

Comparison of antemortem clinical diagnosis and postmortem findings in burn-related deaths

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ABSTRACT

BACKGROUND: Burn injuries are an important public health problem resulting in high morbidity and mortality. Mortality in burn patients is associated with age, the extent of the burn surface, and the presence of concurrent chronic diseases. Studies have revealed differences between antemortem clinical diagnoses and postmortem findings in burn-related deaths.

METHODS: In the present study, postmortem examination reports and autopsy reports issued by the Department of Forensic Medicine in Gülhane Military Medical Academy between 1 January 1994 and 30 May 2013 were retrospectively reviewed together with patient charts in an attempt to compare postmortem findings and antemortem clinical findings in burn-related deaths.

RESULTS: In a period of approximately 20 years, thirty-one (6.9%) of the deaths among 450 cases were burn-related. Of the injuries, 90.3% were caused by flame burns. Mean burn percentage was 70.52%, and the survival of these cases was found to decrease significantly with increasing burn percentage ($r=-0.491$, $p=0.005$). According to autopsy findings, pneumonia was the most frequently overlooked antemortem clinical diagnosis, and mortality was associated with systemic organ failures.

CONCLUSION: Burn-related deaths are an important cause of mortality among soldiers. We believe that postmortem findings revealed by autopsies could significantly contribute to the treatment of burn cases, and that interdisciplinary data sharing would be important in this respect.

Key words: Autopsy; burn injury; soldiers.

INTRODUCTION

Burn injuries are a significant public health problem associated with high morbidity and mortality.^[1-4] In a comprehensive study in Europe, the incidence of major burns was reported to be 0.2-2.9 per 100,000 individuals, with flash burns, scalds, and contact burns being the most common types of burns, and higher mortality being associated with older age, the extent of the burns, and the presence of chronic diseases.^[5]

Although burn-related mortality rates have decreased in recent years due to advances in the treatments provided by burn centers, the actual cause of mortality in burn-related

deaths has still not been fully elucidated.^[6] The comparison of antemortem and postmortem findings has revealed differences between antemortem clinical diagnoses and autopsy findings.^[6-8]

Autopsy may show unexpected or unrecognized clinical findings, and the data obtained from autopsy can be used to elucidate future problems experienced by the patients.

In the present study, post-mortem examination reports and autopsy reports issued by the Department of Forensic Medicine in Gülhane Military Medical Academy between 1 January 1994 and 30 May 2013 were retrospectively reviewed together with the patient charts in an attempt to compare postmortem findings and antemortem clinical findings in burn-related deaths.

MATERIALS AND METHODS

The Turkish Armed Forces is one of the largest and the strongest military forces with respect to personnel number. The Department of Forensic Medicine in Gülhane Military Medical Academy is the only unit within the body of Turkish Armed Forces that routinely performs autopsies due to sol-

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dier deaths of a forensic nature.

In the present study, post-mortem examination reports and autopsy reports issued by the Department of Forensic Medicine in Gülhane Military Medical Academy between 1 January 1994 and 30 May 2013 for patients, in which cause of death was burn-related, were retrospectively reviewed together with the patient charts. The study was approved by the Ethics Committee of Gülhane Military Medical Academy.

In addition to demographic data of the cases, type of burns, burn percentage, and clinical findings were compared and statistical analyzes were performed.

Descriptive statistics included number (%) and mean standard deviation for continuous variables. The Spearman correlation coefficient was calculated to indicate correlations, and a p value <0.05 was considered as statistically significant. SPSS 15.0 for Windows Evaluation Version was used in statistical analyses.

RESULTS

Among the four hundred and fifty cases that underwent postmortem and autopsy examinations in the Department of Forensic Medicine in Gülhane Military Medical Academy between 1 January 1994 and 30 May 2013, thirty-one (6.9%) deaths were found to be burn-related. Of these cases, nineteen (61.3%) were from the ground forces, nine (29%) were from the gendarmerie, two (6.5%) were from the naval forces, and one (3.2%) was from the air forces.

All cases were male, and mean age was 22.9 ± 5.9 (min: 20, max: 45) years. Trauma, after sustaining an accident, was the most common finding in 87.1% of the cases, and twelve cases (38.7%) underwent autopsy. Of the injuries, 90.3% were caused by flame burns.

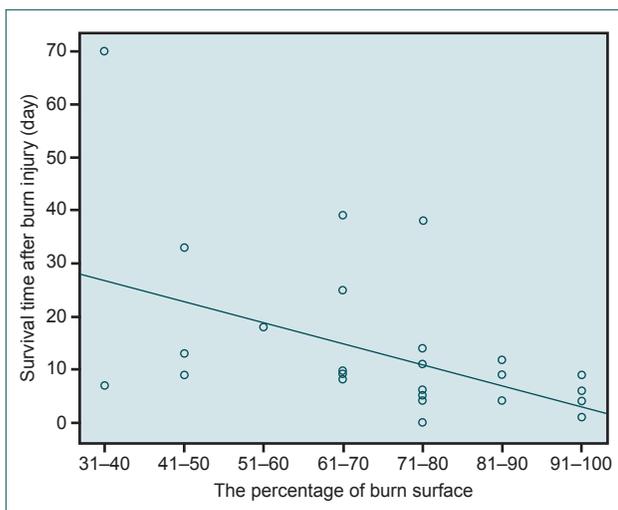


Figure 1. Relationship between body percentage of burn and survival.

Table 1. Characteristics and demographic features of the cases

Patient characteristics	Data
Number of cases	31
Mean age	22.9 ± 5.9 (min: 20, max: 45)
Autopsy	12 (38.7%)
Mean percentage of burn surface	70.52%
Flame burn	90.3%
Inhalation burn	13 (41.9%)
Survival time after burn injury (days)	13 ± 14.4 (min: 0, max: 70)

Table 2. Characteristics of the injuries of the cases

Demographic data of patients and characteristics of injuries	n	%
Distribution of burned areas in the body		
Head and neck	29	93.5
Trunk	23	74.1
Back	26	83.8
Upper extremities	31	100
Lower extremities	31	100
Manner of death		
Suicide	4	12.9
Accident	27	87.1
Type of Burn		
Flame burn	27	87.1
Flame burn + Scalding	1	3.2
Electricity burn	3	9.7
Tracheostomy	11	35.5
Fasciotomy	12	38.7

Inhalation injury was observed in thirteen cases (41.9%), and mean length of hospital stay after the incident was 13 ± 14.4 (min: 0, max: 70) days. Demographic characteristics of the patients are shown in Table 1.

Burn injuries most commonly occurred in autumn, and there was no significant seasonal difference ($p=0.079$). Characteristics of injuries and the presence of fasciotomy and tracheostomy are shown in Table 2.

Mean burn percentage was 70.52%, and the survival ratio of the cases decreased significantly with increasing burn percentage ($r=-0.491$, $p=0.005$). The survival ratio decreased

Table 3. The comparison of clinical findings and postmortem findings in patients who sustained burn injuries

No	Age	Type of burn	(%)*	Day**	Clinical course	Clinical diagnosis and treatment	Postmortem findings
1	21	Flame burn	61	9	Fasciotomy and escharotomy, mechanical ventilation	Inhalation burn, renal failure	Pneumonia
2	23	Flame burn	33	7	Escharotomy, high fever	Wound infection (pseudomonas), Antibiotherapy	Sepsis (Citrobacter Freundii)
3	21	Flame burn	42	33	Escharotomy and grafting, high fever, growth in culture (pseudomonas)	Antibiotherapy	Pneumonia
4	21	Flame burn	84	4	Fasciotomy	–	Pulmonary edema
5	21	Flame burn + scalding	80	4	Fasciotomy, mechanical ventilation	Inhalation burn renal failure	
6	21	Flame burn	82	12	Fasciotomy, homografting, high fever, mechanical ventilation	Inhalation burn, renal failure	Pneumonia Tubular necrosis
7	21	Flame burn	92	4	Fasciotomy, mechanical ventilation	Inhalation burn	Pneumonia
8	21	Flame burn	80	5	Fasciotomy, mechanical ventilation	Inhalation burn, renal failure	Pulmonary edema
9	27	High voltage electricity burn	75	6	Fasciotomy, Mechanical ventilation	–	Electricity injury findings in skin samples
10	21	High voltage electricity burn	48	9	Mechanical ventilation	Maxillofacial fractures, pneumocephalia	Electricity injury findings in skin samples
11	21	Flame burn	70	8	Fasciotomy, grafting	Antibiotherapy	Pneumonia, Pulmonary edema
12	22	Flame burn	42	70	Mechanical ventilation	ARDS, antibiotherapy	Pulmonary edema Pneumonia

*: Total body burn surface area; **: Length of hospital stay.

with increasing age; however, this relationship was not found to be statistically significant ($r=-0.015$, $p>0.935$) (Fig. 1).

The survival period was 14.45 days among patients who required tracheostomy, and 12.20 days among those who did not. Mann-Whitney U test did not indicate a statistically significant difference between these two groups ($p=0.493$).

Patients who underwent fasciotomy survived for 8.42 days on average, while patients who did not undergo fasciotomy survived for 15.89 days on average. Mann-Whitney U test did not indicate a statistically significant difference between these two groups ($p=0.759$).

The comparison of antemortem diagnoses and postmortem

findings in twelve cases who underwent autopsy revealed pneumonia diagnosis in six of the cases (50%) (Table 3).

DISCUSSION

In developing countries, burn-related deaths often occur within younger age groups.^[1,3,9,10] In developed countries, on the other hand, such deaths are more common among children and the elderly.^[7,11] This age difference can be explained by the implementation of more effective preventive measures and greater availability of treatment options in developed countries.

Mean age has been reported as 36.6^[2] and 40.1^[12] years in studies in burn-related injuries and deaths in Turkey. In the present study, mean age was 22.9 years; therefore, burn-re-

lated injuries and deaths are observed more commonly in a younger age group. As it is known, the study center is a military hospital, and most of the patients are military personnel in the army. Higher frequency of burn-related injuries and deaths among the younger population can be explained by the large population of young individuals in Turkey, and the fact that military service is compulsory for all males reaching a certain age.

Burn-related injuries often occur as a result of accidents.^[1,2,7,10,13] Among the burn-related deaths observed in the present study, 87.1% were caused by accidents while 12.9% were caused by suicide. It has been reported that 14–15% of deaths occurring among females in India are associated with burns,^[3] and suicide associated burn injuries rank third with a frequency of 11.4%.^[10] According to the study by Büyük et al., suicide has been associated with 6.3% of burn cases.^[2]

Within a period of 20 years, 6.9% of the deaths evaluated in this study were caused by burns. Similar studies have reported a burn-related mortality ratio of 2.0–19.4%.^[1,2,9,14] These studies have reported no difference between military and civilian mortality rates, and it has been reported to be ranging between 5% and 10%.^[14,15] The fact that burn-related deaths were reported as an important public health concern in India explains the variability in the frequency of burn-related deaths in the literature.^[1,3,9]

Flame burn is the most common cause of burns,^[1,6,7] and it has been reported to be often accompanied by inhalation burn.^[11,14] In parallel to the literature, flame burns were the most common type of burn in the present study, with a frequency of 90.3%, while inhalation burns were observed in thirteen of the cases (41.9%).

Major risk factors for mortality in burn-related injuries include older age, large burn surface area, and presence of concurrent diseases.^[5] In the study by Kumar et al., burn percentage was greater than 40% in 92.52% of the cases^[1] while in the study by Krishnan et al.,^[11] mean burn percentage was determined as 43.7%. In the literature, various studies have reported a mean length of hospital stay of 10.7 days,^[6] 26.4 days,^[11] 13.5 days,^[14] and 16.9 days.^[7] Mean length of hospital stay was thirteen days in the present study. The cases were young patients who did not have concurrent chronic conditions that could affect burn-related mortality. Therefore, systemic organ failures that developed following burns were within the main causes of mortality in the current series of the cases.

Mean ratio of the burned area was 70.52% in the present study. Survival ratio decreased with increasing percentage of the burned area ($r=-0.491$, $p=0.005$) (Fig. 1). In addition, survival ratio decreased with increasing age; however, the difference was not found to be statistically significant ($r=-0.015$, $p>0.935$).

In the study by Kallinen et al., it has been determined that the upper extremities and trunk are the most commonly affected areas of the body, that 38.5% of the patients undergo tracheostomy, and that the patients undergo an average of 2–3 operations.^[6] All patients evaluated in the present study had burns on the lower and upper extremities (Table 2).

Mean survival period was 14.45 days among patients who required tracheostomy, and 12.20 days among those who did not. Using Mann-Whitney U test, no statistically significant difference was identified between tracheostomy and the survival period ($p=0.493$). Patients who underwent fasciotomy survived for 8.42 days on average, while those who did not, survived for an average of 15.89 days. Mann-Whitney U test showed no statistically significant difference between fasciotomy and the survival period ($p=0.759$).

Mortality in burn patients is associated with multiple organ failure, sepsis, prolonged stay in the intensive care unit, and extended use of mechanical ventilation.^[6] Multi-organ dysfunction and sepsis are associated with burn percentage, age and gender.^[1,6,9] According to autopsy findings, pulmonary injury and sepsis were found to be the most common reason of death in all age groups. Edema and congestion have been reported to be worsening with increasing age.^[16]

Multi-organ failure associated with sepsis was found to be the primary cause of death, and *Pseudomonas* was the most commonly reported microorganisms in septic patients. Thanks to the increasing expertise of burn centers, advances in first aid services, and early treatment of burn patients, mortality among severe burn patients has gradually decreased.^[11]

It was previously reported that clinically unrecognized findings revealed by autopsies could make significant contributions to the treatment of burn cases by clinicians.^[6,8,16] Studies have revealed differences between antemortem clinical diagnoses and postmortem findings in burn-related deaths.^[6] In the study by Kallinen et al., autopsy has revealed findings in 14.1% of the cases that were not found on antemortem examination, and pneumonia was the most common diagnosis during autopsy.^[6] The autopsy findings in the present study showed that pneumonia was the most common diagnosis that remained clinically unrecognized. The comparison of antemortem diagnoses and postmortem findings in twelve cases who underwent autopsy revealed pneumonia diagnosis in six of the cases (50%) (Table 3).

In conclusion, burn-related injuries are an important cause of mortality in military populations, as well as the general population. We consider that the findings revealed by autopsies could make significant contributions to the treatment of burn cases and that interdisciplinary data sharing would be important in this respect.

Conflict of interest: None declared.

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ORIJİNAL ÇALIŞMA - ÖZET

Yanığa bağlı ölümlerde antemortem klinik tanılar ve postmortem bulguların karşılaştırması

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AMAÇ: Yanığa bağlı yaralanmalar, yüksek morbidite ve mortaliteyle sonuçlanabilen önemli bir halk sağlığı sorunudur. Yanık hastalarında mortalite; yaşlılık, yanık alanı yüzdesinin geniş olması ve kronik hastalıkların birlikteliği ile ilişkilidir. Yapılan çalışmalar, yanığa bağlı ölüm olgularında premortem klinik teşhisler ile postmortem bulguların farklılık gösterdiğini ortaya çıkartmıştır.

GEREÇ VE YÖNTEM: Bu çalışmada, 1 Ocak 1994 ile 30 Mayıs 2013 tarihleri arasında, Gülhane Askeri Tıp Akademisi Adli Tıp Anabilim Dalı'nda yapılan ölü muayenesi ve otopsi raporları ile hasta dosyaları geriye dönük olarak incelenerek, yanığa bağlı ölümlerde saptanan postmortem bulgular ile antemortem klinik bulguların karşılaştırılması amaçlanmıştır.

BULGULAR: Yaklaşık 20 yıllık bir süre zarfında, 450 olgunun 31'inin (%6.9) yanığa bağlı ölüm olduğu saptanmıştır. Yaralanmaların %90.3 oranında alev yanığı sonucu meydana geldiği saptanmıştır. Olguların yanık yüzdesi oranı ortalaması %70.52 olup bu oran arttıkça yaşam süresinin istatistiksel olarak kısaldığı saptanmıştır ($r=-0.491$, $p=0.005$). Otopsi bulgularına göre; antemortem olarak atlanan en sık klinik tanının pnömoni olduğu ve mortalitenin sistemik organ yetersizliklerine bağlı olduğu saptanmıştır.

TARTIŞMA: Yanığa bağlı ölümler asker popülasyonu açısından önemli bir mortalite nedenidir. Otopsi ile ortaya konulan postmortem bulguların, yanık hastaların tedavisini yürüten klinisyenlere önemli katkılar sağlayacağını ve bu bağlamda disiplinlerarası veri paylaşımının önemli olduğunu değerlendirmekteyiz.

Anahtar sözcükler: Asker; otopsi; yanığa bağlı yaralanmalar.

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