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HIGH VOLTAGE ELECTRICAL INJURIES IN THE UNIVERSITY OF CALABAR TEACHING HOSPITAL.

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ABSTRACT
Background: Burn injuries are a common presentation in Nigerian hospitals and result from a variety of causes. Recently, many have resulted from Petroleum related fire incidents. High voltage electrical injuries are relatively rare; lightning strikes even rarer. In traditional societies where Traditional medicine practitioners are usually the first to be contacted and where late presentation to hospitals is the rule, complications such as the wet gangrene necessitating amputation are common. Even when patients present relatively early and are resuscitated and treated, complete prosthetic rehabilitation is difficult because of poverty and lack of social support systems.

Case Report: This review presents three cases of high voltage electrical burns resulting from typical 11KVA burns as well as lightning strike. It also highlights the role of prompt presentation in a health facility with appropriate resuscitation in determining good treatment outcomes.

Key Words: High Voltage Electrical Burns, Presentations, Superstition, Outcomes. (*Accepted 27 February 2007)*

CASE REPORTS

Case 1

A 30 - year - old Nigerian woman presented in the University of Calabar Teaching Hospital as a referral from a Comprehensive Health Care with a 3 day history of electrical burn injury. She was asleep on the floor near a table fan when a high tension 11KVA and low tension cables fell on the roof of their dwelling during a storm. She woke up and noticed burn injuries involving parts of the right side of her face, arm and abdomen. Her husband was electrocuted and adjoining homes burnt in the incident. She was immediately rushed to the Comprehensive Health Centre where she was resuscitated.

Examination revealed an anxious female, afebrile, not dehydrated with oedema of both eyelids and purulent discharge from the eyes. She had infected 10% partial thickness burns involving the right side of the face, neck, right arm and abdomen. There were no fractures. A diagnosis of infected partial thickness electrical burns was made. She had been treated with intravenous fluids, tetanus toxoid, and antibiotics prior to referral from the Health Centre. A wound swab yielded growth of Staph aureus. She was treated by wound dressing with Honey, antibiotics and chloramphenicol eyedrops. Wound healing progressed satisfactorily and she was discharged to outpatient care after three weeks of hospitalization to continue wound dressing with Honey.

During the first outpatient visit six weeks post injury, the wounds were completely healed. She however had to be referred to a Psychiatrist for depressive symptoms probably due to the loss of her husband. She recovered satisfactorily and was eventually lost to follow-up.

Case 2

A 22 - year - old Nigerian woman presented to our hospital with a 2-month history of pain and inability to use both upper limbs. She had suffered a lightning strike and sustained burns to the face, neck, trunk and upper limbs; and had been taken to a traditional/Spiritual healer because of the superstitious belief she had been attacked by evil forces.

On examination, she was in very poor general condition, markedly anaemic and toxic. Both upper limbs had extensive gangrene extending to the elbows. A clear zone of demarcation between viable and necrotic tissue existed at the elbows. She was resuscitated with fluids, antibiotics and blood transfusion and offered bilateral above-elbow amputations after due counseling. Patient refused amputation and discharged herself from hospital against medial advice. She was not seen again, did not report to any other health facility in the locality

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and subsequently died from complications of sepsis as reported by relatives.

Case 3

A 35 year old electrical utility staff presented 2 hours after a burn injury while carrying out maintenance on high tension (11KVA) cables. He had been on a ladder and fastened to the high tension pole when the accident occurred. Electricity was immediately turned off by alert co-workers who brought him down from the ladder.

Examination showed an anxious, conscious man with stable vital signs. He had 12% full thickness electrical burn injuries of both upper limbs extending from the hands to the lower third of both arms. He also had flash injuries of both axillae. Patient also had myoglobinuria which cleared 4 hours post injury, and had developed bilateral upper limb compartment syndrome which did not improve with fasciotomies. He was resuscitated with intravenous fluids, antibiotics and antitetanus prophylaxis, analgesics and anxiolytics. A urinary output of 50ml/hour was achieved during resuscitation.

A final diagnosis of bilateral upper limb gangrene post high tension electrical burn injury was made. Patient was counseled and offered bilateral above-elbow amputation. He tolerated the procedures well. The post-operative course was complicated by wound sepsis which was treated by swabs Microscopy, Culture and Sensitivity, and appropriate antibiotics. Patient's wounds eventually healed and he was discharged home with a referral for bilateral upper limb prosthetic fitting. He never had the prosthesis because he could not afford one and his employers refused to pay for one.

Figure 1: **Extensive Burns of both Upper Limbs with compartment syndrome and Gangrene.**

Figure 2: **Extensive Burns to both Upper Limbs with gangrene.**

Figure 3**: Hands of Electricity Worker showing entry points.**

DISCUSSION

Electrical shock causes devastating injuries[9] and outright electrocution is a possibility. Heating of tissues and electroporation caused by high intensity electrical fields are the main causes of tissue injury in electrical burns. High voltage electrical burns occur when individuals are exposed to voltages of 1000 Volts or higher. Amputation is frequently required after high voltage electrical injuries because damage to smaller vessels which dissipate heat much less than larger blood vessels and can also develop blood clots more easily.[7, 10] Compartment syndrome can occur following high voltage electrical injuries with consequent gangrene of the extremities (Fig. 1). Tissues with high resistance suffer more severe injuries than those with low resistance to electrical current. [7]

Electrical current produces different types of injuries including myonecrosis, neurovascular damage, cardiac arrythmias and arrest; and lung injuries. Injuries can also result from arcing which ignites clothing and causes flame burns. Flash burns can also occur (Fig 2) from the power source or ignition of clothing or surrounding flammable structures. Traumatic injuries like fractures of the humeral shaft[8] and posterior dislocation of the shoulder result from intense muscle spasm or a fall following electric shock.

Lightning describes "the phenomenon in which the voltage difference between clouds and other objects reaches such a level that dielectric breakdown ("arcing") occurs"[4]. In air, these voltages exceed 2 million volts per minute.[4] Lightning causes injury by one of five mechanisms: direct strike, contact, side flash (flash burns), ground current and weak upward streamer.[1,3] Injuries caused by lightning depend upon the type of energy imparted to the body: mechanical, electrical or thermal. Temperatures associated with lightning injury are extremely high and the burns sustained usually superficial because of the short duration of the strike (10 100ms) and quick dissipation of heat.[4]

The principles of management involve the following: stop the burning, turn off the current where applicable, neutralize heat source and remove smoldering clothing, resuscitation, examination and assessment for other traumatic injuries; and definitive treatment. Early presentation and judicious intervention improve outcome. [1] Our three patients presented in different ways. Cases 1 and 3 presented early, Case 2 presented late and with severe complications because of superstition. In many traditional societies, the traditional healer plays a prominent role in the lives of individuals. Traditional medical practices however have high complication rates. When trained in modern medical practices, traditional healers may be useful. [2] Such training should include an identification of what they cannot treat, early referral and a downplay on superstitions.

In many developing nations, primary and secondary healthcare centres are not fully developed. Case 1 demonstrates the usefulness of a developed secondary health facility. Prompt resuscitation and early stabilization contributed to a good outcome when compared to case 2 who opted for traditional medical care early in the injury. Certain professions carry high risk for injury. Protective mechanisms are thus instituted for the safety of the individual. In many poor societies, these protective mechanisms are spurned by employers. The patient in case 2, was a casual worker with an electricity utility company. There was no history of the use of protective gloves and footwear while at work maintaining an 11KVA cable when power was suddenly restored. His hands were the points of entry (Fig. 3).

In our centre, there is no dedicated burns facility. Early burn debridement and occlusive dressing followed by split autogenous skin grafting when indicated is the method of management. Tangential burn excision is not done and for burns involving a large surface area, cadaveric allograft skin is not available for temporary cover. Often, in many of these poor patients, adequate quantities of appropriate fluids cannot be provided in the phase of resuscitation. Appropriate antibiotics may also be unaffordable. A social support system to help with provision of fluids, antibiotics and other necessary needs is essential for improved outcome. Dedicated burns units within our tertiary institutions will pool personnel, resources and patients and ultimately lead to improved quality of care. Storage systems for cadaveric allograft skin need to be developed to help achieve early adequate skin cover and reduce the risk of infection.

Amputation is frequently required for high voltage electrical injuries. This form of treatment is frequently refused in many African Societies because of stigmatization and taboos associated with the procedure. Poor prosthetic technology also contributes to refusal of amputation. [6] This is demonstrated in Case 2 where the patient opted for discharge against medical advice rather than accept amputation. In instances where the procedure is accepted, a return to functional re-integration is inhibited by lack of finances for appropriate prosthesis. In Case 3, the patient's employers refused to bear the cost of prosthetic replacement.

CONCLUSION

High voltage electrical burns are relatively rare incidents which cause severe injuries. Damage to small blood vessels often necessitates amputation. In societies where superstitions are rife, late presentations are the rule and this may affect optimum outcome. Prevention remains a major step in the management of these injuries. Governments need to strengthen the secondary healthcare system in developing countries where appropriate resuscitation can take place. There is the need for improvement in prosthetic technology and rehabilitation to make limp ablation easily acceptable when indicated. Poverty eradication and efficient social support systems will provide adequate resuscitation, appropriate prosthetic fitting and social reintegration.

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