much as 3 (60%) (Table 3).

Table 4. The complications and comorbidities of electrical burns

Variable	N (%)
Complications and comorbidities	
Hypoalbumin	4 (21.1%)
Anemia	2 (10.5%)
Necrotic on the hand	1 (5.26%)
Hematothorax	1 (5.26%)
Bone exposed regio temporoparietal	1 (5.26%)
Thrombocytopenia	1 (5.26%)
Hematemesis melena	1 (5.26%)
Hypokalemia	2 (10.5%)
Compartment syndrome	1 (5.26%)
Pneumothorax	1 (5.26%)
Pulmonary contusions	1 (5.26%)
Complex tibial plateau fractures	1 (5.26%)
Thoracal vertebral fractures	1 (5.26%)
Hypertension	1 (5.26%)
Increase in transaminase serum	6 (31.6%)
Multiple costae fractures	1 (5.26%)

Increase in Creatine-Kinase MB	1 (5.26%)
Suspect inhalation trauma	1 (5.26%)
Segmental fracture of the mandibular symphysis	1 (5.26%)

Results revealed that there was complication of increasing transaminase serum in 6 (31.6%) patients (Table 4).

4. Discussion

The most common cause of burns was flame that was lined with another study in Iran. This discrepancy may be due to the differences in jobs, cultures, and burned population. [9] Trend that occurs on electrical burn patients was male (100%) and the majority of age was 26-35 years old (36.8%). A study in India found similar result. This may happen because of job that is closely related to electricity. Moreover, many people work or try to fulfill their needs at that range of age. [10]

History of disease obtained that respectively 1 (5.3%) patient had a history of pulmonary disease and Type 2 Diabetes Mellitus. The detail of pulmonary disease was not found. Burn patients in general who have history of diabetes are significantly older with lower percentage of TBSA than non-diabetic burn patients. Diabetic burn patients tend to have cardiac comorbidity and hypertension. There are differences between diabetic and non-diabetic patients in terms of infection frequency. Although infection is often caused by various organisms, the main infective agent in burns is *Staphylococcus aureus*. [11] Whereas patients with history of pulmonary disease such as Chronic Obstructive Pulmonary Disease (COPD) who run Long-Term Oxygen Therapy (LTOT) can increase the risk of burns in relation to smoking and contact with fire sources. However, the burn incidence is low with average rate of 61 per 100,000 person-years. [12]

In this research, from 2014 to 2016, the pattern of burn degree was dominated by II-III degree mixture (84.2%). The result is similar with another study in Turkey, stating that the majority of electrical burn patients had II degree. [13] This may happen because Mechanism Of Injury (MOI). [14] Majority of patients had burn percentage of 0-10% (52.6%). This phenomenon doesn't always occur in every medical institution, as another study in Philippines stated that the majority of its patients was >20%. Factors that can cause differences include type of electrical injury. All electrical burn patients were high voltage injuries (100%). It also fits another result from a study in Philippines stating that the majority of electrical burn patients was high voltage injuries, caused by construction work such as electricians. This can be attributed to the lack of training and education regarding safety and proper handling, moreover there is an increase in exposure to potential hazards due to industrialization of the country. High voltage injuries are directly proportional to injury severity, LOS, clinical complications, and amputation. The average LOS for patients to recover was 11-20 days (47.4%). This result fits a study in Philippines stating that the majority of patients needed 14-28 days. The higher proportion of amputations and compartment syndrome is directly proportional to the longer hospitalization. [15]

Electrical burn patients tended not to undergo amputation (73.7%). In addition, they mostly underwent amputation with the location of upper limb (60%). The result is similar with another study in Kosovo. [16] This may happen because usually these accidents occur while working with electronic devices. Therefore, prevention such as wearing gloves and protective clothing is very important. [7]

The most common complications and comorbidities were increase in transaminase serum (31.6%). The result is similar with another study in India, stating that burn patients experienced 23 times increase in *aspartate aminotransferase* (AST) and 21 times increase in *alanine amino transferase* (ALT). Increased edema formation in burn patients can cause cell damage by releasing liver enzymes such as AST and ALT. AST and ALT are the most sensitive indicators for hepatocyte injury, both usually in low concentrations. But due to cellular injury or changes in the permeability of cell membranes, these enzymes leak into the circulation. Compared to AST, ALT is more sensitive and specific test for hepatocyte injury. This enzyme can be predictor of burn prognosis. [17]

5. Conclusion

This study revealed the most frequent electrical burns are encountered in male workers, reflecting the inefficiency of the electric energy system. It can be caused by the fact of the population's low social and economic level.

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