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ELECTRIC BURN INJURIES: A NOTABLE CAUSE OF PHYSICAL DISABILITIES

General Surgery

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ABSTRACT

Background: With increasing use of electricity, rate of electric burn related amputations and disarticulations are also increasing. The goal of this study was to investigate epidemiological profiles, associated common complications and the resulting disabilities in patients undergoing amputations and disarticulations due to electric burn injuries.
Materials and methods: Data of total 92 patients were collected for this retrospective study between Jan 2017 to April 2020. Mean age of these cases is 29.72±15.59. Men are more prone to electrical accidents (n=78, 84.78%). Rural and suburban area had the maximum number of cases (32.6%+42.39%) with electrical workers and industrial workers being the worst sufferers (30.43%+18.47%). Patients of high voltage injuries had more complications than low voltage injuries.
Conclusion: Electrical injury is culpable for significant physical disabilities due to lack of proper education, decent training, and strict enforcement of safety guidelines which results in unemployment and increased economic burden of the country every year. These losses can be reduced by increasing the awareness among masses.

KEYWORDS

Electric burn, Disabilities, Amputations, Gangrene

INTRODUCTION

Since 1878 when scientist Thomas Edison first used it in incandescent electric lighting, electricity has become indispensability for our living. With its tremendous use, electric burn and its morbid consequences are also increasing, mostly involving the four limbs.[1] Many of them are treated with some form of amputation or disarticulation surgery. The severity of tissue damage can be classified according to the electrical intensity (low and high voltage), the type of current (direct or indirect), the affected part of the body, the contact time, and simultaneous secondary damages.[2] The electrical injuries are broadly divided into low voltage (<1000kv) and high voltage (>1000kv) injuries.[3] High voltage electric current has irreversible localised and systemic consequences with higher risks of damage. HVI (High Voltage Injuries) are potentially devastating events that result in damage not only to the skin but also deep structures like nerves, tendons and bones.[4]

Damage to the underlying muscles in the affected limb can cause the rapid onset of compartment syndrome. It may cause gangrene, charring or flexion contracture in any of the four limbs making amputations and disarticulations unavoidable in these scenarios. The release of the myoglobins can cause myoglobinuria and subsequent renal dysfunction. It can directly damage cardiac muscle and interfere in cardiac pacing. Low tension injuries or LVI (Low Voltage Injuries) from domestic appliance mostly damage to subcutaneous tissues and seldom damage the underlying nerves and muscles in deep burns. The tissue destruction is often severe and progressive due to vascular injury and prolonged production of thromboxanes induced by the electric current.

The goal of this study was to investigate epidemiological profiles, associated common complications and the resulting disabilities in patients undergoing amputations and disarticulations due to electric burn injuries.

MATERIALS AND METHODS

Data of total 92 patients were collected for this retrospective study from Department of General Surgery in Rajendra Institute of Medical Sciences, Ranchi from Jan 2017 to April 2020.

Detailed history including name, age, sex, religion, marital status, address, occupation, time and date of incident, mechanism of electrical injury, type of current and voltage, injury details, ECG findings, urine output at admission, subsequent laboratory investigations and managementswere noted on a data sheet.

Inclusion criteria

- Patients who underwent any kind of amputations or disarticulations as a result of electrical burn injuries.
- Patients who were discharged following recovery after amputations or disarticulations.

Exclusion criteria

- Patients of minor electrical injuries who didn't undergo any amputations or disarticulations during the management.
- Patients of electric burn with previous disabilities.
- Patients suffering psychological or neuromuscular or functional disabilities.
- Patients who expired during treatment or left against medical advice.
- Patients with incomplete medical records.

Figure 1: Gangrenous changes with signs of pseudomonas infection of right hand and forearm in a patient of electric burn injury, who later underwent right below elbow amputation.

Their disability percentages were calculated based on guidelines & gazette notification, issued by Ministry of Social Justice and Empowerment, GOI (2001). All the data were analysed and presented in simple descriptive statistics.

RESULTS AND DISCUSSION

Total number of electric burn patients admitted during the period is 871. Only 13.54% of them underwent some kind of amputation or disarticulation. In our study we selected 92 cases based on inclusion and exclusion criteria.

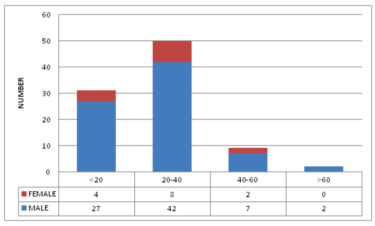

Figure 2: Gender and age distribution of all cases

Mean age of these cases is 29.72+15.59 which is relatable to most studies like **Tolouie et al**[9] (31.56), **Alper et al**[10] (26.4+13.2), **Quan Li et al**[11] (26.8). The patients are mostly in the age group of 20-40yrs, as they are more risk taking and careless. Men are usually the earning member in families, thus are more prone to electrical accidents (n=78, 84.78%).

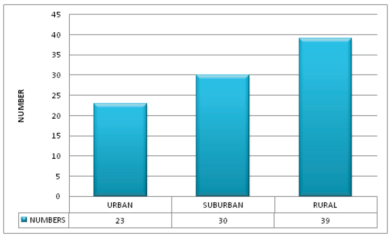

Figure 3: Distribution of areas of address

Among them rural and suburban area had the maximum number of cases (32.6%+42.39%) which is relatable to study by **Srivastava et al** [12] (Urban:Rural=2:1). People in these areas lack access to basic amenities like electricity, roads and schools, people commonly steal electricity for their unneeded convenience. Lack of adequate knowledge of safety guidelines put their lives in jeopardy. Even electrical workers seldom use helmets, electric gloves and risk touching live wires. Furthermore lack of proper insulated transmission lines and dearth of enforcement of strict rules by the government.[5-8]

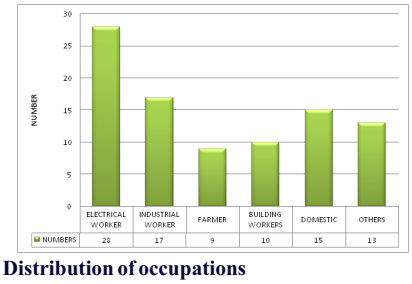

Figure 4: Distribution of occupations

Our study shows among all, electricians and industrial workers are the worst sufferers as they work with electrical circuits and machines for their livelihood (30.43%+18.47%) which is similar to many studies. Most patients (57.6%) were admitted within 24hrs of incidents, which proves improved ambulance service in recent years. Blackish discoloration and pungent smell with the onset of gangrene also oblige their early presentation in the emergency room. But the patients who presented after 24 hrs of incident ended up with more disabilities than who presented within 24hrs. Patients of HVI (66/92) greatly outnumber that of LVI which is relatable to **Tolouie et al**[9] (62.96%), **Alper et al**[10] (50%), **Lunawat A et al**[13] (76.36%), **Srivastava et al**[12] (73.04%) **Li et al**[16] showed that most of the patients were affected by low voltage. Mean length of days stayed in hospital in HVI (15.82+8.05) is more than LVI (12.88+5.49), which is comparable to most studies but Consequently, it should be noted that early intravenous fluid resuscitation, antibiotics, early intervention and close observation of patients is essential in the treatment of electrical burn injury.

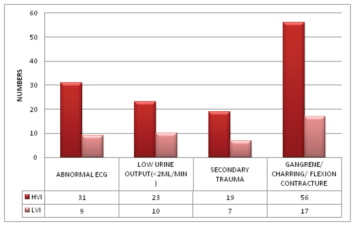

Figure 5: Distribution of complications at admission in HVI and LVI

HVI patients have presented with more complications like abnormal ECG findings, low urine output, secondary trauma and gangrene / charring / flexion contracture of the affected limbs. Secondary injuries were more common in HVI (11/19), relatable to **Alper et al**[10].

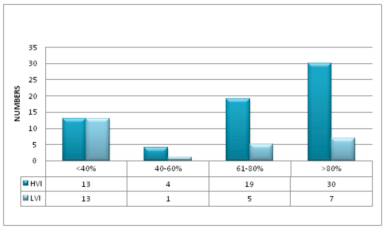

Figure 6: Distribution of disability percentages in HVI and LVI

HVI is also responsible for maximum number patients of disability in category of more than 80% (30 out of 37). Although patients with electrical burn injuries account for less than 5% of all admissions in the burn centers globally, they bring out significant morbidities and mortalities.[14,15] Study shows that HVI has far more destructive consequences than LVI.

CONCLUSION

Factors associated with physical disabilities due to electric burn injuries are:-

1. Male
2. Age group 20-40yrs
3. Electrical or industrial worker
4. Rural and suburban areas with low socioeconomic class
5. Brought to the ER after 24 hrs of incident
6. Patients of HVI
7. Gangrene / charring / flexion contracture at admission.

Electrical injury is culpable for significant physical disabilities due to lack of proper education, decent training, and strict enforcement of safety guidelines which results in unemployment and increased economic burden of the country every year. These losses can be reduced by increasing the awareness among masses about safe use of electrical equipments and construction of safer electrical distribution networks with implementation of more effective means of occupational safety in factories.

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