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FATAL ELECTROCUTION
A 10-YEAR RETROSPECTIVE STUDY IN THE LISBON AREA[1]

Abstract: Electric current can determinate a fatal outcome – electrocution – which is a relatively unique death. The aim of our 10-year retrospective study is to characterize the trend of deaths by electrocution occurred within the Lisbon Area. Database of the Forensic Pathology Department, between 1999 and 2008, was scanned for fatal electrocution, and several medico-legal variables were analysed. Of the 25 victims, only one was female, 60% were between 18 and 34 years-old and 64% had professions related to construction and electricity industries. Death occurred on place in 76%, the passage of current was direct in 76%, related to low voltage in 52%, and in 68% was the result of a labour accident. Electrical burns were found in 84% and thermal burns in about 50%. Signs of passage of electric current were identified in about 50%. Ethanol and cocaine were present in 2 separated cases. Death was caused directly by the passage of electric current in 84%, of which 24% were associated with blunt force trauma or thermal burns. Results are quite similar to those of other studies, and underscore the importance of a better understanding of the phenomenon in order to prevent this kind of fatal incidents.

Keywords: Fatal electrocution; electric burns; labour accidents; forensic pathology.

Introduction

Electric current is a physical agent that acting within the body can determine a fatal outcome. Nevertheless, despite the common use of electricity, electrocution also referred to as electrical injury, is relatively rare [1]. Most cases result from accidents, suicides are less usual and homicides extremely rare. Fatalities caused by electrocution depend on many factors such as individual's characteristics, environmental factors and electric current features, especially the source of electricity [2]. In most fatal electrical accidents, death is caused by the passage of the electric current itself and should be suspected whenever an individual falls while near a charged source [1]. Not uncommonly the electrotrauma becomes associated with mechanical injury. Usually

[1] Preliminary results presented at the XXI Congress of the International Academy of Legal Medicine, May 2009, Lisbon – Portugal.

these type of deaths often lack characteristic morphologic findings and specific results are absent in autopsies, which can cause considerable problems to the correct diagnosis of electrocution [1, 3-5].

Therefore the objectives of our retrospective study is to characterize the victims of fatal electrocution, investigate the presence of any trend of deaths, to better understand this phenomenon and to ascertain characteristics features aiming to a better identification and prevention of these situations.

Materials and methods

Autopsy cases of fatal electrocution were identified after scanning the database of the Forensic Pathology Department of the South Branch of the National Institute of Legal Medicine of Portugal (NILMP) concerning the Lisbon Area during a 10-year period, between January 1, 1999, and December 31, 2008.

In order to understand this type of fatalities, deaths due to or related to electrocution were carefully analysed regarding several variables, such as social-demographic ones, circumstances of death, available information and results of medico-legal autopsies.

In this study, regarding alternating current, low voltage current is considered between 50-1000 V, and high voltage is >1000 V, while for direct current, low voltage current is between 120-1500 V, and high voltage is >1500 V.

Results

During the 10-year period considered, a total of 14.663 autopsies were performed at the Forensic Pathology Department of the South Branch of the NILMP of which 25 cases were related to fatal electrocution.

Of the 25 victims only one was female. Concerning age, victims had a medium age of 29 years-old (range 8 months to 56 years), with 15 of the cases (60%) between 18 and 34 years-old (Figure 1). Two cases were children: 8 months and 2 years-old. According to occupation, 16 victims (64%) had professions related to construction and electricity industries (Figure 2).

Concerning the place of death, 19 cases (76%) deaths occurred on place after contact with electric current: 15 at the work place, 3 at home and 1 on train tracks. One case was related to a baby still found in contact with the electric source. In 2 cases (8%), death occurred during the transport to the hospital, and in 4 cases (16%) it occurred during the hospital admittance or after a hospitalization period of more than 13 days. In relation to time of death, 60% of fatal electrocution was registered during daytime, mainly between noon and 6 pm, at the work place.

The passage of current was direct in 19 cases (76%) (Figure 3). Low voltage was present in 13 cases (52%), high voltage in 10 cases (40%), and in the remaining 2 cases (8%) there was no information about the type of electric current (Table 1).

External examination of the body revealed electrical burns in 21 cases (84%), being the hands the anatomical region most affected. Thermal burns were found in 13 cases (52%), mainly due to Joule effect or to the ignition of garments, most of

them 2nd and 3rd degree burns (Figure 4). Seven of all cases with thermal burns were related to high voltage, with a more heterogeneous distribution of 1st, 2nd, 3rd and 4th degree thermal burns than in the cases related with low voltage (Figure 5). External blunt force trauma was found in 13 cases (53%), of which 6 had concurrent internal blunt force trauma, and in 3 cases blunt force trauma was considered to be the direct cause of death.

In the internal examination of the body, excluding non specific findings, only 12 cases (48%) had signs of electric current flow, mainly focal diaphragmatic haemorrhages (Figure 6). In 20 cases (80%), petechial haemorrhages were found. Organ congestion was present in 22 of the cases (88%), including 16 cases of generalized congestion (Figure 7). Organ oedema was present in 17 cases (68%), including 11 cases of oedema of the lungs (Figure 8). Most of the cases with signs of internal blunt force trauma had traumatic lesions on the head.

Toxicology exams were positive in two cases: 1,97g/l of ethanol in a labour accident, and 2650 ng/ml of cocaine metabolites in an otherwise not specified accident – a youngster painting graffiti at a subway station.

In 21 deaths (84%), the direct cause of death was due to the passage of electric current, of which 6 (24%) were associated to other causes of death: 3 (4%) to blunt force trauma; 2 (8%) to thermal burns or 1 (4%) to acute cocaine intoxication. In 4 cases (16%) the death resulted from infectious complications consecutive to electrocution.

According to the manner of death, 17 cases (68%) were the result of a labour accident. The remainder 8 cases (32%) were related to 4 household accidents, 3 accidents not otherwise specified, and one case of undetermined manner of death (Figure 9). The household accidents included: two children, a woman in the bathtub, and a man at home.

Discussion and conclusions

Overall, the findings of this study are in accordance with other similar studies. In fact the review of the literature shows a male predominance (81-91%), mostly due to accidents (near 70%), including 30% of labour accidents. Most deaths are due to low voltage current (65-83%). Almost 81-83% present characteristic electrical burns, mostly located at the fingers and feet. Petechial haemorrhages are present in 12-74% [3,5].

In the present study, considering all the 25 victims of fatal electrocution, 68% of deaths were due to labour accidents, all males, mostly with ages between 18 to 34 years-old and mainly related to building construction and electricity industries professions. 16% were household accidents including: two children, a woman in the bathtub and a man at home. Lack of any information, one case was considered as undetermined manner of death, probably a labour accident since there was cement on the body's surface. In 76%, death occurred in place, the passage of current was direct in 76% and related to low voltage in 52 %. External examination of the body revealed electrical burns in 84%, and in about 50% of the cases, there were thermal burns. Internal examination revealed signs of the passage of electric current in 48% of the cases, the majority of which were focal diaphragmatic haemorrhages. Toxicology findings revealed the presence of ethanol and cocaine in 2 different cases. Death was

caused directly by the passage of electric current in 84%, of which 24% were associated with blunt force trauma or thermal burns. In the other 16%, deaths were due to post electrocution infectious complications.

The current results point out the importance of a more extensive research concerning this cause of death, namely the identification of the circumstances of electrical injuries and underlying factors, in order to take proper preventive measures, especially in labour-accidents field.

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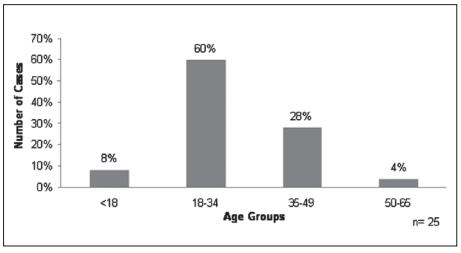

Figure 1 – Distribution by age groups

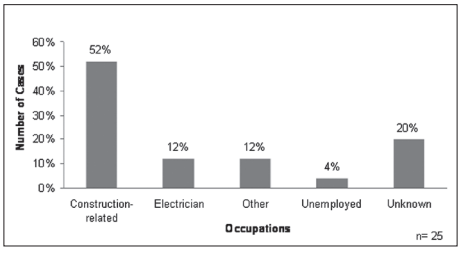

Figure 2 – Distribution by occupation

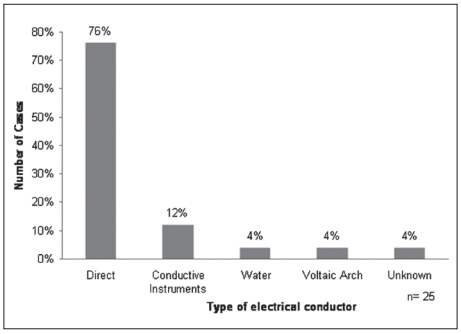

Figure 3 – Distribution by electrical conductor

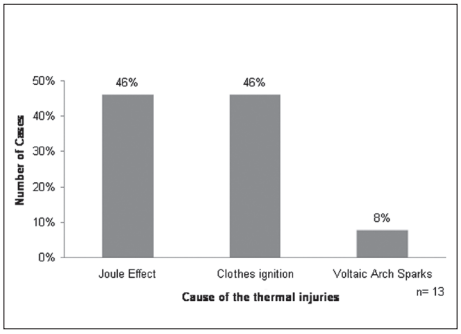

Figure 4 – Distribution by the cause of the thermal burns

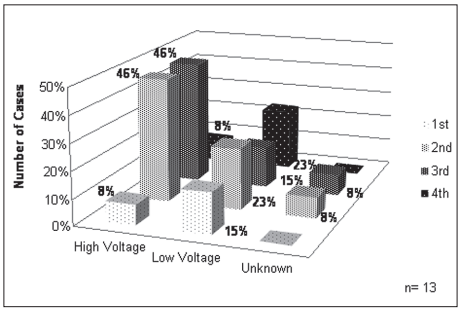

Figure 5 – Distribution of the thermal burns by the voltage of the electrical current

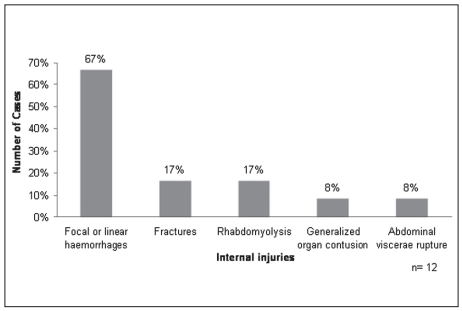

Figure 6 – Distribution of internal signs of current passage

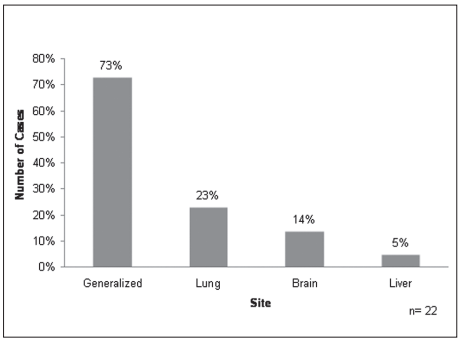

Figure 7 – Frequency of congestion

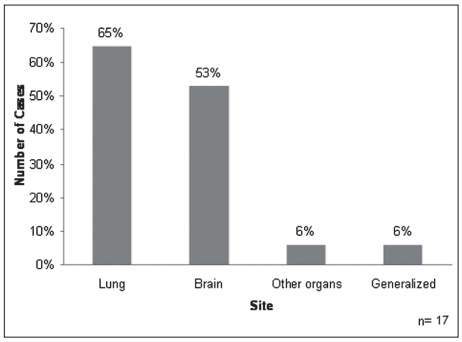

Figure 8 – Frequency of oedema

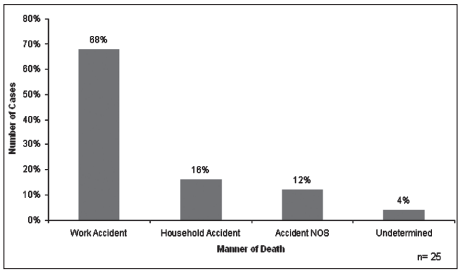

Figure 9 – Distribution by manner of death

Manner of death		Voltage		
		Low	High	Unknown
Accidents (total)		13	10	1
	Work accident	7	9	1
	Household accident	4	4	-
	Accident NOS	2	1	-
Undetermined		-	-	1
Total		13	10	2

Table 1 – Relation between manner of death and voltage of electric current