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EPIDEMIOLOGY AND OUTCOME OF ELECTRIC BURN WOUND PATIENT ADMITTED IN A TERTIARY LEVEL HOSPITAL

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ABSTRACT

Background: Electrical injury is the 4th most common cause of burn which continues to be one of the most distressing trauma injuries in developing countries. The epidemiological characteristics of electric burns vary widely throughout the world. Therefore, accurate understanding of the epidemiological characteristics of electric burns is necessary for strategic planning of effective prevention programs and management. Considering the shortage of literatures, the study was designed to evaluate the epidemiology characteristics and outcome of electrical burn injury patients admitted in a tertiary level hospital. **Methods:** This hospital based prospective cross-sectional study was conducted at the department of Burn and Plastic surgery in Khulna Medical College Hospital (KMCH), for six months of period following approval of this protocol. All burn patients will be screened and finally selected in according to the inclusion and exclusion criteria. Written informed consent were taken from the subject and ethical issues were ensured according to Helsinki declaration. In this study, total 90 individual were interviewed. Data were collected by researcher himself focusing sociodemographic profile (e.g. age, sex, etc.), cause and severity of injury, outcome, and hospital stay. Data were registered, documented and analyzed in the statistical program Statistical Package for Social Science (SPSS) version 22.0. The data were systematically described and summarized and presented through descriptive statistics and expressed by graph and chart whichever is relevant. **Results:** Mean age of the study populations was 43.57±16.43 SD (years) [age range 18-80 years] with male predominance (95.6% male vs 4.4% females). Most of them were construction workers (43.3%) followed by electrician (16.7%) and service holder (11.1%). The extent of burn per mean body surface area (BSA) was found to be 19.87±18.3%. The range was 1% to 60%, the median was 16% BSA. Eighty four percent of patients were affected by high voltage electricity (>1000 V) and only sixteen percent were affected by low voltage (<1000 V) power supply and injury were higher in high voltage electricity exposure ($p<0.05$). Superior extremities were more affected with hand (23.3%) and fingers (18.9%) being the main point of contact ($p < 0.0001$). Foot (14.4%) was more affected in inferior extremities, and in 7.8% of patients other regions were involved (head, thorax, abdomen). Of all, 43.33% (39) patients required intervention by either sloughtectomy, fasciotomy, or skin graft. The mean hospital stays were 16.6±12.9 days with a range of one to 55 days. Among the participants (n=90), 21.1% were cured without complications, similar percentage of patients developed scar, 15% patients developed any form of deformity. Moreover, 30% patients referred to ICU and overall mortality rate was 12.2% (n=11). **Conclusion:** Electrical burn was more prominent in male patients which showed variable outcome in our setting.

KEYWORDS: Electric Burn, epidemiology characteristics, fasciotomy, skin graft.

INTRODUCTION

Burns injuries are among the most devastating of all injuries and a public health problem throughout the world. Estimated that about 265,000 deaths occurs due to burn in every year.[1] An electrical burn occurs due to electricity passing through the body causing rapid injury and it is different from other burns because of extensive local destruction of tissue at the points of entrance and exit and internal tissue damage.[2] Electrical injuries are uncommon but potentially devastating and hospital admission approximately 0.04 to 5% in developed countries, and about 27% in developing countries. This Injuries occurs in the adult population primarily affect men, are most often work-related, and are the fourth

leading cause of traumatic work-related death.[3] Electrical injuries is typically divided into low-voltage and high-voltage. The severity of the damage determine by four electrical factor, those are voltage, current, resistance, and frequency. The severity of the burn also depends on the pathway the current takes through the body. Generally, the pathway of the current will follow the course of the least resistant tissues: firstly blood vessels, nerves, and muscle, then skin, tendon, fat, and bone.[4] Electric burn occurs in different mode as like as-conduction of electricity and flash burn. Like other burns, skin involvement of electrical burn patients have 3 degrees of severity, each with distinctive symptoms: First-degree burns involves only outer layer of skin which are red and painful. Second-degree burns which are deeper and more severe. It causes blisters and more significant swelling. Third-degree burns that cause damage to all layers of the skin and it may cause little or no pain because the nerves in the skin are destroyed.[5] Most commonly, electric injuries primarily damage the outer limbs, but more critical portions of the body may be affected as well causing severe complications such as gangrene and the damaged body parts may need to be amputated. Treatment will depend on the individual's response to the electric shock and what injuries were caused. Less severe symptoms may only require observation and time to fade. Some symptoms can linger over long periods of time. Sometimes wounds may require skin grafting, debridement, excision of dead tissue, and repair of damaged organs.[6] Several studied shows neurological complications of electrical injuries involving both cerebral and peripheral symptoms and permanent psychological damage.[7] Usually death occurs in electrical injuries from multiple-organ failure or sudden cardiac arrest and many more are left with lifelong disabilities and disfigurements. However, in electrical burn injuries we can markedly reduced the longterm complication by adequate management and sophisticated operative techniques.[8]

OBJECTIVES

General Objectives

To describe the epidemiology characteristics and outcome of electrical burn injury patients admitted in a tertiary level hospital.

Specific Objectives

- To assess the clinical characteristics of electrical injured patients.
- To evaluate the outcome of the patients.
- To determine the socio-demographic characteristic of the respondent.
- To make a strategy for prevention of burn.

MATERIALS AND METHODS

Study Design: Cross-sectional study.
Place of Study: Department of Burn and Plastic Surgery in Khulna Medical College Hospital.
Study Period: Six months period after approval of protocol.
Study population: Patients with electrical burn admitted in KMCH.
Sampling Method: Purposive convenient sampling.
Sample size: Total 90 study population were included for the study.

Selection criteria

Inclusion criteria

- All age patient
- Both sex
- Patient with history of electrical burn evidenced by clinically
- Willing to give written informed consent.

Exclusion criteria

- Patient having electrocution but have not any significant burn injury.
- Not willing to participate.

Study procedure

Following admission, the patients were resuscitated and stabilized first. Blood grouping, cross matching and relevant investigation were done accordingly. Blood were kept ready in blood bank in case of any eventuality. After describing the aim, objectives, potential hazard and benefits of the study, written informed consent were collected from each patient. Face to face interview was conducted by using a semi-structured questionnaire containing socio-demographic parameters, relevant information about their clinical features, disease duration, type of electrical source, details about contact, time required to reach hospital. Analysis was done SPSS 22.

Data Processing and Analysis

After collection of all the required data, the collected data thoroughly cleaned and entered into MS-Excel spread sheets and analysis was carried out by using the SPSS 22.0 (IBM Inc., Armonk, NY, USA). The procedures involved were transcription, preliminary data inspection, content analysis, and interpretation. Data were presented as the proportion of valid cases for discrete variables and as means ± standard deviations and/or medians for continuous variables and the frequencies of categorical variables were presented as percentage. Chi-square test was used to compare the proportions of categorical variables and student *t*-test to compare the mean of continuous variables. A P value < 0.05 was considered significant.

RESULTS

Ninety patients with various degrees and percentage of affected body surface area with electric burn injury who were admitted in the department of Burn and Plastic surgery in Khulna Medical College Hospital (KMCH), Khulna were included in this study. When they were grouped according to their ages, highest numbers of patients were found to be in 18-30 year-age group (27.8%) followed by 21.1% in 31-40 years group with mean age of f Figure 1 shows the detail.

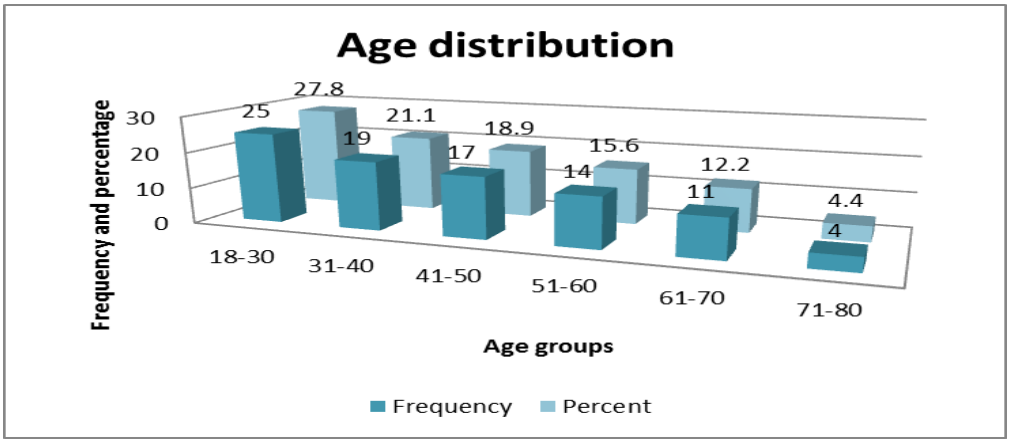

Figure 1: Age distribution of patients (n=90).

This study consisted of 4 females and 86 males giving a female-to-male ratio of 1:21.5. Figure 2 shows a pie chart of the gender distribution.

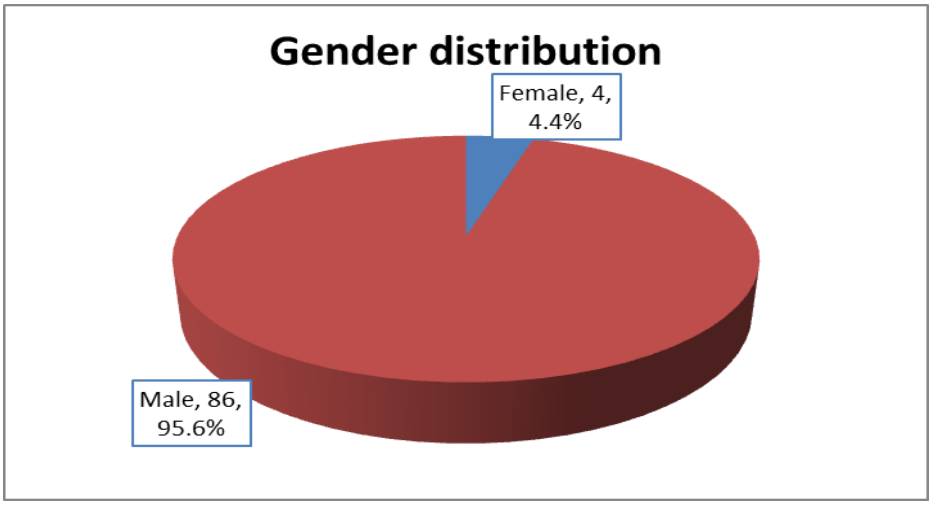

Figure 2: Gender distribution of patients (n=90).

Following bar chart shows that most of our patients were construction workers (43.3%) followed by electrician (16.7%) and service holder (11.1%). Five patients who were categorized in others group were suspected cable thief.

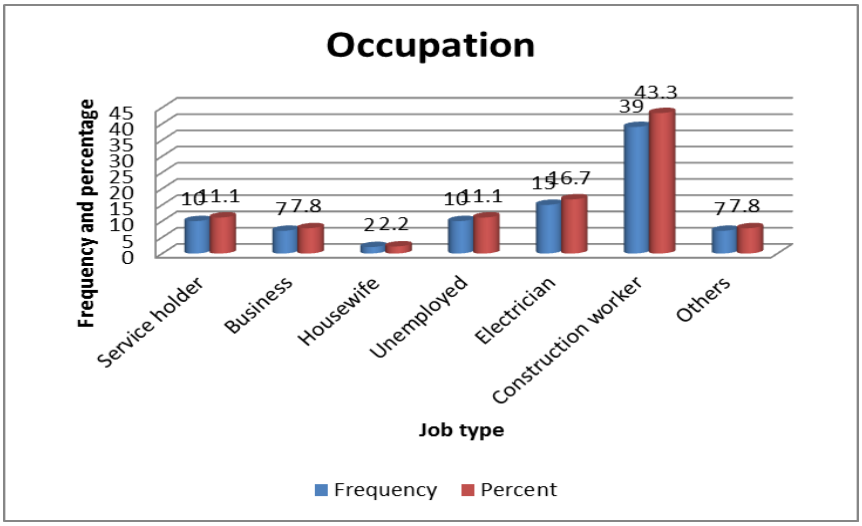

Figure 3: Occupation of patients (n=90).

The extent of burn per mean body surface area (BSA) was found to be 19.87±18.3% (Figure 5.). The range was 1% to 60%, the median was 16% BSA.

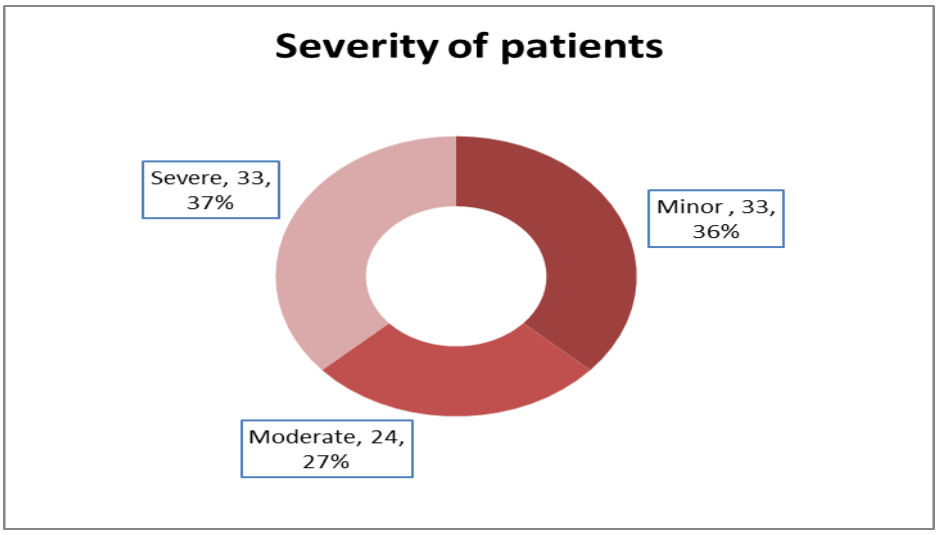

Figure 4: Severity of burn (n=90).

Eighty four percent of patients were affected by high voltage electiricity (>1000 V) and only sixteen percent were affected by low voltage (<1000 V) power supply. The high voltage current was directly related to severity of injuries (p<0.0001). Table 1 shows the details.

Table 1: Relation between electric power and severity of injury (n=90).

Electric power	Minor (0-10% TBSA)	Moderate (11-19% TBSA)	Severe (> 20% TBSA)	p-value
High voltage (n=76, 84%)	19 (25.00%)	24 (31.60%)	33 (43.40%)	28.636, <0.0001
Low voltage (n=14, 16%)	14 (100%)	0	0	

The circumstances of injury were categorized into 6 groups, including the 12 cases whose hospital records were incomplete (see Figure 6.). The vast majority of injuries occurred at work with significant difference with other circumstances while p-value was calculated by one-sample T-test (p<0.0001). Additionally, we found that a significant higher percentage of females than males (100% vs 15.1%, p=0.003) reported home injuries.

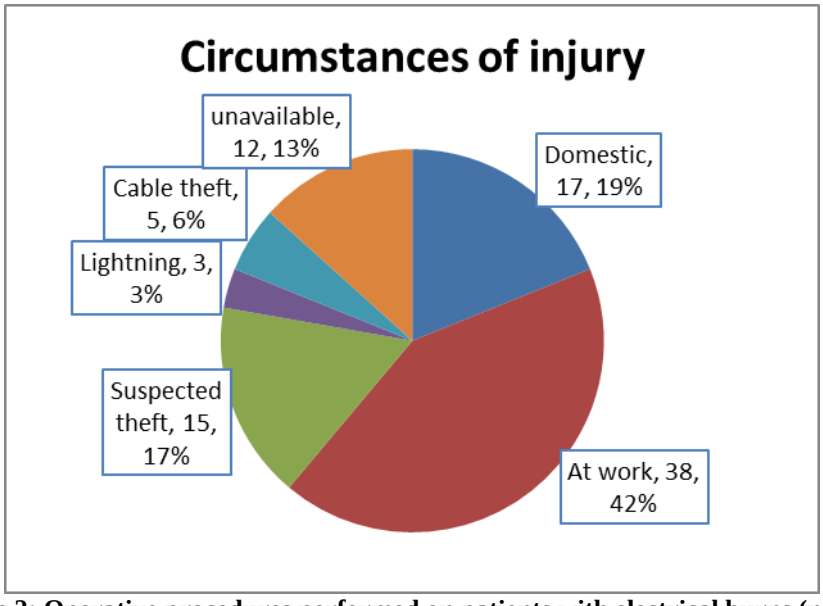

Table 2: Operative procedures performed on patients with electrical burns (n=39).

Type of surgery	Frequency	Percent
Sloughectomy	27	69.2
Fasciotomy	13	33.3
Skin graft	14	35.9
Amputation	11	28.2

While discussing the outcomes of our patients, in table 5, we see that eleven patients (12.22%) had died due to various complications. Nineteen patients (21.1%) survived with permanent scar and another 14 cases (15.6%) sustained deformity of the affected extremities including those who needed amputations.

Table 3: Outcome of the patients (n=90).

Outcomes	Frequency	percentage
Death	11	12.2
Complete cure	19	21.1
Referred to ICU	27	30
Scar	19	21.1
Deformity	14	15.6

Electrical burn patients who did not survive (n=11, 12.22%) had a mean of 31.1 ±5.74% BSA burnt. [range: 22% to 60%]. Four mortality cases (36.36%) had more than 50% BSA burns. Another 3 cases (27.27%) had 30% to 40% BSA burns and the remaining four cases had 22% and 30% BSA burns respectively. The 22% BSA burns case had serial amputations of the upper limbs but died of multi-organ failure. The length of hospital stay of the mortality subgroup was 21.27 ±3.9 days [range: 15 to 26]. Table 6 shows other details.

Table 4: Circumstance of electrical burn injury resulting in mortality (n=11).

Circumstances of injury	Mortalities	percentage
Suspected cable theft	4	36.36
Lightning	2	18.18
Domestic accidents	1	9.1
Unavailable data	4	36.36

Twenty-seven patients were referred to ICU with twenty-one requiring ventilation, dialysis and/or inotropes (Table 6). The mean peak serum creatinine of these ICU patients was 112.3±86.7 mmol/l (range: 56 to 673 mmol/l). Furthermore, a total of 47 units of blood were used in these cases. Table 7 shows further details.

Table 5: Organ support given to patients.

	Frequency	Percent	Mean±SD (days)	Range (days)
Ventilation	12	13.3	8.5±3.4	4-14
Dialysis	21	23.3	12±1.6	9-14
Inotropes	11	12.2	18±3.2	14-23

DISCUSSION

Electrical injury, a certain type of burn, is the most devastating and is the 4th most common cause of admission in burn units worldwide.[9] Burn centers across the globe have been reporting less and less incidence of electrical injuries.[10] This is in part due to findings and recommendations from international studies regarding preventive programs for electrical injuries.[11]

In the present study, ninety patients with various degrees and percentage of affected body surface area with electric burn injury who were admitted in the department of Burn and Plastic surgery in Khulna Medical College Hospital (KMCH), Khulna were included between 18 to 80 years, mean age of whom was 43.57±16.43 years. Highest number of patients were between the age of 18 to 30 years. Similar study conducted very recently in the Department of Emergency Medicine, American University of Beirut Medical Center, Beirut, Lebanon by Gilbert et al.[12] "Epidemiology of burn patients presenting to a tertiary hospital emergency department in Lebanon" in 2018, in the Medical Studies Department, General Direction of Safety and Health, Electricite´ de France, France by Piotrowski et al.[13] "Outcome of occupational electrical injuries among French electric company workers.

With respect to gender, our distribution was male predominant which is similar to the distribution reported in studies from Oman, Brazil and Europe.[14-16] In contrast, several international studies[17,18] showed a female predominandce. This can potentially be explained by women having lower threshold to seek medical care in our Bangladeshi population. Of note, the literature holds conflicting data regarding gender distribution and the reasons behind male or female predominance.[19]

The occupational profile of electrical burn patients admitted in the study is consistent with other studies: adult, male construction workers.[20] This can be attributed to the lack of appropriate training and education with regards to safety and proper handling of electricity plus the increased exposure to potential hazards due to the country's industrialization as reported by Asian Monitor Research Centre in 2012.[21] A 10-year retrospective study in China, which reviewed 383 patients, also revealed similar findings. Their patients were predominantly male (90.3%), and were composed by those injured in work-related incidents (78.3%).[44] In India, 84 patients with electrical injuries were analyzed from 2004 to 2009 to identify the causative and demographic risk factors. The age of patients ranged from 3 to 61 years and males accounted for 84.5%.[22] Work-related activity was responsible for the majority of these high-voltage injuries, with the most common occupations being linemen and electricians. These patients tended to be younger men in the prime of their working lives who are more at risk due to the fact that

their occupation involves more exposure to electric current, high voltages, heavy machinery and equipment. This may also be due to improper equipment, education and/or training. Human error can also be a factor but proper training and education can negate this, as was indicated in other studies.[23,24]

Most patients in our study sustained their injuries at work (42%). This is in keeping with a systematic review of electrical burns admitted in a Philippine Tertiary Hospital Burn Center which reported that 80% of electric burns occurred at work.[9] This has been also echoed by a recent review on the epidemiology on burns in Albania.[18] Additionally, we found that a higher percentage of females than males (100% vs 15.1% p=0.003) reported home injuries in a sub-analysis. This finding correlates with multiple studies nothing that most female victims were housewives and burns were sustained in the kitchen.[12]

In contrast to the available international data, there were no work-related injuries in this study. A possible explanation for this difference is that in Bangladesh, the formal occupational injuries were routinely managed by the private health-care sector. However, a good portion (23%) of suspected and documented cable-theft electrical injuries that were treated in this centre were included in this study. Although this is not conclusive evidence to support the prevalence of cable-theft injuries, this study does, however, suggest that cable theft injury is common in the Bangladeshi setting. This is in agreement with data from Blumenthal's[25] and Padilha's[26] study. Furthermore, Curinga et al, link this type of injury to rising copper prices.[27] It is evident that over the last 5 years the number of electrical burns cases has increased significantly, lending more weight to this argument. Indeed, 36.36% of the deaths reported in this study were suspected to be due to cable-theft, confirming that this is not a trivial injury.

High voltage electrical injury was noted to be a common cause of admission at KMCH which was also directly related to severity of injury and length of hospital stay. Similar to a study in Brazil, where high voltage was directly correlated to severity, clinical complications, and amputation. A higher proportion of amputations and compartment syndrome were noted along with lengthier hospital stays, higher number of patients subjected to flaps as well as a higher incidence of cardiac arrhythmias.[28]

Post injury, the quality of life and work of patient with electrical burns suffer. Most patients have significant difficulty in returning to work. Only 21.1% of patients were able to return to their previous employment and perform the same duties after complete cure, with a mean time off work of 11 weeks, and 36.6% of patients did not return to work at all or took on modified duties with the same employer or worked in an entirely new setting altogether. The return to work characteristics are known to be much worse than reported in general burn literature[29] but similar to Philippine's.[22] It needs approximately 1000 US Dollar per patient per day to provide standard care of electric burn patient in Western World. Clearly It is not possible our country to spend this huge amount of money and resources. So prevention of the burn, based on epidemiology of electric burn, remains the major way of reducing mortality and morbidity. Adequate preventive measures towards high risk population and special working groups should be adopted.

Government programs must be utilized to educate people on safety and proper handling of electricity, where compulsory training should be stressed as the primary weapons to combat and ensuring a safe work environment by strict laws.[30] Workers exposed to electrical current and electrical equipment should be fully trained or certified and wear of personal protective equipment necessary to avoid burns by electricity. To avoid harm from electrical sources, high voltage areas and machinery should be clearly marked. Workers should also make sure to identify live wires, avoid contact with water while working with electricity. Strict laws should be applied to service places, both in Government and private sectors, related to electric works about their workers training, safety and ideal working environment. NGOs can play a major role in preventive measures by showing awareness program of electric burn prevention in projector both in urban and rural areas.

CONCLUSION

In this study, electric burn incidence significantly differs in respect to gender. And it is more common among the persons who deals with electricity as occupation. Overall rate of development of complications were about one thirds and rate of complete cure about 21.1%. However, further larger cohort study is needed to finalize the findings.

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