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Epidemiology and acute management of high tension electrical burns in a rural-based medical college

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Abstract

Introduction. Electrical burns are one of the most common causes of burns besides flame burns and scalds. High tension electrical burnslead to greater morbidity and mortality. Active management strategies are required to manage high tension electrical burns. Common epidemiological features and surgical management of wounds are described. Role of highligation in high tension electrical burns has been described.
Purpose. To describe the epidemiology, main features of the presentation and acute management of high tension electrical burns.
Materials and methods. This study was done for the duration of 2 months. All patients who were admitted with high tension electrical burns were included in the study. Patients' demographics, mode of injury, % age of burn areas involved, entry-exit wounds were recorded on the day of admission. Emergency fasciotomy was done in cases of impending gangrenous changes inlimbs to prevent compartment syndrome and peripheral neuropathy. Reconstructive surgeries were done depending on thelocation and depth of burns.
Results. 64% patients were below 30 years. The majority of the patients who sustained electric burns were males (82.3%). All the patients were from low and middle socioeconomic status according to the modified kuppuswamy scale. The majority of patients sustained electric contact burns (55.8%). The majority of the patients were unskilled workers working in the fields (94.2%). Surgical treatment of all patients includes fasciotomies in 15 patients, debridement/ amputation in 32 patients, reconstructive surgeries in 42 patients.
Conclusion. High tension electrical burns are one of the most common causes of burns, especially in rural areas. Public awareness and compliance with safety standards as well as respect for the potentially deleterious effects of electricity are of utmost essential for avoiding these deadly injuries.

Keywords: electrical burns, high tension burns, management, highligation, sulfadiazine

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Эпидемиология и оказание неотложной помощи при ожогах электрическим током высокого напряжения в сельском медицинском колледже

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Резюме

Введение. Одной из наиболее частых причин ожогов, помимо воздействия пламени, а также горячей жидкости и пара, является действие электрического тока. Ожоги электрическим током высокого напряжения приводят к большей заболеваемости и смертности. Для лечения ожогов электрическим током высокого напряжения необходимо наличие стратегий оказания неотложной медицинской помощи. В статье описаны общие эпидемиологические особенности оказания помощи, а также хирургическое лечение ран. Показано важное значение наложения высокой лигатуры при ожогах электрическим током высокого напряжения.
Цель. Представить эпидемиологию, основные характеристики проявления ожогов электрическим током высокого напряжения и оказание неотложной помощи.
Материалы и методы. Данное исследование проводилось в течение двух месяцев. В исследование были включены все пациенты, поступившие с ожогами электрическим током высокого напряжения. Демографические данные пациентов, механизм травм, процент

ожоговых поражений, наличие входных и выходных ран отражены на день поступления. В целях профилактики синдрома сдавливания и периферической невропатии при угрозе развития гангрены конечностей была выполнена экстренная фасциотомия. Реконструктивные операции выполняли в зависимости от локализации и глубины ожогов.

Результаты. Доля пациентов моложе 30 лет достигала 64%. Среди пациентов, получивших электроожоги, преобладали мужчины (82,3%). Все пациенты принадлежали к низшему и среднему социально-экономическому классу по модифицированной шкале Куппусвами. Большинство пациентов получили электроконтактные ожоги (55,8%). Большая часть пациентов были заняты неквалифицированным трудом, работая в поле (94,2%). Хирургическое лечение включало фасциотомию у 15 пациентов, некрэктомию/ампутацию у 32 пациентов, реконструктивные операции у 42 пациентов.

Выводы. Одной из наиболее частых причин ожогов, особенно в сельской местности, являются ожоги электрическим током высокого напряжения. Разъяснительные мероприятия и соблюдение правил безопасности, а также предупреждение о потенциально опасном воздействии электрического тока крайне важны для избежания смертельных травм.

Ключевые слова: электрические ожоги, ожоги электрическим током высокого напряжения, лечение, высокая лигатура, сульфадиазин

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INTRODUCTION

Electrical burns are one of the common causes of burns besides scalds and flame burns. Factors contributing to higher incidence include misuse of electricity, compromised safety standards, and lack of public awareness [1]. Despite major improvement in our understanding of pathophysiology and management strategies of electrical burns, electrical burns stilllead to significant socioeconomic, functional and aesthetic problems [2–4].

Electrical burns may be due to low tension (<1000 V) or high tension (>1000 V) burns. In general, exposure to higher voltage leads to higher morbidity and mortality. Exposure to high-voltage electrical current, in particular, can result in death due to cardiac arrhythmias and respiratory muscle paralysis. These are very severe injuries, amplified by progressive tissue necrosis [5–8].

Purpose and objectives. High tension electrical burn injuries are uncommon in the developed world so there are not many studies on high tension electrical burns. So purpose of this study is to describe the epidemiology, main features of the presentation and acute management of high tension electrical burns.

MATERIALS AND METHODS

This prospective study was done in our department for the duration of 2 months. All patients who were admitted with high tension electrical burns were included in the study. The patients wholeft against medical advice were excluded from the study. Informed consent was obtained from all the patients included in the study. All patients who sustained high tension electric burns admitted through emergency and OPD were included in the study. Patients' demographics, mode of injury, % age of burn areas involved, entry-exit wounds were recorded on the day of admission.

Initial evaluation of the high tension electrical burn patient begins with airway, breathing and circulatory assessment of standard trauma care. Once the patient is stabilised, a detailed history and examination are carried out. History ofloss of consciousness, fall, seizures are important to rule out associated injuries. It is critical to perform a neurovascular examination of the limbs. ECG and serum electrolytes are done to rule out cardiac arrhythmias.

The treatment starts with aggressive fluid resuscitation to maintain the urine output of more than 1.5 ml/kg/hr. Mannitol was given with the dose of 100 ml/hr thrice a day. Emergency fasciotomy was done in cases of impending gangrenous changes in limbs to prevent compartment syndrome and peripheral neuropathy. Splintage and elevation were done for limbs to decrease oedema formation and pain. The dressing was done using silver sulfadiazine ointment. Debridement/ amputation was done after demarcation of injured tissue, usually at 5-7 days of burn trauma. High ligation of the artery was done before proceeding for amputation to decrease blood loss during surgery. Reconstructive surgeries were done depending on the location and depth of burns. Final outcome was decided based on hospital stay and mortality rate.

OBSERVATIONS AND RESULTS

34 patients with high tension electrical burns were included in the study over the 2 years. The average age of the patients was 26.24 years. The majority of the patients were below 30 years (64%). The majority of the patients who sustained electric burns were males (82.3%). All the patients were from low and middle socioeconomic status according to the modified kuppuswamy scale. The majority of patients sustained electric contact burns (55.8%). The majority of the patients were unskilled

Table 1. Baseline characteristics of the patients
Таблица 1. Исходные характеристики пациентов

Characteristics	Numbers (n =34)
Age (in years)	26.24
Gender	Men (82.3 %), female (17.7 %)
Socioeconomic status	Low (55.8%), middle (44.8 %)
Occupation	Unskilled (94.2 %), skilled (5.8%)
Type of burns	Contact (55.8%), flash (29.4%), flame (14.8%)
Average % TBSA involved	19.2%
Entry Wound	Left hand (50%), right hand (38.2%), scalp (11.8 %)

Table 2. Surgical management of patients
Таблица 2. Хирургическое лечение пациентов

Type of procedure (Number)	Fasciotomy (15), debridement/amputation (32), reconstructive surgery (42)
No. of procedures (no. of patients)	One (6), two (9), three (12) four (8)
Type of flap	Locoregional flap (6), Distant flap (11)
Complications	Locoergional flaps -3, Distant flaps -4
Mean hospital stay	39 days
Mortality rate	11.7 %

workers working in the fields (94.2%). Only 2 patients were skilled electricity department employees (*Table 1*).

The average percentage of TBSA involved was 19.2%. The left hand was the commonest entry wound site (50% cases) followed by the right hand in 13 patients (38.2 %). 5 patients had bilateral hand involvement. 5 patients had scalp as entry wounds (*Table 1*).

Surgical treatment of all patients includes fasciotomies in 15 patients, debridement/ amputation in 32 patients, reconstructive surgeries in 42 patients. Most of the patients required serial debridements and staged reconstructive procedures. Total 17 flap reconstructive surgeries were performed in these 34 patients. In 5 cases, wound coverage by locoregional flap was done. 12 cases required distant flaps to cover deep burns wounds with tendons and bone exposed over the distal leg. Among locoregional flaps, 3 cases had complications in 6 patients and distant flaps, 4 complications in 11 cases. 12 patients needed 3 procedures, and 8 patients needed even 4 procedures for acute management of high tension electrical burn wounds (*Table 2*). 4 patients died during the course of the study.

DISCUSSION

High tension electrical burns are one of the most devastating injuries. It is important to understand that the outside appearance of high tension electrical burns does not accurately predict the true extent of the injury. These injuries demand the highest level of medical care for the successful survival and rehabilitation of patients. Surviving patients have to go through multiple surgeries and psychological trauma. These injuries are more common in younger age groups. In our study, the average age of the patients was 26.24 years. Majority of the patients' age was below 30 years. The majority of the patients who sustained high tension electric burns were males. A similar study was done by Kur Alper et al. in which the age and gender profile of patients were similar [9]. Our results are comparable to a few others' studies also [10–12]. This may be due to the higher handling of men to electrical appliances and their professional work in the fields, factories, and buildings. It also shows that the individuals affected more often are invariably the breadwinners of the family, thus affecting their entire family.

The majority of patients were from low and middle socioeconomic status according to the modified kuppuswamy scale. However no study has recorded the socio-economic status of patients, but results reflect the decreased awareness of the dangers and consequences of electrical burns in these populations.

The majority of the patients were unskilled workers working in the fields. Only 2 patients were skilled electricity department employees. Unskilled labourers repairing the fuse at the transformer was a common cause of high tension electrical burns. Lack of public awareness and unemployment are the major causes of these injuries. Preventive measures include public awareness and involvement of government administration for the same by various means. The second most common cause was found to be children handling live wires accidentally at the roofs. Again, this is a preventable cause of electrical burns. The most common entry wound site was the left hand, followed by the right hand and scalp. Other sites of entry wound included shoulder, neck, and nose. S.Y. Haddad et al. [2] also conducted a similar study and found that most electrical injuries occur in males at work or in children handling exposed electrical lines. The majority of patients had involvement of the left upper limb (58.3%).

Various means to decrease the incidence of high tension electrical burn include standardization and proper use of electrical devices, using "DANGER" labels on highly dangerous electrical instruments, awareness regarding avoiding the use of unskilled labourers to repair electrical problems in fields, taking extra care of children and

settlement of continuous educational programs for workers and electrician, and explaining to them preventive measures to them would be beneficial in decreasing the incidence of high tension electrical burns.

Surgical treatment of all patients includes fasciotomies i.e. 15 patients, debridement to 20 patients, amputation to 12 patients, STSG, and flap surgeries to 42 patients. Many patients underwent staged reconstruction using flap/grafts. A.B.D. Al-Aziz, H.A. Ahmad et al. [13] also conducted a similar study and performed similar surgical procedures. Most of the patients with high tension electrical burns needed serial debridements owing to the progressive necrosis of wounds. For similar reasons, highligation of vessels was required to decrease the chances of a blowout of vessels. In our study, 3 cases had gangrenous changes till the shoulder joint. Shoulder disarticulation was performed after performing the high ligation of the axillary artery through a separate incision in the infraclavicular region. This incision involves thelateral third of the clavicle [14].

Most of the patients had necrosis of skin and soft tissue with exposed tendons/ nerves; for which flap reconstructive surgeries were performed so that option of tendon/nerve reconstruction was available atlater stages.

Regarding complications, these were comparatively more in cases oflocoregional flaps as compared to distant flaps. We believe that it is due tolocal damage to vessels and other tissue done by high tension electrical current.

The mean hospital stay of patients in our study was 39 days ranging from 16 to 76 days. In a study published by G. Zijak, the mean hospital stay was 58 ± 24 days [15]. Similar results were noted by K. Kowalske in his study in the year 2009 [16]. The overall mortality rate from high tension electrical burns has been reported to be up to 21.7%. In our study, the mortality rate was 11.6%. However, all these patients had an associated high % age of flame burns with their clothes catching fire. We consider that the better overall survival rate of high tension electrical burn patients may be explained by the early presentation of patients to our burn unit, aggressive fluid resuscitation and early active management of wounds.

CONCLUSION

High tension electrical burns are one of the most common causes of burns, especially in rural areas. Unskilled labourers at fieldwork and children are commonly affected. Hands are the most common site of entry wounds. Most of the patients require staged debridements and reconstruction leading to higher hospital stays. Distant flaps have less complication rate as compared to locoregional flaps. High ligation of vessels should be done to avoid acute haemorrhage in high tension electrical burns. Public awareness and compliance with safety standards as well as respect for the potentially deleterious effects of electricity are of utmost essential for avoiding these deadly injuries.

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