Original Article | Indian Journal of Burns

Clinico-etiological profile and outcome of electric burns at RLJH, a tertiary care centre of South India

Ambikavathy Mohan[1], Kumar Srinivasan[2], Bhaskaran Ashokan[3]

[1]Departments of Surgery and [2]Medicine, Vydehi Institute of Medical Sciences and Research Centre, Whitefield, Bangalore, [3]SDUMC, Kolar, Karnataka, India

Correspondence to:
Dr. Ambikavathy Mohan, Assocate Professor,
Department of Surgery, VIMS and RC, Whitefield, Bangalore 66, Karnataka, India.
E-mail: ambikaashri67@live.com

Abstract

Introduction: The incidence of electrical accidents has increased, due to use of electricity in the house hold, institutions and industries. Electrical injuries can cause extensive disfigurement to that of significant functional disability and sometimes can be fatal due to cardiac events and therefore the patients need to be closely monitored in an ICU set up. Management of electrical burns patient requires a team work of surgeons and physicians. **Materials and Methods:** This retrospective study was conducted between January 2007 and December 2012 in the Burn Unit of Sri Devaraj Urs Medical College, Kolar, Karnataka, a rural tertiary care center of South India, to assess the demography, degree of disability and loss of life due to electrical burn. **Result:** We had 47 patients of electric burns admitted in our center. Most of the accidents leading to the electrical burn injuries could have been prevented. **Conclusion:** Prevention is possible by increasing public awareness through primary education among the rural people and by taking adequate precautions such as the use of personal protective equipments (insulated gloves and footwear.) and following national electrical codes.

Key words:

Atrial fibrillation, electric burn, electric injury, medical management

INTRODUCTION

Electricity is very useful to mankind, and it can be dangerous if not carefully used. Since 1849, the maximum use of electricity is seen for commercial purpose. Electric burns can be caused by low-voltage or high-voltage currents. The intensity of electric burn depends on the voltage, current flow and tissue resistance.[1-3] The damage caused by electric burn is based on three mechanisms, the local generation of heat causing coagulative necrosis of the cells and that due to direct passage of current causing disruption of cell membrane leading to cell death and tissue loss and injuries caused due to fall following electric shocks. The burns may vary from first degree to third degree depending on the duration of time the victim was in contact with the current.

Access this article online	
Quick Response Code:	Website: www.ijburns.com
	DOI: 10.4103/0971-653X.147013

MATERIALS AND METHODS

This study was conducted in R.L. Jallappa Hospital (RLJH) from January 2007 to December 2012. Forty-seven (19.67%) patients were admitted with electrical injury and treated by surgeons and physicians, ten patients (21.27%) were in the age group of 21-30 years and in above fifty ten (21.27%), followed by five in 0-5 (10.6%), seven in 11-20 years (14.8%) eight in 31-40 (17.02%) and seven in 41-50 (14.8%) [Table 1 and Figure 1]. The various types of electrical burns were accidental in nature with extremity injuries. Fourteen patients (29.21%) had electrical injury while working with irrigation pump motors and ten (21.27%) by contact with domestic current in the kitchen, seven (14.81%) due to contact with live wire, four (8.5%) sustained electrical burns, while working on electric pole, had a fall from height with multiple rib fractures and hemopneumothorax for which intercostal drainage was inserted and monitored for respiratory failure in the icu, six each (12.76%) were due to earthing/rain and contact with housing current [Table 2 and Figure 2]. Skin grafting was done in 25 patients and ten underwent fasciotomy and all 30 patients settled well with local debridement and twenty six with disarticulations, three required fore foot amputations and two fore head flap rotation due to head injury with loss of scalp and two required intercostal drainage for rib fractures with pnueumothorax [Table 3 and Figure 3]. We had one patient (2.1%) of acute renal failure settled with dialysis, ten patients developed septicemia and responded well to appropriate antibiotic therapy. Two patients (4.2%) had respiratory failure and were managed with ventilator care, eight (17.02%) developed atrial fibrillation and were treated by physicians in the intensive care unit with metaprolol and reverted to normalcy. Six (12.7%) had wound infection and did well with conservative management [Table 4 and Figure 4]. There was no loss of life in electrical burns patients in our set up.

DISCUSSION

Electrical injury is different from other burns because of extensive local destruction of tissue at the points of entrance and exit. In our study, the percentage of burns estimated was between 10% and 30% superficial to deep burns ranging from first degree to third degree. There were 30 patients in our set up who required extensive wound debridement/escharotomy initially and revision debridements and ten fasciotomies of the extremities to avoid further damage followed by debridements and regular dressings [Table 3]. Artz described electric burns as severe muscle crush injury; Hunt showed that the deep-tissue loss is secondary to extremely high temperatures from resistance of the skin and bone to the passage of electric current. Joule's equivalent explains the heat exchange in thousands of degrees of centigrade; it is usually the voltage that can be determined and probably is the most important factor. High tension >1000 volts and low tension <1000 volts and direct and indirect currents all exert variable effects.[1-3]

Arc burns can occur without the patient contacting the electrical source but can be quite destructive. Electrical injury can affect many organ systems, depending on the path of the current. The volume conductor theory explains why extremity burns are much worse than torso burns and why extensive debridement is usually necessary.[4-6] We had 26 patients with finger and toe injuries caused due to contact with live wire and domestic current and motor pump shock injuries leading to amputations and disarticulations,

Table 1: Distribution of patients according to age

Age (years)	Number of patients	Percentage
0-10	05	10.6
11-20	07	14.8
21-30	10	21.27
31-40	08	17.02
41-50	7	14.8
Above 50	10	21.27

Table 2: Distribution of various causes of electrical burn injuries

Causes of electrical burn injuries	Number of patients	Percentage
Domestic current (cooking, mixie, grinder) electric injuries	10	21.27
Contact with live wires	7	14.87
Climbing electrical poles for repair	4	8.5
Irrigation motor pump electric injuries	14	29.78
Earthing injuries during rains/lightening	6	12.76
Housing/lighting current	6	12.76

Table 3: Various surgical procedures performed

Surgical procedures performed for electrical burn patients	Number
Fasciotomy	10
Debridement/escharotomy and revision surgery	30
Superficial skin grafting	25
Fore foot amputations	3
Intercostal drainage	02
Flap rotation	02
Amputations/disarticulations	26

Table 4: Complications seen in electric burn patients

Complication	Number of patients	Percentage
Acute renal failure	01	2.1
Septicaemia	10	21.27
Respiratory failure	02	4.2
Severe anaemia	10	21.27
Atrial fibrillation	08	17.02
Wound infection	06	12.7

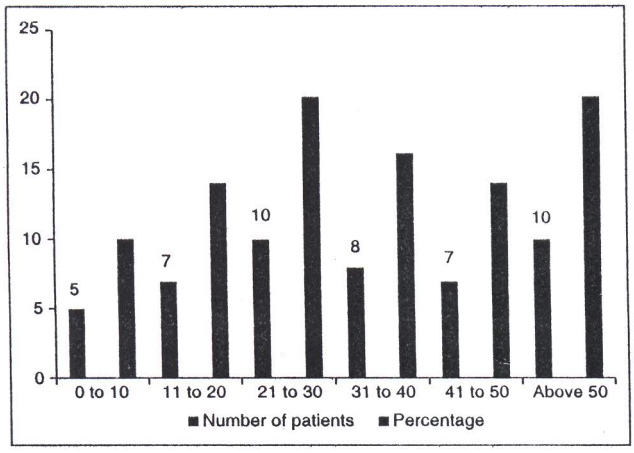

Figure 1: Bar graph showing distribution of burns patients according to age group

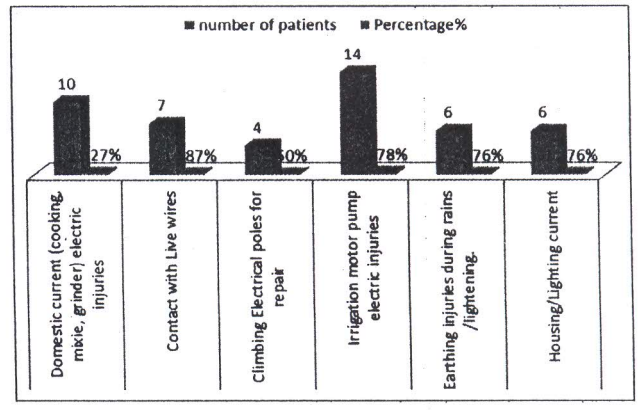

Figure 2: Bar graph showing various causes of electric burns

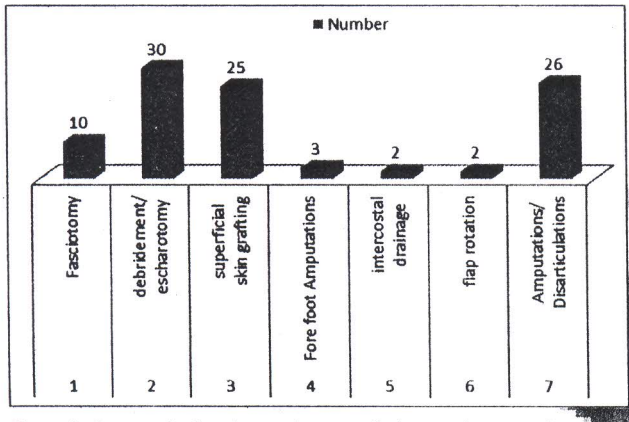

Figure 3: Bar graph showing various surgical procedures performed in burns patients

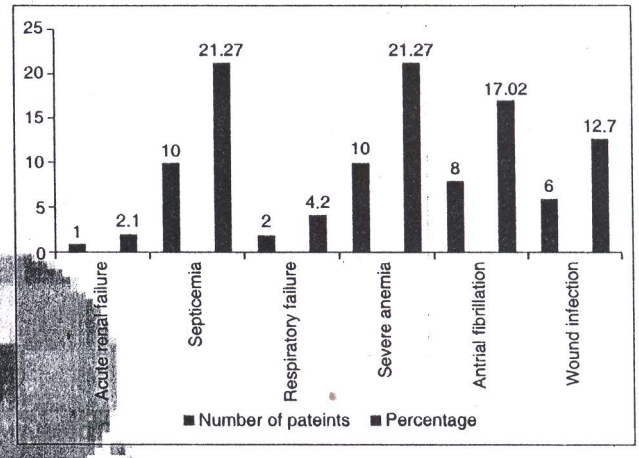

Figure 4: Graph showing complications seen in burns patients

three patients underwent disarticulation of toes initially but required fore foot amputation as a second stage due to extensive tissue and bone destruction [Tables 2, 3 and 5 and Figure 5]. The progressive destruction of tissue is best explained by small vessel occlusion and also by elevated levels of arachidonic acid in areas of greatest heat production. Acute cardiac events such as atrial fibrillations can occur and therefore patients are to be admitted under supervision of physicians in the intensive care unit and cardiac monitored to avoid loss of life. We had eight patients who developed atrial fibrillations during treatment for electric burns in the first 48 h and reverted to normal with timely medication [Table 4]. Atrial fibrillations are known to evolve during the first twenty four to 48 h called as the crucial period as atrial fibrillation though self-limiting, at times may turn fatal in the absence of proper monitoring.[3] Resuscitation must be aggressive to provide adequate circulatory volume. We had one renal failure patient who did well with dialysis. Normal vital signs should be maintained along with a urine output of 100 ml/h to overcome the destructive renal tubular effect of myoglobin and hemoglobin products. There were six patients

Table 5: Amputations performed in electric burn patients

Type of amputation	Number
Fore foot amputation	3
Left below knee	0
Left above knee	0
Right below knee	0
Right above knee	0
Left below elbow	0
Left above elbow	0
Right below elbow	0
Right above elbow	0
Finger amputation/disarticulation	16
Toe amputation/disarticulation	10

with wound infection and ten patients with septicemia in our set up which was due to poor nutrition and anemia [Table 4]. Thorough and repeated wound debridements, correction of anemia and improving nutrition helped our patients to recover well. We had two patients with multiple rib fractures sustained from the fall from the electric pole due to the electric contact during repair work and required

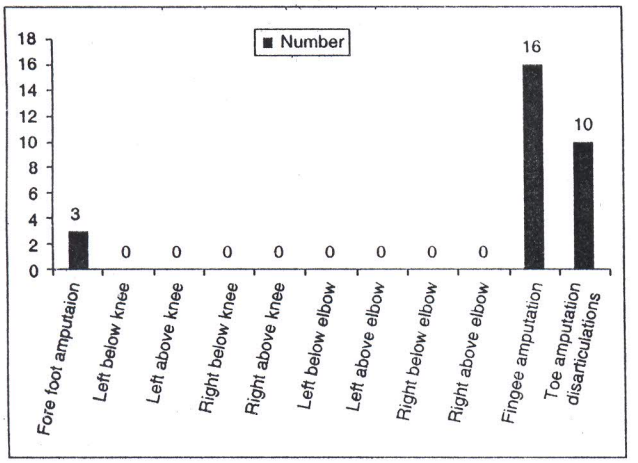

Figure 5: Bar graph showing amputations/disarticulations performed inclectric burns patients

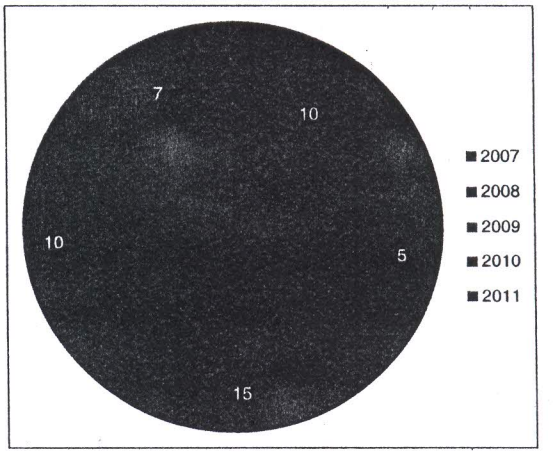

Figure 6: Pie chart showing year wise distribution of electrical burns patients

Table 6: Yearly distribution of electric burn patients admitted to R.L.Jallappa Hospital burn unit

Year	Number of electric burn	Percentage of total admission
2007	0	0
2008	10	21.27
2009	05	10.63
2010	15	37.91
2011	10	21.27
2012	07	14.89

intercostal drainage; respiratory failure was managed with ICU and ventilatory support and they recovered [Tables 3 and 4]. Superficial skin grafting was done in 25 patients while two had fore head rotation flap with good outcome. There were no deaths due to electric burns in our study. Control of sepsis and its complications through aggressive wound management is critical for survival.[7-9] There was fall in the number of electric injury patients noted in our study from 39.91% in 2010 to 14.89% in 2012 [Table 6 and Figure 6], although the exact cause is not known, we presume that our counseling/education of patients towards use of safety measures could have brought a change by way of word to mouth in the villages or there is a possibility of cases being treated elsewhere.

To bring down the incidence of electrical burns and safe guard human lives it is worthwhile to educate and train our rural people and those working with electricity regarding the National Electrical Safety Codes such as:

1. Use of color coded wiring, safety model circuits and volt regulating equipments.
2. Locking out and tagging out of circuits.
3. To put off energy source/power before repairs.
4. Avoid inadequate wiring, exposed electrical wires, wet conditions, overloaded circuits and damaged tools/equipments.
5. Ensure good earthing and insulation techniques.
6. Training in use of personal protective equipments, First aid safety measures, emergency medical services, awareness of fire extinguishers and cardio pulmonary resuscitation.

CONCLUSION

Since ours is a rural area where most of the occupation is agriculture, the electric burns by accidents are common. Hence, creating awareness, education and following of safety measures like use of insulated gloves and footwear play a key role in prevention. Electrical burn patients need to be monitored and treated for cardiac events in the first 48 h. As disability from electrical injury is a possibility, efforts for rehabilitation and counseling should be a part of our treatment protocol.

REFERENCES

1. Sachade J, Shaikh MF, Suri M, Kapadia K, Agarwal S. Electric burns.A two year study. Indian J Burns 2008;16:19-23.
2. Handschin AE, Vetter S, Jung FJ, Guggenheim M, Künzi W, Giovanoli P. A case-matched controlled study on high-voltage electrical injuries vs thermal burns. J Burn Care Res 2009;30:400-7.
3. Kumar S, Ambikavathy M. Atrial fibrillation due to low tension electric shock. A case report. J clin Biomed Sci 2013;3:1
4. Mohammadi AA, Amini M, Mehrabani D, Kiani Z, Seddigh A. A survey on 30 months electrical burns in Shiraz University of Medical Sciences Burn Hospital. Burns 2008;34:111-3.
5. Haddad SY. Electrical burn - a four-year study. Ann Burns Fire Disasters 2008;21:78-80.
6. Chandra NC, Siu CO, Munster AM. Clinical predictors of myocardial damage after high voltage electrical injury. Crit Care Med 1990;18:293-7.
7. Varol E, Ozaydin M, Altinbas A, Dogan A. Low-tension electrical injury as a cause of atrial fibrillation: A case report. Tex Heart Inst J 2004;31:186-7.
8. Akdemir R, Gunduz H, Erbilen E, Ozer I, Albayrak S, Unlu H, *et al.* Atrial fibrillation after electrical shock: A case report and review. Emerg Med J 2004;21:744-6.
9. Bøggild H, Freund L, Bagger JP. Persistent atrial fibrillation following electrical injury. Occup Med (Lond) 1995;45:49-50.

How to cite this article: Mohan A, Srinivasan K, Ashokan B. Clinico-etiological profile and outcome of electric burns at RLJH, a tertiary care centre of South India. Indian J Burns 2014;22:79-82.
Source of Support: Nil, **Conflict of Interest:** None declared.