



## A REVIEW ON BURN AND ITS MEDICOLEGAL ASPECTS

**Rashmi Choudhary<sup>\*1</sup>, Dr. S. R. Inchulkar<sup>2</sup> and Dr. Prafulla<sup>3</sup>**

<sup>1</sup>M.D. Scholar, <sup>2</sup> Professor & H.O.D, <sup>3</sup>Reader

Post Graduate Department of Agad Tantra Evam Vidhi Vaidyak, Govt. Ayurved College, Raipur, Chhattisgarh.

**\*Corresponding Author:** Rashmi Choudhary

M.D. Scholar Post Graduate Department of Agad Tantra Evam Vidhi Vaidyak, Govt. Ayurved College, Raipur, Chhattisgarh.

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### ABSTRACT

Burn injuries constitute a serious medical, psychological and public health problem. Burn injuries occur due to a variety of thermal, electrical, mechanical products. Burning incidents amongst married women are a major concern in India as they have become persistent throughout all social levels and geographical areas. Burn injuries are very high among the most severe types suffered and attributing to high morbidity and mortality. Further, burns are also the important mode of suicide and homicide in the world. Moreover, the circumstances of these injuries are wrapped in obscurity, mystery, lies, and unreliable statements. The medicolegal investigation in deaths due to burns helps in the determination of manner and cause of death, the nature of burn injuries, i.e., antemortem or postmortem, time since death are important.

**KEYWORDS:** Burn, injury, homicide, postmortem, medicolegal.

### INTRODUCTION

A burn is an injury which is caused by application of heat or chemical substances to the external and internal surfaces of the body, which causes destruction of the tissue. Burn injuries are the fourth common type of trauma in the world, following traffic accidents, falls, and interpersonal violence.<sup>[1]</sup> Burn injuries are the global public health problem, the incidence is estimated to be around 26,5000 deaths per year. In India, annually 1 million people are injured due to burn.<sup>[2]</sup> The accidental burn is the commonest manner, with residential fires accounting for 10% of all accidental fatalities in developed countries.<sup>[3]</sup> In all societies burns constitute a serious medical and psychological problem. It has also severe economic and social consequences not only to the individuals, but also to their family and society in general.<sup>[4]</sup> Burn injuries are a major public health problem due to its high mortality, morbidity and disability amongst young and middle-aged adults. It may be associated with accidental, suicidal or homicidal causes. So, burn injuries have medicolegal significance, as they might be considered as common causes of unnatural deaths in India.

### Causes of burn<sup>[5,6]</sup>

1. Heated solid- A highly heated solid body or a molten metal, produces blister, reddening and the epidermis may found blackened, dry and wrinkled.
2. Flame-When a person exposed to open fire. Produces vesication, roasted patches of skin or

deeper parts may be seen. Hair singed by the flame becomes curled, twisted, blackish, breaks off or totally destroyed.

3. Liquids- kerosene oil, petrol produces sooty blackening and having characteristics odour.
4. X-ray and radium- produces redness of skin, shedding of hair, pigmentation. Severe exposure may produce burns with erythema, blistering or dermatitis or ulceration.
5. Explosions-in coal mines gun powder are usually very extensive and produces blackening and tattooing.
6. Ultraviolet rays-Uv rays, infrared rays produced by sun and mercury vapour lamp causes erythema or acute eczematous dermatitis.
7. Corrosive substances- shows ulcerated patches and are usually free from blisters; hair is not singed and the red line of demarcation is absent. Strong acids produces dark leathery burn. Strong alkalis cause skin to slough and leave moist, slimy, greyish areas.
8. Electrical burns-It is a injury resulting to skin at points of contact to the electrical source.
9. Radiant heat burn- electromagnetic waves produces redness in the skin.
10. Microwave burns- well demarcated, full thickness burn without charring.

### Dupuytren's Classification<sup>[7]</sup>

According to depth of tissue involved he classified burn injuries into six categories

- 1. First Degree:** When low degree heat is applied for very short duration, there occurs erythema or redness over area of contact, lasts for few hours to several days. Leaves no scar on healing.
- 2. Second Degree:** Caused by Prolonged application of flame, liquid much above the boiling point of water. The skin is blackened, hair is slightly burnt, painful blisters are present last for few days. No scar left on healing but slight staining may remain.
- 3. Third Degree:** The epidermis is completely destroyed with involvement of dermis. There occurs blister formation with red line. They ulcerate and may get infected and are extremely painful. They heal with formation of scar.
- 4. Fourth Degree:** Whole thickness of skin is involved. These are not much painful owing to destruction of nerve ending. Usually followed by sloughing after some days.
- 5. Fifth degree burns:** Involves the penetration of deep fascia and muscles. Results in great scarring and deformity.
- 6. Sixth Degree:** Involves the charring of the whole limb including bones, adjacent tissues and organs. Usually result in death.

#### Clinical classification<sup>[8]</sup>

- a. **Superficial burn (1 to 4)-** If entire skin is damaged.
- b. **Deep burn (5 and 6) –** deep fascia and muscles involvement.

#### Hebra's Classification<sup>[8]</sup>

1. **Epidermal burns-** 1st and 2nd degree
2. **Dermo – epidermal burns-** 3rd and 4th degree
3. **Deep burns-** 5th and 6th Degree

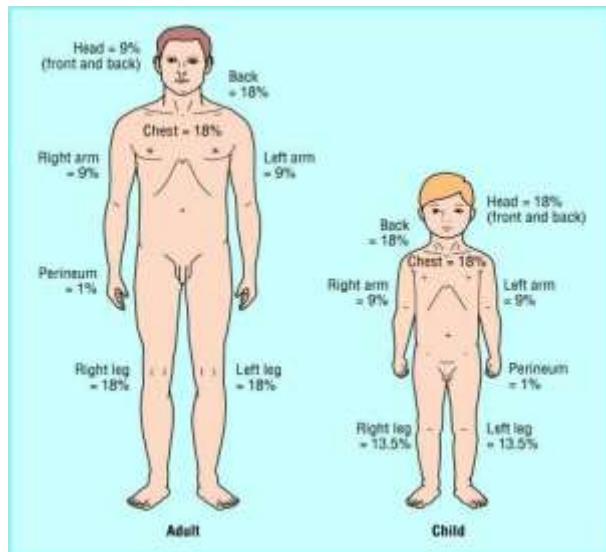
#### Effect of Burns<sup>[9]</sup>

Effects will depend upon factors like

- a) **Degree of heat applied:** Effects are severe, if heat applied is very great.
- b) **Duration of exposure:** prolonged the exposure, more severe will be the effect
- c) **Assessing the size** (extent of body surface affected): The total body surface area (TBSA) involved is usually worked out by the **Wallace Rule of Nines** which used for adults. When burn surface involves 1/3rd of body surface area or more (usually 30–50%), the result is nearly always fatal.

<b>Head and neck</b>	<b>9%</b>
<b>Front of chest</b>	<b>9%</b>
<b>Back of chest</b>	<b>9%</b>
<b>Front of abdomen</b>	<b>9%</b>
<b>Back of abdomen</b>	<b>9%</b>
<b>Right upper limb</b>	<b>9%</b>
<b>Left upper limb</b>	<b>9%</b>
<b>Front of right lower limb</b>	<b>9%</b>
<b>Back of right lower limb</b>	<b>9%</b>
<b>Head and neck</b>	<b>9%</b>
<b>Front of chest</b>	<b>9%</b>
<b>Front of left lower limb</b>	<b>9%</b>

<b>Back of left lower limb</b>	<b>9%</b>
<b>Perineal area/Pudendal area</b>	<b>1%</b>
<b>Total</b>	<b>100%</b>



Estimation of the TBSA using the Wallace's Rule of Nines is not accurate in children because of the relatively larger head surface area. **Lund and Browder** described a method for compensating for the differences. In children < 1 year, head is 18% of TBSA and each leg is 14% of TBSA. Trunk and arms represent the same percentages as in adults. For each year above 1 year old, add 0.5% to each leg and reduce 1.0% to the head until adult values are reached. **Rule of palms:** The surface area of a patient's palm (including fingers) is roughly 1% of TBSA. Palmar surface can be used to estimate small burns (< 15% TBSA) or very large burns (> 85%, when unburnt skin is counted).

- d) **Site:** Burns of head and neck, chest and abdomen, especially anterior abdominal wall including genitals and perineum, even when superficial are more dangerous than deep burns involving the extremities or back.
- e) **Age:** Children < 2 years and elderly (> 60 years) are more susceptible.
- f) **Sex:** Women are more susceptible.

#### Causes of Death in Burns<sup>[10]</sup>

Death usually occurs either before 48 hours or after 48 hours, hence, the causes can be classified accordingly into two groups.

**Immediate death**– occurring within 24 to 48 hrs of burn. Causes are as follow

**Shock-** Primary (*neurogenic*) due to fear, severe pain, injury to vital organs leading to death within 24 to 48 hours.

**Secondary (*vascular*)** due to loss of serum from burnt area, developing depletion of blood volume and

hypovolaemic shock, leading to death within 24 to 48 hours.

**Coma** - Coma due to congestion of brain and serious effusion into ventricles.

**Asphyxia**- Suffocation due to the inhalation of smoke or gas of combustion. Asphyxia may also be caused by pressure on the chest due to falling roof, beams, walls, etc. when a house is on fire.

**Delayed death**<sup>[11,12]</sup> – occurring after 5 or 6 weeks or even longer.

1. **Pulmonary edema:** Death occurs in a day or two due to pulmonary edema, glottic edema or laryngeal edema.
2. **Electrolyte imbalance Exhaustion** mainly hypokalaemia can also lead to death in early period after sustaining burn injuries
3. **Toxaemia:** There occurs systemic absorption of various toxins in blood which are produced at ulcerated areas after burns. Death due to shock as a result of toxæmia usually occurs in 36-48 hours.
4. **Septicaemia:** Signs of systemic infection usually appear by 48 hrs after sustaining burn injuries. Most of deaths occurring after 48 hours are due to infection of serous membrane and internal organs like meningitis, pneumonitis, pericarditis, peritonitis, pleurisy and other complications
5. **Renal Failure:** There occurs acute tubular necrosis which leads to renal failure and death occurs usually on 3rd/4th day.
6. **Gastro-intestinal Ulceration:** Initially there occurs ulcer formation in stomach due to prolonged confinement which is called as *Dupuytren's ulcer*. Afterwards ulcers may also be formed in duodenum which is called as *Curling's Ulcer*. These are late complications of burn injuries produced as a result of stress and local ischaemia and person may succumb to death when there occurs uncontrollable bleeding from there.
7. **Anaemia and Hypoproteinaemia:** The victim may die even after weeks, as he develops anaemia and hypoproteinaemia.
8. **Septic Absorption:** Septic absorption from excessive suppuration. Suppurative case death may occur by 5 to 6 weeks or even after a longer time. Pseudomonas is most common organism responsible for infection and sepsis in turn.

#### Postmortem Appearances of Burns

In any case of burns postmortem signs of burns will be present even if burns are postmortem in nature, but signs of antemortem burns suggest death due to burns.

#### External<sup>[13]</sup>

**Clothing** It should be removed carefully and examined for the presence of kerosene, petrol and other such inflammable and combustible substances.

**Any other articles** Such as keys, metallic rings, ornaments, etc., worn on the body should be removed and preserved. It may be useful in establishing identity.

**Face** Usually distorted, swollen with tongue protruded out. There may be absence of burns and/or soot deposits in the corners of the eyes ('crow's feet')

**Skin** Findings observed vary according to the nature of the substance used to produce burns. Highly heated solid objects when applied momentarily causes blister and reddening corresponding to the shape and size of the material used. Prolonged application causing Roasting and charring. Explosions in coal mines or by gun-powder causes blackening and tattooing of the parts. Kerosene oil burns shows characteristic odor and sooty blackening of the parts. However, all antemortem burns skin will show line of redness (hyperemia) which is a sign of vital reaction. Degloving / destocking may be seen due to cuticular peeling.

**Hair** They undergo a peculiar effect of heat called singeing. The singed hair looks curly and is highly fragile.

**Pugilistic attitude (Boxer's attitude, Fencing attitude)** It is a condition wherein the body assumes a rigid position with the limbs flexed and resembles a boxer in defending position. All the four limbs are flexed with closed fist, body is bent forward and skin is tense, leathery, hard and frequently shows splitting. Caused under the effect of heat, the muscle proteins coagulate causing them to become contracted.

**Cracks and fissures resembling incised wound** may be seen in line with blood vessels exposed through them.

**Charring of the body** depends on degree of postmortem burns or burning of the body after death

**Postmortem staining** is cherry red in color from presence of carbon monoxide (CO), if the individual was alive and breathing during fire.

**Heat ruptures:** These are splits occurring in the skin due to contraction of the heated and coagulated tissue.

#### Internal Findings<sup>[14,15]</sup>

##### i. Skull

**Heat hematoma** is an artifact and has the appearance of extradural hematoma. It is large, thick (about 1.5 cm) and contains 100–120 ml of blood. **Cause:** The blood may come from the longitudinal venous sinuses or the diploic veins. The heat may force blood out of the marrow of the calvarium through veins and out over the surface of the dura. Skull bones may be fractured and burst open along the sutures due to intense heat.

**ii. Brain:** Congested, and appears swollen with widening and flattening of the gyri and obliteration of the sulci due to the contraction of the coagulating dura against the

surface of the brain. Subdural hemorrhage may be present.

**iii. Neck:** Hemorrhage in the root of the tongue and neck muscles-considered vital reactions in burn victims.

**iv. Larynx, trachea and bronchioles:** Contain carbon and soot particles, and the mucosa is congeste with frothy mucus secretions. This is **the surest sign of antemortem burns**, which is due to inhalation of gases. However, soot usually disappears by the 2<sup>nd</sup> day of hospitalization. Detachment of the mucosa of the trachea bronchial tree, pharynx, epiglottis or esophagus; and epiglottic swelling—indicators of vitality (air is a poor conductor of heat and thermal injury is usually limited to the upper airways).

**v. Pleura:** Congested and inflamed with serous effusion.

**vi. Lungs:** Congested and edematous, may be shrunken.

**vii. Heart:** Chamber full of blood, cherry red in color due inhalation of CO.

**viii. Stomach and intestines:** Stomach may contain carbon particles impregnated in mucous membrane. It may be red in color. There is inflammation and ulceration of Peyer's solitary glands of intestines. *Curling's ulcers* may be seen in severely burnt patient's gastric antrum and first part of duodenum after 72 hr. 34-36. It develops due to mucosal ischemia as a result of stress and shock, and not related to acidity.

**ix. Spleen:** Enlarged and softened.

**x. Liver:** Cloudy swelling and fatty liver or necrosis of the cells, if death is delayed. Jaundice may occur.

**xi. Kidneys:** Show signs of nephritis, thrombosis and infarction.

**xii. Adrenals:** May be enlarged and congested. The prolonged exposure of the body to high temperatures (results in vaporization of body fluids) along with the direct effect of the heat cause shriveling of the internal organs which became firm, hardened and cooked by heat—the so-called '**puppet organs**'.

#### Medicolegal Importance<sup>[16]</sup>

**1. Identification of the deceased**—Though identification of the deceased is difficult when the body is completely burnt, following may be helpful

- Metallic objects on the body like rings, bangles, keys, etc.
- Sex of the deceased: Prostate and nulliparous uterus will not get burnt even at very high temperature and could help in sex identity.
- Age of the deceased: Usually established by the teeth and ossification of the bones.

2. *Whether the burns are antemortem or postmortem?*
3. *Whether the burns are the cause of death or not?*

Following two factors confirm burns as cause of death:

- Presence of carbonaceous or soot particles in the respiratory tract mixed with mucoid secretions.
- Cherry red discolouration of blood due to carboxyhaemoglobin.

**4. Whether the burns are suicidal, accidental or homicidal?**

- *Suicidal burns* are common among Indian women. They pour kerosene oil and set fire to themselves. Some women stuff clothes inside the mouth also to prevent shouting and being heard by others.
- *Accidental burns* are common among children and elderly people. Accidental kerosene stove bursting is also reported often.
- *Homicidal burns* are quite common in India. The pernicious customs of dowry among certain Hindu castes, sometimes leads to young maidens, being murdered by pouring kerosene and set on fire by husband or in-laws (later claimed to be accidental burns death). This has lead to the concept of dowry deaths or bride burning which has enforced a rule by the Home Ministry of India to involve a panel of two doctors in conducting the postmortem examination of married woman dying of burns or any other reasons within 7 years of marriage or if her age is less than 30 years at the time of death in suspicious circumstances (IPC, Section 304B).

**5. Self-inflicted burns for false accusation**—these burns are usually seen on accessible parts of the body.

**6. Spontaneous combustion and preternatural combustion**—occasionally cases are reported of burns occurring due to the natural gases evolved in the intestine, (*inflammable gases such as hydrogen sulfide, methane, etc.*). When these gases are passed out per anal come across a flame may lead to burns. Recently all these cases have been turned down considering them as myth.

**7. Dead body of victim may be burnt after death to conceal homicide.** Head injury and fatal neck compression are commonly reported methods of homicide.

#### 8. Age of burn<sup>[17]</sup>

- Immediately after burn, redness appears.
- Within one hour, vesication (blister).
- 6-8 hrs:- epidermis, dermis shows inflammatory exudate.
- 72 hrs:- exudate forms a dry brown crust
- 12-24 hrs:- exudate begins to dry.
- 2-3 days:- pus may form due to infiltration of WBCs
- 4-6 days:- superficial slough separates out.
- 1-2 weeks:- deeper sloughs separates out.

- 2-3 weeks:- granulation tissues begins to cover the surface of burns.
- 3-4 weeks:- scar is formed or wound is healed.

## DISCUSSION AND CONCLUSION

There are variety of factors that may lead to fire fatalities. The most frequent are smoke inhalation and burn injury. In developing countries, the problem of burn injuries is more severe due to the reason that the care of burn patients requires specialized units that are expensive and not always readily available. About 45% of the burns patients are dying due to septicemia. Examination of victims who have died from smoke inhalation usually reveals soot in the nostrils and mouth as well as burns, and coating of the larynx, trachea, and bronchi. Further, the extent of the burn is determined by the classic “rule of nine”. Most victims of house fires die from exposure to carbon monoxide gas or at least are affected by it. In enclosed areas, in addition to carbon monoxide, hydrogen cyanide is responsible for death from smoke inhalation. The various reasons behind this may be personal, domestic, occupational, social tragedy, and particularly dowry. Homicidal by burning of women who are married is a major concern in India for the medical and legal authorities associated with disputes of dowry all over the country. In such cases, it is often essential to determine antemortem versus postmortem burning. And hence, Burn injuries have medicolegal significance, as they might be considered as common causes of unnatural deaths in India and may be associated with accidental, suicidal or homicidal causes.

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