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Original Article / Özgün Araştırma

Analysis of fall from height cases due to electrical injury: evaluation by comparing with fall from height and only electrical injury cases

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Abstract

Objective: Trauma is the leading cause of deaths worldwide. Electrical injury causes many damage to the body according to the elektrical load, considerably mortality.

Falls from height are one of the most common causes of trauma in the world, it is a condition with high morbidity and mortality.

Falls from height due to electrical injury that caused by mechanisms both electrical injury and falling from a height are complex injuries .

Although cases of falling from height due to electrical injury have been reported in the literature, there are no studies examining them.

The aim of this study is to examine cases of falls from height due to electrical injury, its clinical features were compared to only electrical injury cases and only falls from height.

Methods: This is a retrospective cross-sectional study. Cases admitted to the emergency department of Dicle University Hospital between January 2015 and December 2021 were examined. In this study, 75 cases who fell from a height due to electrical injury, 75 cases who had only electrical injury, and 75 cases who fell only from a height were received.

Trauma cases included in the study were examined age, gender, ground of fall, fall height, workplace accident and suicide status, electrical voltage, burn and trauma scores, laboratory findings, mortality.

Results: Among the 75 cases falling from height due to electrical injury, 69 (92%) survived, 6 (8%) died. The median age was 24 (IQR: 17-37) years old. Of the cases, 70 (93.30%) were male, 53 (70.70%) were high voltage, 35 (46.70%) were workplace accidents. Among the variables examined, lactic dehydrogenase (LDH), creatinine kinase (CK), creatinine kinase myocardial band (CK-MB), total body burn surface area (TBSA%), Glasgow Coma Scale (GCS), Abbreviated Injury Scale (AIS) for burns were the factors affecting mortality($p<0.05$). Comparison of cases who fell from a height due to electric injury and cases of only electric injury TBSA%, AIS for burns, Abbreviated Burn Severity Index (ABSI), Injury Severity Score (ISS), complications, high voltage, length of stay (LOS) were higher in patients who fell from height due to electric injury, with a significant difference ($p<0.001$). Comparison of cases of falling from a height due to electric injury and cases of only falling from height age, male gender, workplace accident rate were higher in patients who fell from height due to electric injury, with a significant difference ($p<0.001$).

Conclusion: Falls from height due to electrical injury are major traumas that affect young adult men and have high mortality and complication rates, caused by high-voltage electrical injury. This trauma mechanism shows differences from only electric injury and only falls from height injuries.

Keywords: Fall from height due to electrical injury, fall from height, electrical injury, mortality, workplace accident

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Elektrik çarpması nedeniyle yüksekten düşme olgularının analizi: yüksekten düşme ve sadece elektrik çarpması olguları ile karşılaştırılarak değerlendirilmesi

Öz

Amaç: Travmalar dünya çapında ölümlerin önde gelen nedenidir. Elektrik çarpması maruz kalınan elektrik yüküne göre vücutta pek çok hasara yol açar, önemli oranda mortaliteye neden olur. Yüksekten düşmeler dünyada travmanın en sık nedenlerinden biri olup, morbidite ve mortalitesi yüksek bir durumdur. Elektik çarpması nedeniyle yüksekten düşme olguları hem elektrik çarpması hem de yüksekten düşme mekanizmaları ile meydana gelen kompleks yaralanmalardır. Elektik çarpması nedeniyle yüksekten düşme olguları literatürde belirtilmesine rağmen inceleyen çalışmalar yoktur. Bu çalışmanın amacı elektik çarpması nedeniyle yüksekten düşme olgularını incelemek, klinik özelliklerini sadece elektrik çarpması olguları ve sadece yüksekten düşme olguları ile karşılaştırmaktır.

Yöntemler: Bu çalışma retrospektif kesitsel bir çalışmadır. Dicle Üniversitesi Hastanesi acil servisene 2015 ocak ve 2021 aralık tarihleri arasında kabul edilen olgular incelendi.Elektrik çarpması nedeniyle yüksekten düşen 75 olgu, sadece elektrik çarpması 75 olgu ve sadece yüksekten düşen 75 olgu çalışmaya alındı. Çalışmaya alınan travma olgularında yaş, cinsiyet, düşme zemini, düşme yüksekliği, iş kazası ve suisid durumu, elektrik voltajı, yanık ve travma skorları, laboratuar bulguları, mortalite incelendi.

Bulgular: Elektrik çarpması nedeniyle yüksekten düşen 75 olgunun 69 (%92) u yaşadı, 6 (%8) sı öldü. Ortanca yaş totalde 24(IQR: 17-37) idi. Olguların 70 (%93,30)'i erkek, 53 (%70,70)'ü yüksek voltaj, 35 (%46,70)'i iş kazası idi. İncelenen değişkenlerden laktik dehidrogenaz (LDH), kreatinin kinaz (CK), kreatinin kinaz miyokard bandı (CK-MB), total vücut yanık yüzey alanı (TBSA%), Glaskov Koma Scalası (GCS), yanıklar için kısaltılmış yaralanma ölçeği (AIS) mortaliteyi etkileyen faktörlerdi($p<0.05$). Elektrik çarpması nedeniyle yüksekten düşen olgular sadece elektrik çarpan olgular ile karşılaştırıldığında TBSA%, yanık için AIS, kısaltılmış yanık şiddet indeksi (ABSI), yaralanma şiddet skoru (ISS), komplikasyon, yüksek voltaj, yatış süresi (LOS) elektrik çarpması nedeniyle yüksekten düşen olgularda daha yüksekti, anlamlı fark vardı ($p<0.001$). Elektrik çarpması nedeniyle yüksekten düşen olgular ile sadece yüksekten düşen olguların karşılaştırmasında yaş, erkek cinsiyet, iş kazası oranı elektrik çarpması nedeniyle yüksekten düşen olgularda daha yüksekti ve anlamlı fark vardı ($p<0.001$).

Sonuç: Elektik çarpması nedeniyle yüksekten düşmeler genç erişkin erkekleri etkileyen, yüksek voltajlı elektrik çarpması nedeniyle oluşan mortalite ve komplikasyon oranları yüksek olan mayor travmalardır. Bu travma mekanizması sadece elektrik çarpması ve sadece yüksekten düşme yaralanmalarından farklılıklar göstermektedir.

Anahtar kelimeler: Elektrik çarpması nedeniyle yüksekten düşme, yüksekten düşme, elektrik çarpması, mortalite, iş kazası.

INTRODUCTION

Trauma is caused by many mechanisms, such as motor vehicle injuries, falls from height, assault, penetrating sharps injuries, gunshot wounds, cycling, pedestrian, machine injuries, burns, and electric injuries[1,2]. Emergency physicians need to know the potential injury models in order to demonstrate a multidisciplinary approach to trauma patients in the diagnosis, treatment, and follow-up stages[3].

Electric injury causes much damage to the body according to the electrical charge exposed and causes significant mortality[2]. Falls from height are among the most common causes of trauma worldwide and have high morbidity and mortality[3]. Falls from heights are classified as falls from roofs, balconies, windows, stairs, trees, indoor furniture, swings, laps, construction, electricity pylons, and other causes[4-6].

Cases of falling from height due to electric injury are referred to as "falling from electricity pylon or electrician accidents and falling from height" in the literature[5-7]. When the studies on electrical injuries were examined, Cancio et al.[8] reported that 25.1% of these cases were non-burn injuries, Kaya et al.[9] reported that 31.6% of the cases fell from height due to electric injury, Habouchi et al.[10] reported that 30.5% of the cases were throwing or falling injuries. However, no studies are examining the cases of falls from height due to electric injury in the literature. These cases are complex injuries caused by both electric injury and fall-from-height mechanisms. This study aimed to analyze the clinical features of electric injury and fall from height cases and to compare their clinical features with cases of only electrical injury and cases of only fall from height.

METHODS

Study design and ethics statement

This retrospective study includes cases of fall from height due to electric injury, cases of only electrical injury, and cases of only fall from height admitted to the emergency department of Dicle University Hospital.The study was approved by the Ethics Board with session number

28.02.2023/63. Since the study was retrospective, patient consent was not obtained.

Study population and exclusion criteria

Patients admitted to our emergency department who were followed up and treated were included in the study. Patients transferred to another emergency department or whose patient data were incomplete or inaccurate were excluded from the study. This study analyzed 150 consecutive patients who fell from height due to electric injury and were treated between January 2015 and December 2021. Seventy-five patients who had fallen from height due to electric injury were excluded from the study due to transfer to another emergency department or missing data. Thus, 75 patients who fell from height due to electric injury were included in the study. Additionally, 75 cases of electrical injury only and 75 cases of falling from height only were consecutively included in the study. In these added cases, those who were transferred to another emergency department, who were not followed up or treated, and whose patient information was missing or incorrect were excluded from the study.

Data collection and variables

Patient information was obtained from the electronic hospital record system by examining patient files. Age, gender, pulse rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), low voltage and high voltage status, location of electrical input and output, burn site, suicide, work accident, fall ground, fall height, percentage of total body surface area burned (TBSA%), Glasgow Coma Scale (GCS), injured body parts, hemoglobin, hematocrit, white blood cell (WBC), creatinine kinase (CK), alanine aminotransferase (ALT), aspertate aminotransferase (AST), lactic dehydrogenase (LDH), creatinine kinase myocardial band (CK-MB), troponin, urea, creatinine values, duration of hospitalization, complications, length of stay (LOS), survival data were recorded. Injury Severity Score (ISS), Abbreviated Injury Scale (AIS) for burns, Abbreviated Burn Severity Index (ABSI), and BAUX score were calculated. Patients who had fallen from a height due to electric injury were compared with those who had only fallen from a height and those who had been electrically injured.

Statistical Analysis

Kolmogorov Smirnov was used as a control test to determine whether the data were normally distributed and to determine the statistical tests to be used in pair group comparisons. Continuous variables with numerical abnormal distribution were expressed as the median, interquartile range (IQR, q1-q3), and Mann-Whitney U-test were applied. Categorical variables were expressed as frequency percentages, and the Chi-square test ($\chi 2$) was applied. All tests were two-way. A value of $p<0.05$ was considered statistically significant. IBM SPSS 21.0 for Windows statistical package program was used for statistical analysis.

RESULTS

Clinical characteristics and factors affecting mortality in cases who fall from a height due to electric injury

Of 75 patients who fell from a height due to electric injury, 69 (92%) survived, and 6 (8%) died. The median age was 24 (17-37) years in total. Among the cases, 70 (93.30%) were male. Comparison of the median (q1-q3) values of DBP and SBP in the living and dead; DBP was 70 (61-80) vs. 50 (0-65), SBP was 100 (118-128) vs. 90 (0-98) and were lower in the dead and were the factors affecting mortality (p-value: 0.006, 0.005, respectively). Comparison of the median (q1-q3) values of LDH, CK, CK-MB in the living and dead, respectively; LDH 250 (200-510.75) vs. 821.50 (287.50-1510.75), CK 763. 90 (175-2000) vs. 2721.55 (1250-13913.50), CK-MB 30.5 (10-61.55) vs. 143.50 (55-368.25) and were higher in the dead and were factors affecting mortality (p-value: 0.017, 0.029, 0.09, respectively). Comparison of median (q1-q3) values of TBSA%, AIS for burns, and GCS in living and dead, respectively; TBSA% was 10 (2-22) vs. 35 (10-51), AIS for burns 2 (1-3) vs. 4 (1.75-5), GCS 15 (15-15) vs. 3 (3-12. 50), and TBSA% and AIS for burns were higher in those who died, and GCS was lower in those who died, factors affecting mortality (p-value: 0.040, 0.044, 0.001, respectively) (Table I).

Table I: Clinical characteristics to fall from heıght cases due to electrical injury and factors affecting mortality

Variables	Total (n = 75)	Survival (n =69)	Mortality (n =6)	p-value
Age, year, (median[IQR])	24(17-37)	25 (18-37)	17 (14-29)	0.305
Gender, n(%) male	70 (93.30)	64 (92.80)	6 (100)	1.000
Vital signs, (median[IQR])				
Heart rate, (beats/min),	90 (80-100)	90 (80-100)	67 (0-110)	0.455
DBP, (mmHg)	70 (60-80)	70 (61-80)	50 (0-65)	0.006
SBP, (mmHg)	110 (100-126)	100 (118-128)	90 (0-98)	0.005
Laboratory findings, (median[IQR])				
Hemoglobin, (g/dl)	13 (12-14)	13 (12-14)	12 (11.75-14.25)	0.443
ALT, (U/L)	60 (40-220)	60 (40-180.60)	250 (50.87-666)	0.087
AST, (U/L)	90 (50-250)	70 (50-209.60)	250 (243.22-697.62)	0.058
LDH, (U/L)	250 (200-600)	250 (200-510.75)	821.50 (287.50-1510.75)	0.017
CK, (U/L)	1000 (200-3574.20)	763.90 (175-2000)	2721.55 (1250-13913.50)	0.029
CK-MB, (µg/L)	40 (12-70.10)	30.5 (10-61.55)	143.50 (55-368.25)	0.009
Troponin, (ng/L)	0.25 (0.04-5)	0.25 (0.04-4.26)	1.75 (0.07-269.6)	0.245
Scores, (median[IQR])				
TBSA%, (%)	12 (2-25)	10 (2-22)	35 (10-51)	0.040
AIS for burns	2 (1-3)	2 (1-3)	4 (1.75-5)	0.044
ABSI	4 (3-5)	4 (3-5)	5.50(3.50-9)	0.155
BAUX	38 (29-54)	38 (29-53)	50 (25.25-86)	0.390
GCS	15 (15-15)	15 (15-15)	3 (3-12.50)	<0.001
ISS	16 (1-25)	13 (1-22)	26 (16.75-29)	0.075
Complications, n(%)	31(41.30)	27 (39.10)	4 (66.70)	0.224
Fasciotomy	8 (10.70)	7 (10.10)	1 (16.70)	0.504
Compartment syndrome	7 (9.30)	6 (8.70)	1 (16.70)	0.456
AKI	6 (8)	4 (5.80)	2 (33.30)	0.070
Rhabdomyolysis	23 (30.70)	19 (27.50)	4 (66.70)	0.068
High voltage, n(%)	53 (70.70)	47 (68.10)	6 (100)	0.171
Low voltage, n(%)	22 (29.3)	22 (31.90)	0 (0)	
Form of electrical injury, n(%)				0.157
Pure	59 (78.70)	56 (81.20)	3 (50)	
Arc	1 (1.33)	1 (1.40)	0 (0)	
Pure and arc	15 (20)	12 (17.40)	3 (50)	
Regions of electrical injury, n(%)				0.662
Head	8 (10.70)	7 (10.10)	1 (16.70)	
Thoracoabdominal	9 (12)	9 (13)	0 (0)	
Upper extremity	47 (62.70)	42 (60.90)	5 (83.30)	
Lower extremity	1 (1.33)	1 (1.40)	0 (0)	
Fall height,(m), (median[IQR])	3 (2-5)	3 (1.50 -4.50)	4 (3.50-5.75)	0.110
Ground of fall, n(%)				0.593
Soft	15 (20)	13 (18.80)	2 (33.30)	
Hard	60 (80)	56 (81.20)	4 (66.70)	
Blunt injury regions, n(%)				
Head	11 (14.70)	11 (15.90)	0 (0)	0.583
Maxillofacial	4 (5.30)	2 (2.90)	2 (33.30)	0.030
Thorax	24 (32)	23 (33.30)	1 (16.70)	0.657
Abdomen	18 (24)	16 (23.20)	2 (33.30)	0.626
Extremity	25 (33.30)	24 (34.80)	1 (16.70)	0.657
Pelvis	2 (2.70)	2 (2.90)	0 (0)	1.000
LOS(days), (median[IQR])	5 (1-10)	5 (1-10)	4 (1-6)	0.522
Workplace accident, n(%)	35 (46.70)	33 (47.80)	2 (33.30)	0.679
Suicide, n(%)	1 (1.33)	1 (1.40)	0 (0)	1.000

Abbreviations: ABSI, Abbreviated burn severity index; AIS, Abbreviated injury scale; AKI, Acute kidney injury; ALT, Alanin aminotransferaz; AST, Aspertat aminotransferaz; CK, Creatine kinase; CK-MB, Creatine kinase-myokardial band; DBP, Diastolic blood pressure; GCS, Glasgow

coma scale; IQR, Interquartile range ; ISS, Injury severity score ; LDH, Lactate dehydrogenase; LOS, Length of stay; SBP, Systolic blood pressure; TBSA%, Percentage of total body surface area burned.

Comparison of cases who fell from a height due to electric injury and cases of only electric injury

Comparison of median (q1-q3) values of patients who fell from a height due to electric injury and cases of only electric injury; ALT 60 (40-220) vs. 40 (30-60), AST 90 (50-250) vs. 40 (30-60), CK 1000 (200-3574.20) vs. 150 (60-282), CK-MB 40 (12-70.10) vs. 8 (5-13), troponin 0.25 (0.04-5) vs. 0.04 (0.02-0. 10), TBSA% 12 (2-25) vs. 2 (1-4), AIS for burns 2 (2-3) vs. 1 (1-1), ABSI 4 (3-5) vs 3 (2-4), ISS 16 (1-25) vs 1 (1-1), complications 31 (41.30) vs 0 (0), high voltage 53 (70.70) vs 21 (28), LOS 5 (1-10) vs 1 (1-2), and were higher in patients who fell from height due to electric injury, with a significant difference (p<0.001). LDH was 250 (200-600) vs. 200 (157-250), BAUX was 38 (29-54) vs. 29 (15-42), workplace accident was 35 (46.70) vs. 18 (24), and it was higher in cases who fell from height due to electric injury, there was a significant difference (p-value respectively: 0.003, 0.001, 0.004) (Table II).

Table II: Comparison of fall from heıght cases due to electrıcal injury with cases of only electrical injury

Variables	Fall from heıght cases due to electrıcal injury (n =75)	Cases of only electrical injury (n =75)	p-value
Age, year, (median[IQR])	24 (17-37)	25 (14-36)	0.705
Gender, n(%) Male	70 (93.30)	67 (89.30)	0.562
Vital signs, (median[IQR])			
Heart rate, (beats/min),	90 (80-100)	90 (75-110)	0.541
DBP, (mmHg)	70 (60-80)	70 (60-80)	0.201
SBP, (mmHg)	110 (100-126)	120 (100-130)	0.454
Laboratory findings, (median[IQR])			
Hemoglobin, (g/dl)	13 (12-14)	13 (12-14)	0.280
ALT, (U/L)	60 (40-220)	40 (30-60)	<0.001
AST, (U/L)	90 (50-250)	40 (30-60)	<0.001
LDH, (U/L)	250 (200-600)	200 (157-250)	0.003
CK, (U/L)	1000 (200-3574.20)	150 (60-282)	<0.001
CK-MB, (µg/L)	40 (12-70.10)	8 (5-13)	<0.001
Troponin, (ng/L)	0.25 (0.04-5)	0.04 (0.02-0.10)	<0.001
Scores, (median[IQR])			
TBSA%, (%)	12 (2-25)	2 (1-4)	<0.001
AIS for burns	2 (2-3)	1 (1-1)	<0.001
ABSI	4 (3-5)	3 (2-4)	<0.001
BAUX	38 (29-54)	29 (15-42)	0.001
GCS	15 (15-15)	15 (15-15)	0.002
ISS	16 (1-25)	1 (1-1)	<0.001
Complications, n(%)	31(41.30)	0 (0)	<0.001
Fasciotomy	8 (10.70)	3 (4)	0.210
Compartment syndrome	7 (9.30)	3 (4)	0.326
AKI	6 (8)	0 (0)	0.028
Rhabdomyolysis	23 (30.70)	5 (6.70)	<0.001
High voltage, n(%)	53 (70.70)	21 (28)	<0.001
Low voltage, n(%)	22 (29.30)	54 (72)	
Form of electrical injury, n(%)			<0.001
Pure	59 (78.70)	75 (100)	
Arc	1 (1.33)	0 (0)	
Pure and arc	15 (20)	0 (0)	

Regions of electrical injury, n(%)			0.079
Head	18 (24)	7 (9.30)	
Thoracoabdominal	9 (12)	7 (9.30)	
Upper extremity	47 (62.70)	59 (78.70)	
Lower extremity	1 (1.33)	2 (2.70)	
LOS(days), (median[IQR])	5 (1-10)	1 (1-2)	<0.001
Workplace accident, n(%)	35 (46.70)	18 (24)	0.004
Suicide, n(%)	1 (1.33)	0 (0)	1.000
Mortality, n(%)	6 (8)	3 (4)	0.494

Comparison of cases of falling from a height due to electric injury and cases of only falling from height

Comparison of median (q1-q3) values of cases who fell from height due to electric injury and cases of only fall from height; age 24 (17-37) vs. 6 (4-13), male gender 70 (93.30) vs. 47 (62.70), hematocrit 38 (36-40) vs. 32.40 (29.60-35. 80), ALT 60 (40-220) vs. 22 (17-42), AST 90 (50-250) vs. 37 (28-71), LDH 250 (200-600) vs. 377 (300-552), CK 1000 (200-3574.20) vs. 227 (166-412), and were higher in cases who fell from height due to electric injury, with a significant difference (p<0.001). Comparison of n (%) values of cases who fell from height due to electric injury and cases of only fall from height; thoracic trauma 24 (32) vs 3 (4), workplace accident 35 (46.70) vs 4 (5.3), and were higher in cases who fell from height due to electric injury, with a significant difference (p<0.001) (Table III).

Table III: Comparison of fall from height cases due to electrical injury with cases of only fall from high

Variables	Fall from height cases due to electrical injury (n =75)	Cases of only fall from high (n =75)	p-value
Age, year, (median[IQR])	24 (17-37)	6 (4-13)	<0.001
Gender, n(%)			
male	70 (93.30)	47 (62.70)	<0.001
Laboratory findings, (median[IQR])			
Hematocrit, (%)	38 (36-40)	32.40 (29.60-35.80)	<0.001
ALT, (U/L)	60 (40-220)	22 (17-42)	<0.001
AST, (U/L)	90 (50-250)	37 (28-71)	<0.001
LDH, (U/L)	250 (200-600)	377 (300-552)	<0.001
CK, (U/L)	1000 (200-3574.20)	227 (166-412)	<0.001
Scores, (median[IQR])			
GCS	15 (15-15)	15 (14-15)	0.921
ISS	16 (1-25)	16 (9-16)	0.392
Fall height, (m), (median[IQR])	3 (2-5)	3 (2-4)	0.657
Ground of fall, n(%)			1.000
Soft	15 (20)	15 (20)	
Hard	60 (80)	60 (80)	
Blunt injury regions, n(%)			
Head	11 (14.70)	29 (38.70)	0.002
Maxillofacial	4 (5.30)	4 (5.30)	1.000
Thorax	24 (32)	3 (4)	<0.001
Abdomen	18 (24)	18 (24)	1.000
Extremity	25 (33.30)	27 (36)	0.731
Pelvis	2 (2.7)	3 (4)	1.000
LOS(days), (median[IQR])	5 (1-10)	3 (1-7)	0.447
Workplace accident, n(%)	35 (46.70)	4 (5.3)	<0.001
Suicide, n(%)	1 (1.33)	0 (0)	1.000
Mortality, n(%)	6 (8)	4 (5.3)	0.743

DISCUSSION

Most of the cases of fall from height due to electric injury were young adult males. The majority of cases were occupational accidents and high-voltage electric injuries. The cases were falls from the roof, balcony, and electric pole due to electric injury; the minimum fall height was 1 m, and the maximum was 10 m. The majority of cases were falling on hard ground. While this type of trauma was similar to high-voltage electric injuries regarding clinical and laboratory features, the ISS value increased due to the fall from height after electric injury. The literature, ISS≥15 is defined as major trauma[11]. This trauma mechanism can be defined as major trauma, according to ISS.

When falling from height due to electric injury cases were compared with cases of only electrical injury, there was no difference in terms of age, gender, or mortality, but there was a significant difference in terms of burn scores, GCS and ISS scores, LOS, serum and cardiac enzymes, and complications (Table II). This may be explained by the fact that most of the cases of falls from height due to electric injury were high-voltage electric injuries. The difference in trauma scores may be explained by subsequent falls from height.

When the cases of falls from height due to electric injury are evaluated in terms of age, gender, occupational accident, and serum enzymes, it is seen that they have a different trauma pattern than the cases of only falls from height. With these characteristics, falls from height due to electric injury seem to be combined and complex traumas consisting of both destructions caused by the high-voltage electric current due to electric injury and blunt injury due to kinetic energy acting on the body due to falling from height.

In a study investigating only electric injuries, the mean age was 34.61 years; the age range was 1.3-72 years; 74.47% of the cases were young and middle-aged, 89.36% were male, and the majority were work accidents[12]. In another study, 95% of the cases were male and between 15 and 40 years of age[13]. In a study examining only fall-from-height cases, the mean age was 37± 14.7 years, and 86% were male.[14] In studies conducted in our country that only investigated fall from height cases, the age range was 3 month-98 years, and most of the cases were boys[4,15]. In this study, there was no difference in age, gender, and occupational accident between the cases of fall from height due to electric injury when compared with the cases of electrical injury only, but there was a difference between the cases of fall from height only when compared with the cases of fall from height only. This difference can only be explained by the fact that the cases of falling from height in our region are mostly children falling from flat roofs.

Electrical injuries are generally classified as low voltage (<1000 volts) and high voltage (>1000 volts)[16]. Serum CK, CK-MB, ALT, and AST values are higher in high-voltage electrical injuries compared to low-voltage[17]. In previous studies, TBSA%, ABSI, LOS, and complication rates are higher in high-voltage electrical injuries than in low-voltage electrical injuries[12,18,19]. TBSA%, ABSI, CK, CK-MB, renal failure, and sepsis affect mortality in electrical injuries[18,20]. In this study, serum enzymes, burn scores, LOS, and complication rates were higher in cases of fall from height due to electric injury because they were mostly high-voltage electrical injuries and differed from cases of electric injury only. In this study, serum enzymes were higher in cases of fall from height due to electric injury because they were mostly high-voltage electrical injuries and were different from cases of fall from height only. In this study, the mortality rate in cases of fall from height due to electrical injuries was similar to the studies on electric injuries in the literature.

Falls from height cause morbidity and mortality by affecting many organs and systems.

Lapostolle et al.[21] determined age, height of fall, ground of fall, and body part that first hit the ground as independent prognostic factors in falls from height. In previous studies, it was observed that ISS increased, GCS decreased, LOS increased, intensive care unit stay increased, and mortality and complications increased with increasing fall height[3,14]. Liu et al.[22] examined cases older than 16 years and above 6 m in height; age, gender, height of fall, and hemoglobin did not affect mortality, whereas ISS and GCS were the factors affecting mortality. In this study, age, gender, height of fall, and ground of fall were not factors affecting mortality in cases of fall from height due to electric injury. GCS was a factor affecting mortality, as in the study by Liu et al.

In the post-mortem study of Türkoğlu et al.[4] in 213 patients falling from a height, the most common site of injury was the head and neck (84.5%), followed by thorax (62.4%), abdomen and pelvis (42.7%) and extremities (34.7%). In the study of Liu et al.[22], who examined the cases of falls from a height above 6 m, when the injured body parts were analyzed, head injuries was 35.3% among those who lived and it was 73.3% among those who died, thoracic injuries was 51% among those who lived and it was 73.3% among those who died, abdominal injuries was 23.5% among those who lived and it was 20% among those who died. In the study of Nau et al.[3], who examined the cases of falls from a height of more than 3 m, head injury was 44.1%, thoracic injury 49.7%, upper extremity fractures 32.2%, and lower extremity fractures 31.1%, pelvic fracture 21.5%, vertebral fracture 38.4%. In the study by Alizo et al.[14] on falls from height, orthopedic injury (56.3%) and neurospine injury (52.9%) were the most common injuries. Electrical injuries mostly affect the upper extremities[23]. In a study by Habouchi et al.[10] of 200 cases of electric injuries, 30.5% of the patients were affected by throwing or falling, 21% had traumatic lesions, and 2.5% had polytrauma. The proportion of traumas caused by throwing and falling compared to all-electric injury cases was as follows: soft tissue injury 11.5%, head trauma 3%, thoracic trauma 3%, vertebral trauma 3%, osteoarticular trauma 3.5%, maxillofacial trauma 2%. If we evaluate these trauma rates of Habouchi et al. only in cases of fall from height due to electric injury, these trauma rates triple. However, in this study, the most commonly injured body parts in cases of fall from height due to electric injury were extremities, thorax, abdomen, and head, respectively. The distribution of injured body parts in this study was not similar to the study of Habouchi et al. but was similar to the only fall-from-height studies in the literature.

The mortality rate starts at 1.2% in hospitalized fall-from-height cases and increases up to 34% with the addition of out-of-hospital cases[21,24]. The mortality rate in electrical injuries starts from 0% at low voltage and increases to 26.7% at high voltage[12,20]. In the present study, the mortality rate in falls from height due to electric injury was moderate and was not statistically different from that in cases of electric injury only and falls from height only, but it was higher than both.

Limitations

There were some limitations in this study. First, it was a retrospective cross-sectional study. Second, the study was single-centered. Third, the number of cases in the study was limited. However, although it was a retrospective cross-sectional study, the cases were included consecutively. This study covers cases in a specific region of our country; therefore, we cannot generalize all the results. Therefore, there is a need for studies in other parts of the world to investigate the cases of falls from height due to electric injury.

CONCLUSION

Falls from height due to electrical injuries are occupational accidents caused by high-voltage

electric injuries affecting young adult males. They are major traumas with high mortality and complication rates. Although this trauma mechanism appears to be a combination of only electric injury and only fall from height injuries, it appears to be a different trauma pattern.

Ethics Committee Approval: The study was approved by Dicle University School of Medicine Ethics Committee for Non-interventional Clinical Research with session number 28.02.2023/63. Since the study was retrospective, patient consent was not obtained.

Conflict of Interest: The authors declared no competing interest.

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