Original Research Article

Evaluation of electrical injuries in our institution

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Abstract

Electrical burn is less prevalent in comparison to other forms of burn injuries; however this type of injury is considered as one of the most devastating due to high morbidity and mortality. Understanding the incidence, prognosis and preventation of electrical burns helps reducing to this type of injury. This study was conducted to evaluate electrical burn injury at our center. We assessed 35 electrical burn patients (7.32% of all burn patients); the mean age was 23.8 years and 85.71% were males. Most commonly affected population by electrical injuries were industrial workers and labourer i.e. 12 (34.28%). The 2nd most common occupation was of farmers i.e. 9 (25.71%). 1 (2.85%) was housewife, and 8 (22.86%) were students. In our series most of the patients had less than 30% burns, the most common group was between 11-20 % i.e. 15/35 (42.86%). Most common type of burn observed were contact burns seen in 30 patients (85.71%). Evidence for muscle necrosis, to include myoglobinuria and elevated phosphokinase (CPK) level was noted. Fasciotomy was predicted by presence of myoglobinuria with an overall accuracy of 72.8%. Patients with gross myoglobinuria are also at a higher risk of requiring amputation. In our study 7 patients died during the study i.e. mortality rate of 7/35 i.e. 20 %. Mortality in acute phase is most commonly due to multiple organ damage and renal failure. Mortality after acute phase is usually due to sepsis. Electrical burn injuries are still amongst the highest accident-related morbidities and mortalities. Educating the population about the dangers and hazards associated with improper use of electrical devices and instruments is imperative.

Keywords: Electrical burns**,** epidemiology, incidences, morbidity, mortality.

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INTRODUCTION

Electrical burn injury is one of the most devastating injuries seen in the emergency room. It is a special type of thermal injury with a potentially devastating capacity for functional and aesthetic sequelae. It occurs less frequently than scald and direct flame burn. Electrical injuries occur when the human body comes into contact with an electric arc, due to electricity passing through the human body.[1] Electrical burn can come from low-voltage or high-voltage currents. The pathophysiology of electrical burn depends on the voltage, current flow, and tissue resistance. The damage caused by electrical burn is due to two mechanisms, the local generation of heat and the direct action of the passage of the current itself through the tissue. The heating causes coagulative necrosis of the cells and the current cause cell membrane disruption that leads to tissue loss and death.[1]. Although the incidence of electrical burn is not as common as other burns, its complications are mostly due to involvement of various organs.[2]. The more surgical intervention and hospitalization time needed for electrical burn caused it to be as one of the most important problems in different communities.[3,4] The treatment of electrical burn by symptoms and its care can improve the prognosis. Identification of the mechanism of injury and preventive measures are the most effective methods to reduce the incidence and severity of electrical injury.[2] Most electrical injuries occur in males at work or in children handling exposed electrical lines, and most of them are preventable through proper education.

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MATERIAL AND METHODS

This prospectively study was carried out in the Department of Burns and Plastic Surgery and Department of General Surgery collectively of 35 victims of electrical injuries admitted from July 2013 to July 2015. The data was collected on the basis of age, gender, percentage of burn. The patients admitted in burns ward, had their detailed history noted and treatment initiated with IV access, Central line insertion, Foleys catheterization as and when indicated, immunization with tetanus toxoid and tetanus immunoglobulin, analgesics and antibiotics. Fluid resuscitation given as follows

- For Ringer's lactate, 10 mL/kg/h IV administered during initial resuscitation. Alternatively, we use NS 10-20 mL/kg bolus IV.
- If myoglobinuria exists, fluids administered should produce a urine output of 70-100 mL/hr in adults or 1 to 1.5 mL/kg/hr until myoglobin is cleared .
- Urine output should be maintained thereafter at 50 mL/hr or at 0.5 to 1.0 mL/kg/hr.
- The fluids resusication protocol used was according parkland's formula for flame burns.

Silver Sulphadiazine dressings were used for deep burns and non adherent and biological dressings were done for partial thickness burns. The blood investigations were sent twice weekly and when required. Specific investigations CPK-TOTAL, CPK-MB, Urine myoglobin were done. Blood products were transfused to keep the hemoglobin levels above 10 g%. The patients were also given high protein diet, exercises and splints and psychological support. The antibiotics were changed as per blood culture reports

OBSERVATION AND DISCUSSION

Thirty five patients of electrical burns were studied during the period July 2013 to July 2015. The overall incidence of electrical burns in comparison to thermal burns was found to be 7.32%. In 1998, EI Gallal. A.R.S. Young S.M.[5] found a 7.4% incidence of the admission of electric burns. Gang RK[6] reported a 5.3% incidence. Electrical burns were seen in all age groups. Minimum age was 6 years and maximum age was 58 years in this series. In our study greatest incidence was found in the age group of 15-30 i.e. 21 patients (60%). Seven patients were found in 15-20 yr age group and 4 patients in 11-15 yr age group. In our study mean age was 23.85 year. Haddad S Y *et al*[6] found a mean age of 22.7 years. A study was conducted by Subrahmanyam M[7] in sangli, India and he found patients with age ranging from 3 years to 60 years. In this study mean age was 26 years. As this age group 21-30 is the working class, it is more commonly involved in working with electrical appliances, live wires and electric poles. Hence electric burn is most common in this age group. Males were more involved in electrical burns than females in this series 30/35 i.e. 85.71%. Similar findings were observed by Haberal M[8], who studied 137 patients with electrical burn and found 89.36% male incidence. Hussman *et al*[9] and Subrahmanyam M[7] both reported an 85% incidence in Males. Males are injured in large number in electrical injuries in general because they are exposed to electric current while working or otherwise. Most commonly affected population by electrical injuries were industrial workers and labourer i.e. 12 (34.28%). The 2nd most common occupation was of farmers i.e. 9 (25.71%). 1 (2.85%) was housewife, and 8 (22.86%) were students. A Mohammadi *et al*[10] found an incidence of 50% in professional employees and 59.3% of the electrical burns occurring at the work site. Haberal M[8] had 42.3% electricians in his study while Brandit *et al*[11] reported 81% as occupational injuries. Subrahmanyam M[7] studied 40 electrical burn patients, out of these 14 were farmers and only 1 was an electrician. Incidence found in this series shows increased incidence among labourers and industrial workers. Climbing electric poles, holding live electrical wires and undertaking the repair of electrical devices without proper knowledge are responsible for the high incidence, seen in male population. (Table- 1) In our series most of the patients had less than 30% burns, the most common group was between 11-20 % i.e. 15/35 (42.86%). Between 0-10% there were 9/35 i.e.25.71% and between 21-30% there were 5/35 i.e. 14.28%. Subrahmanyam M[7] found less than 10% involvements in 31 patients (i.e. 77.5%), 11-20% in 3 patients (7.5%), 31-40% in 3 patients (7.5%) and more than 60% in 3 patients (7.5%). Gang R.K.[6] found less than 10% body surface area involvement in 80% of the patients. Our study is consistent with the study in literature that electric burns cause less than 20% surface burns most commonly. There was no mortality when the percentage of burns was less than 10%. There was 100% mortality in patients admitted with more than 40 % of TBSA burns. The Mortality increases as the percentage TBSA increases. Compared to thermal burns, mortality in electrical burns was seen with less percentile burns because of associated complications of electric burns.(Table-2) Only 8 patients had electrical burns in any specific anatomical site. 46 patients had injuries in more than one anatomical region. (Table-3) Upper extremities**:** They are frequently involved in electrical burns. This is because of the functional ability and the direct contact with electrical conductor or accidentally. In the upper limb, hand is the most commonly involved part. Escudero Nafs *et al*[12] found Right Upper Limb to be involved in 70% of cases while Left Upper Limb was involved in 60% of cases. Lochaitis

et al[13] found upper limb involvement in 75% of his cases. In our study, upper extremity was involved in 28 patients (80%), comparable to above studies. Lower Extremities**:** Lower extremities are also frequently involved as they are the usual exit sites for the current. Escudero Nafs *et al*[12] found lower extremity in 60% of cases. In our study lower extremity were involved in 24 cases (68.57%). Most common type of burn observed were contact burns seen in 30 patients (85.71%). Mixed burns (contact + thermal) were seen in 22 patients (62.86%) while Flash burns or flame burns were seen in 5 patients (14.28%). Dega S[14] observed 541 out of 665 patients (81.35%) were of purely contact burn cases.100 out of 665 (15.03%) were due to mixed and 24 (3.60%) of flash or flame burns. Results of our study are almost similar to above study. Mixed burn includes contact + thermal. Thermal burn occurs due to ignition of clothing and can be superficial or deep.(Table-4) Biochemical abnormality detected in form of increased level of CPK –total CPK-MB and urine MYOGLOBIN. In our study CPK total, CPK-MB and Urine myoglobin were elevated in 22, 15 and 18 patients respectively. CPK total, CPK-MB and urine MYOGLOBIN found elevated mostly in high voltage injuries. Most of the patients with elevated biochemical markers required fasciotomy and amputations of limbs. Cancio LC, Jimenez Rajna JF *et al*[15] studied 195 patients with high voltage electric burns. Evidence for muscle necrosis, to include myoglobinuria and elevated phosphokinase (CPK) level was noted. Fasciotomy was predicted by presence of myoglobinuria with an overall accuracy of 72.8%. Patients with gross myoglobinuria are also at a higher risk of requiring amputation. Most common surgical procedure performed was skin grafting and flap coverage. A total of 23 STG and 16 flaps were done in 24 patients. A total of 81 procedures were done. The most common surgical procedure performed was skin grafting followed by flaps, fasciotomy and amputation. Fasciotomy was done in 15 patients, Amputation in 14 patients, Flap in 16 cases and debridement in 7 patients. A total of 81 procedures were done in 35 patients. Lochaitis A, *et al*[13] performed debridement in 33%, Escharotomies 58%, Fasciotomies 45.83%, Amputations 37.50%. Early coverage (SSG) 8.33%. Haberal M[16] and performed a total of 152 procedures on 76 patients including. Major amutations – 32 Minor amputation – 17 Craniectomies – 3 Laparotomy with vagotomy for GI bleeding – 1. Escudero Nafs *et al*[12] studied 70 patients with high tension electrical burns and performed a total of 179 operation 2.5 operations per patients. 36 patients underwent 56 amputations. 14 patients had multiple amputations.(Table-5) Total 25 patients suffered the disability in which 12 patients (48 %) lost their upper limb. And the second common disabilities were digital loss.(Table-6). In our study 7 patients died during the study i.e. mortality rate of 7/35 i.e. 20 %. All died patients in our study were affected by high voltage electrical injury. Lochaitis *et al*[13], Haberal M *et al*[16], Subrahmanyam M[7] found Mortalities of 17%, 27% and 25% respectively. Mortality in acute phase is most commonly due to multiple organ damage and renal failure. Mortality after acute phase is usually due to sepsis. Mortality is more in high tension electric burns than low tension electric burns and highest in lightning injuries. Mortality rate in our study is comparable to the mortality in other studies mentioned above. In our study of 35 patients, 7 patients died. We followed remaining 28 patients, out of them 4 patients were lost follow up after 3 months .7 patients started doing routine work after 6 months and 12 patients (42.85%) started work after 1 year of follow up. 5 patients are still coming in follow up.

Table 1: Distribution of Occupation

Occupation	No. of cases	Percentage
Industrial workers and laborers	12	34.28
Electricians	2	5.71
Farmers	9	25.71
Housewives	1	2.85
Students	8	22.86
Others	3	8.57
Total	**35**	**100.00**

Table 2: Percentage of Burns with Mortality

Percentage of burns	No. of cases	Percentage	Mortality
00 – 10	9	25.71	
11 – 20	15	42.86	1(6.67%)
21 – 30	5	14.28	2(40%)
31 – 40	3	8.57	1(33.33%)
41 – 50	1	2.86	1(100%)
51 – 60	2	5.71	2(100%)
61 – 70	0	0.00	
71 – 80	0	0.00	
81 – 90	0	0.00	
91 – 100	0	0.00	
Total	**35**	**100.00**	**7**

Table 3: Anatomical Distribution

Anatomical region	No. of cases	Percentage
Upper extremities	28	80
Lower extremities	24	68.57
Head, Face, Neck	7	20
Back	7	20
Abdomen and groin	9	25.71
Genitalia	2	5.71
Chest	16	45.71

Table 4: Type of Burns

Type of burns	No. of cases	Percentage
Contact burns	30	85.71
Flash burns	5	14.28
Mixed burns (Contact + thermal)	22	62.86
Lightning	-	-
Total	**35**	**100.00**

Table 5: Surgical Treatment

Procedure	No. of cases	Percentage
Debridement	7	20
Fasciotomy	15	42.86
Amputation	14	40
Shoulder disarticulation	3	8.57
Skin grafting	23	65.71
Flap	16	45.71
Tracheostomy	1	2.86
Collagen application	2	5.71

Table 6: Electric burns and morbidity

Morbidity	Number Of Patients	%
Upper Limb Loss	12	48%
Lower Limb Loss	3	12%
Finger Loss	4	16%
Toe Loss	3	12%
Nerve palsy	1	4%
Total	**25**	

CONCLUSION

Electrical injury is a very serious and important type of burn, which constitutes a considerable health hazard. It provides a great challenge in management both in the acute stage and throughout the rehabilitation period. Victims can end up with major disabilities. Most of the injuries are preventable with proper education and knowledge. Since such devastating injuries stem from largely avoidable hazards, there is need for adoption of preventive strategies. Most common age group affected is the working age-group i.e. 15-30. Industrial workers and laborers are more commonly affected in electric burns, and farmers are 2nd most commonly affected in our country. This may be due to climbing electric poles, holding live wires and repair of electric devices without proper precautions and knowledge. Most of the time lack of safety measures is an important cause for burn. Present Hospital setting provides a good opportunity for burn prevention because families of burn patients visit the hospital for several times until their patients are cured, during which time safety education is provided through medical and paramedical workers/medico-social workers. Accurate information about this issue must be conveyed to the population through mass media and other appropriate communication channels. Public awareness through different communication channels and education through schools could be provided about burn-related safety practices. Community education on safer first-aid practices such as applying cold water soon after sustaining burns is essential. Precautions and safety measures taken during working environment could help to prevent burns. There should be availability of good burn care facilities in all public institutions as near to the place of accident as possible. Burn surveillance could probably be one of the priorities for the health authorities regarding burn prevention

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