

Clinicopathological Study of Fatal Burn Cases with Medicolegal Implications: An Autopsy-Based Observational Study

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Abstract:

Background: Burn injuries continue to be a major public health concern and an important cause of unnatural deaths worldwide. Fatal burn cases frequently pose diagnostic and medicolegal challenges regarding determination of cause, manner, and timing of injuries. Clinicopathological correlation through autopsy examination provides valuable insights into burn pathology, mechanisms of death, and forensic interpretation.

Objectives: To study the demographic profile, clinicopathological features, autopsy findings, causes of death, and medicolegal aspects of fatal burn cases.

Materials and Methods: A prospective autopsy-based observational study was conducted on 150 consecutive fatal burn cases brought for medicolegal autopsy to the Department of Forensic Medicine of a tertiary care teaching hospital over a period of two years. Detailed information regarding age, sex, marital status, manner of death, total body surface area (TBSA) involvement, survival period, treatment history, clinical complications, and autopsy findings was collected. Histopathological examination of skin and internal organs was performed in selected cases. Data were analyzed using SPSS version 25.0. Chi-square test was used for statistical analysis and $p < 0.05$ was considered significant.

Results: The majority of victims belonged to the age group of 21–40 years (50.0%). Females constituted 62.0% of cases. Flame burns accounted for 86.0% of cases. Accidental burns were observed in 68.7%, suicidal burns in 24.0%, and homicidal burns in 7.3% cases. Septicemia (38.0%) was the most common immediate cause of death followed by shock (26.0%) and multiorgan dysfunction syndrome (14.7%). Mortality increased significantly with increasing TBSA involvement ($p < 0.001$). Histopathological examination revealed coagulative necrosis, inflammatory infiltration, vascular congestion, edema, and granulation tissue formation.

Conclusion: Fatal burn injuries predominantly affect young females and are commonly accidental in nature. Autopsy and histopathological examination provide crucial evidence regarding burn vitality, cause of death, and medicolegal interpretation. Comprehensive evaluation of burn deaths is essential for accurate forensic conclusions and administration of justice.

Keywords: Burns, Autopsy, Histopathology, Forensic Medicine, Medicolegal, Fatal Burns.

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Introduction

Burn injuries represent one of the most devastating forms of trauma encountered in medical and forensic practice. They are associated with substantial morbidity, prolonged hospitalization, permanent disability, psychological distress, and mortality. Globally, burns account for approximately 180,000 deaths annually, with the majority occurring in low- and middle-income countries where unsafe cooking practices, overcrowding, poverty, and inadequate burn care facilities contribute significantly to the burden of disease. [1]

In India, burn injuries constitute a major public health and medicolegal problem. Fatal burn cases frequently involve young adults, particularly females, and often occur within domestic environments. [2] The circumstances surrounding burn deaths may range from accidental household incidents to suicides, homicides, dowry-related violence, and deaths resulting from negligence. Consequently, every fatal burn case assumes medicolegal significance and requires meticulous investigation. [3]

The pathological effects of burns depend upon the nature of the thermal agent, duration of exposure, and extent of tissue involvement. Thermal injury causes protein denaturation, coagulative necrosis, microvascular damage, inflammatory reactions, fluid loss, and systemic responses that may culminate in shock, infection, respiratory failure, or multiorgan dysfunction. [4]

Autopsy examination plays a vital role in determining the cause and manner of death in burn victims. External findings such as burn distribution, depth, line of redness, vesication, heat ruptures, and pugilistic attitude provide important clues regarding the nature and vitality of injuries. Internal findings including soot deposition in air passages, elevated carboxyhemoglobin levels, pulmonary edema, visceral congestion, and septic changes aid in establishing whether burns occurred during life and contribute to the determination of cause of death. [5]

Histopathological examination further enhances forensic interpretation by demonstrating evidence of tissue vitality such as inflammatory cell infiltration, vascular reactions, edema, and reparative changes. These findings help distinguish antemortem burns from postmortem thermal artifacts and assist in estimating wound age. [6]

Although several studies have investigated epidemiological aspects of burns, relatively few autopsy-based studies have comprehensively examined clinicopathological findings and their medicolegal implications. The present study was therefore undertaken to evaluate fatal burn cases subjected to medicolegal autopsy with emphasis on demographic profile, clinicopathological characteristics, autopsy findings, histopathological changes, causes of death, and medicolegal significance.

Materials and Methods

This prospective observational study was conducted in the Department of Forensic Medicine of a tertiary care teaching hospital over a period of two years from January 2024 to December 2025. A total of 150 consecutive fatal burn cases brought for medicolegal autopsy were included in the study.

Inclusion Criteria

1. All fatal burn cases subjected to medicolegal autopsy.
2. Cases with complete hospital and police records.
3. Cases with confirmed burn injuries as the primary cause of death.

Exclusion Criteria

1. Advanced decomposition obscuring burn findings.
2. Cases with incomplete documentation.
3. Mass disaster victims with extensive body destruction.

Information regarding age, sex, marital status, socioeconomic status, residence, circumstances of injury, survival period, treatment history, and alleged manner of death was obtained from police inquest reports, hospital records, relatives, and investigating officers.

Detailed autopsy examinations were performed according to standard forensic protocols. The following observations were recorded:

- Type and distribution of burns
- Percentage of total body surface area involved
- Degree of burns
- Presence of soot deposition
- Heat ruptures
- Pugilistic attitude
- Internal organ findings
- Cause of death

TBSA involvement was estimated using the Rule of Nines.

Representative tissue samples from burn margins, lungs, liver, kidneys, and spleen were preserved in 10% buffered formalin and processed routinely for histopathological examination using hematoxylin and eosin staining.

Data were entered into Microsoft Excel and analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation. Chi-square test was applied to assess associations between TBSA involvement and mortality-related variables. A p-value less than 0.05 was considered statistically significant.

Results:

Table 1: Age Distribution of Fatal Burn Cases (n=150)

Age Group (Years)	Number	Percentage
<20	22	14.7
21–40	75	50.0
41–60	39	26.0
>60	14	9.3

The majority of victims belonged to the 21–40 years age group.

Table 2: Sex Distribution

Sex	Number	Percentage
Male	57	38.0
Female	93	62.0

Female predominance was observed with a female-to-male ratio of 1.63:1.

Table 3: Type of Burns

Type	Number	Percentage
Flame	129	86.0
Scald	8	5.3
Electrical	9	6.0
Chemical	4	2.7

Flame burns constituted the majority of fatal cases.

Table 4: Manner of Death

Manner	Number	Percentage
Accidental	103	68.7
Suicidal	36	24.0
Homicidal	11	7.3

Accidental burns represented the most common manner of death.

Table 5: TBSA Involvement and Mortality Pattern

TBSA (%)	Cases	Mean Survival (Days)
<40	21	18.2 ± 4.1
41–60	46	12.4 ± 3.8
61–80	55	7.3 ± 2.6
>80	28	2.8 ± 1.1

Chi-square = 26.48; p < 0.001

A statistically significant association was observed between increasing TBSA involvement and reduced survival duration.

Table 6: Immediate Cause of Death

Cause	Number	Percentage
Septicemia	57	38.0
Shock	39	26.0
MODS	22	14.7
Pneumonia	15	10.0
Acute Kidney Injury	10	6.7
Others	7	4.6

Septicemia was the leading immediate cause of death.

Histopathological Findings

The most frequent microscopic findings were:

- Coagulative necrosis of epidermis (84%)
- Dermal edema (79%)
- Vascular congestion (74%)
- Neutrophilic infiltration (68%)
- Fibrin thrombi (31%)
- Granulation tissue formation (42%)

Discussion

Burn injuries continue to represent a major cause of unnatural mortality in developing countries. The predominance of young adults observed in the present study is consistent with previous reports by Peck et al., Daruwalla et al., and Sharma et al., who

documented the highest incidence among economically productive age groups. [7-9] Female predominance observed in the present study may be attributed to greater domestic exposure to cooking activities, use of inflammable clothing, and sociocultural factors. Similar observations have been reported in several Indian studies. [10,11] Flame burns constituted 86% of cases and represented the predominant mechanism of injury. This finding is comparable with studies conducted in India and other developing countries where kerosene stoves, LPG cylinders, open flames, and unsafe cooking practices continue to be major contributors. [12,13] The majority of deaths were classified as accidental. However, nearly one-fourth of cases were suicidal and 7.3% were homicidal. Distinguishing among these categories remains one of the most challenging aspects of forensic investigation. Careful evaluation of scene findings,

witness statements, dying declarations, burn patterns, and autopsy findings is essential before reaching conclusions regarding manner of death. [14] The present study demonstrated a statistically significant association between TBSA involvement and survival duration ($p < 0.001$). Extensive burns result in profound fluid loss, inflammatory mediator release, immunosuppression, and metabolic derangements that increase mortality risk. Similar observations have been reported by Jeschke et al. and Brusselsaers et al. [15,16] Septicemia emerged as the most common immediate cause of death. Loss of skin integrity facilitates bacterial invasion leading to systemic infection and multiorgan dysfunction. Hospital-acquired infections caused by multidrug-resistant organisms further contribute to mortality [17]. Histopathological examination revealed coagulative necrosis, edema, vascular congestion, and inflammatory infiltration. These findings represent vital reactions and confirm the antemortem nature of burns. Inflammatory cell migration and vascular responses develop only in living tissue and therefore possess considerable forensic significance. [18] The distinction between antemortem and postmortem burns is often crucial in criminal investigations. Antemortem burns characteristically show line of redness, vesicle formation containing protein-rich fluid, inflammatory infiltration, soot deposition within air passages, and elevated carboxyhemoglobin levels. Postmortem thermal injuries generally lack these vital reactions. [19] Heat ruptures constitute another important medicolegal consideration. They may mimic lacerated wounds and occasionally create suspicion of assault. Unlike true traumatic lacerations, heat ruptures usually demonstrate intact blood vessels crossing the defect and absence of hemorrhagic infiltration. [20] Pugilistic attitude, frequently observed in severely charred bodies, results from heat-induced muscle contraction and does not indicate defensive posture or ante-mortem struggle. Awareness of this phenomenon is important for accurate forensic interpretation. [21] Dowry-related burn deaths remain a significant concern in India. Under relevant legal provisions, deaths of married women occurring within seven years of marriage under suspicious circumstances warrant detailed investigation. [22] Consequently, proper documentation, collection of evidence, and recording of dying declarations assume paramount importance. The findings of the present study highlight the indispensable role of autopsy examination in determining the cause and manner of burn deaths. Comprehensive evaluation integrating clinical history, pathological findings, histology, toxicology, and investigative information ensures accurate medicolegal conclusions.

Limitations: The study was conducted at a single tertiary care center and may not represent community-wide burn mortality patterns.

Histopathological examination was performed selectively rather than universally. Long-term clinical follow-up prior to death was not available in all cases.

Conclusion

Fatal burn injuries predominantly affect young adult females and are most commonly caused by flame burns occurring in domestic settings. Septicemia remains the leading cause of death, while increasing TBSA involvement significantly influences survival. Autopsy examination supplemented by histopathological evaluation provides valuable evidence regarding burn vitality, mechanisms of death, and medicolegal interpretation. Accurate documentation and multidisciplinary investigation are essential for distinguishing accidental, suicidal, and homicidal burns and ensuring the proper administration of justice.

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