

AN AUTOPSY-BASED STUDY ON THE PATTERNS OF INJURIES OF BURN CASES IN JORHAT DISTRICT, ASSAM

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ABSTRACT

Objective: This autopsy-based study aimed to determine the incidence of burn-related fatalities in Jorhat District, Assam, identify associated factors, investigate injury patterns and severity, explore contributing factors, examine the relationship between injuries and cause of death, differentiate between dermo-epidermal and deep burns, investigate circumstances surrounding burn injuries, and offer recommendations for prevention and forensic investigation improvements.

Methods: Data were collected from medico-legal autopsies conducted at the Mortuary of the Department of Forensic Medicine, Jorhat Medical College and Hospital, Jorhat, between May 11, 2020, and May 10, 2021. Demographic information, burn characteristics, autopsy findings, and circumstances of injuries were analyzed.

Results: Out of 628 medico-legal autopsies, burn-related deaths comprised 7.32% of cases. Victims with 51–60% total body surface area burns were most common (23.91%). Burns often occurred indoors, notably in kitchens (56.52%) and bedrooms (26.08%), with a majority in closed rooms (54.35%). Synthetic (47.82%) or cotton (41.30%) clothing was prevalent, and kerosene was common in alleged suicidal cases (23.92%). Most victims died within 24 h (43.46%), primarily due to shock (52.17%), and septicemia (45.65%). Dermo-epidermal burns were prevalent (93.47%), and deaths were mainly accidental (65.21%). Histopathological analysis revealed dermis and epidermis separation (82.60%), flattened and elongated epithelial cells (73.91%), congestion (76.09%), leukocyte infiltration (73.91%), capillary dilatation (67.39%), and edema (67.39%).

Conclusion: This study provides comprehensive insights into burn injury characteristics, circumstances, and consequences. Recommendations include preventive measures and improvements in forensic investigation practices related to burn injuries, offering valuable implications for health care, forensic medicine, and public awareness initiatives.

Keywords: Burn injuries, Autopsy, Burnt skin histopathology, Septicemia.

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INTRODUCTION

Burn injuries are a serious public health issue that affects many people worldwide, especially in developing countries where the resources and infrastructure for prevention and treatment are often inadequate. India being the most populous country in the world faces a high burden of burn injuries and deaths, with an estimated 70 lakh burn injuries per year, resulting in around 1.4 lakh deaths and 2.4 lakh disabilities. The mortality rate in India is over 8.3/100,000 population, which is much higher than the global average of 3.9/100,000 population. Moreover, India loses about 5 million Disability-Adjusted Life Years annually due to burn injuries, which is a measure of the years of healthy life lost due to death or disability [1]. Burn injuries not only have physical and psychological consequences for the victims and their families but also have social and economic impacts on society.

One of the factors that contribute to the high incidence and severity of burn injuries in India is the socio-cultural context, which exposes certain vulnerable groups, such as young women, to a higher risk of intentional or accidental burns. In India, young women are more than 3 times as likely as young men to be killed by fire, and many of these deaths are related to dowry disputes, domestic violence, or self-immolation. Dowry is a practice where the bride's family pays money or gives goods to the groom's family as a condition of marriage. Although dowry is illegal in India, it is still widely practiced and often leads to harassment, abuse, or murder of the bride if the dowry is deemed insufficient or delayed. According to the National Crime Records Bureau, dowry-related matters accounted for the lives of

19 women every day in 2020, and 6966 dowry deaths were reported in the same year. In 2018, of the 12,748 fire deaths, 66.6% were females, and out of the 7244 women killed, 441 were injured. A crime against women is committed every 3 min, a woman is raped every 29 min, and a dowry death occurs every 77 min [2]. These statistics show the alarming situation of women's safety and rights in India and the need for urgent action to prevent and address the violence and discrimination they face.

In the Jorhat district of Assam, a northeastern state of India, burn injuries are among the major causes of death and disability. In the period from 2011 to 2020, there were 5337 medico-legal autopsies in Jorhat, out of which 481 (9.01%) cases were reported to be flame burn injuries. This indicates that flame burns are a common and fatal type of injury in this region and that there is a need for more research and intervention to understand and address the problem. However, there is a lack of comprehensive data on the epidemiology, etiology, and outcomes of burn injuries in Jorhat, which hampers the development of effective prevention and management strategies. Therefore, the objective of this study is to analyze the patterns of burn injuries in Jorhat and identify the risk factors, causes, and consequences of burns in this population. By doing so, this study will contribute to the existing knowledge on burn injuries and provide evidence-based recommendations for reducing the burden of burns in a small district like Jorhat.

Aims and objectives

1. Determine the incidence of burn-related fatalities in Jorhat District and identify associated factors

2. Investigate and describe the specific patterns and severity of injuries observed in burn cases through autopsy findings
3. Explore potential factors that contribute to the occurrence and severity of burn injuries
4. Examine the relationship between the observed patterns of injuries and the ultimate cause of death in burn cases
5. Differentiate between dermo-epidermal and deep burn injuries in autopsy reports and assess their prevalence and correlation with fatal outcomes
6. Investigate the circumstances surrounding burn injuries to determine the prevalence of accidental, suicidal, and homicidal cases
7. Based on the autopsy findings, offer recommendations for preventive measures and improvements in forensic investigation practices related to burn injuries.

MATERIALS AND METHODS

Data collection

- The study comprised 46 cases of deaths due to burn injuries from 628 medico-legal autopsies conducted at the Mortuary of the Department of Forensic Medicine, Jorhat Medical College and Hospital, Jorhat.

Inclusion criteria

- All cases of flame burns were brought for autopsy in Jorhat Medical College
- Both sexes of all age groups were considered
- Only cases conducted within a 1-year timeframe were included.

Exclusion criteria

- Decomposed cases of fatal burn injuries were excluded
- Burn injuries caused by electricity, ultraviolet rays, infrared lights, X-rays, and corrosive chemicals were excluded
- Unidentified dead bodies of burn cases were excluded.

Materials

- Documents obtained from the police, including forwarding letters, inquest reports, and dead body challans, were utilized
- Burned skin tissue samples, alongside junctional unburnt skin tissue, were dissected from cadavers of burn injury victims during the specified 1-year period
- The autopsy process involved an autopsy table and instruments, a magnifying lens, measuring tape, and a DSLR camera for photography
- Microscopes with varying focal lengths, laboratory reagents, and equipment were employed
- Skin tissues collected underwent histopathological examination at the Department of Pathology, Jorhat Medical College and Hospital
- The study incorporated a detailed review of histories obtained from relatives, police, and hospital records
- All pertinent data were meticulously recorded in a pre-designed pro forma.

Data analysis

- Data analysis was conducted in MS Excel, utilizing calculations to determine percentages and derive insights from the data
- Comprehensive data analysis involved categorizing and quantifying the types and severity of injuries sustained by burn victims.

Study setting

- The study was conducted at the Mortuary of the Department of Forensic Medicine and Toxicology, Jorhat Medical College and Hospital, Jorhat.

Study period

- The data collection period for the study spanned from May 11, 2020, to May 10, 2021, encompassing a 1-year time frame.

Methodology

- The study is an observational, autopsy-based, descriptive study regarding the pattern of fatal flame burn injuries along with a histopathological study of the skin brought for autopsy at the Mortuary of the Department of Forensic Medicine and Toxicology, Jorhat Medical College and Hospital over a period of 1 year.

RESULTS AND OBSERVATIONS

Table 1 shows that a total of 628 autopsies were performed during the study period, of which 46 cases were identified as burn-related, constituting 7.32% of the total autopsies conducted.

In Table 2, it is evident that the highest number of cases (23.91%) involved victims with burn injuries covering 51–60% of the total body surface area. The majority of the deceased individuals, comprising a total of 40 cases (86.92%), had sustained burn injuries exceeding 40%. Interestingly, there were no reported cases within the 0–20% range.

From Table 3, it can be said that out of the 46 cases, the highest occurrence was in the kitchen with 26 (56.52%) cases followed by bedrooms in 12 (26.08%) cases.

Table 4 demonstrates that 25 (54.35%) rooms were closed at the time of the incident and 19 (41.30%) were open/properly ventilated. In 2 (4.35%) cases, the status of the room could not be ascertained.

Table 5 shows that 20 (43.46%) victims died within 24 h of sustaining burn injury. However, a significant number of 11 (23.91%) cases survived for 3–7-day period following the incident, followed by 1–2-week duration with 7 (15.21%) cases.

Table 6 shows that the depth of burn sustained in the majority of the victims was dermo-epidermal in nature with 43 (93.47%) cases. Deep burn injury in combination with dermo-epidermal burn injury was sustained in 3 (6.52%) cases.

Table 7 depicts that a majority of deaths due to burn injury were accidental in nature with 30 (65.21%) cases. Next, it was followed by suicidal nature with a significant number of 16 (34.79%) cases. In the present study, there were zero (0) homicidal cases.

From Table 8, the major cause of death was ascertained to be due to shock (neurogenic/hypovolemic) in 24 (52.17%) cases followed by septicemia in 21 (45.65%) cases.

Table 9 shows that the singeing of hair was present in all cases except 6 (13.05%) cases where prominent hair concentration areas of the scalp, face, axilla, and pubic region were not singed.

Table 10 shows that line of redness was present in 34 (73.91%) cases, vesicles in 11 (23.91%) cases, pugilistic attitude was present in 4 (8.69%) cases, smell of kerosene was present in 12 (26.09%) cases, and soot particles in trachea beyond the bifurcation were detected in 6 (13.04%) cases at the time of conducting autopsy.

Table 11 illustrates the correlation between the room's status, the materials of garments worn by the victims, the presence of kerosene odor on their bodies during autopsy, and the deposition of soot particles in the trachea beyond the bifurcation. In closed rooms where the incidents occurred (54.35%), the majority of victims (56%) were found to be wearing cotton garments, with kerosene odor present in 36% of cases during autopsy, and 16% displaying soot particles in the trachea. Conversely, in open rooms (41.30%), the majority wore synthetic garments (52.63%), with kerosene odor noted in 15.79% of cases and soot particles detected in the trachea in 10.53% of cases. Notably, the findings suggest a prolonged presence of kerosene odor on bodies in closed rooms, exceeding that in open rooms by more than double (36%). In addition, the deposition of soot particles in the trachea was almost double in closed rooms compared to open rooms, at 16%.

Table 12 shows the various morphological changes in burnt skin. The most common finding was a red line of demarcation in 34 (73.91%) cases. Pus and signs of healing were seen in 22 (47.83%) and 12 (26.09%) cases, respectively. Blisters were found in 11 (23.91%) cases.

Table 1: Total number of autopsies performed during the period and corresponding number and percentage of burn cases during the same period

Total number of autopsies	Number of burn cases	Percentage of burn cases
628	46	7.32%

Table 2: The percentage of total body surface area that sustained burn injuries

Percentage of Burn	Number of cases	Total	Percentage
0-10			
0-5	0	0	0.00
6-10	0		
11-20			
11-15	0	0	0.00
16-20	0		
21-30			
21-25	0	1	2.17
26-30	1		
31-40			
31-35	3	5	10.86
36-40	2		
41-50			
41-45	7	7	15.21
46-50	0		
51-60			
51-55	5	11	23.91
56-60	6		
61-70			
61-65	3	4	8.69
66-70	1		
71-80			
71-75	5	5	10.86
76-80	0		
81-90			
81-85	6	7	15.21
86-90	1		
91-100			
91-95	5	6	13.04
96-100	1		
Total	46		100

Table 3: Site of occurrence inside residence

Rooms	Number of cases	Percentage
Kitchen	26	56.52
Bedroom	12	26.08
Bathroom	1	2.19
Corridor	4	8.69
Not known	3	6.52
Total	46	100

Table 4: Condition of room in which incident took place

Condition	Number of cases	Percentage
Closed	25	54.35
Open	19	41.30
Not known	2	4.35
Total	46	100

Table 13 shows the histopathological findings in burnt skin. The most common finding was that of separation of dermis and epidermis with a total of 38 (82.60%) cases. Flattened and elongated epithelial cells were present in 34 (73.91%) cases. Petechial hemorrhage and vacuolization were seen in 33 (71.74%) and 32 (69.56%) cases, respectively.

Table 5: Survival period following the burn injury

Duration	Number of cases	Percentage
On spot	10	21.73%
0-12 h	6	13.04%
12-24 h	4	8.69%
24-48 h	6	13.04%
48-72 h	0	0.00%
3-7 days	11	23.91%
1-2 weeks	7	15.21%
2-3 weeks	1	2.17%
3-4 weeks	1	2.17%
≥1 month	0	0.00%
Total	46	100%

Table 6: Depth of skin by burn

Depth	Number of cases	Percentage
Dermo-Epidermal	43	93.47
Dermo-Epidermal/Deep	3	6.52
Deep	0	0
Total	46	100

Table 7: Nature of death

Nature	Number of cases	Percentage
Suicidal	16	34.79
Accidental	30	65.21
Homicidal	0	0.00
Total	46	100

Table 8: Cause of death

Cause	Number of cases	Percentage
Shock	24	52.17
Septicemia	21	45.65
Others	1	2.17
Total	46	100

Table 9: Singeing of body hair

Singeing of body hair	Number of cases	Percentage
Scalp/Face/Pubic/Axilla	40	86.95
Nil	6	13.05
Total	46	100

Table 14 denotes the histopathological findings in junctional skin. It shows that the most common finding was congestion with a total of 35 (76.09%) cases. Infiltration of leukocytes was present in 34 (73.91%) cases. Capillary dilatation and edema were both found in 31 (67.39%) cases, respectively.

DISCUSSION

During the study period from May 11, 2020 to May 10, 2021, burn cases constituted 7.32% of the total autopsies performed, showing a 1.46% increase compared to the previous year. Choudhury *et al.* [3] reported a similar prevalence of burn cases aligning with our findings. Victims sustaining 51-60% total body surface area burns comprised the highest number (23.91%), with the majority (86.92%) experiencing over 40% burn injury, consistent with previous studies by Afify *et al.* [4], Mazumder and Patowary [5], and Mishra *et al.* [6]. A majority of burn incidents (56.52%) occurred in kitchens, possibly due to the prevalent use of fires and crude fuels, echoing Gupta *et al.* [7], Subrahmanyam [8], Chawla *et al.* [9], Gupta *et al.* [10], Das *et al.* [11], and Debbarma [12]

Table 10: Status of external features and soot particles in the trachea

External features	Status					
	Present		Absent		Total	
	No. of cases	%	No. of cases	%	No. of cases	%
Pugilistic attitude	4	8.69	26	56.53	46	100
Line of redness	34	73.91	12	26.09	46	100
Smell of kerosene/petrol	12	26.09	34	73.91	46	100
Vesicles (Blisters)	11	23.91	17	36.96	46	100
Soot particles in the trachea	6	13.04	40	86.96	46	100

Table 11: Co-relation of condition of room, material of clothes worn, smell of kerosene, and presence of soot particles in the trachea.

Condition of room	Material of clothes worn	Smell of kerosene/petrol present	Soot particles present
Closed – 25 (54.35%)	Cotton – 14 (56%)	9 (36%)	4 (16%)
	Synthetic – 11 (44%)		
Open – 19 (41.30%)	Cotton – 4 (21.05%)	3 (15.79%)	2 (10.53%)
	Synthetic – 10 (52.63%)		
	Silk – 2 (10.53%)		
	Not known – 2 (10.53%)		
	Woolen – 1 (5.26%)		

Table 12: Morphological changes in burnt skin

Changes	Present		Absent	
	Number of cases	%	Number of cases	%
Blisters	11	23.91	35	76.09
Pus	22	47.83	24	52.17
Signs of healing	12	26.09	34	73.91
Redline of demarcation	34	73.91	12	26.09

Table 13: Histopathological findings in burnt skin

Findings	Present		Absent	
	Number of cases	%	Number of cases	%
Separation of epidermis and dermis	38	82.60	8	17.40
Vacuolisation	32	69.56	14	30.44
Petechial hemorrhage	33	71.74	13	28.26
Flattened and elongated epithelial cells	34	73.91	12	26.09

Table 14: Histopathological findings in junctional skin

Findings	Present		Absent	
	Number of cases	%	Number of cases	%
Capillary dilatation	31	67.39	15	32.61
Edema	31	67.39	15	32.61
Congestion	35	76.09	11	23.91
Infiltration of leukocytes	34	73.91	12	26.09

observations. Closed rooms were the predominant location for burn incidents (54.35%), correlating with findings by Nath [13] and Ashkan *et al.* [14], but differing from Paul [15], who noted more incidents in open rooms. The study revealed that 20 individuals, constituting 43.46% of the sample, succumbed to burn injuries within 24 h of the incident. Notably, a significant proportion of 11 cases (23.91%) survived between 3 and 7-day post-injury, followed by 7 cases (15.21%) enduring for 1–2 weeks. These findings underscore the acute fatality of burn injuries within the initial 24-h period, emphasizing the critical importance of prompt management following such incidents. The results align with previous studies by Mishra *et al.* [6], Das *et al.* [11], Kumar *et al.* [16], and Manigandaraj and Selvakumar [17]. However, they diverge from the findings of Tasgaonkar *et al.* [18]. The

majority of the burn cases were dermo-epidermal in nature with a total of 43 (93.47%) cases. Deep burn injury in combination with dermo-epidermal burn injury was seen in 3 (6.52%) cases. Present findings are similar to Mazumder and Patowary [5] and Mishra *et al.* [6] but vary from Chawla *et al.* [9]. Accidental burns accounted for the majority of deaths (65.21%), followed by suicidal cases (34.79%), with no homicidal cases reported, consistent with earlier findings by Buchade *et al.* [19], Chawla *et al.* [9], Mishra *et al.* [6], and Das *et al.* [11]. The primary cause of death was determined to be shock (neurogenic/hypovolemic) in 24 cases (52.17%), followed by septicemia in 21 cases (45.65%). Remarkably, almost all individuals who succumbed to shock passed away within 24 h of hospital admission, at the scene of the incident, or en route to the hospital. Furthermore, a majority of

these cases exhibited burn injuries covering a larger surface area and/or deeper burns. These findings are consistent with studies by Afify *et al.* [4], Mazumder and Patowary [5], Mishra *et al.* [6], Das *et al.* [11], and Manigandaraj and Selvakumar [17]. However, they diverge from the perspectives of Chawla *et al.* [9], Gupta *et al.* [10], Paul [15], and Goswami *et al.* [20], who suggested that most deaths resulting from burn injuries were attributable to septicemia. Singeing of hair was observed in all cases except for 6 (13.05%) instances where prominent hair concentration areas such as the scalp, face, axilla, and pubic region were unaffected. This finding closely resembles that of Nath [13] but differs from Das *et al.* [11]. In addition, our study identified the presence of various other findings such as a redness line observed in 34 (73.91%) cases, vesicles in 11 (23.91%) cases, a pugilistic attitude in 4 (8.69%) cases, the smell of kerosene in 12 (26.09%) cases, and soot particles beyond the tracheal bifurcation in 6 (13.04%) cases. These findings closely align with Paul [15] regarding the presence of a pugilistic attitude (6.38%), the smell of kerosene (25.89%), vesicles (19.50%), and soot in the respiratory tract (10.64%), as well as with Nath [13] regarding the presence of a pugilistic attitude (4.4%), vesicles (19.50%), and the smell of kerosene (23.08%). However, our results regarding the presence of a redness line (76.02%) are consistent with Das *et al.* [11] whereas differ from Paul's [15] results (40.43%). The study investigated morphological and histopathological changes in burnt skin and junctional skin. In burnt skin, the most prevalent morphological finding was the red line of demarcation in 34 cases (73.91%), followed by pus and signs of healing observed in 22 (47.83%) and 12 (26.09%) cases, respectively, with blisters present in 11 cases (23.91%). Histopathological examination revealed the separation of dermis and epidermis as the most common finding in burnt skin, observed in 38 cases (82.60%), along with flattened and elongated epithelial cells in 34 cases (73.91%), and petechial hemorrhage and vacuolization in 33 (71.74%) and 32 (69.56%) cases, respectively. In junctional skin, congestion was the predominant histopathological finding in 35 cases (76.09%), followed by leukocyte infiltration in 34 cases (73.91%), with both capillary dilatation and edema observed in 31 cases (67.39%) each. The present findings are almost similar to those of Sevvitt [21], Mant [22], Emanuel and Faber [23], Ritchie [24], and Parikh [25].

CONCLUSION

The aim of this study was to examine the patterns of injuries in flame burn cases in Jorhat District, Assam, India, and to provide an understanding of prevention and management of burn injuries. The study analyzed 46 burn-related fatalities out of 628 medico-legal autopsies conducted at the Mortuary of the Department of Forensic Medicine, Jorhat Medical College and Hospital, Jorhat, from May 11, 2020, to May 10, 2021. The study revealed various aspects of burn injuries, such as the location, cause, manner, extent, duration, and histopathology of the burns, as well as the autopsy findings.

The study found that most of the burn injuries occurred indoors, especially in kitchens and bedrooms, and in closed rooms. This suggests that domestic accidents and intentional self-harm or homicide are the major causes of burn injuries in this region. The study also found that synthetic and cotton clothing, and kerosene as an inflammatory material, were common factors in burn cases. These factors may increase the severity and spread of the burns, as well as the difficulty of extinguishing them. The study also observed that most of the victims died within 24 h of the injury and that dermo-epidermal burns, shock, and septicemia were the predominant types and causes of death. The study also performed histopathological analyses of the skin samples from the burn victims and found various changes in the dermis and epidermis, such as separation, flattening, congestion, leukocyte infiltration, capillary dilatation, and edema.

The findings of this study have important outcomes for the prevention and management of burn injuries in this region. The study highlights the need for raising public awareness about the risks and consequences of burn injuries and the ways to prevent them. The study also

emphasizes the importance of improving the living standards, cultural practices, and education of the people, especially women and children, who are more vulnerable to burn injuries. The study also recommends the establishment of adequate and accessible health-care facilities, including burn trauma centers that can provide timely and specialized medical care to the burn victims. The study also stresses the significance of forensic expertise in determining the nature and manner of burn injuries and in providing evidence for legal proceedings. The study also suggests the need for conducting more studies and implementing burn injury registries that can provide epidemiological data and insights for targeted interventions.

ETHICAL CONSIDERATIONS

Ethical clearance was obtained from the Institutional Ethics Committee of the Medical College where the study was conducted.

CONFLICTS OF INTERESTS

The authors declare that they have no conflicts of interest related to the research study.

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