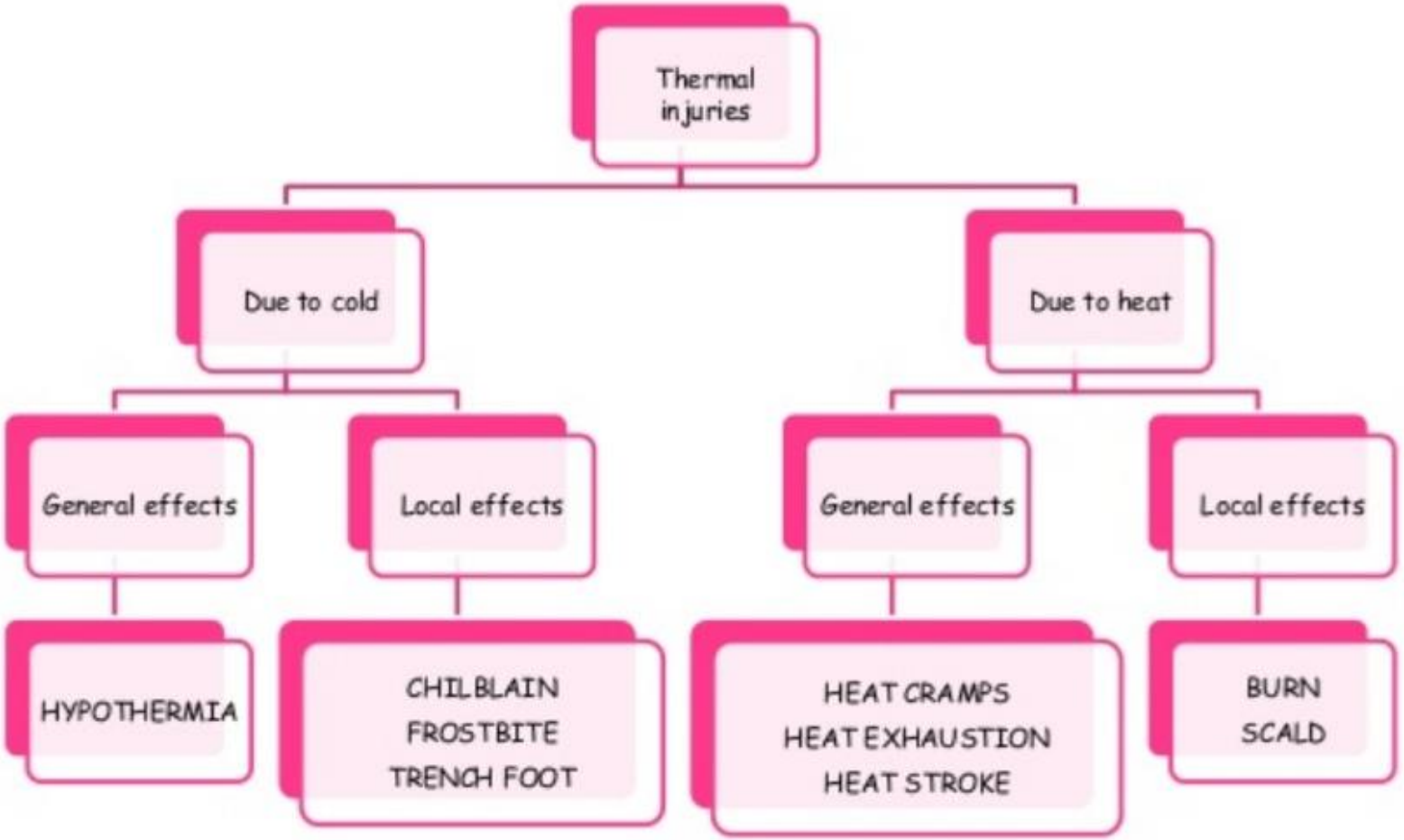
Thermal injuries

By Dr. Nayella Bangash

Definition

Tissue injury resulting from the effects of systemic(general) and/localized exposure to HEAT or COLD to the external or internal body surfaces.

CLASSIFICATION



COLD INJURY

- Frost bite
- Trench foot
- Immersion foot;and
- Chilblain

HYPOTHERMIA

- Exposure to cold produces hypothermia where the core body temperature is below 35°C
- Oesophageal or rectal probe measures temp as low as 25°C
- Oral or axillary thermometers are inaccurate.
- Moist cold is more dangerous than dry cold.

RISK FACTORS-

- Low environmental temp.
- Extremes of ages (children & ≥ 60 years)
- Immersion in water & wet clothing.
- Mountaineering & sailing.
- Hypothyroidism, atherosclerosis, inadequate nutrition & dementia.
- Intoxicated persons (alcohol, tranquilizers or opiates)

EFFECTS OF HYPOTHERMIA

- Direct – in fatty tissues & myelinated nerves.
- Indirect – ischemia (due to vascular damage).

CLINICAL FEATURES

- **1st stage:** Cold & shivers with fall in body temp.

- **2nd stage:** Shivering stops at or below 32°C
  Depressed to lethargic, drowsy & sleepy to stupor & coma.
  Muscles stiffen & mobility impaired.
  Drunken gait.
  Respiration, circulation, metabolic processes & oxygenation of cells are slowed down.

- **3rd stage:** At ≤ 27°C for 24 hrs resulting death due to failure of vital centers bcz anoxia.

COMPLICATIONS

- Hemorrhagic pancreatitis.
- Pneumonia.
- Ulcers & focal hemorrhages in GIT.
- Acute tubular necrosis.
- Myocardial fiber necrosis.

POSTMORTEM FINDINGS

EXTERNAL FEATURES

- Pink /brown-pink areas over & around the large joints (knee, elbow & hip joints).
- PM lividity is pink /bright red (antemortem oxyhemoglobin & its postmortem diffusion).
- Oedema may be seen in feet & lower legs.
- Extremities may be cyanosed /white (white death).

INTERNAL FEATURES

- Ice crystals can be found in blood vessels, heart & tissue spaces.
- Blood :- bright red in colour (due to retention of oxyHb).
- Stomach :- numerous brown-black acute erosions,ulceration with hemorrhages similar to pre-death stress (Wischnewsky spots).
- Pancreas :- fat necrosis with adjacent omentum & mesentry.
- Lungs :- pulmonary oedema, hemorrhages.
- Kidney :- acute tubular necrosis
- Micro-infarcts in many organs (heart, intestine.....)
- Congestion of internal organs.
- Perivascular hemorrhages (brain, muscles, pancreas, lungs, GIT...)

MLI

- Most deaths are result of accidents especially in
  - drunkenness
  - mountaineering
  - persons lost in snow-drifts
  - who have been immersed in ice-water.

- Infanticide & homicide in adults are rare where unconscious person is left in freezing temp.

FROSTBITE

- Results from exposure to great extreme of severe cold (-2.5)°C.
- Dry cold injury.
- Extremities & also nose, ears & face.
- It is only produced in living state, can't be caused postmortem.

Clinical presentation

- **Mild**- numbness, prickling & itching due to involvement of skin & subcutaneous tissues.
- **Deep**- infarction of the peripheral digits with oedema, redness & later necrosis & gangrene formation beyond the line of inflammatory demarcation. Paresthesia & stiffness of deeper structures.
- T/t:-
- Rewarming
- Protection of the affected part (don't rub)
- Tetanus prophylaxis & antibiotics

TRENCH FOOT

- Results from prolonged exposure to severe cold (5-8) °C.
- Moist cold injury.
- Extremities are affected in these condition.

Seen in

- Soldiers during winter warfare
- Trenches
- Persons exposed to prolonged immersion or exposure at sea.

Clinical presentation

- Pre-hyperemic : cold & anesthetic.
- Hyperemic : burning & shooting pain.
- Post-hyperemic : decrease pulsation with paleness or cyanosis.

T/t :-

- Air drying at room temp.
- Protect from trauma & secondary infection
- Avoid heating, moistening, massaging & immersing in water.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Immersion Foot

This refers to a form of cold injury to the foot occurring after prolonged exposure to cold water, as typically experienced in artic areas and in warfare.

Chilblain

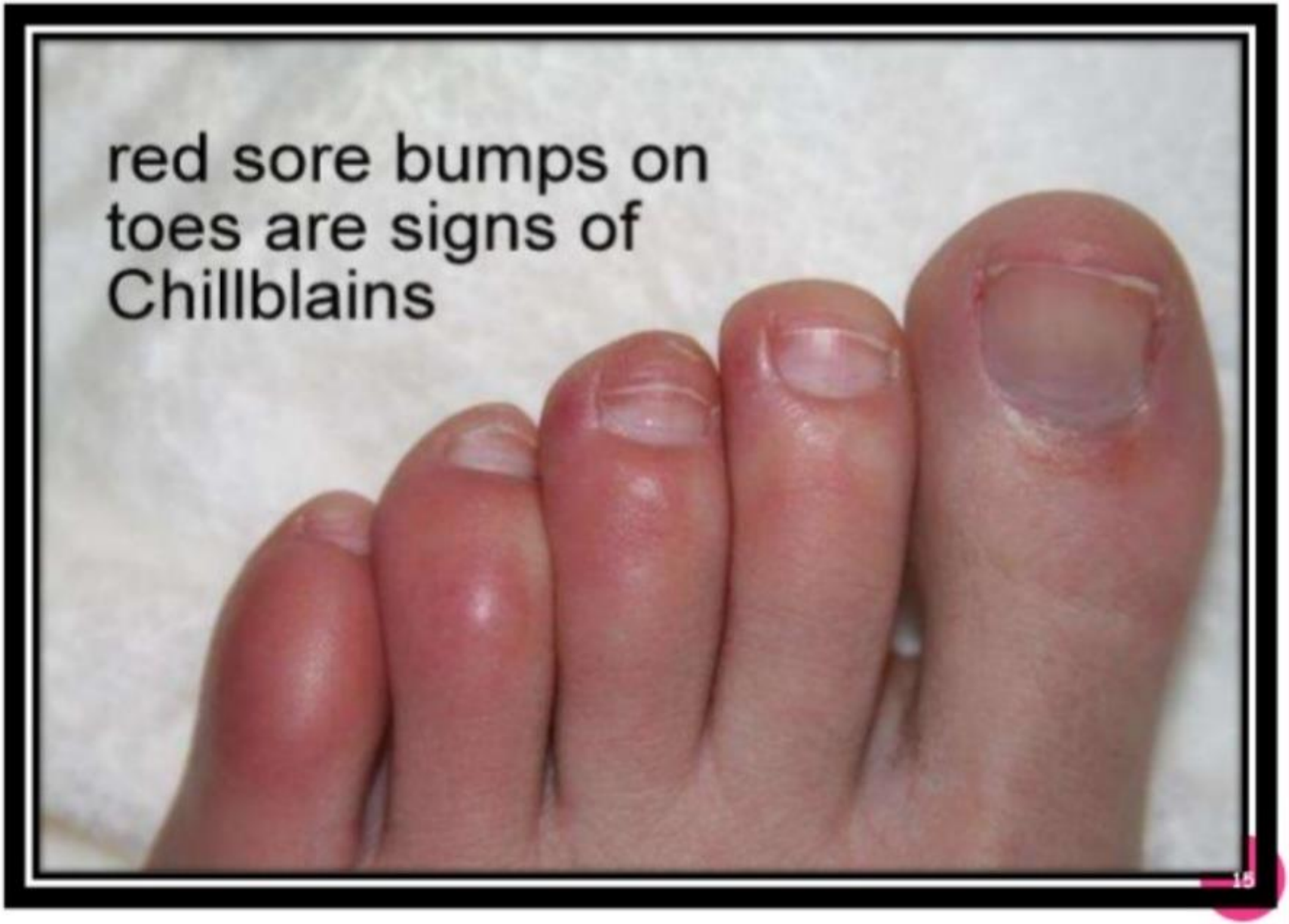
Painful inflammation of the small blood vessels in the skin(hands & feet) that occurs in response to repeated exposure to cold but not freezing air.

CHILBLAIN / ERYTHEMA PERNIO

- Red, itching skin lesion affecting the extremities.
- May be associated with oedema & blistering.
- Ulcerative & hemorrhagic changes may occur in continue exposure to cold.
- Aggravated by warmth.

T/t :-

- Elevation of the part
- Relax in room temp (not to be heated)
- Don't rub.


red sore bumps on
toes are signs of
Chillblains

PARADOXICAL UNDRESSING

- Occur in severe accidental hypothermia.
- During terminal stage, the person becomes disoriented & confused and may partially or fully undressed himself.
- Paralysis of thermoregulatory center causing failure of vasoconstriction leads to flow of blood from the core of the body, giving exaggerated sensation of warmth.
- In such case, there may be suspicion of sexual offence.

HEAT INJURY

Exposure to high temperature causes three clinical conditions;

- **Heat cramps**
- **Heat exhaustion;and**
- **Heat stroke**

Persons Affected

- Soldiers on the march
- Furnace men
- Stokers
- Miners
- Workers in bakeries,laundries,sugar refineries
- Those working in confined places with hot and humid atmosphere

Predisposing Factors

- Alcoholism
- Fatigue
- Hunger
- Lack of sleep
- Lack of adequate fluid intake
- Anything that causes mental depression

Heat Cramps

These are painful spasms of voluntary muscles which follow strenous work in a hot atmosphere.These cramps are caused by loss of water and salt from profuse perspiration.Mortality rate from this condition is low.

Clinical Presentation

- Sudden onset
- Severe,painful paroxysmal cramps due to dilutional hyponatremia(arms, legs and abdomen;lasting for 2 to 3 minutes)
- Flushed face
- Dilated pupils
- Dizziness
- Tinnitus
- Headache
- Vomiting
- Skin is moist and cool

MILD INJURY

HEAT CRAMPS

- Miner's /Stoke's /Fireman's Cramps.
- Loss of electrolytes & water through sweating.
- Seen with workers in high temp when sweating has been profused.

Clinical presentations

- Onset is sudden.
- Severe painful paroxysmal cramps occur due to dilutional hyponatremia (arms, legs and abdomen....lasting 1-3 mins)
- Face is flushed, pupils dilated
- Dizziness, tinnitus, headache & vomiting complain.
- Skin is moist & cool.

T/t :-

- Moved to a cool place
- Oral or IV saline to replenish the electrolyte & water.
- Rest for 2-3 days.

Treatment of Heat Cramps

- Move to a cold place
- Make patient lie down
- Elevate feet
- Apply cold compress
- Use fan/air conditioner to lower temperature
- Give saline water to drink/administer intravenous saline to replenish fluid loss
- Patient should rest for 2 to 3 days


Use a fan to lower temperature
Elevate feet
Apply cold compresses
Have victim lie down
Have victim drink fluids
A.D.A.M.

Heat Exhaustion

This is a condition of collapse without any elevation of body temperature,which follows exposure to hot and humid atmosphere.

The syndrome is characterised by prostration(complete physical and mental exhaustion)accompanied by evidence of peripheral vascular collapse such as;

- Poor venous return
- Facial pallor;and
- hypotension

It occurs in those persons who are susceptible to heat.

Travelling standing in an overcrowded smoking carriage may prove more than a person can deal with.

Clinical Presentation

- Preliminary circulatory stimulation as evidenced by subjective sensation of heat,flushed face,throbbing temples,and scanty perspiration,followed by collapse
- As a general rule,the patient recovers and death is unusual from uncomplicated heat exhaustion.

MODERATE INJURY

HEAT SYNCOPE

- Heat exhaustion /Collapse /Prostration.
- CVS collapse & syncope due to intense dehydration.

Clinical presentations

- Headache, dizziness, fatigue, anxiety, impaired judgment, hysteria & occasionally psychosis.
- Increased pulsation, skin is moist.
- It may progress to heat stroke if the sweating ceases.

T/t :-

- Adequate hydration
- Oral salt replenishment & active cooling .

Treatment of Heat Exhaustion

- Adequate hydration; oral salt replenishment
- Active cooling
- Supportive treatment such as;
  - Glucose
  - Saline and sodium bicarbonate
  - Active cooling

Heat Stroke

This is attributed to impaired functioning of the heat regulating mechanism caused by failure of cutaneous circulation and sweating.

Predisposing Factors

It is due to prolonged exposure to the sun's infra-red rays,and/to hot atmosphere.

- **A temperature of 32 degrees Celsius with 100% humidity may lead to heat stroke.**

Clinical Presentation

- Sudden onset
- Prodromal symptoms
  - Headache
  - Nausea
  - Vomiting
  - Dizziness
  - Weakness in legs;and
  - Excessive desire to micturate
- Sudden unconsciousness; victim falls and hence known as heat stroke.
- Flushed face
- Skin is hot and dry(sweating failed)

- Pulse full and rapid
- Respiration stertorous
- pupils contracted
- Temperature rises as high as 43 degrees Celsius(hyperpyrexia)
- Delirium and convulsions may precede death.

Mortality Rate

It is relatively high in this condition.

Cause of Death

Death results from paralysis of medullary heat regulating centre.

Fatal Period

Varies from a few minutes to three days.

Treatment of Heat Stroke

- Regulating temperature and humidity at workplace
  - Avoiding overburdening by clothes
- Cold or ice water sponging(till body temperature drops to 38 degrees Celsius
- Temperature measurements at regular intervals for several hours until regulatory mechanism regains control(prevention of secondary hyperpyrexia)

SEVERE & FATAL INJURY

HEAT STROKE

- Heat hyperpyrexia /Thermic fever /Sun stroke.
- Failure of thermoregulatory system due to direct exposure to sun due to failure of cutaneous blood flow & sweating.
- Triad of cerebral dysfunction composed of -
  - Impaired consciousness
  - Increased core body temp > 41°C (rectal)
  - Absence of sweating.

- Neurological disturbances -
  - Psychosis
  - Delirium
  - Stupor
  - Convulsions & coma.

- Risk factors-
  - Environmental –
    - High temp
    - Increased humidity
    - Muscular activity
    - Lack of acclimatization

At 100% humidity, 32°C temp may lead to HEAT STROKE

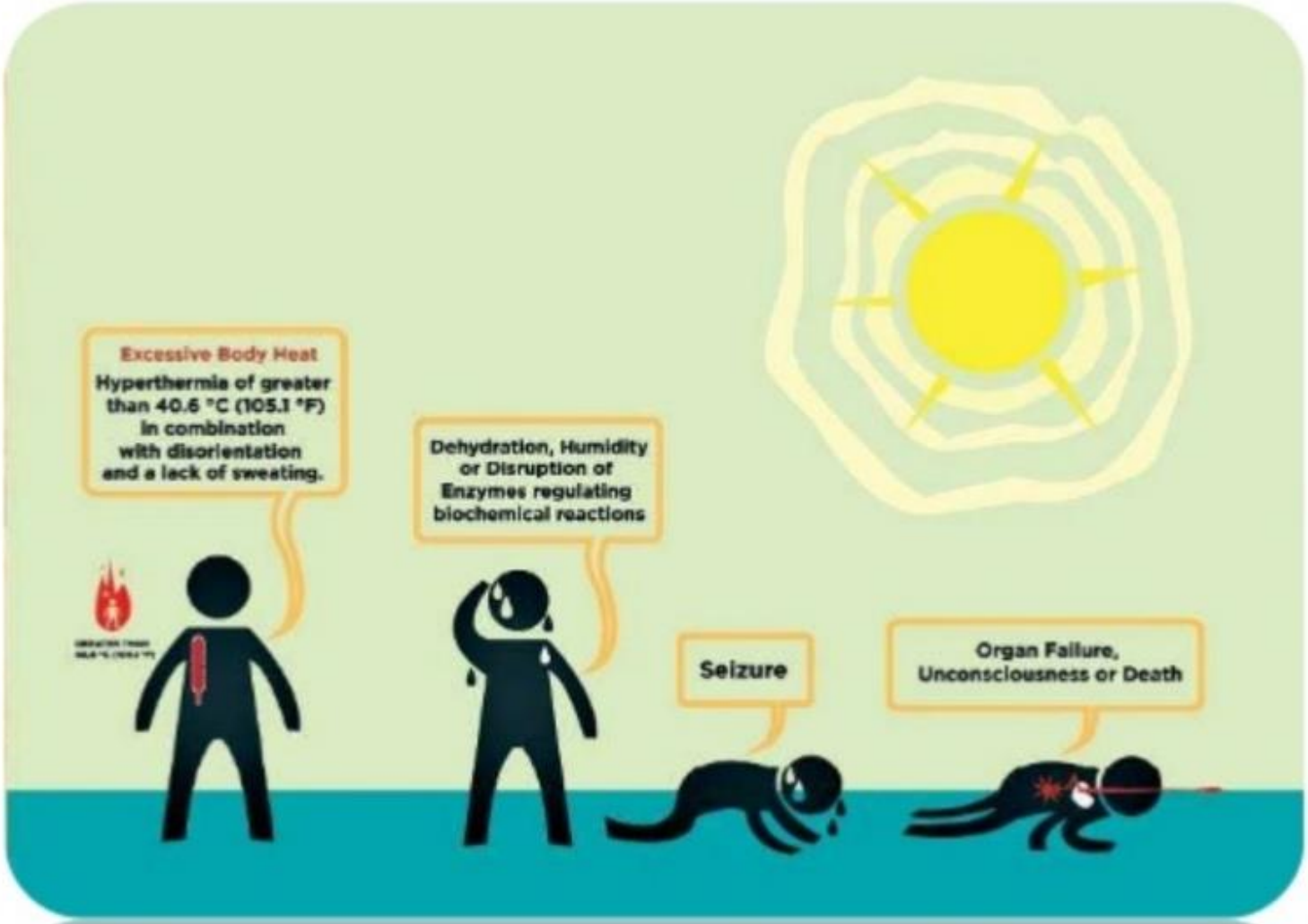
  - Non-environmental-
    - Older age
    - Alcoholism
    - Obesity
    - Brain hemorrhages, malignant hypertension, thyrotoxicosis, salicylate overdose.
    - Perceiving medications like anticholinergics, antihistamines or phenothiazines.
    - Use of major tranquilisers.

Types :-

- **Classic** – seen in persons with compromised homeostatic mechanism during heat waves (older persons).
- **Exertional** – seen in healthy persons undergoing strenuous exertion (athlets, military personal) in a thermally stressful environment.

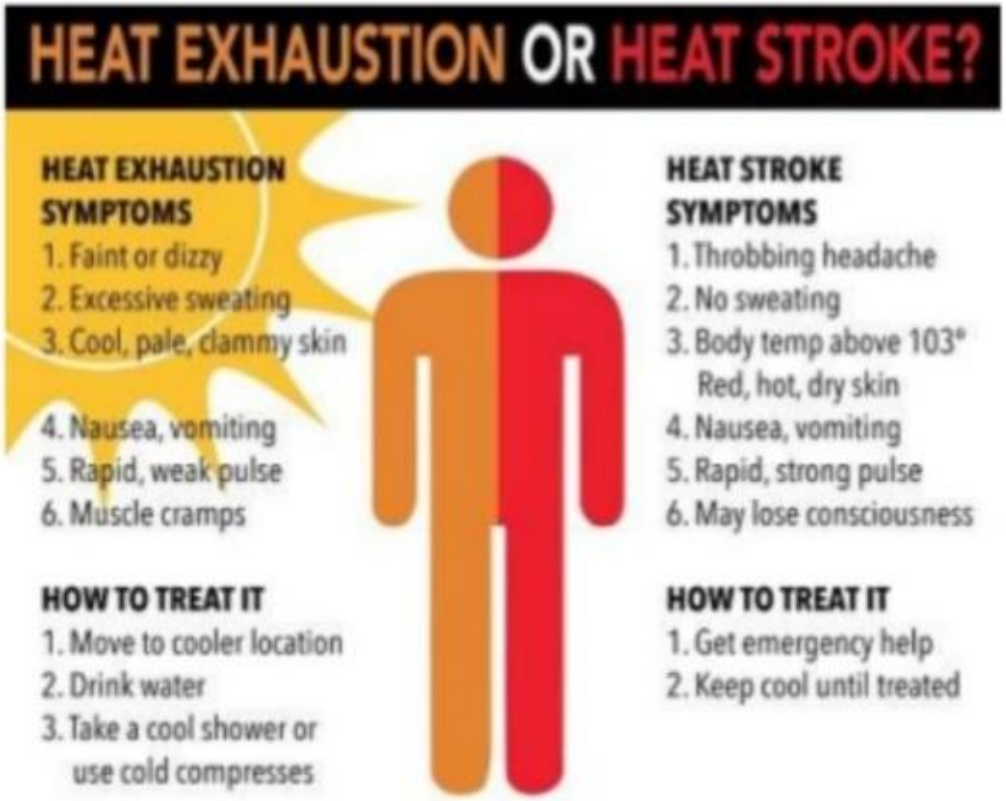
T/t :-

- Unclothed & spread water (20°C).
- Immersion in an ice water bath is very effective.
- Chlorpromazine diazepam is given to control shivering.
- Fluid administration & alkalinization of urine are recommanded.


Excessive Body Heat
Hyperthermia of greater than 40.6 °C (105.1 °F) in combination with disorientation and a lack of sweating.
Dehydration, Humidity or Disruption of Enzymes regulating biochemical reactions
Seizure
Organ Failure, Unconsciousness or Death

Complications :- survive > 24 hrs

- Lobar pneumonia
- Myoglobinuria
- DIC
- Tubular necrosis
- Hepatic necrosis



Recognize the Symptoms of Heat Injury

	Heat Cramps	Heat Exhaustion	Heat Stroke
Description	**Painful muscle spasms** caused by loss of salt from excessive sweating.	**Advanced** and serious stage of heat injury.	**Body's temperature is increased** and if not treated immediately may result in coma, brain damage or death.
Symptoms	• Muscular pain and excessive sweating	• Tired, weakness • Headache • Goosebumps, tingling skin • Increased heart rate and breathing, sweating • Nausea	• Increased temperature (very warm to the touch) • Mental impairment (agitation, confusion) • Possible loss of consciousness • Headache, nausea, vomiting, flu like symptoms • Rapid breathing, heart rate • Possibly dry skin

When In Doubt, Treat as a Heat Injury

Illness	Signs	Response
Heat rash	● Red blister-like eruptions/bumps ● Itching (prickly sensation)	✓ Rest in a cool place ✓ Allow the skin to dry ✓ Monitor for infection
Heat cramps	● Painful spasms usually in legs or abdomen ● Grasping the affected area ● Possibly heavy sweating	✓ Apply firm pressure and massage cramped area ✓ Rest in a cool place ✓ Drink water or an electrolyte drink ✓ Seek medical attention if cramping is severe or does not go away
Heat exhaustion	● Headaches, light-headedness ● Weakness ● Mood changes, irritability or confusion ● Feeling sick to your stomach and/or vomiting ● Extreme sweating ● Decreased and dark-colored urine ● Pale clammy skin	✓ Move the person to a cool, shaded area ✓ Loosen and remove heavy clothing ✓ Have the person drink some cool water ✓ Get something cool on them ✓ If the person does not feel better in a few minutes call for emergency help
Heat stroke	● Dry, pale skin ● Sweating may still be present ● Nausea and vomiting ● Hot, red skin (looks like sunburn) ● Mood changes, irritability, confusion, and not making any sense ● Collapse (will not respond) ● Fever (104°F or higher)	✓ Call for emergency help (ambulance or 911) ✓ Move the person to a cool, shaded area. Don't leave the person alone ✓ Remove heavy and outer clothing ✓ Have the person drink small amounts of cool water ✓ Get something cool on them

Heat Exhaustion:	Heat Stroke
• Heavy sweating • Heavy thirst • Panting/rapid breathing • Rapid pulse • Headache • Blurred vision • Exhaustion, weakness • Clumsiness • Confusion • Dizziness or fainting • Cramps	• No sweating • Red or flushed, hot dry skin • Any symptom of heat exhaustion but more severe • Difficult breathing • Pinpoint pupils • Bizarre behavior • Convulsions • Confusion • Collapse

Postmortem Appearances

- When death occurs from heat stroke,there are no characteristic necropsy findings
- The temperature remains high after death or may rise further(postmortem caloricity)
- Dead bodies with eyes open will show changes such as drying of cornea,and pitting and sinking of the eyeballs within a few hours after death,giving sometimes an appearance of avulsion of the eyes
- Rigor mortis sets in early and disappears early
- Putrefaction is rapid
- Lividity is marked
- Degeneration of neurons in the cerebral cortex,cerebellum,and basal ganglia is common

- Visceral congestion is usually well marked and petechial hemorrhages are found in the skin,viscera,and in the walls of the third and fourth ventricles and the aqueduct
  - Pulmonary edema is sometimes found

Preservation of Viscera

Blood should be preserved for alcohol estimation.

Medicolegal Aspects

- No medicolegal importance linked to deaths from heat stroke except in those cases when a worker dies at his workplace where adequate facilities for temperature regulation are not provided,adequate fluid intake is somehow impeded,and compensation is being claimed
- The condition is accidental and diagnosed by the circumstances of the case(prevailing temperature,occupation,symptoms of the attack,and the absence of any other cause of death.

Danger of Heat Exposure

Its link to rapid and unexpected increases in the incidence of skin cancer and one sun burn may be enough to initiate it.

BURN INJURY

DEFINITION

- A burn is an injury which is caused –
  - By the application of heat / chemical substances
  - Either by conduction / radiation
  - To the external / internal surfaces of the body
  - Causes destruction of the tissues.

- Radiation causes damage through conversion of infrared frequencies into thermal heat on absorption at the skin interface.
- Minimum temp for producing a burn - 44°C x 5-6 hrs
- 65°C x 2 sec – sufficient to produce burn.
- 70°C for less than 1 sec – full thickness destruction of skin.

CHARACTERISTICS

- Contact burn : with hot solid or molten metal. Blister with erythema.
- Flame burn : contact with flame. Vesication, singeing of hair & blackening of the skin.
- Flash burn : type of flame burn. Due to sudden ignition or explosion of gases / petrochemicals. Only exposed surface is burnt not the folds of skin.
- Scalds : hot liquids.
- Radiant heat burn : EM heat waves. No contact with sources. Erythematous & blistered .....light brown & leathery.
- Ionizing radiation burn : localized / generalized. Redness to dermatitis following pigmentation. Wart-like growth of fingernails.
- Chemical burns : acids, alkalis & vesicants. Ulcerated patches, distinct colouration, hair is not singed, no demarcative lines.
- Electric and lighting burns.
- Microwave burns : greater the water content of the tissue greater the heat production. Muscles > fat.

DRY HEAT VS MOIST HEAT VS CHEMICAL BURNS

Features	Dry heat	Moist heat	Chemicals
Cause	Flame, heated solid, X-ray	Steam or liquid above 60°C	Corrosive chemicals
Site	At & above the site of contact	At & below	At & below
Splashing	Absent	Present	Present
Skin	Dry, wrinkled	Sodden & bleached	May be destroyed
Vesicles	At the circumference of burnt area	Over the burnt area	Very rare
Red line	Present	Present	Absent
Colour	Black	Bleached	Distinctive
Charring	Present	Absent	Present
Singeing	Present	Absent	Absent
Ulceration	Absent	Absent	Present
Scar	Thick & contracted	Thin & less contracted scar	Thick & contracted
Clothes	Burnt	Wet, non burnt	May be burnt, show characteristic stain.

CLASSIFICATION OF BURN INJURY

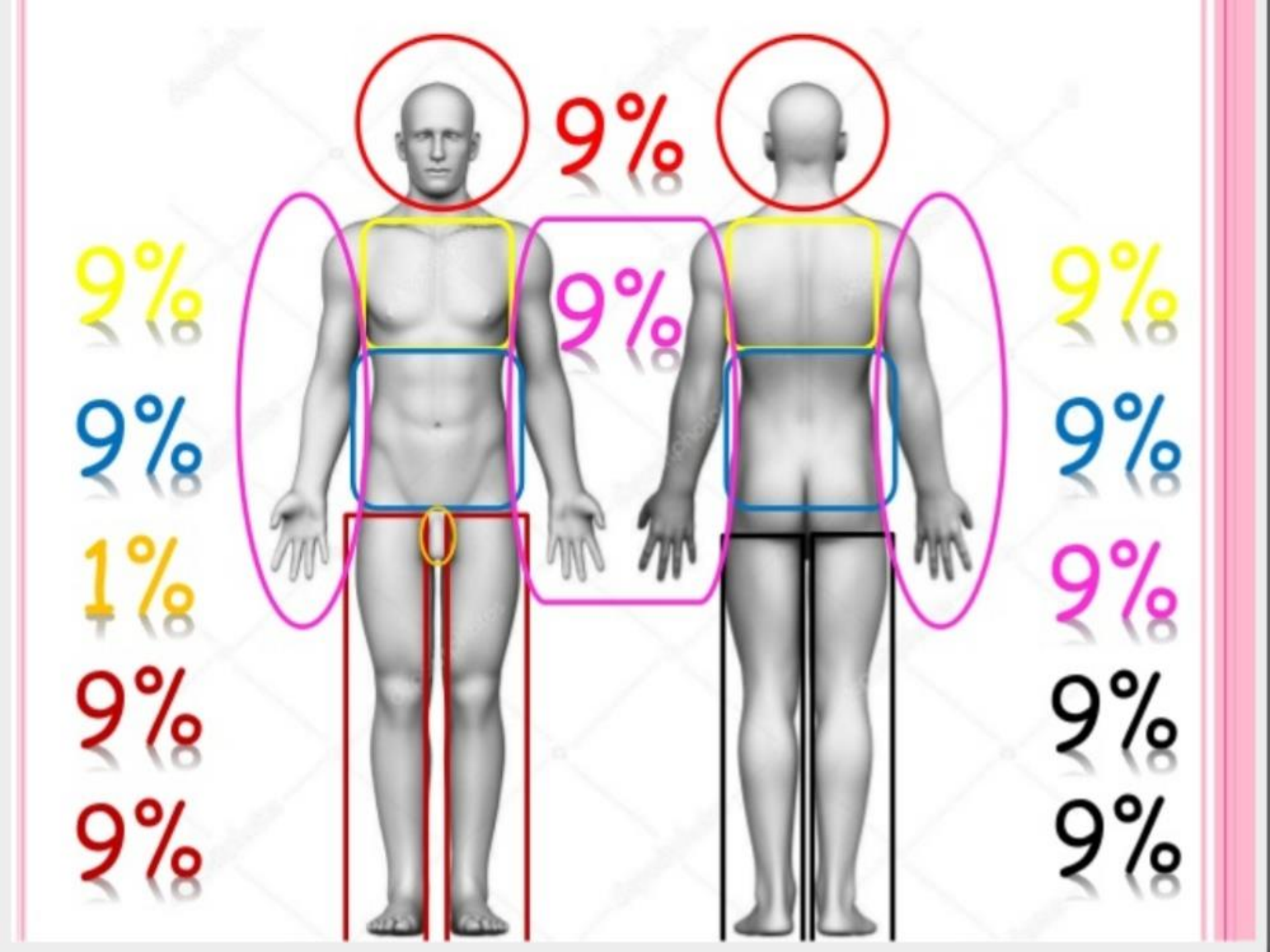
Characteristics	Dupyutren's	Hebra's	Wilson's	Modern	Characters
Superficial reddening	1°	1°	Epidermal	Superficial	Painful No scar Heals in 3-6 days
Vesication / Blistering	2°				
Destruction of superficial skin (Epidermis)	3°	2°	Dermo-epidermal		Painful ± Scarring Heals in 3 weeks
Destruction of whole skin (Dermis)	4°			Deep	
Destruction of deep fascia, muscles	5°	3°	Deep burn		Painless Scarring May takes months / May need grafting
Complete charring (vessels, nerve & bone)	6°				

EFFECTS OF BURN

- Degree of heat applied : severity increases with increased amount of heat.
- Duration of exposure : symptoms are more severe if the heat is applied for prolong time.
- The extent of the surface :
  - For burns in adult : Wallace's Rule of nines.
  - For burns in children : Lund & Browder chart.
  - For patchy burn : Rule of palm (1% of TBSA)

Involvement of 1/3 of TBSA (30-50)% : always fatal for the victim

- Site : head & neck, trunk or anterior abdominal wall are dangerous.
- Age : children are more susceptible. Older are less ....
- Sex : women are more susceptible.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9% X 11 = 99%

99% + 1% =100%

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Wallace Rule of 9s

- LUND and BROWDER method :

- For infants head is 18%.
- Each leg is 13.5%.
- Trunk & upper limb are the same as adult.
- For each year above 1 year, add 0.5% to each leg & reduce 1% to the head until adult values are reached.

CAUSES OF DEATH

- Immediate causes :-

- Primary / Neurogenic shock : due to pain & fright.
- Asphyxia : suffocation may result from
  - ✓ Smoke inhalation of CO, CO_2
  - ✓ Cyanide
  - ✓ Oxygen deprivation
  - ✓ Free radicals

- Accident & injury : injuries due to falling masonry, timber on the body.
- Vegal inhibition : cardiac arrest.

- Delayed causes :-

- Secondary / Hypovolumic shock : due to fluid loss from burnt surfaces. (after 1st 48 hrs)
  - ✓ Involvement of 15% of TBSA : circulatory collapse.
- Acute renal failure : 3-4 days
- Toxemia : absorption of various metabolites from the burnt tissues (3-4 days)
- Sepsis : mc cause of death (4-5 days or longer after burn)
  - ✓ Septicemia following wound infections by Pseudomonas, Staphylococcus.
- Oedema of glottis & pulmonary oedema.
- Inhalation of irritant smoke & hot gases (3 days).
- Hypokalemia.
- Acute peptic ulcer & hemorrhage in stomach.
- Pulmonary embolism following DVT.
- Infection : Bronchitis, bronchopneumonia, enteritis.

- Remote causes :-

- Gangrene, pyaemia, tetanus, anaemia & jaundice.
- Fat embolism.
- Marjolin's ulcer – untreated or non healing wounds may lead to malignant transformation.
- Curling's ulcer.

POSTMORTEM APPEARANCES

- Before doing the autopsy the following should be done :-

- Photographic documentation.
- Clinical history regarding the circumstances of death.
- X-ray : to rule out presence of any bullets / lead shots, antemortem fracture, stab wounds .

EXTERNAL PM FINDINGS

- Clothing :
  - Ignition of cotton fabrics > other fabrics
  - Loose, long garments > tight fitting (underwear, belt, buttoned collor)
  - Examination for presence of kerosene, petrol etc.
- Site involved : wheather the burnt areas are appropriate for the position of the body found.
- Face : swollen & distorted.
- Tongue : protrudes & burnt due to contraction of the tissues of neck & face.
- Froth at the mouth & nose due to pulmonary oedema by irritation of air passages by smoke.
- Cornea : whitish & translucent.
- Lense : opaque.
- Skin : marbled appearance due to standing out of the superficial veins.

- Hair : singed hair due to melting & resolidification of keratin.
  Gray hair .....reddish /brown. Black hair doesn't change.
- Hand : skin detaches as gloves.
- PM staining : cherry red for CO.
- Antemortem burn : hyperemia (Vital rex^{n}).
- Blister :fluid filled /ruptured small or involve large area.

Secondary burn blisters are not distingused from

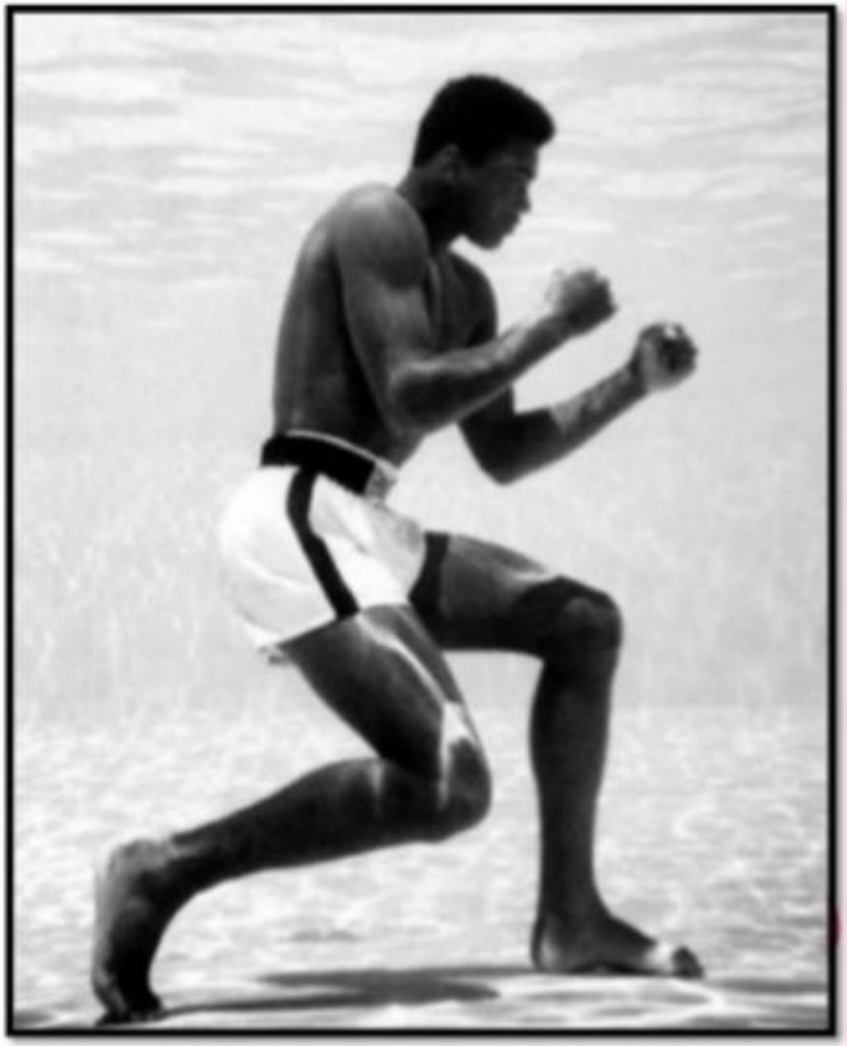
- ✓ CO poisoning
- ✓ Ante/Postmortem gasoline exposure
- ✓ Deep coma

- Pugilistic / Boxing / Fencing / Defense attitude :

- Due to heat stiffening.
- Features -

1. Legs are flexed at hips & knees.
2. Arms are flexed at elbows & wrists, held out infront of the body.
3. Fingers are hooked /clawed.
4. Head is extended.
5. Contraction of paranasal muscles - opisthotonus.

- Muscles contract due to coagulation of muscle protein & dehydration.
- Flexors being bulkier than extensors, contract more- generalized flexion of the joints.
- Occurs wheather the person was alive or dead at the burning time & bears no MLI.
- Extreme version of this phenomenon - Sit up & beg attitude.



- Heat rupture :

- Splitting of the charred skin due to contraction of the heated tissue.
- Nonspecific in nature.
- Usually seen over fleshy areas of body (calves, thigh, extensor surface of joints)
- Mimic laceration & incised wound.

Differentiated by

- ✓ Absence of bleeding - heat coagulation of blood.
- ✓ Intact vessels & nerves.
- ✓ Absence of bruising.
- ✓ Presence of irregular margin.

INTERNAL PM FINDINGS

- Heat hematoma :
  - Head is exposed to intense heat.
  - Resembles Extradural haemorrhages without any association of blunt force injury.
  - Blood come out from the diploic vein or longitudinal venous sinuses.
  - Formed clot is distributed closely with the charred outer table of skull.
  - Size – about 1.5 cm, volume – 100-120 ml blood.
  - Honey Comb appearance.
- Skull fracture :
  - Sutural #
  - Stellate #

Suerest sign of antemortem burn

- Brain : congested, subdural haemorrhage.
- Neck : Vital rex^{n} in the root of the tongue & neck muscles.
- Respiratory system : presence of carbon & soot particles beyond the bifurcation of trachea .
- Pleura, Pericardium : congested & petechial haemorrhages.
- Heart : cherry red coloured blood (CO).
- Stomach & Intestine :
  - Carbon imprignated stomach mucosa.
  - Ulceration of peyer's patches & solitary glands of intestine.
  - Curling's ulcer :-
    - Stress ulcer produced in the gastric antrum & duodenum.
    - In 70% cases.
    - After 72 hrs (3-10 days post survival).
    - Sharply punched out mucosal defect (superficial & deep).

- Spleen : necrosed germinal centers with congestion.
- Liver : cloudy swelling & necrosis....Jaundice may develop.
- Kidney : capillary thrombosis & infarction.

> 30% of TBSA involvement causes haemoglobinuria.

- Puppet organs : organs cooked by heat
- Exposed to high temperature.....vaporization of fluid.....firm, hardened internal organs.

ANTEMORTEM VS POSTMORTEM BURNS

Characters	Antemortem Burns	Postmortem Burns
Line of redness	Present	Absent
Blister	Contain serous fluid with protein & chlorides. Base is red & inflamed.	Contain air & thin clear fluid. Base is dry,hard, yellow.
Soot in respiratory tract	May be present	Absent
Carboxy Hb	Present	Absent
Healing & repair	Present	Absent
Vital reaction	Present with reactive changes in the tissues.	Absent
Enzymes	Peripheral zone of burn shows increase enzymatic reaction.	Absent

SCALDS

SCALDS

Scald is an injury resulting from application of liquid at or near boiling point,or from steam.

Characteristics & Types

- Application of liquid > 60° or steam.
- Involves the superficial layers of skin.
- Water > 70°C can affect full thickness.
- Types :

1. Immersion burn : accidental or deliberate immersion in hot water.
2. Splash burn : bursting of hot water bottles, boilers, pulling over saucepans or kettles by children.
3. Steam burn : exposure to superheated steam.

- Sharp demarcation with tickle marks, soddening, no singed hair or blackened skin.
- Inhalation causes death by asphyxia due to oedematous mucous membrane.

Classification of Scalds

Scalds are classified into three degrees;

1) Reddening of skin(erythema)
2) Blister formation(vesication due to increased capillary permeability)
3) Necrosis of the dermis(deeper layer of the skin)

Redness

It appears at once.

Blister Formation

- Blistering takes place within a few minutes
- The blisters are surrounded by a thin bright red area of inflammation
- There is reddening and swelling of the papilla in the floor of the blister
- If the blister is removed,it will leave a pink raw surface.

Necrosis

If superheated steam is inhaled,the mucosa of larynx and trachea may be necrosed and detached in shreds(laryngeal edema being cause of death).

Severity of scald injury

It depends primarily on the temperature and duration of contact.

- **Burns result in;**
  - 20 seconds at 131 degrees Fahrenheit
  - 3 seconds at 140 degrees Fahrenheit
  - 2 seconds at 150 degrees Fahrenheit;and
  - 1 second at 158 degrees Fahrenheit

Depth of scald injury

- When hot liquids are drunk,the injury is likely to be limited to the skin,or mouth and throat
- A greater depth is achieved on contact with liquids such as hot oil,tar or molten metals which are many times hotter than boiling water
- In these cases,the deeper layers of the skin are also affect.

Identification of scald injury

- The liquid responsible for scalding may be seen on the clothes and body
- Sometimes its smell may be obvious
- The skin is soddened and bleached in appearance
- Vesication(blistering)is an important feature.Vesicles are abundant along the course of running liquid
- The clothes are usually wet
- Burning of clothes,singeing of hair,deposition of carbonaceous material and charring of tissues are not seen

- Since the hot fluid and steam is cooled during its passage through clothing,the distribution of scalds is normally on unclothed parts of the body
  - Hot liquids are cooled while being dispersed.Thus,scalds are severe at places where hot liquid has come into initial contact with skin
  - As the liquid runs down the body,the degree of scalding also progressively diminishes.

Almost all scalds caused by inadvertent turning of hot water tap could be avoided if the setting of hot water does not exceed 120 degrees Fahrenheit.

Disfigurement by scalds

Scars of scalds are much thinner than those of burns and cause much less contraction and disfigurement.

Medicolegal Importance Of Scalds

- Scalds are usually accidental due to splashing of fluid from cooking utensils or pouring hot water during bath.Children may upset the vessels containing boiling liquids or suck spouts of kettles containing hot milk or tea resulting in severe scalds of mouth and throat
- Boiling water may be thrown with intent to annoy on face of body
- Boiling water may be thrown with malicious intent to injure or disfigure

- Deliberate scalding by hot fluids common in child abuse.A straight horizontal pattern across the body or an extremity is always suggestive of forceful immersion.

DRY HEAT VS MOIST HEAT VS CHEMICAL BURNS

Features	Dry heat	Moist heat	Chemicals
Cause	Flame, heated solid, X-ray	Steam or liquid above 60°C	Corrosive chemicals
Site	At & above the site of contact	At & below	At & below
Splashing	Absent	Present	Present
Skin	Dry, wrinkled	Sodden & bleached	May be destroyed
Vesicles	At the circumference of burnt area	Over the burnt area	Very rare
Red line	Present	Present	Absent
Colour	Black	Bleached	Distinctive
Charring	Present	Absent	Present
Singeing	Present	Absent	Absent
Ulceration	Absent	Absent	Present
Scar	Thick & contracted	Thin & less contracted scar	Thick & contracted
Clothes	Burnt	Wet, non burnt	May be burnt, show characteristic stain.

The End.