Original Research Article

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20173339

Associated injuries in electrical burns: a 2 year retrospective study in a tertiary care burns unit

Jagdeep Rao, Mitesh Bedi*, Aditya Patil, Vipin Kumar Barala

Department of Burns, Plastic and Reconstructive Surgery, SMS Medical College and Hospital, Jaipur, Rajasthan, India

Received: 18 June 2017 Accepted: 10 July 2017

*Correspondence: Dr. Mitesh Bedi,

E-mail: miteshbedi03@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Electric burns are associated with a high degree of morbidity and mortality. The association of multiple injuries in burn patients further complicates the management problem. The injuries require prompt diagnosis and redressal for better outcomes.

Methods: We decided to undertake a study to note characteristics of associated injuries in patients with electrical burns. A retrospective review was done of all patients admitted in Burn Unit of SMS Medical College and Hospital, Jaipur over a period of 2 years, who had sustained electric burns and had sustained associated injuries.

Results: A total of 770 patients were admitted with electric burns over this duration. Associated injuries were noted in 4.15% of these patients. Young, male patients were more commonly affected, with a male to female ratio of 4:1.

Conclusions: The incidence of associated injuries in electrical burns is not insignificant. A low threshold for suspicion is required in managing doctors to diagnose such injuries for optimal treatment and improved outcome in patients with electrical burns.

Keywords: Electrical burns, Associated injuries, Fractures, Spinal cord injury

INTRODUCTION

Electrical burn injuries require special attention among all the emergency patients because of the resultant high morbidity. Although these comprise a comparatively lesser proportion of burn patients, long term associated morbidity and psychosocial outcomes are worse. The devastating sequelae in electric burn survivors through adulthood have been documented. The sudden nature of the accident, the instantaneous effects that include flames, unconsciousness, violent muscular contractions, depth of damage, and the mutilating surgeries required have combined to make electrical injury a devastating accident. The clinical spectrum of electrical burns can vary from mild complaints that do not require serious medical help to life-threatening conditions. In spite of the serious nature of electrical burn injuries and the fact

that they are mostly man-made, they remain understudied, mostly in the developing world. Illiteracy, lack of public awareness, and ineffective government policies could be factors that place the developing world population at risk of electric burns.⁵

There are very few studies that focus on concomitant injuries associated with electrical burns in an Indian setup. This led us to conduct a study to evaluate the various aspects and characteristics of electrical burn injuries in our region.

METHODS

Medical records were retrospectively reviewed for all patients who were admitted to the Burns Unit of Department of Burns and Plastic Surgery, Sawai Man Singh Hospital, Jaipur, India for evaluation and management of electrical burns over a period of 2 years (January 2015 to December 2016).

Details of demographic data, mode of injury and associated injuries were collected. Data was collected by the authors from the burns proforma. Parents or guardians were contacted by phone when adequate information was not available.

RESULTS

Demographic data

There were 3142 admissions in the Burns Unit during this period. Of these, 770 patients had suffered electrical burn injuries (24.5%).

Patients largely belonged to rural areas (n=548; 71.2%) compared to urban areas (n=222; 28.8%) (Figure 1). The youngest patient was 3 years old and the oldest was 68 years old. Males (618; 80.2%) were more commonly injured than females (152; 19.7%) in all age groups with an overall male:female ratio of 4.1:1 (Figure 2).

Electrical burn injuries were most commonly seen in the age group of 25-34 years (Figure 3).

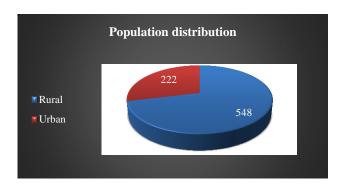


Figure 1: Population distribution.

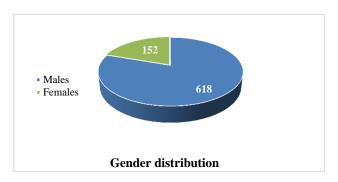


Figure 2: Gender distribution.

Table 1:	Type of	voltage,	mode of	injury	and age.
----------	---------	----------	---------	--------	----------

Voltage	Mode of injury	Age (in years)					Total
		1-14	15-24	25-34	35-44	>45	Total
Low voltage	Biting electric wire	8	0	0	0	0	8
	Contacting low-voltage wire or electric appliance	14	28	16	18	16	92
	Placing object in wall socket	10	3	4	6	5	28
High voltage	Contact while playing/working in field	28	42	138	110	84	402
	Contact on house roof	11	10	12	10	20	63
	Contact on balcony	11	10	24	8	6	59
	Contact while climbing tree	18	3	2	1	1	25
	Contact while flying kite	15	26	7	2	1	51
	Fall of live wire while walking or moving on a vehicle	8	16	4	4	10	42
Total		123	138	207	159	143	770

Table 2: Associated injuries.

S.No	Injury	Number of patients (n=32)
1.	Head injury	12
2.	Maxillofacial trauma	3
3.	Orthopaedic injury	5
4.	Spinal cord injury	8
5.	Vision loss	2
6.	Chest trauma/multiple rib fractures	1
7.	Intestinal perforation	1

There were 128 (16.6%) low voltage burns and 642 (83.4%) high voltage burns. High voltage burns were

more common in older age groups while incidence of low voltage burns was comparable across the age groups (Table 1).

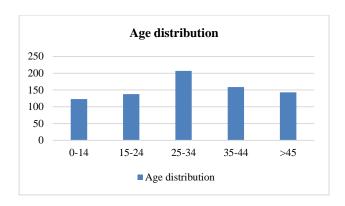


Figure 3: Age distribution.

A mortality rate of 12% [n=93] was seen over this duration and most of these were seen in patients with high voltage burns.

Associated injuries

Concomitant injuries were seen in 32 patients (4.15%) (Table 2). Of these, 12 patients (31.25%) had closed head injury – 10 patients were managed conservatively while 2 underwent drainage of extradural hematoma by neurosurgery department. There was 1 patient of mandibular fracture and 2 with zygomatic fracture for which internal fixation was done following initial resuscitation.

Orthopaedic injuries were seen in 5 patients of which 2 patients had fractures of the humerus, 2 patients had a fractured femur and 1 had a compound fracture calcaneum. All patients underwent intervention after consultation from Department of Orthopaedics.

Spinal cord injury was seen in 8 patients, which were managed conservatively in consultation with the Department of Neurosurgery and Physical Medicine and Rehabilitation.

Two patients suffered complete loss of vision following the injury and were referred to ophthalmology department for further management.

One patient had multiple rib fractures which was managed with insertion of intercostal drainage tube and 1 patient had intestinal perforation which was managed with urgent laparotomy.

DISCUSSION

Electrical current usually takes the route of lowest resistance in a low voltage difference, whereas in a high voltage difference (more than 1000 V), take the shortest route.⁶ Within the human body, the resistance of such tissues as nerve, blood vessel, skin, tendon, fat and bone increases in this order.⁷ In the course of in vivo electrical conduction described above, electrical energy transforms into heat, thus compensating for the resistance of the

tissue.⁸ The resultant heat loss causes an injury in vascular intima and adventitia and ischemic injury to tissue.⁹

Males were seen to be more frequently affected - a trend which is similar to most other studies. This can be attributed to increased outdoor activity thereby exposing them to high voltage injuries by various means. 10-13

Alternating current is known to be more dangerous than direct current because it produces muscular contraction and relaxation with each cycle. Extreme muscular contractions may lead to secondary injuries and can complicate treatment. Early intervention for skeletal and head injuries has shown better outcomes and is recommended. 14-16 We observed associated injuries in about 4.15% patients. To explain the mechanism of spinal cord injury following an electrical burn, Kanitkar and Robert proposed the following: (1) thermal damage within the nerve due to heat production by electrical current; (2) vascular damage causing thrombosis and hemorrhage; (3) direct mechanical trauma from fracture or dislocation resulting from intense muscle spasm; (4) 'radiation-like' effect caused by changes in tissue proteins following passage of electrical current which may lead to secondary vascular changes; and (5) a buildup of electrostatic forces leading to violent tissue disruption in ungrounded victims.

Purdue and Hunt published the largest study in the literature in 1989 with 3550 burn patients and a prevalence of combined burn and trauma of 5% over an eight year period. In a study by Santaniello et al, the prevelance of combined burn and trauma was 5.8% which is comparable to that seen in our study of 4.15%.

In a study by Dossett et al, Twenty-eight patients with 34 fractures were treated with operative fixation over a 10 year period, and the authors suggest an early fixation of fractures for better patient management and favorable outcomes.¹⁴

In a study by Ko et al, 13 patients with spinal cord injury over a period of 6 years due to electrical burns were reviewed. Most of the patients in their study had incomplete paraplegia, and no complete loss of sensation was noted; we also found similar findings in many of our cases and only conservative management was required in all our patients.

In a study by Sohal et al, the most common associated injury was head injury followed by upper limb and lower limb bone injuries, but the rate of associated injuries in their study was higher compared to ours and most of the studies in literature.⁵

The mortality rate is reported in literature to range from 2.7% to 10%, which is similar to that observed in our study (12.1%) as recorded by our burn center registry.⁴

In our study most of the patients belonged to a rural background (71.2%) and consequently, most of the injuries were related to high voltage injuries in the fields. The common causes were unsafe electric poles in the farms, passage of uninsulated electric wires very close to the roof, substandard electric wiring in the houses, low quality or unavailability of electric appliances, lack of knowledge about safety measures, improper drainage of water after rains, poverty, and illiteracy.⁵

Most patients with burns and associated injury are stigmatized by serious functional deficits, temporary loss of their social independence, injury-associated psychological reactions of different levels, and unusual reversible deficits in their higher cortical functions. The result is a prolonged stage of acute treatment and rehabilitation as well as very often the lifelong need for highly specialized care by physicians and other medical professionals. ¹⁹

CONCLUSION

Electrical burns may involve multiple organs and have significant residual sequelae. The treating doctor should have a low threshold for suspicion of the associated injuries to other systems to prevent inadvertent neglect of these injuries.

Funding: No funding sources Conflict of interest: None declared Ethical approval: Not required

REFERENCES

- 1. Zeitlin RE. Long-Term Psychosocial Sequelae of Paediatric Burns. Burns 1997;23(6):467-472.
- 2. Burke JF, Quinby WC, Bondoc C, McLaughlin E, Trelstad RL. Patterns of high tension electrical injury in children and adolescents and their management. Am J Surg. 1977;133:492–8.
- 3. Patil SB, Khare NA, Jaiswal S, Jain A, Chitranshi A, Math M. hanging patterns in electrical burn injuries in a developing country:should prevention programs focus on the rural population? J Burn Care Res. 2010;31(6):931-4.
- 4. Adukauskiene D, Vizgirdaite V, Mazeikiene S. Electrical injuries. Medicina (Kaunas). 2007;43(3):259-66.
- Sokhal AK, Lodha KG, Kumari M, Paliwal R, Gothwal S. Clinical spectrum of electrical burns - A

- prospective study from the developing world. Burns. 2017;43(1):182-9.
- Sturim HS. The treatment of electrical injuries. J Trauma. 1971;11:959–65.
- 7. Christensen JA, Sherman RT, Balis GA, Wuamett JD. Delayed neurological injury secondary to high-voltage current, with recovery. J Trauma. 1980;20:166–8.
- 8. Hoover BB, Baxter CR, Kirkpatrick MR. Electromyographic findings in high voltage electrical burns. South Med J. 1971;64:1392–4.
- 9. Ko SH, Chun W, Kim HC. Delayed spinal cord injury following electrical burns: a 7-year experience. Burns. 2004;30:691–5.
- Celik A, Ergün O, Ozok G. Pediatric electrical injuries:a review of 38 consecutive patients. J Pediatr Surg. 2004;39(8):1233-7
- 11. Zubair M, Besner GE. Pediatric electrical burns: management strategies. Burns. 1997;23(5):413-20.
- 12. Gupta M, Gupta OK, Yaduvanshi RK, Upadhyaya J. Burn epidemiology: the Pink City scene. Burns. 1993;19(1):47-51.
- 13. Tiwari VK, Sharma D. Kite-Flying: A unique but dangerous mode of Electrical injury in Children. Burns. 1999;25:537-9.
- 14. Dossett AB, Hunt JL, Purdue GF, Schlegel JD. Early orthopedic intervention in burn patients with major fractures. J Trauma. 1991;31(7):888-92.
- 15. Chen CT, Yang JY. Electrical burns associated with head injuries. J Trauma. 1994;37(2):195-9.
- 16. Purdue GF, Hunt JL. Multiple trauma and the burn patient. Am J Surg. 1989;158(6):536-9.
- 17. Kanitkar S, Roberts AH. Paraplegia in an electrical burn: a case report. Burns Incl Therm Inj. 1988;14:49–50.
- Santaniello JM, Luchette FA, Esposito TJ, Gunawan H, Reed RL, Davis KA. Ten year experience of burn, trauma, and combined burn/trauma injuries comparing outcomes. J Trauma. 2004;57(4):696-700.
- 19. Ziegenthaler H, Neumann U, Fritzsche U, Sühnel B. Polytraumatized burn injury victims. Orthopade. 2005;34(9):906-16.

Cite this article as: Rao J, Bedi M, Patil A, Barala VK. Associated injuries in electrical burns: a 2 year retrospective study in a tertiary care burns unit. Int J Community Med Public Health 2017;4:2882-5.