Electrical Burn Patients According to Electrical Voltage in Shahid Motahari Burn Center

Aghakhani K[1], Heidari M[1*], Okazi A[2], Yousefinejad V[2], Abdolkarimi L[1]

[1] Forensic Medicine Department, Shahid Motahari Hospital, Iran University of Medical Sciences, Tehran, Iran
[2] Forensic Medicine Department, Tehran University of Medical Sciences, Tehran, Iran

ARTICLEINFO

Article Type:
Original Article

Article History:
Received: 1 Apr 2014
Revised: 15 Jul 2014
Accepted: 15 Aug 2014

Keywords:
Electrical Burn
Mortality
Morbidity
Electrical voltage

ABSTRACT

Background: Electrical injuries are rarely happened but it makes more harmful lesions comparing to other thermal injuries. The aim of this study was to report electrical burned patients according to electrical voltage in Shahid Motahari Burn Center.

Methods: This Routine data base study was performed on patients with electrical burns which were admitted to Shahid Motahari Burn Center from April 2010 to March 2012. Demographic and clinical data had gathered from medical records. Association between voltage and morbidity or mortality was evaluated used SPSS v. 16.

Results: Mean total body surface area of 287 patients (283 (98.60%) male and 4 (1.4%) female) with mean age of 30±0.7 years was 13.56±0.76% (range 1-100). There were 203 patients (70.7%) with low and 84 patients (29.31%) with high voltage injury. There was significant association between voltage and place of injury (p=0.001).

Conclusion: High voltage injuries constitute large number of electrical injuries which more of these injuries occurred outdoor and in workplace and need more hospitalization. High voltage injuries are related with more amputation, so people and authorities should pay more attention to such injuries.

►*Implication for health policy/practice/research/medical education:* Electrical Burn Patients According to Electrical Voltage

► *Please cite this paper as:* Aghakhani K, Heidari M, Okazi A, Yousefinejad V, Abdolkarimi L. *Electrical Burn Patients According to Electrical Voltage in Shahid Motahari Burn Center*. *International Journal of Medical Toxicology and Forensic Medicine*. 2015; 5(1): 17-21.

Corresponding author: Heidari M, MD. Assistant of Forensic Medicine, Shahid Motahari Hospital, Iran University of Medical Sciences, Tehran, Iran
E-mail: Heidarimansoure83@yahoo.com

1. Introduction:

Comparing to other forms of thermal injuries, electrical injury is not that common although it has high morbidity rate and potential to be more destructive (1). Electrocution is the current of electricity through the tissue which can

cause skin burn, cardiac arrhythmia and deep tissue injury. Electrocution can be caused by high voltage (v>1000), lowvoltage (v<1000) and also electrical flash burn. As high voltage injury mostly happen in workplace, industrial workers are more prone to be injured. However most of the low voltage injuries usually happen inside the home and also in workplace. There is not any passage of electrical current through the tissues with flash burn injuries (2).

Singerman *et al* studied on 115 patients with electrical injury. In their study there were 92% men and 8% women with a mean age of 45 years and 8.9% total body area surface. The majority (97%) was work-related injuries; the most of them (58%) were low voltage (3). Chudasama *et al* studied on 115 patients (110 males and 5 females with mean age of 35 years) with electrical injury. The cause of injury was high voltage in 60 cases, low voltage in 25 cases, flash burn in 29 cases and lightning in 1 case. Patients with high voltage injury had significantly larger burn size, longer intensive care unit (ICU) stay and significantly higher rates of fasciotomy and amputation (4). In other related study Tarim *et al* studied on 1440 patients. There were 44 patients undergoing amputations. Amputations were significantly higher in men. Majority of amputations were due to higher voltage electrical injury (5).

Current, resistance, voltage, pathway and duration of electrical current are the main factors determine the severity of tissue injury (1, 7). While the electricity is passing through the tissue it generate heat which can cause skin burn and deep tissue necrosis and destruction that can lead to different type of surgery like fasciotomy, graft and even amputation. The amputation rate in different studies was 10% to 68% (6). With all these surgery methods, organ damage, sudden death and delay death may encounter (2).

Exact incidence of electrical injuries is not clear (2). It is exclaimed as fifth cause of occupational death in US and mortality rate has been reported 3-15% in US (8, 3). Despite effort for safety of production in our country, still there are complications such as amputation and high mortality percentage.

Shahid Motahari is one of the burn centers in Tehran, capital city of Iran. In this retrospective study, we reviewed the medical records of patients with this type of injury who admitted to Motahari hospital. The aim of this study was to report electrical burn patients in Shahid Motahari Burn Center from April 2010 to March 2012.

2. Materials and Methods:

This Routine data base studywas performed on patients with electrical burns admitted to burn center, Motahari hospital in Tehran from April 2010 to March 2012. Demographic and clinical data including gender, age, hospitalization, total body surface area (TBSA), burn degree, electrical voltage, current pathway, surgical procedures and place of electrical burn were gathered from medical records.

Electrical voltage according to the medical history had documented in patient's medical records. All variables were entered in check list from patients' documents. Patients were divided into two groups: high voltage (voltage>1000) and low voltage group (voltage<1000). Data was analyzed through SPSS v. 16 and appropriate statistical tests like chi-square, Fisher's exact test and independent t- test were done at the significant level of $p<0.05$.

3. Results:

Between 2010 and 2012, 287 patients, including 283 male (98.6%) and 4 (1.4%) female, with electrical burns were admitted to the burn center of Motahari hospital in Tehran. Mean age of these patients was 30±0.7 years (range 1-71) and mean TBSA was 13.56±0.76% (range 1-100). Mean length of hospital stay was 17.74±1 days (range 1-115). The mortality rate was 2.4% (7 out of 287).

As seen in figure 1, totally 859 surgical procedures were performed on 232

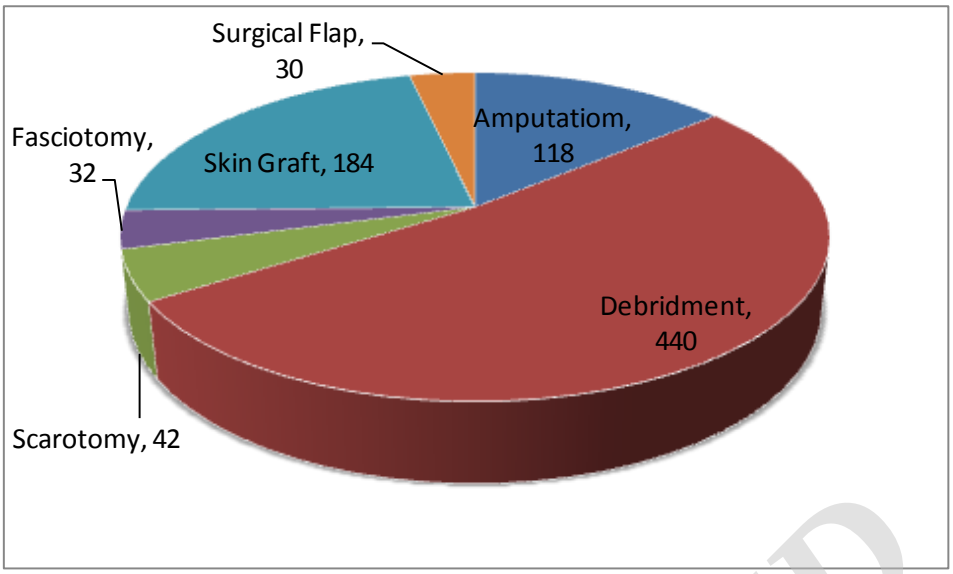

Fig. 1. Surgery procedures subtypes.

(80.8%) patients. These included 118 amputations on 83 patients. Seven patients (2.4%) were admitted into ICU.

There were 203 patients (70.7%) with low and 84 patients (29.31%) with high voltage injury. Mean of total body surface area (TBSA) in patients with low voltage injury was 12% while in patients with high voltage injury was 17.23%. This difference was not statistically significant (p>0.05).

Mean of Hospitalization in high voltage patients is significantly higher than low voltage patients (p value< 0.001). A hundred and sixty (78.9%) of low voltage patients and 71(85.7%) of high voltage patients needed surgery, which was not statistically significant (p value> 0.05). There was significant association between frequency of amputation and voltage (p value=0.04). Mortality rate had not significant difference between these two groups of patients (p>0.05). Details had shown in table 1.

56 patients (19/5%) were injured in home fortuity, 66 patients (23.0%) injured while climbing power pole in order to steal the cables and 165 patients (57.5%) injured in workplace incidents. From patients who were injured in the work place, 111 (67.3%) were in low voltage group and 54 (32.7%) were in high voltage group. From patients with domestic injury, 51 (91.1%) were in low voltage and 5 (8.9%) were in high voltage group, also 41 (62.1%)

Table 1: Comparison of TBSA, hospitalization, need to surgery or amputation and mortality in high and low voltage injuries

	Low Voltage N=203	**High Voltage N=84**	**p value**
TBSA (%)	12%	17.23%	p>0.05
Length of –Hospitalization (day)	15.29 (SD=15.98)	23.67 (SD=18.51)	p<0.001
Surgery (%)	78.9%	85.7%	p>0.05
Amputation	48 (23.6%)	36 (42.9%)	p=0.04
Mortality (%)	3 (1.5%)	4 (4.8%)	p>0.05

patients who had outdoor injury, were in low voltage while 25 (37.9%) of them were in high voltage group.

4. Discussion:

Electrical burns are not prevalent form of burning injuries, although they are more potentially destructive comparing to other burning injuries. Our study was compatible with other previous studies. Most of the patients were male with mean age of 30 and one-fifth of the injuries happened at home and four-fifth of that happened in industrial centers (3, 4, 8, 9).

Regarding the prevalence of electrical injury in young man and in workplace, electrical injury should be considered disabling factor for active working population. Indoor children and housewives were more subjected to electrical injury so the mean age was less. It is supposed that oral contact with electrical cord and even sockets is common in toddlers group. Thereby basic and appropriate prevention trainings are mandatory for all public community especially for all mothers (10). It should be emphasized on the safety of workplace and home electrical equipment and also standard guidelines should implement in all type of electrical equipment.

Amputation rate due to high voltage was more common comparing to low voltage ($p<0.005$) that was parallel with other studies (8, 11, 12). High voltage electricity can induce limbs destructive lesion due to burning musculoskeletal and deep tissue burn. It can be concluded that the rate of amputation varies by electrical voltage proportionately. A large number of the patients who suffered from serious complications and sequels like limb amputation were young men who had started their social activities and job. It is obvious that they were unable to return to their previous job if they had limb amputation. As a suggestion it is valuable to evaluate their future work situation if there is any chance for returning to the same work in this amputated workers group.

Our study showed that in high voltage patients need more hospitalization than low voltage patients, that suggest more costs, time and also severe damages is in high voltage injuries.

We found significant association between frequency of amputation and voltage. Although it is difficult to determine the significance of any particular factors in amputation rate, we suggest that extent of was directly related to the injuring voltage.

There was significant association between voltage and place which injury had occurred, such as more high voltage injuries were occurred first outdoor and then in work place, while most of low voltage injuries were occurred in home. It could be because of using tools with high voltage in work place, so more attention and care in these injuries is needed.

5. Conclusion:

High voltage injuries constitute large number of electrical injuries which more of these injuries occur outdoor and in workplace and need more hospitalization. High voltage injuries are related with more amputation, so people and authorities should pay more attention to such injuries. Also Training for protection should be mandatory for the workers, and then they could be able to protect themselves by disconnecting from electrical sources immediately.

References

1. Koumbourlis AC. Electrical injuries. Crit Care Med. 2002;30:424-30.
2. Tintinalli J, Stapczynski J, Ma OJ, Cline D, Cydulka R, Meckler G, Tintinalli's Emergency Medicine: A Comprehensive Study Guide. 7thed. McGraw Hill. 2010.
3. Singerman J, Gomez M, Flish JS. Long-term sequel of low-voltage electrical injury. J Burn Care Res. 2008;29(5):773-7.
4. Chudasama S, Goverman J, Donaldson JH, van Asalt J, Cairns BA, Hultman CS. Does voltage predict return to work and neuropsychiatric sequelae following electrical burn injury? Ann Plast Surg. 2010;64(5):522-5.

5. Tarim A, EzerA. Electrical burn is still a major risk factor for amputations. Burns. 2013;39(2):354-7.
6. Arnoldo B, Klein M, Giibran NS. Practice guidance for the management of electrical injuries. J Burn Care Res. 2006;27:439-47.
7. Saukko P, Knight B. Forensic Pathology. 3rd ed. London: Arnold press. 2004.
8. Maghsoudi H, Adyani Y, Ahmadian N. Electrical and lightning injuries. J Burn Care Res. 2007;28(2):255-61.
9. Soto CA, Albornoz CR, PenaV, Arriagada C. Prognostic factor for amputation in severe burn patient. Burns. 2013;39(1):126-9.
10. Aghakhani K, MehrpishehSh, Memarian A, Taheri I.Demographic Characteristics of Pediatric Burn in ShahidMotahhari Hospital. International Journal of Medical Toxicology and Forensic Medicine. 2013;3(1):28-33.
11. Arnoldo BD, Purduc GF, Kowalske K, Helmpa. Electrical injuries: a 20-years review. J Burn Care Rehabil. 2004;25(6):479-84.
12. Luz DP, Millan LS, Alessi MS, Uguetto WF, Paggiaro A, Gomez DS, Ferreira MC. Electrical burns: a retrospective analysis across a 5-year period. Burns. 2009;35(7):1015-9.