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Review Paper

Electrical burn injury: An institutional account of 38 patients

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Abstract

Electrical burn refers to burn injuries resulting from electrical voltage or current passing through the body. The current, among other mechanisms of injury causes necrosis at the entry point in the skin and along its path through the muscle, blood vessels, nerves, and bone. Management is multidisciplinary and outcome can be devastating. To evaluate the aetiology and management outcome in patient managed for electrical burns over a 10 period in UBTH, Benin City. This study is a 10 year retrospective study of all patients admitted and managed for electrical burn injury between 2010 and 2019. Data of patients were obtained from our archives; case notes, nurses charts and medical records. These were presented in graphs and charts. 38 patients were admitted and treated for electrical injury. This accounted for 3% of the 1,269 treated for major burns over the 10 year period. Male accounted for 89.5% (34 patients) and females 10.5% (4 patients), with a male to female ratio of approximately 10:1. The mean age was 32.2 years. Thirty patients (78.9%) had injuries from high tension lines. 73.7% of the patients had their injuries outdoor. Six patients (15.8%) had amputations with 5 involving the upper limbs and one had lower limb amputation. Three patients had debridement and subsequent STSG. Two patients had neurological deficit. Mortality was 15.8%. Electrical injury still remains one of the common causes of severe injuries, with high tension injuries accounting for a large number. Linesmen, technicians and workmen are the highest occupation at risk. Management of these patients is multidisciplinary with amputations ranking high in the procedures carried out.

Keywords: Electrical burns, voltage, current amputation, debridement.

Introduction

Electrical burn refers to burn resulting from electrical voltage or current passing through the body[1]. The current travels from the point of contact, through the tissue, and exits to an electrical sink (ground). The current causes necrosis at the entry point in the skin and along its path through the muscle, blood vessels, nerves, and bone. The extent of the injury is proportional to the intensity of voltage, and duration of exposure. This varies from small superficial wound to extensive necrosis of tissues[2]. Virtually every organ of the body can be affected from the point of entry to the exit point. It accounts for 2-5% of burn unit admissions with 15% of these patients having other associated trauma[3,4].

Peak populations are usually male utility workers in their 3rd to 4th decades. Power company linemen and electricians, construction workers, laborers and crane operators are at high risk of electrical injury[5]. Low-voltage injuries are caused by voltage less than 1,000V and high voltage (high tension) injuries are caused by that above 1000V. Low voltage injuries are mostly caused by household current. Injuries sustained ranged from commissure, face and oral injuries by children who bites into the cords to occupational injuries resulting from the use of small power tools, or those who become grounded while touching an object that is electrified[6].

Burn injuries from electrical burn can result from arc burn, flash burn or from the heat generated when electric current pass through the body. Arc injuries occur when an object come into the electrical arc of an electrical source thereby completes the electrical circuit[7]. The temperature of an electrical arc can be as high as 40000C which can ignite resulting in flash burns[7].

When electric current passes through the body, the injuries sustained depends on the type of current, voltage, and tissue resistance[8]. This can result in tissue damage via thermal and non-thermal means (electroporation)[9]. The integrity of the cell membrane is dependent on the sodium-potassium-ATPase pump operating at −90 millivolts direct current. High voltage and alternating current disrupt this pump resulting in pores in the cell membrane (electroporation of cellular membranes)[9,10].

Management of electrical burn injury is multidisciplinary involving various specialties: plastic surgeons, trauma surgeon, anesthetists, orthopedic surgeons, nurses, physiotherapist, and occupational therapist. Outcome can be devastating[11]. This study is aimed at evaluating the aetiology and treatment outcome in patients managed for electrical burns in University

of Benin Teaching Hospital. This will contribute immensely to the knowledge of the treatment of electrical injuries as well as the possible preventive measures that can be beneficial.

Objective: The objective of this study is to evaluate the aetiology and management outcome in patient managed for electrical burns over a 10 year period in UBTH, Benin City.

Materials and methods

This is a 10 year retrospective study of all patients admitted and managed for electrical burn injury between 2010 and 2019. It involved a review of 38 patients treated within this period. Data of patients were obtained from our archives; case notes, nurses charts and medical records. These were presented in graphs and charts.

Results and discussion

Males accounted for 89.5% (34 patients) and females 10.5% (4 patients), with a male to female ratio of approximately 10:1 (Figure-1). Patients 38 patients were admitted and treated for electrical injury. This accounted for 3% of the 1,269 treated for major burns over the 10 year period. Patients between the ages of 20 to 40 years accounted for the highest number of burns (23 patients) as shown in Figure-3 children of age 2 years and 4 years had injuries from poorly insulated household appliances. The mean age was 32.2 years.

30 patients had injuries from high tension lines as source of injury which amounted to 78.9% (Figure-2), one of these occurred from faulty industrial appliance. 73.7% of the patients had their injuries outdoor. Two work men had burns while building under high tension lines, with the steel rods contacting the power lines. Six patients were lines men with the distribution companies, while one the patient low tension injury while working on an electrified roof of a store without switching off the connection. One patient was a gardener who was clearing around a step down transformer that was powered and had electrical burns. Four patients had high tension burns when a high tension wire fell on the roof of their houses.

The burn sizes ranged from 0.5% body surface area burn to 44%, with a mean burn size of 17.3%. The patients with burn size of 10% or less accounted for the highest figure 15(39.5%) as shown in Figure-4.

Seven patients had amputations (15.8%) with 5 involving the upper limbs and the lower limb two. Three patients had debridement and subsequent STSG. Two patients had neurological deficit, one of which had paraparesis which resolved after 23 day. The second had delayed (5days after injury) neurological deficit with loss of sensation distal to T 10. Patient recovered with incomplete power of 4/5 on the lower limbs and ambulates on support. One patient had penile burns (figure 5). Mortality was 15.8%.

Discussion: Electrical burns represent devastating injuries which accounted for 3% of burns injury managed in our centre. This was higher than that from a 5 year study in Enugu in which electrical injuries accounted for 1.4% of all burns[12]. While the study done in Irrua, Edo State Nigeria was slightly higher accounting for 7% of burns patient managed over a 5year period[13]. This figure from this series is lower than that of studies from the United States which ranged from 4% to 5% of burns injury[14]. The lower value in our setting may not be unconnected with decline in power supply over the period of study. This figure may rise with restoration of constant supply.

Male between the ages of 18 to 40 year are more at risk of electrical injury15. This represents the youthful and active age group. Patients between the age of 21-30 and 31 to 40 years accounted for 34.2% and 26.3% respectively of the total patients treated for electrical injury (Figure-3). This corroborated the study done in Kosovo, and Midwestern Nigeria, where the highest number of patients with electrical burn ranged from 20-39 years[15,16].

The occupations with high risk of electrical injury are from this study were workmen, linesmen and technicians. This findings are in keeping with previous works done which placed these categories of persons at high risk[5,17]. Non adherence to safety precautions and rules, faulty electrical lines and appliances are some of the aetiological factor in our environment that further put them at risk. Also, lack of proper maintenance of electrical lines and non-adherence to set-back on buildings could be responsible for the fall of electrical lines on houses and workmen injuries while working under such lines.

High tension injuries resulted in more extensive injuries when compared to low voltage injuries which was comparable to other documented findings[6,11]. More so, high tension injuries accounted for 78.9% of patient treated in our setting. This is higher than that recorded from centres outside our clime[17]. This may be due to poor maintenance of facilities for transmission of electricity with fallen cables and poles not attended to. The commonest surgical procedure done in patients with electrical burn injury is amputation[18,19]. This is comparable to this study in which 15.8% (6 patients) had amputations with 5 involving the upper limbs.

Three had debridement and subsequent skin grating. The rest had partial thickness burns wounds that re-epithelised following wound dressing. Mortality was 15.8%. This excluded fatalities at sites of trauma and patients brought in dead. The mortality figure is comparable to studies done by Jiburum and Olaitan, but higher than that from studies done by Srivastava et al in India which had a figure of 10.5%[12,20]. The higher mortality rate may not be unconnected with poor maintenance of high tension lines and lack of pre-hospital emergency services to offer pre-hospital care.

Conclusion

Electrical injury still remains one of the common causes of severe injuries, with high tension injuries accounting for a large number. Poor maintenance and lack of appropriate regulations of construction works under high tension lines are some of the causes. Linesmen, technicians and workmen are the highest occupation at risk. Management of these patients is multidisciplinary with amputations ranking highest in the procedures done.

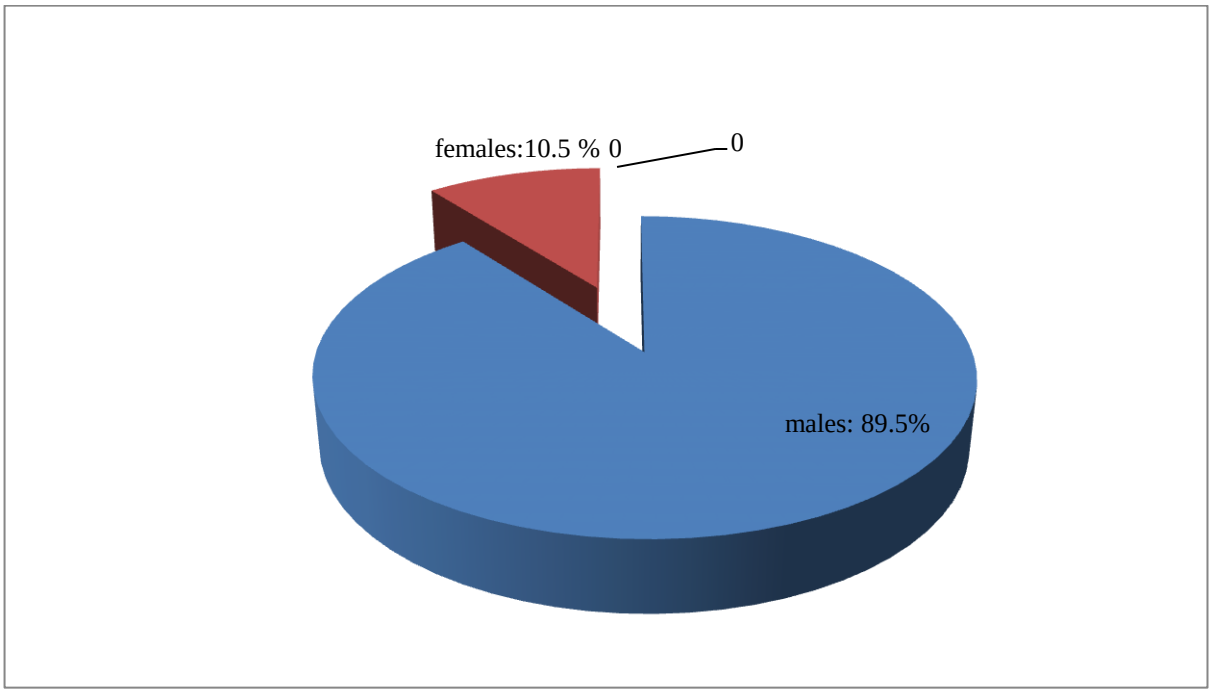

Figure-1: Sex distribution.

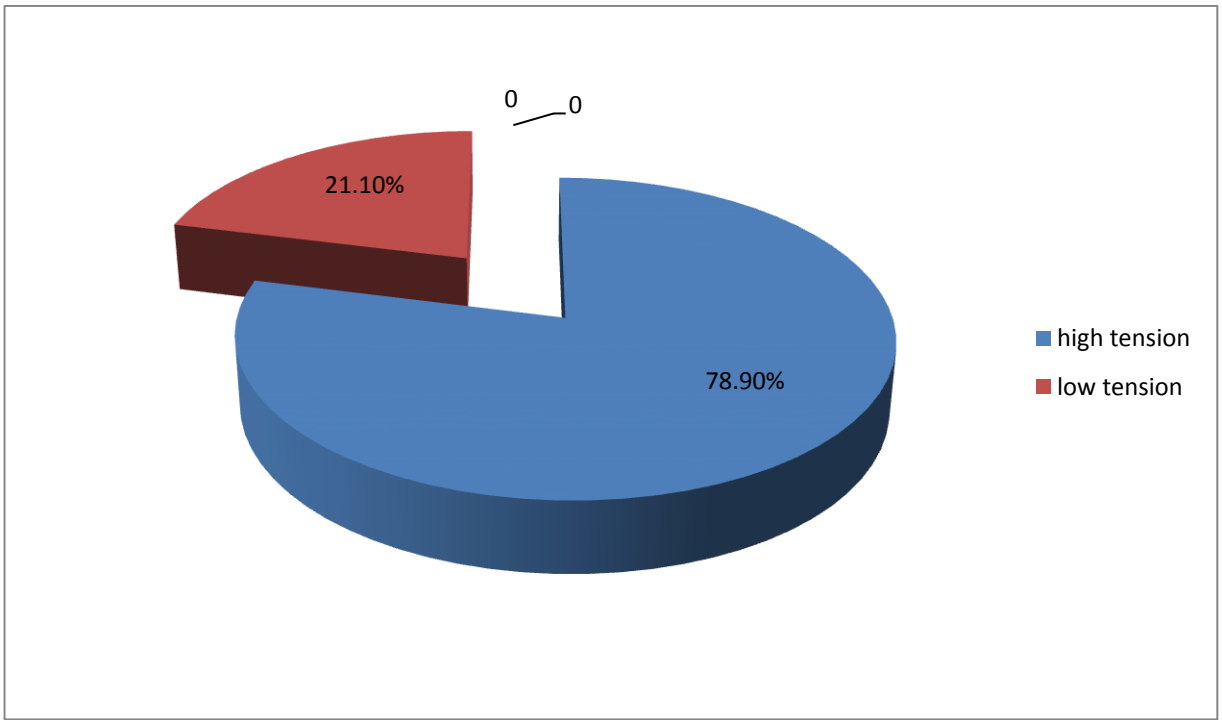

Figure-2: Aetiology.

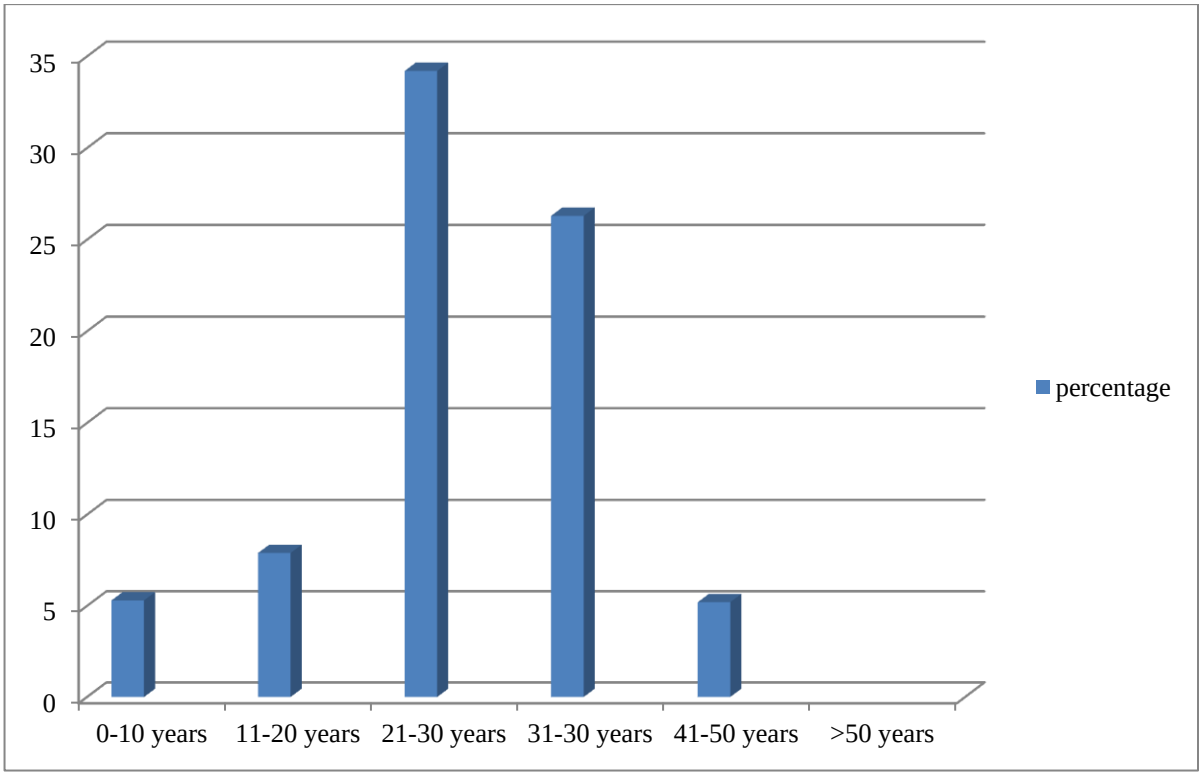

Figure-3: Age Distribution of patients.

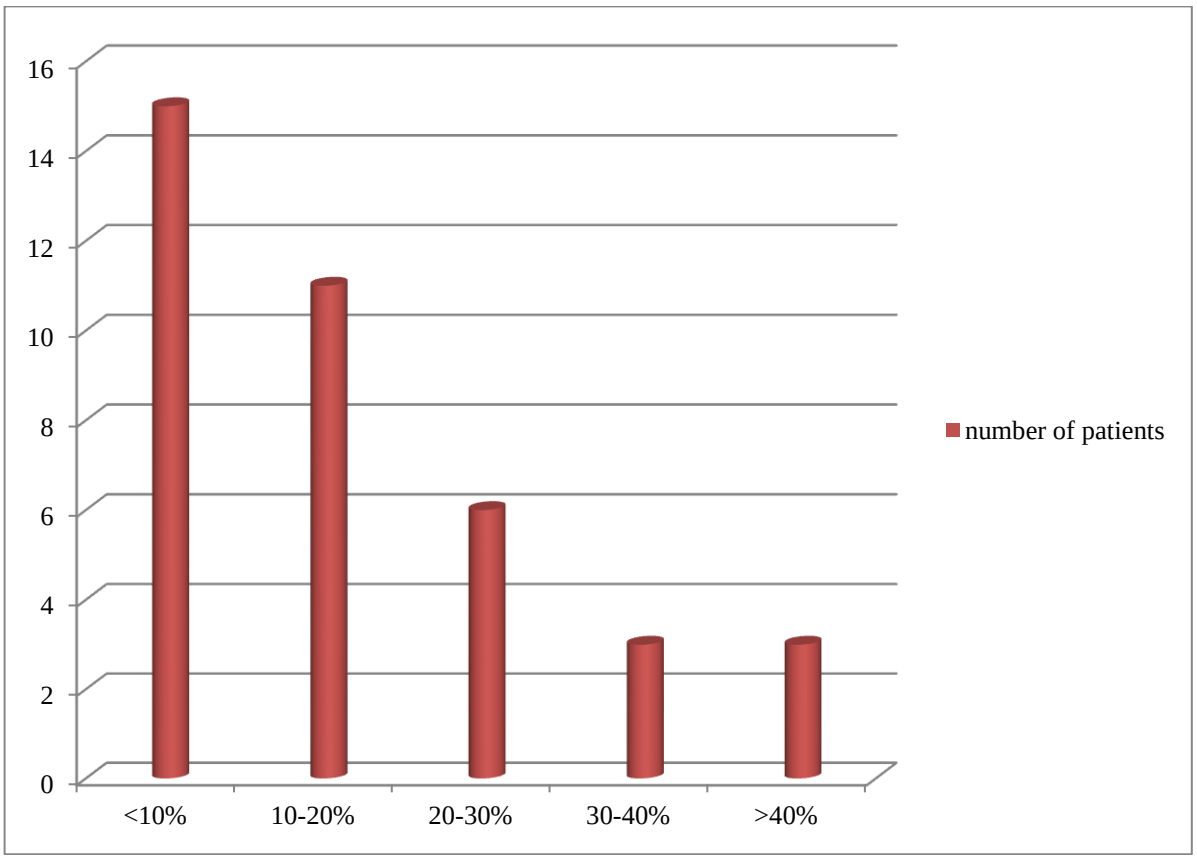

Figure-4: Body surface area burn.

Figure-5: An iron bender with full thickness burns to the thighs and penis following construction under high tension line.

Figure-6: A linesman with the distribution company, who had high tension injury. Had amputation of the right upper and lower limbs.

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