

Osmangazi Journal of Medicine

e-ISSN: 2587-1579

Forensic Medical Evaluation of Electric Shock Cases

Elektrik Çarpması Olgularının Adli Tıbbi Değerlendirilmesi

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Abstract: The study aims to examine the demographic characteristics, types of injuries, treatment processes and contents of forensic reports of patients admitted to the emergency department due to electric shock. This retrospective study included 132 patients admitted to Harran University Hospital between 2019-2024 due to electric shock. Patient data, including age, gender, presence of entry or exit lesions, whether a forensic report was kept, If a forensic report has been prepared, its content, anatomical location of the lesions, mortality status, and length of hospital stay, were obtained from the hospital's information management system. Of the 132 patients, 61.4% were male, with a mean age of 25.0±14.91 years, and 38.6% were female, with a mean age of 21.4±16.67 years. Electric shock incidents occurred most frequently at home (47%), followed by the workplace (18.9%) and outdoor areas (25%). Entry lesions were most commonly observed on the hands (48 cases), while exit lesions were most often seen on the feet (7 cases). Thirteen patients required intubation, and 7 of them subsequently died. A total of 11 patients died due to electric shock. Electrical injury cases are frequently observed in young adults and children and are particularly associated with domestic and occupational accidents. The presence of entry and exit wounds serves as a significant indicator of both clinical severity and the necessity for forensic evaluation. It is emphasized that emergency physicians should not only focus on clinical treatment but also require increased awareness and training regarding their responsibilities in forensic documentation.

Keywords: Electric shock; Electrical injury; Emergency department; Forensic evaluation

Ethics Committee Approval: This retrospective study was carried out with the permission of the Clinical Research Ethics Committee of Harran University Rectorate (Decision number: 11, dated: November 18th, 2024).

Informed Consent: It is a retrospective patient screening study. The study was conducted with permission from the hospital chief physician and ethics committee.

Authorship Contributions: Concept: UD, Design: HK, Data Collection or Processing: HK, HG, IU, Analysis or Interpretation: UD, HK, HG, Literature Search: HG, Author: UD, HK

Copyright Transfer Form: Copyright Transfer Form was signed by all authors.

Conflict of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Financial Disclosure: The authors received no financial support for the research, authorship, and/or publication of this article.

Received : 11.03.2025

Accepted : 02.05.2025

Published : 06.05.2025

Özet: Çalışma, elektrik çarpması nedeniyle acil servise başvuran hastaların demografik özelliklerini, yaralanma türlerini, tedavi süreçlerini ve düzenlenen adli rapor içeriklerini incelemeyi amaçlamaktadır. Bu retrospektif çalışmaya 2019-2024 yılları arasında Harran Üniversitesi Hastanesi'ne elektrik çarpması nedeniyle yatırılan 132 hasta dahil edildi. Hasta verileri, yaş, cinsiyet, giriş veya çıkış lezyonlarının varlığı, adli rapor tutulup tutulmadığı, adli rapor tutulmuş ise içeriği, lezyonların anatomik konumu, mortalite durumu ve hastanede kalış süresi gibi bilgiler hastanenin bilgi yönetim sisteminden elde edildi. 132 hastanın %61,4'ü erkek olup ortalama yaşları 25,0±14,91 yıl, %38,6'sı kadın olup ortalama yaşları 21,4±16,67 yıldır. Elektrik çarpması olayları en sık evde (%47) meydana gelirken, bunu işyeri (%18,9) ve dış mekanlar (%25) takip etti. Giriş lezyonları en sık ellerde (48 vaka) görülürken, çıkış lezyonları en sık ayaklarda (7 vaka) görüldü. On üç hasta entübasyon gerektirdi ve bunlardan 7'si daha sonra öldü. Toplam 11 hasta elektrik çarpması nedeniyle öldü. Elektrik çarpması olguları sıklıkla genç erişkinlerde ve çocuklarda görülmekte olup, özellikle ev ve iş kazaları ile ilişkilidir. Giriş-çıkış lezyonları, hem klinik ciddiyetin hem de adli değerlendirme gerekliliğinin önemli bir göstergesi olarak öne çıkmaktadır. Acil servis hekimlerinin, yalnızca tedavi değil, aynı zamanda adli raporlama konusundaki sorumlulukları konusunda daha fazla farkındalık ve eğitim almaları gerektiği vurgulanmalıdır.

Anahtar Kelimeler: Elektrik çarpması; Elektrik yaralanması; Acil servis; Adli değerlendirme

How to cite/ Atf için: Demir U, Gürbüz H, Kafadar H, Forensic Medical Evaluation of Electric Shock Cases, Osmangazi Journal of Medicine, 2025;47(4):550-555

1. Introduction

Injuries resulting from electrical current exposure are generally preventable through implementation of basic safety measures. These injuries manifest across a broad spectrum, ranging from low-voltage domestic accidents to high-voltage occupational incidents. While low-voltage injuries typically present with cutaneous burns and myalgia, high-voltage contact constitutes a medical emergency associated with significant morbidity and mortality risk, characterized by an extensive clinical spectrum encompassing severe tissue damage, cardiac arrhythmias, and potential fatality (1-5).

Electrical injuries occur due to various circumstances, including occupational accidents, domestic incidents, and high-voltage transmission lines. The nature and severity of physical damage observed in electrical injuries vary according to multiple factors, including duration of contact, voltage, whether the case is adult or pediatric and the pathway of current through the body. Consideration of these factors is of critical importance during the therapeutic process. Emergency departments, being the primary healthcare units where electrically injured patients initially present, play a pivotal role in implementing rapid and effective interventions to preserve life and initiate recovery processes (1,3,6,7,8).

Healthcare professionals attending to patients presenting to emergency departments following electrical injury bear a dual responsibility: addressing the immediate need for life-saving interventions and subsequently preparing a detailed forensic report. This documentation holds significant importance in legal investigations and in determining the precise mechanism of injury (2,9).

The increasing incidence of electrical injury cases in emergency departments in recent years has emphasized the necessity for healthcare professionals to conduct meticulous forensic evaluations for patients presenting with electrical injuries, in addition to diagnosis and treatment (2,9,10). Forensic medical assessment in electrical injury cases encompasses systematic documentation of injury patterns, including entry and exit wounds, and evaluation of secondary complications such as cardiac dysrhythmias and internal organ damage. Research and guidelines have indicated that such assessments require close collaboration between emergency services and forensic experts to ensure that clinical and legal data are recorded accurately (9,10).

In the Guideline On The Evaluation Of Injury Crimes Defined In The Turkish Penal Code From A Forensic Medicine Perspective, which is the guideline to be taken into consideration when preparing a forensic report in our country, it is stated that a report should be prepared stating that "Electric shock (in the presence of entry and/or exit lesions or clinical findings indicating that electric current has passed through the body)" is a life-threatening situation, whereas in the opposite case, that is, if there is no finding or clinical data indicating that electric current has passed through the body after an electric shock, a report should be prepared stating that there is no life-threatening situation (10).

This study aims to examine the demographic characteristics, types of injuries, and treatment processes of patients presenting to the emergency department due to electrical injuries. The primary objectives are to assess the prevalence of electrical injuries and emphasize the relationship between clinical management and forensic evaluation processes in electrical injury cases. The findings from our study are anticipated to contribute to the development of strategies for preventing electrical injuries and improving healthcare management.

2. Materials and Methods

Patient data, age, gender, whether there was an entry or exit lesion due to electric shock, whether a forensic report was kept, anatomical location of the entry or exit lesion if any, mortality status of the patients, and length of hospital stay were obtained from Harran University Hospital Hospital Information Management System (FONET). Hospital records for the 6-year period between 2019-2024 were retrospectively reviewed and cases admitted after electric shock were identified and included in the study.

A total of 132 cases from the FONET database were included in the study within the specified time period. The study covered all age groups available in the hospital system, and cases with incomplete or missing discharge summaries in the system or cases with missing data were excluded from the analysis. The location of the electric shock was classified as home, workplace, outdoor area and cases where the location of the electric shock was not defined in the medical document.

Statistical analysis

Data were analysed using SPSS for Windows version 21.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean and standard deviation (SD) values for continuous variables and as frequency (n) and percentage (%) for categorical variables.

The normality of continuous variables was assessed using the Shapiro-Wilk test. Although most variables did not follow a normal distribution, non-parametric tests were not extensively performed due to the limited number of comparison groups and the overall sample structure.

For categorical variables, group comparisons were made using the Chi-squared (χ^2) test, provided that the expected frequency in each cell was greater than 5. When this assumption was not met, results were interpreted with caution, or Fisher's exact test was considered where appropriate. A p-value < 0.05 was considered statistically significant in all analyses.

3. Results

In the 6-year period between 2019 and 2024, 132 patients were admitted to our hospital due to electric shock. Of the 132 patients, 81 (61.4%) were male, with a mean age of 25.0 ± 14.91 years (range, 5-75 years), and 51 (38.6%) were female, with a mean age of 21.4 ± 16.67 years (range, 1-64 years), with a mean age of all cases of 23.6 ± 16.12 years (range, 1-75 years).

Among the patients admitted after electric shock, 39.4% (n=52) were under 18 years of age, 36.4% (n=48) were between 18-34 years of age, 18.2% (n=24) were between 35-50 years of age, and 6% (n=8) were over 50 years of age.

All electric shock cases were observed to have occurred as an accidental origin, and no case of murder or suicide origin was found in the records. In electric shocks, the place of occurrence was observed as 47% domestic accidents, 18.9% workplace accidents and 25% outdoor accidents.

In a total of 59 cases with electric shock entry lesions: 48 cases were detected in the hand region, 8 cases in the arm region, 1 case in the foot region, 1 case in the perineal region and 1 case in the frontal region of the head.

In the case with electric shock in the penis region, a child who was electrocuted while urinating into a three-way electrical socket had an electric shock entry scar on his penis. In a total of 12 cases with electric shock exit lesions: 7 in the foot region, 3 in the hand region, 1 in the thigh region and 1 in the skull, an electric shock exit scar was detected.

After electric shock, 13 cases were intubated and 7 of the intubated cases later died. 6 cases were seen to be discharged healthy after medical follow-up and treatment after intubation.

In total, 7 of the 11 cases who died were intubated, the other 4 were admitted to the emergency room with GKS 3 and died after CPR was applied in the emergency room without the opportunity to be intubated. In our study, a statistically significant difference was found between the place of the incident and gender and age groups (p=0.000). A statistically significant difference was found between electric shock entry-exit lesion and forensic case entry and between cases that died with intubation. (p=0.011). No statistically significant difference was found between the other groups.

The mean hospitalization duration of the patients who were hospitalized, except for the patients who were discharged on the same day and died in the emergency department, was 5.3 ± 8.9 days (range, 1-49 days).

It was observed that a general forensic examination report (forensic report) was prepared in 106 cases. It was stated that "60 of the cases were life-threatening and could not be resolved with simple medical intervention, while 46 were not life-threatening and could be resolved with simple medical intervention". Since it was seen that no evaluation was made in other forensic parameters in the vast majority of the forensic reports, were not mentioned.

Table 1. Distribution of electric shock incidents and outcomes by gender.

Gender	Males	Females	Total	P-value
Scene of accident	n	n	n %	P=0.000
Domestic accidents	28	34	62 (%47,0)	
Workplace accidents	24	1	25 (%18,9)	
Accidents outside the home	21	12	33 (%25)	
Unknown	8	4	12 (%9,1)	
Forensic report issued				P=0.184
Positive	68	38	106 (%80,3)	

Negative	13	13	26 (%19,7)	
Total	81	51	132 (%100)	
Electric shock entry-exit lesion				P=0.144
Positive	42	17	59 (%44,7)	
Negative	29	28	57 (%43,2)	
Unknown	10	6	16 (%12,1)	
Total	81	51	132 (%100)	
Discharge Status				P=0.419
Exitus	8	3	11 (%8,3)	
Healthy discharge / burn center referral	73	48	121(%91,7)	
Total	81	51	132 (%100)	

Chi-square test was applied. Significance at $p < 0.05$ level.

Table 2. Distribution of electric shock incidents and outcomes by age.

Age Groups	0-17	18-34	35-64	>64	Total	P-value
Gender	n	n	n	n		P=0.156
Males	33	24	18	6	81 (%61,4)	
Females	19	24	6	2	51 (%38,6)	
Total	52 (%39,4)	48 (%36,4)	24 (%18,2)	8 (%6,0)	132 (%100)	
Scene of accident						P=0.000
Domestic accidents	37	18	4	3	62 (%47,0)	
Workplace accidents	1	11	10	3	25 (%18,9)	
Accidents outside the home	5	7	0	0	12 (%9,1)	
Unknown	9	12	10	2	33 (%25,0)	
Total	52 (%39,4)	48 (%36,4)	24 (%18,2)	8 (%6,0)	132 (%100)	
Forensic report issued						P=0.360
Positive	45	37	19	5	106 (%80,3)	
Negative	7	11	5	3	26 (%19,7)	
Total	52 (%39,4)	48 (%36,4)	24 (%18,2)	8 (%6,0)	132 (%100)	
Electric shock entry-exit lesion						P=0.232
Positive	27	19	11	2	59 (%44,7)	
Negative	23	22	8	4	57 (%43,2)	
Unknown	2	7	5	2	16 (%12,1)	
Total	52 (%39,4)	48 (%36,4)	24 (%18,2)	8 (%6,0)	132 (%100)	
Discharge Status						P=0.578
Exitus	6	2	2	1	11 (%8,3)	
Healthy discharge / Burn center referral	46	46	22	7	121(%91,7)	
Total	52 (%39,4)	48 (%36,4)	24 (%18,2)	8 (%6,0)	132 (%100)	

Chi-square test was applied. Significance at $p < 0.05$ level.

4. Discussion

Elucidating the mechanisms and anatomical distribution patterns of electrical injuries is paramount for implementing effective preventive strategies, optimizing clinical interventions, and conducting comprehensive medicolegal assessments in cases of inadvertent electrical trauma.

Many studies emphasize that men are at greater risk of electric shock, particularly in occupational environments and during tasks conducted outdoors

(9,11-16). In adults, electric shock mostly occurs in occupational environments and is the fourth leading cause of workplace-related traumatic deaths, and in children, electrical injuries mostly occur at home, and approximately 20% of all electrical injuries occur in children (9,14,15). Electrical injuries in children are most often caused by preventable low-voltage household currents and generally it is stated that it does not require further evaluation unless there is loss of consciousness, deep tissue damage,

or arrhythmia (17). In a study conducted by Dündar et al. on deaths related to electric shock injuries in children and adults, 47.2% of electric shock-related deaths were in children, and most children (81%) died at home due to electric shock (13). In a study Forensic cases presenting to the pediatric emergency clinic conducted by Demirdöken et al. It has been reported that male gender is found to be more common in electric shock cases (18). In our study, 61.4% of patients were seen in men, and this distribution is consistent with the literature supporting that electric shock cases are more common in men. It is also noteworthy that patients occur in children (1-17 years old) and in the younger age group (18-34 years old). This finding shows that the majority of electric shock cases are in children, in addition to home accidents, in individuals of working age and in high rates as work accidents. In our study, a statistically significant difference was found between the place of occurrence of the incident and between gender and age groups.

It was stated that in approximately two-thirds of electrical injury cases, the absence of typical electric marks on the body surface and, if the case has died, how to determine the death is a difficult situation in forensic medicine practice (4). Korkmaz et al. reported that electric shock entry lesions in the body were seen in the upper extremities at a rate of 46.9% (9). In our study, it was determined that the hands were more affected as the electric shock entry point and that there was an entry lesion in the upper extremities at a rate of 42.4%, in line with the literature. In our study, the detection of an electrical entry injury to the penis, particularly in a pediatric patient, represents a rare and unusual case. The incident involved an electric shock that occurred while the child was urinating into a multi-socket electrical outlet. This finding shows that electric shock can be seen in different anatomical regions and that the risks of electric shock events increase especially in children.

It has been reported that electric shock cases should be examined within the scope of forensic cases (9,13). In our study, it was observed that some cases were not reported as forensic, especially cases without electric shock entry-exit lesions were the majority, and a significant difference was found between electric shock entry-exit lesion and forensic case entry in the statistical evaluation. It was observed that the personnel working in the emergency department did not open a forensic case entry if the case was a simple electric shock, and opened a forensic case entry and prepared a forensic report in the presence of an entry-exit lesion suggesting that the electric shock could be serious.

External lesions that occur after electric shock were among the important clinical findings. In our study, especially after an electric shock in the nature of a work accident, falling from a height caused multiple traumas, and complications such as serious internal organ damage and multiple bone fractures were observed in some patients.

It has been stated that objective techniques such as FTIR spectroscopy can be used in the diagnosis of electrical injuries as an adjunct to histological examinations (19), and multidisciplinary approaches are important for early diagnosis and treatment, along with making imaging methods that can be used in the diagnosis of these and similar electrical injuries more sensitive and accessible.

Study limitations

The major limitation of the present study was that it was retrospective and we were unable to extract more descriptive data. Furthermore, this study was conducted in a single tertiary hospital 18 km from the city center in the southeastern part of Turkey, and large multicenter series are clearly needed for useful results that broadly reflect national data. Prospective studies involving a larger patient population are needed on this subject.

5. Conclusions

Electric shock remains a significant public health issue, particularly affecting younger and working-age populations due to domestic and occupational exposures. However, beyond clinical management, this study highlights the critical importance of detailed forensic evaluation in cases of electrical injury. The presence of entry and exit lesions was significantly associated with the issuance of forensic reports, revealing variability in the medicolegal approach among healthcare providers. This finding underscores the necessity for increased awareness and education among emergency physicians regarding their legal responsibilities in such cases. Therefore, future studies and institutional protocols should prioritize the integration of standardized forensic assessment procedures into emergency care practices to enhance both clinical outcomes and legal accuracy.

Understanding the mechanism and regional characteristics of electric shocks plays an important role in the prevention, medical management and forensic evaluation of these injuries. Future large-scale studies will be valuable in supporting existing data in this field and developing clinical guidelines, thereby contributing to more effective management of electrical injuries.

REFERENCES

1. Gentges J, Schieche C, Nusbaum J, Gupta N. Points & Pearls: Electrical injuries in the emergency department: an evidence-based review. *Emergency Medicine Practice*. 2018;20(Suppl 11):1-2.
2. Aydın F, Yavuz MS, Akin U, Kahraman İ. Forensic medical evaluation of electric shock injury. *Ege Journal of Medicine*. 2018;57(2):116-118.
3. Schissler K, Pruden C. Pediatric electrical injuries in the emergency department: an evidence-based review. *Pediatric Emergency Medicine Practice*. 2021;18(12):1-24.
4. Jin X, Chen D, Li X, Zeng X, Xu L, Hu B, Xu G. Advances in forensic diagnosis of electric shock death in the absence of typical electrical marks. *International Journal of Legal Medicine*. 2021;135(6):2469-2478.
5. Tıraşçı Y, Durmaz U, Altınal A, Bulut K, Özdemir Y, Cengiz D, Uysal C, Gören S. A retrospective evaluation of judicial reports issued by Forensic Medicine Department of. *Dicle Medical Journal*. 2016;43(3):424-430.
6. Zhang J, Qiao YR, Yang YD, Pan GZ, Lv CQ. Recovering from prolonged cardiac arrest induced by electric shock: A case report. *World Journal of Clinical Cases*. 2024;12(13):2248-2253.
7. Özdel S, Çakıcı EK, Saylı TR. Pediatric electrical injury in Turkey: five-year retrospective hospital-based study. *Pediatric International*. 2019;61:1155-1158.
8. Behera C, Sikary AK, Rautji R, Gupta SK. Electrocution deaths reported in South Delhi, India: a retrospective analysis of 16 years of data from 2002 to 2017. *Medicine Science and Law*. 2019;59:240-246.
9. Korkmaz M, Uysal C. Evaluation of the death cases due to electric current being performed autopsies between 2007 and 2014 years in Diyarbakır. *Bulletin of Legal Medicine*. 2021;26(1):27-32.
10. Türk Ceza Kanunu'nda Tanımlanan Yaralama Suçlarının Adli Tıp Açısından Değerlendirilmesi Rehberi. Erişim Tarihi: 22.04.2025, Erişim: <https://www.atk.gov.tr/tckyaralama24-06-19.pdf>
11. Y-Salehi SH, Sadat Azad Y, Bagheri T, Ghadimi T, Rahbar A, Ehyaei P, Momeni M. Epidemiology of occupational electrical injuries. *Journal of Burn Care Research*. 2022;43(2):399-402.
12. Demir U, Asirdizer M, Kartal E, Etlı Y, Hekimođlu Y. An investigation of the effect of the COVID-19 (SARS-CoV-2) pandemic on occupational accidents (Tokat-Turkey). *Archives of Environmental Occupational Health*. 2023;78(1):28-37.
13. Dündar AS, Altın İ, Aksöz C, Sarın AB, Özdemir B. Deaths associated with electric shock injuries in children and adults: A 10-year retrospective examination in Şanlıurfa, Southeast Turkey (2012–2022). *Journal of Forensic Sciences*. 2023;68:2076-2084.
14. Zemaitis MR, Lopez RA, Huecker MR. Electrical Injuries. [Updated 2025 Jan 20]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK448087/>
15. Kılınç O, Karagöz Y, İlhan M, Bakan HU. Evaluation of Cases with Forensic Reports Issued Due to Injury Caused Result of Electric Shock Between 2010-2022 by Akdeniz University Forensic Medicine Department. *Akdeniz Medical Journal*. 2024;10(3):450-456.
16. Khor D, AlQasas T, Galet C, Barrash J, Granchi T, Bertellotti R, Wibbenmeyer L. Electrical injuries and outcomes: A retrospective review. *Burns*. 2023;49(7):1739-1744.
17. Berksoy EA, Yazıcı S. Clinical, Demographic Characteristics and Factors Affecting the Clinical Outcome of Children with Electrical Injury: A Single-Center Pediatric Emergency Clinic Experience. *Bulletin of Legal Medicine*. 2019;24(1):30-35.
18. Demirdöken ED, Karbuz A. Retrospective evaluation of forensic cases at pediatric emergency admissions. *Journal of Forensic Medicine*. 2023;37(1):33-38.
19. Zhang J, Lin W, Lin H, Wang Z, Dong H. Identification of Skin Electrical Injury Using Infrared Imaging: A Possible Complementary Tool for Histological Examination. *PLoS One*. 2017;12(1):e0170844.