Research Article

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STRATEGIC ANALYSIS OF ELECTROCUTION FATALITIES IN RURAL SOUTH INDIA OBSERVED IN A YEAR

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ABSTRACT

Background: This study was performed to analyse the frequency, profile and pattern of injuries among electrocution fatalities.

Materials & Methods: Cross sectional study of all electrocution deaths autopsied at Puducherry during the calendar year 2013. We gathered incident information from the relatives & investigating officers, autopsy findings are interpreted and data were analyzed for results.

Results: Electrocution deaths have accounted for 1.29% of all medicolegal autopsies (n=1320) conducted at our study centre during the study period. The chief victims are males and adults in their third and fourth decade of life. The majority of the victims are Hindus, literates, agricultural workers and from rural background. The prime body part injured in electrocution are hands and fingers (65%), followed by soles and toes. Entry marks and exit marks alone were noticed in 47% and 18% respectively, but both marks were noticed in 30% of cases. Most electrocution incidents were occurred during summer season and during the day times. All the cases are accidental in nature.

Conclusions: Electrocution deaths are only a small proportion of unnatural deaths and they are prevalent in domestic and occupational places. Health education & safety precautions are in need to reduce the electrocution mortalities.

Key Words: Electrocution fatalities, Autopsy, Entry and Exit marks, Domestic

INTRODUCTION

Electric current is of greatest importance at domestic and occupational places in today's human life. The amount of body damage caused by the electric current depends upon the type, strength and duration of exposure. Electrical injuries are responsible for considerable morbidity and mortality in developed countries, even with significant improvement in product safety[1] and implementation of rules and regulations. In low income countries electrocution deaths are emerging into an public health problem because of lack of awareness and poor safety issues.[2] Indian national data on accidental deaths and suicides for calendar year 2010 & 2011 has reported 9059 & 8945 electrocution deaths respectively, with a share of 2.4% of total accidental deaths.[3] Almost every electrocution death is an accidental one, but very rarely it is either suicidal or homicidal.[4] Puducherry has reported the highest rate of accidental deaths as compared to the national average. This study was designed to know the frequency, victim's profile, pattern of electrical injuries & manner of death among the study population.

MATERIALS & METHODS

This autopsy oriented, cross-sectional study was conducted at the department of Forensic Medicine, Indira Gandhi Government General Hospital and Postgraduate Institute (IGGGH & PGI), Puducherry during the calendar year 2013 (from 1st January to 31st December). All cases of electrocution deaths autopsied at the study centre were considered. We gathered detailed history of electrocution incident, demographic profile and thereof

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of each case by personal interview with family members / accompanying person, police officers and by referring hospital records.

The medicolegal autopsy was conducted meticulously from head to toe. The deceased was examined thoroughly for electrical injuries and any other mechanical injuries over the body. Ethical principles were upheld by maintaining confidentiality and by obtaining consent from the relatives & medical record department. Finally the deceased profile, examination findings and ancillary investigation (histopathological, chemical analysis) data were collected, entered into Microsoft Excel (2007) sheet, and analyzed for frequencies and percentages. The results were interpreted by using tables and bar diagrams.

RESULTS

1320 medico-legal autopsies were conducted in the study center during the calendar year 2013, among that 17 (1.29%) were on electrocution fatalities. The chief victims were males (gender ratio of 3.2:1) and adults in the age group of 21-40 years (53%) *(Table 1)*. Demographically most victims belonged to Hindu religion (82%), Rural background (53%), Married (53%), Literates (70%) and lower socioeconomic status (59%) *(Table 2)*.

The occupation of the victims was categorized as follows; agricultural workers (29%), laborer (18%), students (18%) and housewives (12%) *(Figure 1)*. To a great extent these incidents were occurred in the summer seasons, *(Figure 2)* and during day times between 6 AM to 6 PM (76%) *(Figure 3)*. It was remarkable that victims were electrocuted while handling domestic appliances in the house (47%), industrial machines (18%) and electric wires (12%). It was noticed that 65% cases were found dead at the scene of crime and the rest were declared dead at the hospital. The frequent location for entry and

Table 1: Gender and Age distribution of fatal cases.

Age groups (in years)	Male gender	Female gender	Number & Percentage of cases
0-10	01 (06%)	01 (00%)	03 (18%)
11-20	02 (12%)	00 (00%)	02 (12%)
21-30	04 (24%)	01 (06%)	05 (30%)
31-40	03 (18%)	01 (06%)	04 (24%)
41-50	02 (12%)	00 (00%)	02 (12%)
51-60	01 (06%)	00 (00%)	01 (06%)
> 60	00 (00%)	01 (06%)	01 (06%)
Total	13 (76%)	04 (24%)	17 (100%)

Table 2: Demographic profile of fatal electrocution cases.

Demographic profile				Total
Domicile status	Rural 09 (53%)	Semi-urban 05 (30%)	Urban 03 (18%)	17 (100%)
Religious Status	Hindu 14 (82%)	Muslim 02 (12%)	Christian 01 (06%)	17 (100%)
Educational Status	Literates 12 (70%)	Illiterates 05 (30%)	-	17 (100%)
Socioeconomic status	Higher 02 (12%)	Middle 05 (30%)	Lower 10 (59%)	17 (100%)
Marital status	Married 09 (53%)	Unmarried 07 (41%)	Widow 01 (06%)	17 (100%)

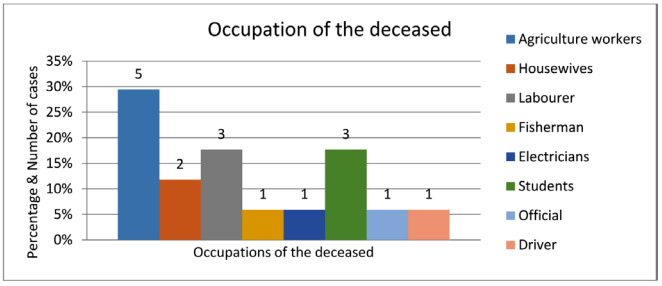

Figure 1: Occupation of the deceased

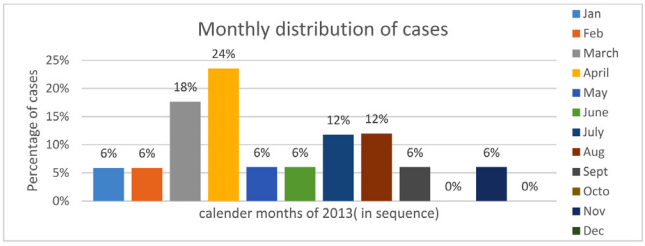

Figure 2: Monthly distribution of electrocution deaths

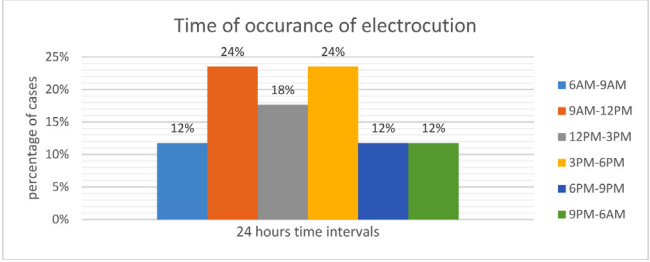

Figure 3: Time of electrocution incidents

Table 3: Type and location of electrical injuries observed over the body at autopsy.

Type of electrical injuries	Number of cases	Percentage	Location of electrical injuries	Number of cases	Percentage
Only entry mark	08	47%	Hand & Fingers (Upper extremity)	11	65%
Only exit mark	03	18%	Sole & Toes (Lower Extremity)	04	24%
Both entry & exit marks	05	30%	Head & Neck	01	06%
No entry or exit marks	01	06%	Chest	01	06%
Burns	02	12%	Abdomen	00	00%
Other injuries	06	35%	Pelvis	00	00%

exit wounds of electrical injuries are hands & fingers (65%) of upper extremities and soles & toes (17%) of lower extremities respectively *(Table 3)*. The manner of death was accidental in nature in all cases and no suicidal or homicidal death was reported.

DISCUSSIONS

We noticed, the low frequency of electrocution deaths (1.29%) in this region compared to studies conducted in various parts of India and abroad (1.9 to 3.3%).[5,6,7,8] The frequency of electrocution fatalities in each territory depends upon multiple factors like weather non-uniformity, education status & awareness of electrocution in general public, safety measures adopted by the public and also rules and regulations followed by the government. Males are predominantly victimized than females, having a resemblance to the conclusions of studies conducted in Coimbatore, South Delhi, Nagpur and Manipur on electrocution deaths. [4,5,6,9] The adults of second to fourth decade are in a vulnerable position to electrocution deaths, but these incidents were rare in extremes of ages. The age findings of the present study are in more congruous with Rautji work (21-40 years). [5] Age group in danger was narrowed to 21-30years in few studies [4,9] & quite wider in most other studies (20-50 years). [6,10] Adult males are more often actively engaged in electricity dependent occupations, either at their workplace or home during their second to fourth decades, hence they are prone to electrocution hazards.

Demographically most deceased are Hindus (82%), Rural people (53%), Married (53%), Literates (70%) and low socioeconomic status (59%). The main occupation of the victims was reported to be agriculture (30%), laborer (18%), students (18%) and housewives (12%). These people are at greater risk of electrocution because of their poor level of education, lack of awareness of electrical hazards and wrong handling of electric appliances at work places. Higher incidents of electrocution deaths during summer may be due to increased humidity and high usage of electric appliances, and these findings are in consistent with Tirasci study.[8] Nearly three-fourth of electrocution accidents were occurred during day time, which is in harmony with highest usage of domestic appliances and industrial machines actively during day times. Approximately three-fourth of the victims were found dead at the scene of the crime and the rest were declared dead at the hospital. The maximal deaths are due to AC current used for domestic purposes (AC, 220-240 Volts) and due to it's "catch on effect". 61% of victims were found dead at the scene of crime in Tehran study[11] and 80% died immediately after electrocution in Manipur study.[9]

The distinct injury marks produced at the site of contact with electric wire (entry mark) and joule burns in electrocution cases can be considered as a classical external sign of electrocution. Entry mark alone were seen in nearly half of the autopsied cases, comparatively the exit mark alone were less than one-fourth of cases, but both marks were noticed nearly in one-third of cases. Previous studies have reported much higher percentage of entry marks varying from 72% to 86.27%.[5,8,9] The hands and fingers of the upper extremities are the most frequent sites for electrical injuries (entry marks), while exit wounds were commonly located on the soles & toes of lower extremities, because extremities are the most common sites of contact with the source of electric current. Similar findings were reported from other studies.[5,8,9]

The chemical investigations were carried out in nine cases and it was found positive for alcohol consumption in three cases. The histological examination of the skin from suspected electrical injury marks were useful for diagnosis in eleven cases. The chemical analysis of the viscera and histopathological examination of the skin from the injury site may be useful in deriving the cause and manner of death in suspected electrocution deaths.

It was remarkable that the manner of death in all the studied cases was determined to be accidental in nature, no suicidal or homicidal cases were reported. Suicidal and homicidal electrocution deaths are very rare to occur. History, visit to the scene of crime, circumstantial evidences, autopsy findings and accessory investigations methods will be very useful to determine the cause of death.

Limitations and suggestions of this study- small sample size, not able to arrive at the exact cause of death based on autopsy findings alone, hasn't visited the scene of crime in most cases & thus manner of death was declared based on the history and autopsy findings. Ancillary investigations were not performed in all cases, but it was useful in deciding the cause and manner of death in investigated cases. Data of electrocution deaths among Puducherry may be useful for statistics, preventive steps and remedies.

CONCLUSIONS

Most of the electrocution deaths were overwhelmingly occurred in middle aged males and during the daytimes, when they are actively involved in the home or workplace activities. These incidents are preventable by endorsing simple safety precautions at work place and home, and also by imparting health education at community levels. Almost all incidents are accidental in nature, but it is difficult to distinguish the manner of death in certain circumstances.

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REFERENCES

1. Koumbourlis AC. Electrical injuries. *Critical care Medicine* 2002;30:424-30.
2. Mashreky SR, Rahman A, Khan TF, Svanstrom L, Rahman F. Epidemiology of Childhood electrocution in Bangladesh: findings of national survey. *Burns* 2010;36:1092-5.
3. Accidental deaths and Suicides in India 2011. National Crime Records Bureau. Ministry of Home Affairs. Available at http://ncrb.nic.in/CD-ADSI2011/ADSI-2011%20REPORT.pdf. accessed on 24 June 2014
4. Shaha KK, Joe AE. Electrocution-related mortality: A retrospective review of 118 deaths in Coimbatore, India, Between January 2002 and December 2006. *Med Sci Law* 2010 Apr;50(2):72-4.
5. Rautji R, Rudra A, Behara C, Dogra TD. Electrocution in South Delhi; A retrospective study. *Med Sci Law* 2003; 43(4):350-2.
6. Shrigiriwar M, Bardale R, Dixit PG. Electrocution: A six year study of Electrical Fatalities. *JIAFM* 2007;29:50-3.
7. Cekin N, Hilal A, Gulmen MK. Medicolegal childhood deaths in Adana, Turkey. *Tohoku J Exp Med* 2005; 206:73-80.
8. Tirasci Y, Goren S, Subasi M, Grukan F. Electrocution related mortality: A review of 123 deaths in Diyarbakir, Turkey between 1996 and 2002. *Tohoku J Exp Med* 2006 Feb;208(2):141-5.
9. Ragui S, Meera T, Singh KP, Devi PM, Devi AS. A study of electrocution deaths in Manipur. *J Med Soc* 2013; 27:124-6.
10. Gupta BD, Mehta RA, trangadia MM. Profile of deaths due to Electrocution: A retrospective study. *JIAFM* Jan-March 2012;34(1):13-15
11. Sheikhazadi A, Kiani M, Ghadyani MH. Electrocution –related mortality; A survey of 295 deaths in Tehran, Iran between 2002 and 2006. *Am J Forensic Med Pathol* 2010;3:42-5.