

An Epidemiological study of Burn Injuries

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Abstract

Background: Burn is the most devastating of all the injuries and a major global public health crisis. Only limited studies have evaluated the epidemiological trends of burn injury.

Aim: To evaluate prospectively epidemiological aspects of burn injury in the hospital situated in the central part of India.

Study design: The consecutive 360 cases of burns admitted in our hospital were analyzed prospectively to review the scenario of burn over a period of 3 years.

Results: The study revealed female (68.81%) predominance with female to male ratio of 2.2:1. Most of the victims of burn were between the ages of 21 to 30 years. Married (69%) outnumbered unmarried. Out of total female victims' majority were Hindus, illiterate and housewives.

The domestic burn was common with Kerosene stove with kerosene being the main accelerant. Shock was the commonest cause of deaths occurring within 48 hours of burn injury while it was septicemia in cases of deaths occurring after three days.

Conclusion: Young married females were the commonest victims of burn injury. Considering the morbidity and mortality owing to burns, government and other social organizations need to put special efforts for the prevention and education programs against burn injuries.

Keywords: Burn, Central India, Medicolegal, Mortality.

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Introduction

Burn injury is one of the common medical emergencies admitted to any hospital and is an important public health problem throughout the world. In India, the burn injuries are only exceeded by motor vehicular accidents as a cause of trauma related deaths. However, an accurate estimation of incidence of burn patients is difficult to obtain as there are many more that are treated by general practitioners, quacks and self-help.

Forensic expert has to face many questions in the court of law on medicolegal examination report or postmortem report in the case of burn. Therefore, a thorough and accurate examination and assessment of these cases is of utmost important.

This is the only study which deals with detailed socio epidemiological and medical features related to burn victim and is a true representation of scenario of burn in a hospital of central India.

Materials and Method

The consecutive 360 cases of burn, either admitted or brought for postmortem examination at Kasturba Hospital, MGIMS, Sevagram, over the period of 3 years (from 1st July 2007 to 30th June 2010) were studied. Each case was followed from the time of admission to casualty

or ward till its discharge or death. The cases which died before reaching the hospital and were directly sent for autopsy were also studied. The burn cases treated in outpatient department were excluded from this study.

A proforma was prepared to record important points. It included a detailed history (age, sex, address, religion, education, occupation, marital and socioeconomic status, time, place, type and manner of burn, pattern of clothing), physical examination of burn case [smell of accelerant, total body surface area (TBSA) involved by burn according to Wallace's rule of nine, classification as dermal, dermoepidermal and deep burns according to Wilson *et al*, a through general examination]. Findings of postmortem examination (external and internal examination) were noted in deceased cases.

Observations and Results

A total of 360 cases of burn injury were studied over 3Yrs. Out of this 171 cases were treated, recovered and discharged from the ward. The postmortem examination was carried out for 189 deceased cases.

A. General information

The detailed history was obtained from the patients close relatives or friends available and the person who was present at the time of incidence or the one accompanying the victim. Information was also collected from the relatives, maternal as well as in laws, neighbors and police investigation reports. In doubtful cases, the dying declaration given by the patient in presence of the magistrate was compared with the statement given by the patient at the time of admission.

Sex and age: Considering the sex the males were 111 and females were 249 with a sex ratio of 2.2:1. The age group most commonly affected was 21-30 years followed by 31-40 years. There was a female predominance in all the age groups.

Table 1: Distribution of burn injury according to age group

Age Group(in years)	Total	Male	Female
0-10	50	22	28
11-20	34	06	28
21-30	115	26	90
31-40	100	37	63
41-50	35	12	23
51-60	12	05	07
More than 60	14	03	10
Total cases	360	111	249

Marital status and time since marriage: Considering the marital status, it was observed that 250(69%) were married, 95(26.5%) were unmarried including the children of unmarriageable age and 15 (4.5%) were widower or widow. Among all female cases, 180 (72.0%) were married, 55 (22%) were unmarried and 14(6.0%) were widows.

Out of all married females, 14 victims were pregnant at the time of admission to burn ward.

Educational status: Most of the burn victims were literate compared to illiterate. Maximum number of victims was educated only up to primary school level.

Table 2: Distribution of burn injury according to educational status

Education	Male	Female	Total
Illiterate	40 (36.00%)	107 (43.00%)	147 (41.0%)
Up to primary level	25 (22.50%)	75 (30.00%)	100 (28.0%)
Middle and high school	37 (33.50%)	48 (19.00%)	85 (24.0%)
College	09 (08.00%)	19 (08.00%)	28 (07.0%)
Total	111 (31.19%)	249 (68.81%)	360 (100%)

Rural/urban incidence: The incidence of burn was more in rural area, both in males and females. This can be because of the main catchment area of our hospital being the rural area.

Table 3: Distribution of burn injury according to the residential area

Rural/urban	Male	Female	Total
Rural	88 (79%)	212 (85.0%)	290 (83.0%)
Urban	23 (21%)	37 (15.0%)	60 (17.0%)
Total	111 (100%)	249 (100%)	360 (100%)

Religion: Majority of the burn victims were Hindus (95.3%) while only 4.7% were Muslims. The majority of population is Hindu in this area.

Occupation: Housewives constituted the largest group comprising 185 cases (51%) of the total burn.

This was followed by unskilled workers including farmers and labors (15.7%), students (09.32%), employed i.e. skilled and professionals (07%) and others including the unemployed and children constituted 14% of total burn victims.

Time of sustaining burn injury: Maximum burn injuries occurred during the usual time of cooking or the working time in the kitchen. Out of total 50 suicidal cases 22 sustained burn between 8 PM to midnight, the same time as for the homicidal burns.

Table 4: Time of sustaining burn injury and manner of burn

Time of burn	Total cases	Accidental	Suicidal	Homicidal
12 Noon-4 am	51(14.1%)	44(14.7%)	06(12%)	01(9.09%)
4 pm - 8 pm	90(25.3%)	86(28.8%)	04(8%)	00(0%)
8 pm - Midnight	68(18.9%)	42(14.00%)	22(44%)	04(36.36%)
Midnight - 4 am	12(03.3%)	09(03.00%)	03(06%)	00(0%)
4 am - 8 am	24(6.6%)	21(07.00%)	00(0%)	03(27.27%)
8 am - 12 Noon	115(31.9%)	97(32.4%)	15(30%)	3(27.27%)
Total	360(100%)	299(83.0%)	50(14.0%)	11(03.0%)

Place of burn: Most of the burn cases were domestic (320 cases) and only 40 cases were non-domestic. The burn injury sustained inside the kitchen and in females working in the kitchen was highest constituting 194 cases (54.0%).

Table 5: Distribution of cases according to the place and the type of burn

Type of burn	Sex Male/Female	0-10	11-20	Age group (years)			51-60	>60	Total cases
				21-30	31-40	41-50			
Flames	Male	03	05	20	29	05	03	03	68
	Female	14	23	82	54	20	06	11	210
	Subtotal	17	28	102	83	25	09	14	278
Scalds	Male	20	02	03	02	03	00	00	30
	Female	15	02	02	02	00	00	00	21
	Subtotal	35	04	05	04	03	00	00	51
Electric	Male	00	00	02	06	02	02	00	12
	Female	00	02	00	00	00	00	00	02
	Subtotal	00	02	02	06	02	02	00	14
Radiation	Male	00	00	01	01	01	01	01	17
	Female	00	00	03	06	03	00	00	
Total		52	34	113	100	34	12	15	360

Table 6: Distribution of burn cases according to place & type of burn

Place	Sex	Flames	Scalds	Electric	Radiation	Total
Domestic						
1. Kitchen	M	31	20	00		51
	F	179	15	00		194
2. Home excluding kitchen	M	19	11	02		32
	F	38	03	02		43
Non-domestic						
1. Field/open place	M	06	00	05	02	13
	F	00	02	00	04	06
2. Place of work	M	05	00	05	04	14
	F	00	00	00	07	07
Total		278	51	14	17	360

Type of burn injury: Burn injury by flame was common in adults and females while scalds were most common in children and males.

Manner of burn: Out of 360 cases studied, accidental manner of burn was most common in all types i.e. Flames, scalds, electrical burns & radiation burns.

Table 7: Manner and type of burn case

Manner	Flames	Scalds	Electrical	Radiation	Total
Accidental	224(80.5%)	49(96%)	14(100%)	17(100%)	304 (83.6%)
Suicidal	47(17.5%)	00	00	00	47(13.7%)
Homicidal	07(2.5%)	02(04%)	00	00	09(02.6%)
Total	278(100%)	51(100%)	14(100%)	17(100%)	360(100%)

Pattern of clothing- Most of burns i.e. 70% occurred due to wearing synthetic & mixed clothing.

Examination findings

Depth of burn injury: Maximum cases sustained dermoepidermal burns and most of them were Dupuytren's fifth degree. With TBSA of 48%. The cause of death was noted from the gross autopsy findings, ante mortem treatment record, investigations and clinical record. Shock was the most common cause of death in cases dying within a day or two.

In the two cases died within a day, the cause of death was the suffocation. In the deaths occurring after.

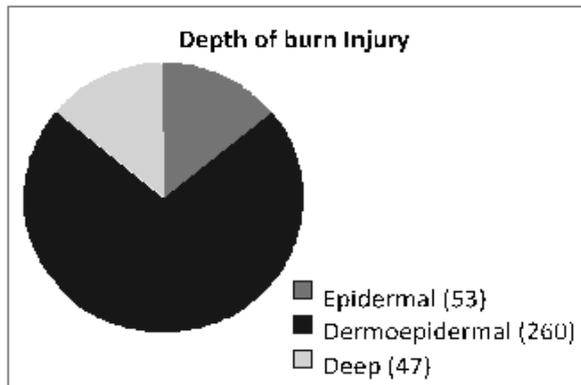


Fig. 1: Distribution of cases according to the depth (according to Wilson et al) of burn injury

Extent of burn injury (TBSA): Burns due to flames were more extensive and mostly involved the TBSA of more than 40 as compared to scalds and electric burn which involved the TBSA of less than 20 except in eight cases.

Mortality rate: Mortality was directly proportional to TBSA. It was more with flame burn injury and dermoepidermal burns. The mortality rate in males was 31.2% and in females it was 68.8%.

Duration of survival and cause of death in expired cases: The duration of survival was calculated from the time of sustaining burn up to the time of death. An immediate death was seen in a case of an electric burn while the death on 54th day was of a flame burn three days, septicemia was a leading cause followed by toxemia because of acute renal failure.

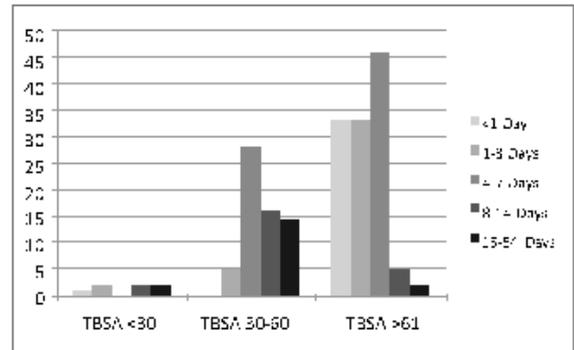


Fig. 2: distribution of the time since death and TBSA involved against the number of cases of burn.

Post mortem findings: Out of the total 189 fatal burn cases, there were 179 flame burns, five electric burns and five scald burns.

External examination: In cases of victims of the flame burn, the minimum body surface area involved was 26% in case of a 80 year old female, in case of scald it was 30% in a 2 year old child and 3% in case of an electric burn. The burn involving more than 90% TBSA were 10.78% and all were flame burns. The smell of kerosene was perceived at the time of postmortem examination in 19.83% cases against 26.59% at the time of hospitalization. Moreover, kerosene being volatile evaporates. Burn wound sepsis was present in 63.49% of the cases. Sooty blackening, singeing of hairs and peeling of skin were observed.

Internal findings: Gross findings of respiratory tract were congestion, petechial hemorrhages and presence of soot particles. Soot in upper respiratory tract was found in 22.31% of cases. Pulmonary edema was observed in 8.73% of the cases and pulmonary congestion was found in 80.95% cases. Generalized congestion of kidneys (61.90% cases) and brain (71.42% cases) was observed. Congestion of the stomach and duodenum with multiple petechial hemorrhages of gastric mucosa was observed in 50% cases.

Discussion

An accurate estimation of burn injury is difficult to obtain as reporting of burn cases is influenced by number of factors. In United States of America, two million civilians require medical care for burn injury, 74,000 are hospitalized and 14000 deaths results from burn every year². In United Kingdome, 175000 cases of burn injury visit Accident and Emergency department every year and 13,000 cases needs admission³. In India, every year about six million burn injuries occur⁴ and approximately one percent of Indian population suffers burn annually.⁵ Majority of studies in India have reported the maximum incidence of burn between the age of 15 to 40 years, with an overall female preponderance^{6,7,8,9,10,11,12,13,14,15,16,17}.

In our study the same was reflected with a female predominance (sex ratio 2.2:1). The commonest age group affected was 21 to 30 years (111 cases) followed by the age group between 31 to 40 years (93 cases). Female dominance in victims of burn was almost in all age group.

This can be attributed to involvement of females in kitchen work even at a younger age, early marriage system, more of a social burden leading to depression and bride burning. The studies carried out in western countries showed male predominance and extremes of ages (children and old peoples) were involved in burns^{2,3,18,19,20,21,22}.

The incidence of burn was maximum in young married females^{6,7,23}. The maximum cases (69%) we studied were married. Educational status plays an important role in decreasing the burn incidence, both by increasing the awareness in handling of inflammable substances, safety measures, improving the economic status and personality. Most of the studies have shown that the incidence of burn was more in illiterate^{6,7,8,9}.

We observed the incidence was more in the literates. But among them maximum were educated only up to primary level. Increasing awareness about the education and governments programs to increase literacy levels may be the reason behind this change in observation as compared to the studies carried out in earlier years. Most of the victims of burn injury in this study were from the rural area and were Hindu by religion, consistent with the findings of other study^{6,12,13}.

Occupation of a person makes him or her susceptible for burn. Majority of victims in our study were housewives engaged in cooking followed by unskilled workers. The predisposing factors for high incidence of burn in housewives were frequent exposure to cooking, inadequate knowledge of handling high pressure stoves, too much demand of work leading to hurried job and accidents and social burden making them susceptible to suicidal or homicidal burn. Ambade et al⁷ and Sharma et al¹⁰ also observed the high incidence of burn in housewives.

Among the victims of electrical burn we studied, three sustained burn while repairing high tension electric cables. Literature reveals that the occupation related burns were common in electricians, welders etc.¹⁶

Most of the burns injuries occurred usually at the time of cooking or working in Kitchen i.e. domestic burn^{6,7,8,10,12}. But the burn accidents during late night hours should not be considered accidental in unusual circumstances. Flame burns are common in adults while scalds are common in children^{6,7,10,12}. In our study, majority of the cases were wearing the loose and long cloths. Considering the female victims, majority had put on the saree at the time of burn Incidence and most often it was synthetic^{7,24}.

Severity of burn was also more in the victims wearing loose and synthetic Saree. Dandapat et al¹⁶ had reported negligible sex difference of flame burns while

the studies carried out in western countries had reported higher incidence of flame burns in Males^{2,3,18}. We observed that the scalds were common in males as compared to females and most of these cases were children below ten years of age. Similar is mentioned in the literature^{3,10,13,19}.

Contrary to this Parks et al²⁵ had reported maximum scalds in adults with equal sex distribution. In the present study most of the electric burn victims were males (85.3%). Dandapat et al¹⁶ in his study reported that all the electric burn cases were males while Ghuliani et al⁷ had reported 90.9% electric burn cases occurring in males. In present study most of radiation burn victim's sustained burns due to accidental exposure to radiation sources, radiation skin toxicity is from the irradiation of breast or chest wall as reported in other reported studies²⁷ & most of victims sustained radiation burn injuries due to prolonged accidental exposure & mostly more in females (70.00%), as compared to males (30%).

The factors like unprotected source of fire, cooking at floor level, loose fitting synthetic garments were mainly responsible for accidental flame burn^{7,8,10,27}. Suicidal burns were common in females^{13,23}. Parks et al²⁵ had reported the incidence of suicidal burn was more in males.

Traditionally, burn surface area is measured from Wallace's rule of nine. The mortality is influenced by multiple factors like severity and depth of burn, age, sex & source of radiation exposure etc. As the percentage of TBSA involved goes on increasing the mortality rate increases. Immediate cause of death in burn is due to primary or neurogenic shock. Secondary shock can cause death within 24 to 48 hours. After about 3-4 days, toxemia, septicemia, acute renal failure, respiratory complications, thromboembolism causes death.

After one week multiple factors comprise are sepsis, nutritional deficiencies, gangrene, etc. come in picture. Few studies have reported maximum deaths within 24 hours of succumbing burn²⁶. In our study, septicemia alone or in combination with other causes was the commonest cause of death (42.32%) comparable to 68% cases reported by Bangal et al¹⁷ and 52.22% by Gupta et al¹³. Shock remained the important cause of death within three days^{1,2,17}.

The medicolegal points which demands consideration in burn cases are whether the lesions found are due to burn, nature of agent causing burn, TBSA involved, cause of death, nature and manner of death. Indian penal codes related with burn injuries are 498-A, 304-A, 306 IPC, 307 IPC and 302 IPC. At postmortem examination, a finding of soot particles in the respiratory tract is a clear indication of ante mortem nature of a burn.

These were contradictory history, inconsistency in dying declaration, in cases of homicide attempt to save the victim by an accused, inconsistency between the stated source of burn and the one on inspection, presence of kerosene on head in cases of accidental burn. It is very difficult at times to label the case as of bride burning.

Law enforcing agencies invariably fail to nab the culprits.

To reduce the morbidity and mortality due to burn few preventive measures are suggested. Education of general public specially the vulnerable group, burning and lightening agents should not be left unguarded, small children should be kept away from fire sources or kitchen, safety means in factories safety precautions while exposure to radiation Should be strictly observed. Above all, it needs a change in the social tradition and custom.

Conclusion

Morbidity & mortality due to burns in developing countries like us is still increasing, despite of all the fact that, existing laws are revised and many non-government organizations (NGOs) are working in this matter, burn fatalities continue to occur.

The present epidemiological analysis of burn injury cases helps to emphasis the fact that, unlike in the western countries, the burn fatalities in India go beyond the meaning implied in term 'accident'. Thus burn cases need a thorough investigation to enable the legal system, public health agencies& medicolegal expert to take necessary action in preventing this social evil.

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