

PATTERN OF SEVERE ELECTRICAL INJURIES IN A NIGERIAN REGIONAL BURN CENTRE

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ABSTRACT

Background: Electrical injuries, though uncommon usually have devastating consequences. They are largely preventable. The objectives of the study were to highlight the pattern of severe electrical injuries seen in our environment, the management problems faced here compared with other studies and proffer suggestions for improvement and prevention.

Methods: A 10-year retrospective study of case files of patients seen with electrical injuries in our centre was carried out from January 1995 to December 2004. Case notes were retrieved and data collated from them were analysed by descriptive statistics.

Results: Twenty four (24) case files met the inclusion criteria and were analysed. Electrical burns constituted 2.8% of total burn admissions. Patients' ages ranged from 15 months to 42 years. Male: Female ratio was 4.8:1. Seven (29%) had high voltage injuries, mostly work-related. Sixteen (67%) had low voltage injuries while one (4%) had a lightning injury. Fourteen (58%) presented or were referred more than 24 hours post injury. Fifteen (63%) had a form of surgical treatment with wound debridement (33%) skin grafting (38%) and amputations (29%) being the commonest ones. The mortality was 12.5% with septicaemia as the leading cause of death.

Conclusion: Late presentation of patients to specialised centres, inadequate management at the primary centres of treatment, poverty and inadequate facilities even at the specialised centres were the main problems encountered.

We recommend re-education of the populace including medical practitioners, enforcement of safety rules in the home and workplaces and upgrading of our health facilities to decrease the menace of severe electrical injuries.

Key Words: Electrical burn, Pattern, Management, Prevention.

INTRODUCTION

Electrical burn can be quite devastating. In several studies on burns in our sub region and other places, they constitute a small percentage of total burns¹⁻⁹. It is most common in the male in the productive age group^{2, 4, 5, 9-11}. Management of the electrically injured patient can be quite tasking. In our environment, poverty, ignorance and dearth of specialised facilities and manpower are compounding problems.

The destructive effects of electricity can result from both direct and indirect contact with the body. The factors determining severity of injury include the type of current (direct or alternating) parts of the body involved, earthing, duration of contact, resistance of the tissues, strength of the current and its peculiar characteristics, amperage and voltage (high or low tension), surrounding circumstances and secondary events^{1,2,4,6,10,12}.

Specific studies on this unique form of injury in

our environment are still scanty. National Orthopaedic Hospital Enugu is a regional trauma centre serving the entire old Eastern Nigeria and parts of the South-South and North-Eastern regions. It has a catchments population of over twenty million mostly rural dwellers. Electricity supply is yet to reach the majority of the populace and supply is epileptic in those areas supplied. Patients travel long distances with poor transportation and road networks to get to our centre. In addition patients electrocuted during criminal activities are unlikely to report to our centre for fear of being caught by security agents.

This hospital based study aims at highlighting the pattern of severe electrical injuries seen in our environment, identifying the peculiar problems encountered in their management, comparing with other parts of the world and proffering solutions for improvement. It will also serve as part of the baseline for further studies on electrical injuries in Nigeria.

Excluded from the study are patients with incomplete records, those with less than 24 hours hospital stay, those treated on out patient bases and those brought in dead. The study exclusion criteria

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no doubt reduced the study cases. However the number twenty four was similar to the number reported in the literature from other studies^{3,4,5,8,10,13}

PATIENTS/METHODS

This is a hospital based retrospective study of consecutive patients with severe electrical injuries managed at the National Orthopaedic Hospital Enugu over a ten year period, January 1995 to December 2004. Information extracted from the case notes included bio-data like age and gender, mechanism and circumstances of injury, injury pattern, treatment modalities including surgeries and amputations, outcome of treatment, length of hospital stay and mortality rate. Only patients case notes that met the inclusion criteria were studied. The data was analysed by descriptive statistics as presented here.

RESULTS

A total of twenty four case notes were reviewed. Ages ranged between 15months to forty-two years. Fig.1 Mean age was 24 while the mode and median were in the 21-30year age group.

There were nineteen males (19) Males (79%) and Five (5) Females (21%), giving a Male: Female ratio of 4.8:1.

Table 1 shows time interval between injury and presentation to hospital. Only four (4) patients (17%) presented within 6 hours of injury.

Table 2 shows disposition of the patients. 58% had work-related injuries and 67% low voltage injuries.

Table 3 shows areas involved. 83% involved the upper extremities.

Table 4 shows surgical procedures carried out on the patients. 37.5% had skin grafting while 29% had amputations.

Figure 2 shows amputated parts. The upper limbs accounted for 57% of amputations. There were three deaths giving a percentage mortality of 12.5%. Two of the deaths (66.7%) were from septicaemia while one was recorded as cardiac arrest.

Figure 1: Age Range.

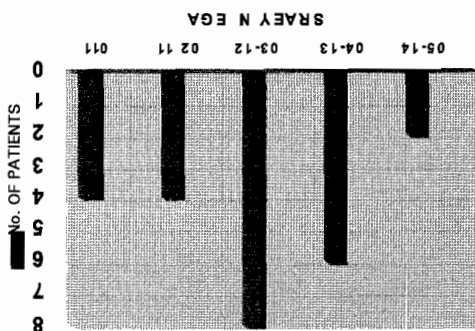


Figure 2: Levels of Amputation

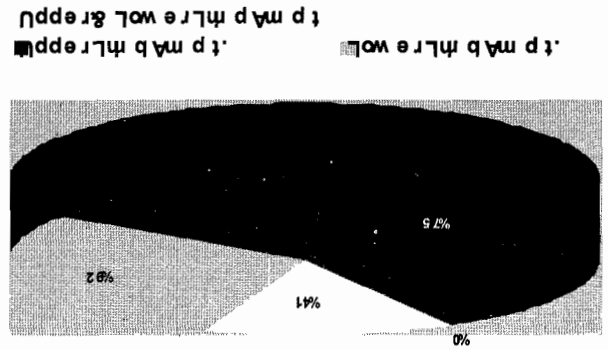


Table 1: Time Interval of Presentation from Scene of Injury

| Time of Presentation | No of Patients | % |
|----------------------|----------------|------|
| <6hrs | 4 | 17% |
| 6-24hrs | 6 | 25% |
| 24-48hrs | 4 | 17% |
| >48hrs | 10 | 41% |
| Total | 24 | 100% |

Table 2: Nature of the Injury

| Injury | Work Related | Non-Work Related | Total | % |
|--------------|---------------|------------------|-----------------|----|
| High voltage | 6 | 1 | 7 | 29 |
| Low Voltage | 8 | 8 | 16 | 66 |
| Lighting | - | 1 | 1 | 4 |
| Total | 4(58%) | 10(42%) | 24(100%) | |

Table 3: Region of the Body Involved

| | High Voltage | Low Voltage | Total | % |
|-------------------|--------------|-------------|-------|----|
| Upper Extremities | 7 | 13 | 20 | 83 |
| Head & neck | 1 | 8 | 16 | 29 |
| Trunk | 4 | 1 | 1 | 29 |
| Perineum | - | - | - | 0 |
| Lower Limbs | 6 | 1 | 7 | 29 |

Table 4: Type of Surgery

| | High Voltage | High Voltage | Total (%) |
|----------------------------|--------------|--------------|-----------|
| Fasciotomy | 1 | 1 | 2(8) |
| Surgical Wound Debridement | 3 | 5 | 8(33) |
| SSG | 4 | 5 | 9 (38) |
| Contracture Release | 2 | 4 | 6 (18) |
| Flap Cover | 1 | 1 | 2 (8) |
| Amputation | 6 | 1 | 7 (29) |

DISCUSSION

Electrical injuries are an uncommon form of injury constituting 2.8% of our burn admissions over the period under review. Iregbulem & Nnabuko³ in a study done in this hospital from 1982 & 1987 found a 0.6% incidence of electrical burns in children while Achebe & Akpuaka⁸ found a 3% incidence in a study involving all age groups. These are similar to ours and also to figures quoted in like studies in other developing countries^{1,13} but lower than figures from more developed societies^{4,14}. This may be because of wider distribution and almost constant supply of electricity in these areas, thus increasing exposure.

The age distribution of the patients in our study was similar to that reported in other studies^{1,2,4,5,10,11}. Most of them were within the productive age group. No Elderly patient was involved unlike what obtains in developed countries like France and England^{6,7}. Apart from differences in the population structure, the other possible explanation for this is that most of our elderly patients are sedentary and live in the rural areas where electricity is rarely available, thus limiting exposure.

There was a male preponderance, with a male to female ratio of 4.8:1. Though similar to figures quoted in many developing societies, it is lower than ratios reported in a study in the developed world⁴. It is however higher than that reported from India⁹. This may be due to poorer home and environmental safety in most developing regions, increasing exposure to this hazard in the home environment where most women sustain this form of injury as shown in this study.

These accidents were work related in 58% and non work related in 42% of the cases, suggesting that these are more often occupational injuries. This is in agreement with other studies^{4,6}. 85% of the high voltage injuries were work related with 66.7% of them being workers with *Power Holding Company of Nigeria PLC* (PHCN) formerly *NEPA*. The figure of 42% for non work related cases may however be on the high side when compared to western studies⁵, but comparable to figures quoted in a developing country⁶. This may be due to poor home safety measures, defective town planning and the low level of public awareness seen in most developing societies like ours. The upper extremities were more often involved in our study with the perineum spared in agreement with international data^{1,6}.

Wound debridement and split thickness skin grafting were among the commonest surgeries performed on our patients. This finding is in agreement with reports from similar studies^{1,6,11,15,20}. Of note however was the fact that fasciotomy and escharotomy were not commonly performed on our patients. This is in contradistinction to what obtains in most developed

countries, where fasciotomy and escharotomy rank amongst the commonest procedures carried out on these patients^{9,16}. This finding is as a result of late presentation to specialist hospitals and poor appreciation of the need for these procedures by primary health practitioners to whom these patients present in the earlier period of injury when these procedures are mostly required. Though we noted a higher surgery rate than that reported in other studies^{2,14,16}, this did not necessarily translate to a better outcome. This is because these surgeries were often delayed due to various factors like cost as patients must pay and provide materials for surgery before operation, inadequate blood bank support and relative lack of sophisticated facilities. This delayed surgical treatment has been clearly shown in various studies to worsen morbidity and mortality^{10,16,17}. In addition to this, the patients end up staying in hospital for a long period of time as reflected in this study, with an average hospital stay of 44 days; more than twice that reported in a similar study in Canada⁵. The high voltage injured patients had a longer hospital stay with an average of 77 days than the low voltage injured patients with average of 28 days.

The amputation rate appears high (29%) as in other studies^{6,9,14}. The most important factor determining the risk for amputation appears to be the voltage strength. Eighty six percent (86%) of patients with high voltage injury required a form of amputation. These surgeries were rather life saving, than limb saving. Our mortality rate of 12.5% was similar to that reported by another author¹¹ but higher than the 0%-4% reported in other studies⁴. This appears to point to the fact that *early* aggressive and not just aggressive treatment is the key to an improved outcome. The commonest cause of death was septicaemia. Others have reported cardiovascular deaths as being the commonest^{1,18,19}. Our finding is partly due to late presentation, and partly due to delayed and often inadequate surgical treatment. Fifty eight percent of our patients presented after 24 hours, when most of the cardiovascular deaths would have occurred. Only 17% presented within 6 hours of injury and of the rest only 25% had resuscitation adjudged to be adequate at the time of presentation from the referral centre.

Education of the populace on electrical safety measure and enforcement by employers of labour like PHCN will surely reduce mortality as seen in other places²⁰. Very important also is education of medical students and re-education of medical practitioners on the role and methods of early adequate resuscitation and referral of these unfortunate victims. Provision of adequate functional facilities at tertiary health institutions like ours can not be over emphasised.

REFERENCES

1. **Subrdmanyam M.** Electrical burn injuries. *Ann. of Burns & Fire Disasters* 2004; Vol. XVII- n. 1.
2. **Remensnyder JR.** Acute electrical injuries. In: *Acute management of the burned patient.* J.A.J. Martyn (Ed.), W.B. Saunders, Philadelphia, 1990.
3. **Iregbulem LM, Nnabuko RE.** Epidemiology of Childhood Thermal injuries in Enugu, Nigeria; *Burns* 1993 19 (3); 223-226
4. **Saadat Ali Janjua.** High Voltage Electrical Injuries *J. Coll Physicians Surg. Pak.* 2002; 12 (3): 140-2
5. **Edward E, Tredget, Heather A.** Shankowsky, and Wendy A. Tilley; Electrical injuries in Canadian burn care: Identification of unsolved problems; *Ann. of New York Academy of Science* 1999; 888:75- 87.
6. **Jorge A, Martinez and Thai Nguyen.** Electrical Injuries. *Southern Medical Journal* 2000; 93 (12): 1165-1168.
7. **EI-GallalARA, Yousef SM.** Pattern of electrical injuries in Al-Jala Hospital Burns Units. *Ann. of Burns and Fire Disaster* 1998; Vol. XI-Nov. 4.
8. **Achebe John I, Akpaka FC.** Chemical Burns in Enugu; *W. Afr. J. Med.* 1989 8(3): 205-207.
9. **Gupta M, Gupta OK, Yaduvanshi RK, Upadhyaya J.** Burn Epidemiology; The Pink City Scene; *Burns* 1993 19 (1): 47-51
10. **Lochaitis A, Iliopoulou E, Poulikakos LG, Asfour S.** Electrical Burns: A Survey of 24 cases. *Ann. Medict. Burns Club* 1992; 5: 75- 7
11. **Georgiade G S, Riefkohl R, Levin LS.** In *Georgiade Plastic, Maxillofacial & Reconstructive Surgery* 3rd Ed 1997; Williams & Wilkins Baltimore p 210.
12. **Greco Richard.** *Emergency Plastic Surgery;* Little, Brown & Com. 1991, P.46-47.
13. **Kidanu Estifanos Nega, Bernt Lindtjorn.** *Ethiop. J. Health Dev.* 2002; 16 (1): 1-7
14. **Faggiano G, De Donno G, Verrienti, Savoia.** A High Tension Electrical Burns; *Ann. of Burns and Fire Disasters* 1998; 11: 162- 4.
15. **Barry Press.** In *Grabb & Smith's Plastic Surgery* 5th Ed. Lippin Cott-Raven Publishers, Philadelphia, 1997 p 186- 187.
16. **Holliman CJ, Staffle JR, Kravitz M et al.** Early surgical decompression in the management of electrical injuries. *Am. J. Surg.* 1982 (44): 733- 9.
17. **Parshely PF, Kilgore J, Pulito JF et al.** Aggressive approach to the extremity damaged by electric burns. *Am. J. Surg.* 1985; 150: 78-82.
18. **Govila A.** Early Excision and Primary Resurfacing of wounds following high voltage electrical burns; *Eur. J. Plast. Surg.* 1989; 12: 147- 54.
19. **Haberal M.** Electrical burns: A 5 year experience; *J. Trauma* 1986; 26: 103-9
20. **Ghosh A, Bharat R.** Domestic burns Prevention and first Aid awareness in and around Jamshedpur, India; *Strategies & Impact; Burns* 2000 26; 605-608.