Burns

Dr Malik Al-Adwan

Burn

- Burn is an injury caused by heat, or by a chemical or physical agent having an effect similar to heat

Characteristics/Types of Burns

- **Contact burns**: There is physical contact between the body and a hot object, like heated solid or molten metal
- **Flame burns**: There is actual contact of body with flame. It may produce vesication, singeing of the hair and blackening of the skin.
- Flash burns are a variant of flame burns which are due to initial ignition from flash fires (sudden ignition or explosion of gases or petrochemicals). It burns the exposed surfaces to the flash, and not the folds of skin and other protected areas.
- Scalds: They are caused by contact with hot liquids, most commonly water, and usually occur on exposed skin

- **Radiant heat burns**: They are caused by heat waves, a type of electromagnetic wave. There is no contact between the body and flame or hot surface.
- **Ionizing radiation burns (X-rays, radium, UV rays**): It can be localized or may involve the whole body depending on radiation exposure
- **Chemical burns**: Classified into acids, alkalis and vesicants (blister forming). Characteristically, there are ulcerated patches, no blisters, hair is not singed and the red line of demarcation is absent

Classification

- Clinically, burns are classified as first degree (superficial) burns, second degree (partial and deep partial) burns and third degree (full thickness) burns

S.No.	Features	First	Second	Third
1.	Depth	Epidermis	Epidermis and dermis	Deeper to dermis
2.	Color	Red/pink	Dark red	White/gray/black (charring)
3.	Pain to stimuli	Painful, tender	Very painful	Painless (destruction of nerve endings)
4.	Blanching	Yes	Yes, but slow	No
5.	Blisters	Not present	Present	May or may not be seen
6.	Appearance	Dry	Moist	Dry/leathery
7.	Healing time	3–6 days; skin peeling	3 weeks	Small areas may take months; large areas need skin grafting
8.	Scar	No scar, slight discoloration	Yes	Yes
9.	Cause	Sunburn, scald, flash flame	Scalds, flash burns, chemicals	Contact with flame, hot surface, hot liquids, chemical, electric
10.	Medico-legally	Simple	Grievous	Grievous

Effect of Burns

- **Effects will depend upon factors like:**
- i. **Degree of heat applied**: Effects are severe, if heat applied is very great.
- ii. **Duration of exposure**: More prolonged the exposure, more severe will be the effect as burning of human skin is temperature and time dependent. Indication of burn depth comes from history.
- iii. **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
- When burn surface involves 1/3rd of body surface area or more (usually 30–50%), the result is nearly always fatal.

- **iv. 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.
- **v. Age**: Children < 2 years and elderly (> 60 years) are more susceptible (> 20% surface area involvement carries poor prognosis)
- **vi. Sex**: Women are more susceptible
- **vii. History of natural disease or concomitant trauma**, electrical injury or inhalation injury also results in poor outcome

Cause of Death

- **Immediate causes**
- i. Primary or neurogenic shock: Due to pain or fright.
- ii. Asphyxia: Suffocation may result from inhalation of CO, CO2, or cyanide or falling of the building on the body during attempt to escape.

CO poisoning is an important cause in most fire deaths (COHb > 50% is confirmatory).

- iii. Smoke- or heat-induced laryngospasm, respiratory arrest, and/or a vagal reflex-caused cardiac arrest are other proposed mechanisms of rapid death

Delayed causes

Parkland formula in case of thermal heat

- i. Hypovolemic, burns or secondary shock: More than half of the deaths occur due to secondary shock within 24–48 h due to loss of fluid and protein, causing decrease in cardiac output and multiorgan failure.
- ii. Acute edema of glottis occurs from inhalation of irritant smoke or hot gases with or without pulmonary edema. Respiratory failure (inhalation injury, pneumonia or ARDS) is also a significant cause of death within 3 days
- iii. Toxemia due to absorption of toxic products from the burnt surface. Death occurs in about 3–4 days

- iv Sepsis: Most important cause of death, occurring in 4–5 days or longer after burn. Septicemia can be caused by burn wound infections
- v. Infective complications: Bronchitis, bronchopneumonia, enteritis
- Sequelae of burns: Scars, keloid, Marjolin's ulcer, Curling's ulcer, corneal capacity, obliteration of external auditory meatus, joint deformity or ankylosis can occur.

- External Findings
- i. Clothing should be carefully removed and examined for presence of kerosene, petrol or any other inflammable substance
- ii. Site, distribution and extent of burning are recorded. Distribution is important in the analysis of whether the burns are appropriate for the position in which the body was found
- iii. Face: Usually distorted and swollen.
- iv. Skin: Owing to the effect of heat on blood, the veins stand out, giving a marbled appearance.
- Blisters, either ruptured/collapsed or filled with fluid may be seen
- Hair: It may be singed, or partially/completely burnt.
- Degloving/destocking may be seen due to cuticular peeling.

- Pugilistic attitude (boxing, fencing or defense attitude): It is due to heat stiffening Cause: Due to coagulation of proteins of muscles and dehydration which causes contraction (flexor stronger than extensor)
- Heat ruptures: These are splits occurring in the skin due to contraction of the heated and coagulated tissue, and the resultant breaches may simulate incised or lacerated wounds (Diff. 14.2). It is usually seen over the area of severe burning, over fleshy areas, like calves and thighs, and over extensor surfaces and joints.

Internal Findings

- **i. Skull**
- Heat hematoma is an artifact and has the appearance of extradural hematoma
- 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. z 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
- **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 congested with frothy mucus secretions. This is the surest sign of antemortem burns, which is due to inhalation of gases.
- **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:**
- **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.

Scald burn

- A scald is a form of thermal injury which results from application of liquid > 60ºC or from steam, and involves only the superficial layers of skin.

Types

- It is of three types:
- **i. Immersion burns**: Accidental or deliberate immersion in hot liquid, usually water.
- **ii. Splash or spill burns**: Usually accidental.
- **iii. Steam burns:** Exposure to superheated steam.

- Hot water accounts for most of the immersion or splash burns.
- scald show sharp demarcation with tickle marks, soddening and bleaching, but do not singe the hair or blacken/char the skin.

- **Clinically, it is classified into three degrees:**
- i. Erythema or reddening by vasoparalysis.
- ii. Vesication or blister formation due to increased permeability of the capillaries.
- iii. Necrosis of the dermis when deeper layer of skin is involved.

Medico-legal Aspects

- It is usually accidental due to splashing or pouring of fluid during cooking.
- Accidents are common in children and in the elderly.
- Boiling water may be thrown intentionally, usually domestic homicide intent with the husband being the victim.
- Deliberate scalding by hot water is common form of child abuse

S.No.	Feature	Dry heat burn	Moist heat burn	Chemical burn
1.	Cause	Flame, heated body or X-rays	Solid steam or liquid > 60°C	Corrosives
2.	Site	At or above the site of contact	At and below the site of contact	At or below the site of contact
3.	Splashing	Absent	Present	Present
4.	Skin	Dry, wrinkled and may be charred	Sodden, bleached	Corroded and devitalized
5.	Vesicles	At the circumference of burnt area	Over the burnt area	Usually not present
6.	Red line	Present	Present	Absent
7.	Color	Black	Bleached	Distinctive coloration
8.	Charring	Present	Absent	Absent
9.	Singeing	Present	Absent	Absent
10.	Ulceration	Absent	Absent	Present
11.	Scar	Thick, contracted	Thin, less contracted	Thick, contracted
12.	Clothes	Burnt	Wet, not burnt	May be burnt, with characteristic stains

may be due to gunshot / stab wound

S.No.	Feature	Antemortem burns	Postmortem burns
1.	Line of redness	Present	Absent
2.	Vesicles	Contain serous fluid, rich in albumin, chloride and some polymorphs	Contain air; if fluid is present, it contain little albumin and no chloride
3.	Base of vesicles	Red and inflamed	Dull, dry, hard and yellow
4.	Soot in upper respiratory tract	May be present	Absent
5.	Inflammation and repair	Present along with pus and slough (redness)	Absent (yellow)
6.	Healing	Granulation tissue seen in old cases	Absent
7.	Carboxyhemoglobin	Present	Absent
8.	Enzyme reaction	Increase in enzymes in the periphery of burns	No such increase

Burns

Fadi Baqleh

Mohammad Oday

Qusai Alkhasib

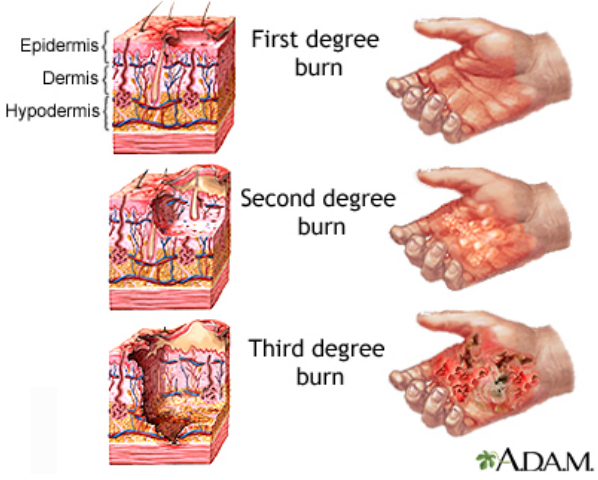
Definition

Burn is an injury caused by heat, or by a chemical or physical agent having an effect similar to heat.

Types

- Contact
- Flame including flash
- Scald
- Radiant heat
- Ionizing radiation
- Chemical
- Electric and lightning
- Microwave

Classification



Differentiation 14.1: Classification of burns (Degree of burns)

S.No.	*Features*	*First*	*Second*	*Third*
1.	Depth	Epidermis	Epidermis and dermis	Deeper to dermis
2.	Color	Red/pink	Dark red	White/gray/black (charring)
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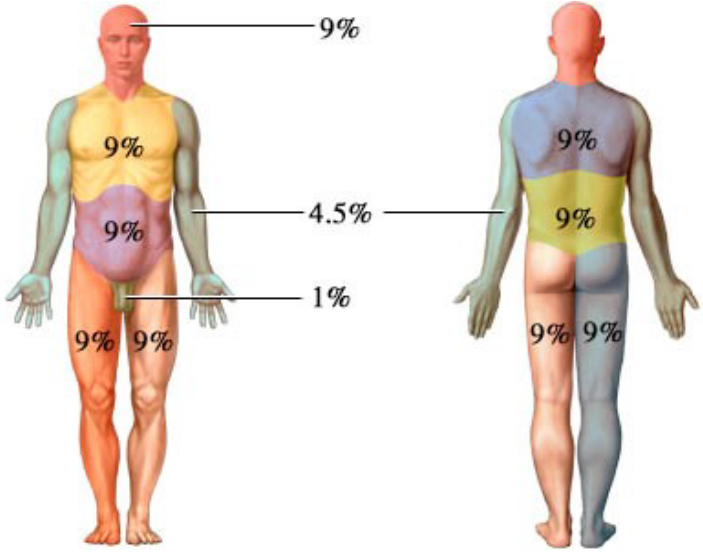
Effect

- Degree of heat
- Duration of exposure
- Body surface area affected



Causes of death

Immediate

- Neurogenic shock
- Asphyxia
- Heat induced laryngospasm

Delayed

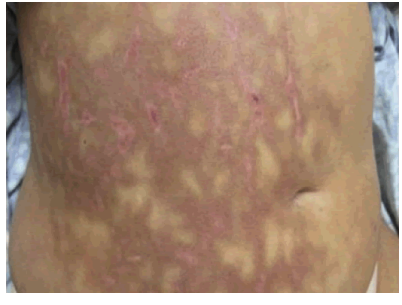
- Hypovolemic shock
- Edema of glottis
- Toxemia
- Sepsis most imp ,4-5 d, pseudomonas s.aureus
- Infection

Post mortem examination

- **Before the autopsy**:
- Photographic documentation.
- Clinical history is reviewed and information is obtained from other sources (e.g. police) depending on the circumstances of the death.
- X-ray to rule out any other trauma.
- Any radio-opaque material such as bullets or lead shots may be detected.
- Antemortem fracture may be found.
- Sometimes, gunshot or stab wounds are often identifiable, although they may be shrunken to a small size.

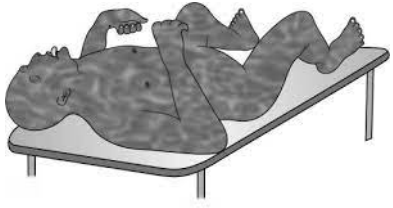
External findings

- Clothing
- Site, distribution,extent.
- Face (swollen, protruding tongue, pink froth, crow's feet)
- Skin (marbled)
- Postmortem staining cherry pink CO poisoning
- Kerosine oil gives a characteristic odor and sooty blackening of parts.



External findings cont.

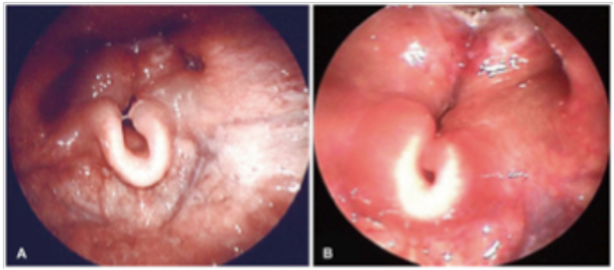
- Hyperemia (antemortem)
- Blisters
- Degloving
- Hair grey— brown , black—black
- Pugilistic attitude(boxing, fencing , defense: heat stifling, flexors bulkier than extensors, alive or dead not medicolegally significant)
- Heat ruptures(simulate incised or lacerated wounds)



Differentiation 14.2: Heat rupture and lacerated wound

S.No.	*Feature*	*Heat rupture*	*Lacerated wound*
1.	Cause	Exposure to heat	Blunt force
2.	Site	Fatty tissue	Anywhere
3.	Vessels and nerves	Intact	Torn
4.	Bruising around the margins	Absent	Present

Internal findings



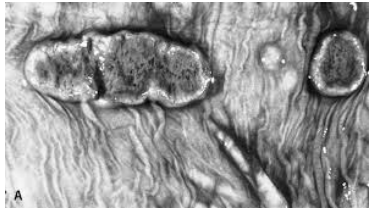
- Skull (heat hematoma, fractures)
- Brain
- Neck
- Larynx, trachea and bronchioles:Frothy mucus is the surest sign of antemortem burns, which is due to inhalation of gases.
- Pleura
- Lungs

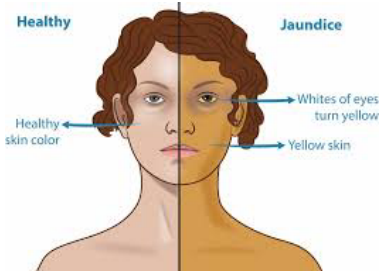
Differentiation 14.3: Epidural hematoma (EDH) due to burns and blunt force

S.No.	*Feature*	*EDH due to burns*	*EDH due to blunt force*
1.	Cause	Charring of the skull due to intense heat	Blunt force to the head
2.	Situation	Anywhere	Usually adjacent to Sylvian fissure
3.	Position	Usually bilateral	Usually unilateral
4.	Distribution	Diffuse	Localized
5.	Characteristics	Evenly distributed or sickle-shaped; honeycomb appearance; soft, granular, foamy, friable clot; chocolate brown in color (pink, if CO is present)[33]	Disc shaped; uniform, smooth, rubbery; reddish-purple color
6.	Skull fracture	Eggshell fracture—elliptical or circular defect without radiating fracture lines, seen above the temple	Fracture line radiating from a skull defect present in temporal area
7.	Crossing of suture lines	It may cross suture lines and overlie the frontal, parietal and temporal area	Hematoma do not cross sutures as the dura is anchored at the suture lines
8.	Injury to CNS	Absent	May be present

Internal findings cont.

- Heart
- GI
- Spleen
- Liver
- Kidneys
- Adrenals





Antemortem vs postmortem burns

Differentiation 14.4: Antemortem and postmortem burns

S.No.	*Feature*	*Antemortem burns*	*Postmortem burns*
1.	Line of redness	Present	Absent
2.	Vesicles	Contain serous fluid, rich in albumin, chloride and some polymorphs	Contain air; if fluid is present, it contain little albumin and no chloride
3.	Base of vesicles	Red and inflamed	Dull, dry, hard and yellow
4.	Soot in upper respiratory tract	May be present	Absent
5.	Inflammation and repair	Present along with pus and slough	Absent
6.	Healing	Granulation tissue seen in old cases	Absent
7.	Carboxyhemoglobin	Present	Absent
8.	Enzyme reaction	Increase in enzymes in the periphery of burns	No such increase

Scald burns

Definition

A scald is a form of thermal injury which results from application of liquid 60°C or from steam, and involves only the superficial layers of skin.

Types

Immersion

Splash or spill

Steam

Degrees:

Erythema

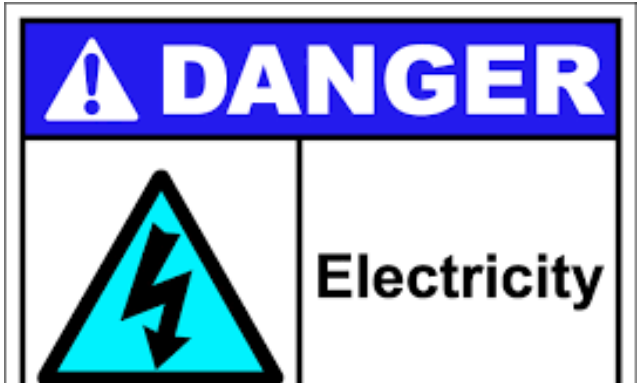
Blisters

Necrosis

Medicolegal aspects

- Accidental
- Homicide
- Child abuse glove and stocking

Electrical burns → Electrocution is mostly accidental



- Electricity exerts two major effects on the body:

1. cellular depolarization of nerves and muscle
2. heat production, reflecting a longer duration of exposure.

- Results in:

C. Low tension injuries

D. High tension injuries

Type AC → Alternative (worse) → Manner (Accidental)
DC → Direct → Cause (Ventricular fibrillation) (electrocution)

Pattern of injury depends

- Kind of current (alternating worse than direct)
- Amount of current
- path of current
- Duration of exposure
- Resistance(Order of increasing resistance of tissues for electrical current blood vessels, nerves and muscle, skin, tendon, fat and bone.)The greater the resistance, the more likely that burns will result.
- Site of contact (Face vs palms)

Local effects

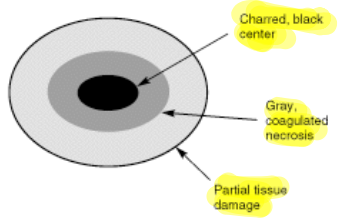
- Burns and blisters : *Joule burns*:
  - Round , oval , irregular
  - Chalky white
  - Shallow
  - Mm -1.5 cm
  - Raised border mild hypermeia
  - Palmar aspect of hands

No exit/entry point in case of wire

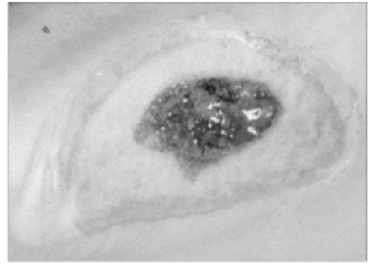
Entry → hand (R. mostly)
exit → sole of foot

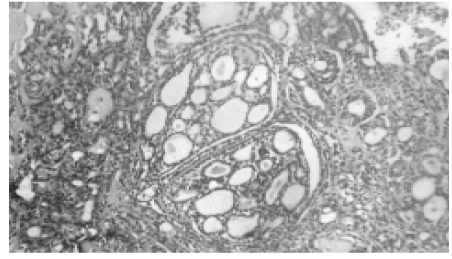
Figure 1a and 1b. Electrical Entry/Exit Burn

1a. The entry/exit contact lesion has three areas:



1b. These three areas can be seen in this foot burn.



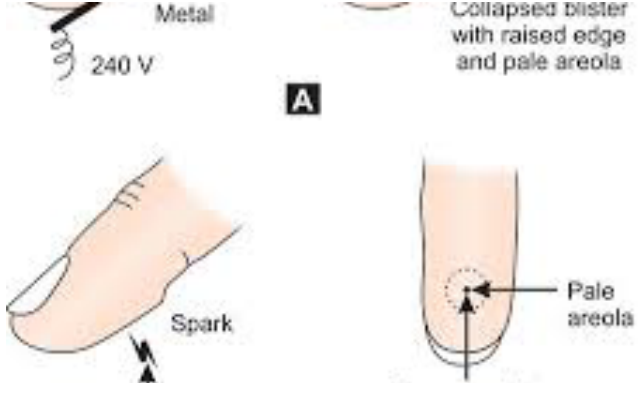


Exit mark

- Often seen as splits in the skin at points where the skin has been raised into ridges by passage of the current.
- In high-voltage current, the exit often appears as a ‘blow-out’ type wound.

Local effects cont.

- Flash or spark burns (exogenous)
- Air gap between skin and conductor
- Outer skin keratin melts then fuses into a hard raised brown nodule.
- Crocodile skin in high voltage burns

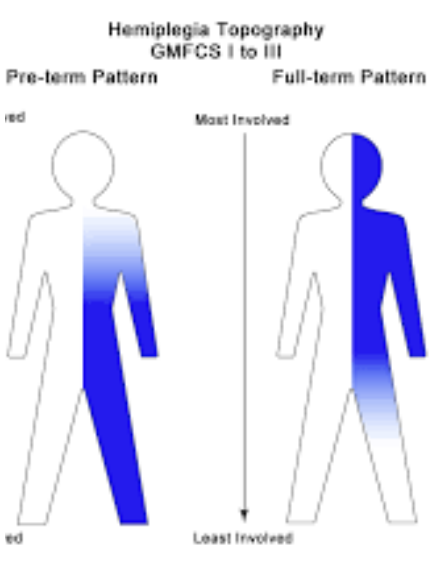


Local effects cont.

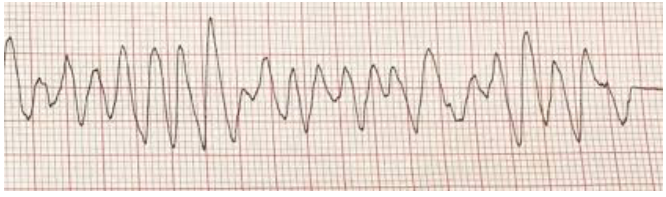
- Wounds
- These are lacerated or punctured with contusions of the margins
- metallic lustre
- Current pearls in deep tissue
- Bone pearls on x-ray

Systemic effects

- Immediate death
- CNS
- Eye (Cataract)
- Suspended animation
- With recovery, there may be muscular pain, fatigue, headache and irritability.



Causes of death



- Ventricular fibrillation (low voltage current)—most common cause
- paralysis of the respiratory muscles (asphyxia)
- a direct effect on the brainstem as a result of current passing through the head and neck.
- Inhibition of respiratory center, electrothermal injury or ventricular asystole (in high voltage).
- Secondary causes: Complications, like infection or septicemia (due to burns) or from mechanical injuries like fall from height.

Post mortem findings

- Before autopsy:

- it is important to examine the scene and the tools, appliances or machinery involved in the incident.
- Examination of the entire body, particularly the hands and especially the fingers, along with examination of the feet and the shoes for evidence of electrical burns is of utmost importance.

External findings

- Face is pale
- eyes are congested
- pupils are dilated.
- Petechiae are seen on eyelids and conjunctiva.
- Rigor mortis appears early, and dark blue-red postmortem staining is well developed.
- . Joule burn at the site of entry is diagnostic. The shape and size of the mark may correspond to the shape and size of the source of the current
- . The site of entry may lack any visible marks or in some cases may show extensive charring with heat coagulation of the muscles.

Negative Autopsy in case of electrocution (Also in seizure)

Internal findings

- Those of asphyxia.
- Lungs: Congested and edematous.
- Heart: Focal necrosis with variable hemorrhage and acute contraction bands in the myocardium and conduction system may be seen.
- Brain, meninges and parenchymatous organs are congested.
- Petechial hemorrhages may be found along the line of passage of the current, under the endocardium, pericardium, pleura, brain and the spinal cord.

Electrical petechiae and acro-reaction test

- The petechiae seen in electrocution not caused by asphyxia but by a combination of venous congestion due to cardiac arrest and a sudden rise in blood pressure induced by muscle contractions.
- Acro-reaction test:It is micro-chemical test for metals at the site of entry of the electric current. The test is applicable for detection of metals which are soluble in HCl or HNO3.

Medico-legal aspects

- Deaths are usually accidental.
- Suicides are rare and homicides are even rarer:Common method of homicide is to drop a plugged-in electrical device into a bucket/bathtub while the individual is taking a bath. There is usually no electrical burn, and if the electrical device is removed, the cause of death will be missed.
- Iatrogenic accidents may lead to a charge of negligence.
- Traumatic injury may be sustained from electric shock itself during electro-convulsive therapy in treatment of mental disorder or through improperly earthed instruments in the operation theater.

Judicial electrocution

- Death penalty is carried out using the electric chair in some States in the U.S. The condemned man is strapped to a wooden chair, and one electrode is put on the shaven scalp and the other on the right lower leg (head and body shaved to provide better contact with the moistened copper electrodes) by the executioner.
- The voltage varies in power from State to State, and is also determined by the convict's body weight. The first jolt is followed by several more in a lower voltage. In Georgia, executioners apply alternating current of 2,000 V for 1 seconds, 1,000 V for the next 11 seconds and then 201 V for 2 min.
- The findings during autopsy are an annular burn on the head due to the scalp electrode and a burn on the right calf due to the anklet, both due to electrical current flow.

Thank you