

Postmortem

- Cause of death: injury or disease (stab wound, adenocarcinoma, ...).
- Mechanism of death : physiologic derangement produced by the cause of death (Hemorrhage, acidosis, ...).
- Manner of death: how the cause of death came (natural, accidental, homicide, suicide or undetermined).
- Mode of death: the abnormal physiologic state that pertained at the time of death (coma, syncope, or asphyxia).
- Agonal period: the time between a lethal occurrence and death

Early changes :

Tache noire

- Yellow triangles in sclera >> brown >> black.
- Happen due to drying and deposition of cellular debris, mucus and dust if eye opened for 3-4h after death

Kevorkian sign

- Retinal vessels appear segmented (cattle trucking or shunting).
- Happens within seconds to minutes and persists for about an hour

Algor mortis

- Cooling of the dead body, where the body temperature equilibrates with its environmental temperature (within 16-20 h).
- Cause: cessation of the energy production and inactivity of the heat regulating center

Livor mortis :

- Cause: Gravitational settling of the blood in the toneless vessels.
- Site: Undersurface of skin in the superficial layer of the dermis.
- Start after 30 min to 1 h as small patches -> increase in size after 3-4h -> fully developed in 5-6h.
- If the body is undisturbed it will be fixed in 8-12h and persist until putrefaction.
- the non-stained areas are called contact pallor (due to the pressure)

Rigor mortis :

- Muscle stiffening & rigidity with some degree of shortening.
- Caused by persistent attachments of actin filaments to myosin due to the lack of ATP along with the loss of muscle softness and elasticity.
- Starts 1-2 h after death (after primary relaxation), takes 9-12h to develop from head to foot, persists for 12h and takes 12h to pass off.
- Develops faster in case of electrocution (faster ATP depletion) & high temperature.
- Earlier in involuntary muscles , first in small muscles (eye, jaw & neck)
- Among voluntary muscles develops sequentially & descending pattern.
- The rigidity disappears in the same order in which it has appeared.
- Stays for maximum duration in the muscles of the lower limbs.

Cadaveric spasm

- The muscles were contracted immediately before death and continue to be so after death without passing through primary relaxation.
- It's antemortem phenomenon reflects the last act of the body.
- **Heat stiffening** : pugilistic attitude
- **Cold stiffening** : The body is exposed to freezing temperature for a reasonable period, the tissue become frozen and stiffed stimulating rigor. There will be a freezing of body fluids and hardening of the subcutaneous fatty tissue

Late changes :

- Clostridium Welchii is the main organism in putrefaction
- Degradation: loss of integrity of skin (skin slippage, degloving & loosening of hair and nails).
- Dissolution: occurs with progressive decomposition that leads to liquefaction and disappearance of tissue and organs and eventual skeletonization.
- Trachea and the larynx (first) >> stomach & intestine >> liver & spleen >> brain >> heart.
- Maceration it is a aseptic autolysis of the dead fetus in the uterus
- Insects post mortem important in determining timing of death

Discoloration :

- The first external sign of decomposition, starts 2 days after death , first in RIF
- reaction between H₂S and deoxygenated Hb
- Internally, this is seen under the surface of the liver

Marbling of skin :

- passage of bacteria in the vessels
- happens due to decomposition of Hb to sulphmethemoglobin in the inner wall of superficial vessels.

Adipocere (Saponification) :

- The surest sign of death , in hot and moist environments

Mummification

- 3-12 months after death , hot dry environment
- Rapid dehydration of the dead body with preservation of the natural features of the body

Wounds

Abrasions :

- rough blunt force , epidermis , usually no bleeding or scar formation
- 1. compression force : Imprint (pattered) , Pressure (crushed)
- 2. Tangenital force : Linear (scratch) , Graze (sliding or brush)
- When the friction force is great, grazed area appears like burn injury and it is called in such cases the brush burn.
- When the pressures abrasion resemble the shape of the object it is called imprint abrasion

Contusion :

- Extravasation or collection of blood due to rupture of blood vessels caused by blunt nature without loss of continuity of tissue.

Color	Age	Caused by
Red	Fresh	Extravasation of blood
Bluish	1 – 3 days	Deoxyhemoglobin
Bluish dark to brown	4 days	Hemosiderin
Greenish	5 – 6 days	Hematoidin
Yellow	7 – 12 days	Bilirubin
Complete disappearance	2 weeks	-

Lacerated :

- Slitting or tearing of tissues caused by blunt force (involves the whole skin thickness).
- The most common type of wound seen in the ER.
- Irregular margins & slightly inverted
- Swallow tails which are small tears at the angle of the main lacerated wound
- Some fibrous tissue, nerves, and blood vessels remain intact at the base of the wound represented as “tissue /structure bridging” and it is a characteristic sign

Incised wound :

- Caused by drawing or striking the edge of sharp object on the skin and underlying tissues.
- Broader than the edge of the weapon causing it because of retraction of the divided tissues.
- The length is greater than the breadth (depth in stab wounds).
- Clean, well defined margins mostly everted but maybe inverted & no bruises
- Direction of application of force can be known by the “tailing”, it is the end point.

Chop wound :

- Type of incised wound made by hacking or chopping motion with fairly
- sharp and relatively heavy weapon such as axe.
- Wounds are wider and deeper than incised wounds but not so sharp.
- Two parts in the chop wounds may be identified :The part of wound nearer to the assailant, known as heel end of the chop, is deeper than distal part from the assailant, known as toe end of the chop.

Stab wounds :

- Entry point is larger and inverted, the exit point is smaller and everted.
- The depth of stab wound is more than length and width

- Width (breadth) of weapon -> wound length
- Length of weapon -> wound depth
- Thickness of weapon -> wound width (breadth)

Firearm injuries

- Smokeless powder produce much less smoke, resulting in less blackening and tattooing around the entry wound than black powder
- Abrasion collar : reddish-brown ring around a bullet entry wound, caused by the bullet stretching and rubbing against the skin before penetration.
- Grease collar : black colored narrow ring of skin, lining the defect and is sharply outlined from the removal of substances from the bullet as it passes through the skin.
- Tattooing : Appear as reddish-brown punctate abrasions surrounding the wound entrance (intermediate range)
- Blackening : Appear as black-gray discoloration surrounding the wound entrance (contact or close range)
- Muzzle/recoil imprint mark : in contact
- Blowback phenomenon : Cruciate, stellate or ragged laceration is seen, especially if there is a thick bone immediately under the skin, such as the
- Back spatter : In a contact shot, the muzzle blast and negative pressure in the barrel may suck blood, hair, fragments of tissues and cloth fibers back into the barrel
- As range increases, the size of exit wound also increases

Contact shot	Muzzle imprint , blow back if over bony surface
Close shot	Soot , singeing , blackening
Intermediate shot	Tattooing
Distant shot	Only abrasion and grease collars

Beveling :

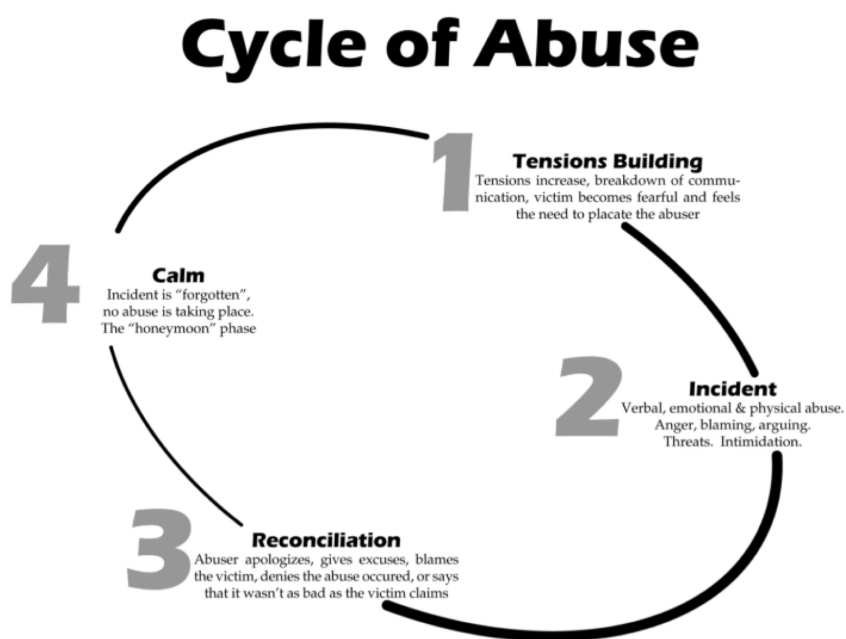
- Entry wound : internal beveling
- Exit wound : external beveling

Child abuse

- The most common mode of death is head injury then rupture of an abdominal viscus.
- Child abuse syndrome (or battered baby syndrome) : a neonate or child suffers from a repetitive physical injuries from the parents or another caregiver in circumstances that exclude accident.
- shaken baby syndrome triad (brain swelling, retinal hemorrhage, subdural hematoma)
- Neonaticide : killing of a newborn (within the first 24 hours of life) by the mother.
- Infanticide : killing of an infant (under 1 year of age) by the mother.
- Filicide: killing of a child above 1 year of age (by a parents or caregiver).

Domestic abuse

- Physical abuse includes forcing drug/alcohol use
- Stalking refers to a repeated, unwanted attention and harassment directed at a person, causing them to feel fear, distress, or concern for their safety. It can involve physical following, surveillance, communication, or threats.
- Cyberstalking refers to online action or repeated emailing that lead to emotional distress in the recipient.



Medicolegal reports

- simple wounds : up to week
- Laceration : on joint : 2 weeks
- Upper limb # : 6-8 weeks
- Lower limb # : 12-16 weeks
- Small bones : 2-4 weeks
- Depressed skull # : 2-3 months

Drowning

- cold water : ventricular dysrhythmia
- Fresh water (hypotonic) : cardiac arrest "V fib" (fatal period is 4-5 min)
- Sea water (hypertonic) : pulmonary edema & heart failure/asystole (fatal period is 8-12 min)
- Dry drowning : Water does not enter the lungs due to laryngospasm (blocks air entry) "negative autopsy findings and dry lungs"
- Immersion syndrome/cold water drowning : Vasovagal reflex that leads to cardiac arrest due to sudden immersion in cold water -> LOC -> secondary drowning
- Near drowning (post-immersion syndrome):
- The patient died beyond 24h due to complication (ARDI, DIC, hypoxemia induced encephalopathy).
- Shallow water drowning : Submersion of the unconscious (alcoholics, drugged, epileptic) in shallow water
- Most common cause of death is asphyxia
- Rigor mortis appears earlier
- Paltauf's hemorrhage: mottled areas of red and gray distended alveoli (reflects intra-alveolar hemorrhages)
- Gettler test: Normally, the chloride content of the right and left side of heart is nearly same. If difference is 25 % or more, it is suggestive of antemortem drowning.
- The presence of diatoms in the lung substance, bloodstream, brain, liver, kidneys, bone marrow of femur (best site for analysis) or humerus or in the skeletal muscle has been claimed to be suggestive proof of antemortem drowning

S.No.	Feature	Antemortem drowning	Postmortem submersion
1.	Froth over mouth and nostrils	Fine, lathery froth, appears spontaneously	Absent, even if present, it is coarse, not spontaneous
2.	Cadaveric spasm in hands	Aquatic vegetations, mud may be present	Not observed
3.	Trachea and bronchioles	Presence of algae, mud along with frothy mucus	Absent
4.	Lungs	Ballooned up, bulky, edematous, bear indentations of ribs	Collapsed, decomposed
5.	Mud and algae in stomach and small intestine	May be present	Absent
6.	Diatom and Gettler tests	Positive	Negative
7.	Injuries	If present, need to be consistent with drowning	Injuries inconsistent with drowning
8.	Other suggestive signs	Water in middle ear, retracted genitals, cutis anserina, washerwoman's hands, wet clothing, mud and sand	Water is never present in middle ear; others are not valuable and corroborative findings

Burns :

immediate causes of death :

- primary or neurogenic shock
- Asphyxia (co poisoning) "COHb > 50% is confirmatory"
- Smoke or heat induced laryngospasm , respiratory arrest , vagal reflex caused cardiac arrest

Delayed causes of death :

- Hypovolemic, burns or secondary shock (24-48 hrs)
- Acute edema of glottis
- Respiratory failure (3 days)
- Toxemia (3-4 days)
- Sepsis "the most important cause of death" (4-5 days)
- Infective complications
- Pugilistic attitude : happens due to coagulation of muscles proteins and dehydration , singeing is visible in all the body
- Heat hematoma is bilateral, symmetrical, diffuse and lack signs of active bleeding inflammation
- Epidural hematoma is unilateral, associated with localized trauma, and shows signs of active bleeding and possibly inflammation
- Brain -> wide flat gyri and obliteration of sulci
- 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.

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

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

Electrocution

- More resistance = less conduction but severe injury (bone highest and blood lowest , skin high when dry and low when wet)

- AC worse than DC

Causes of death :

- V fib (cardiac arrest) -> most common
- Asphyxia
- Thermal injury
- Multi-organ failure & CNS damage.
- Secondary trauma

- Joule burn: burn due to thermal effects caused by electrical energy (more in low-voltage)
- Crater lesion: usually seen in case of the high-voltage electrocution
- Exit wound: Larger and more irregular. May have a charred edges with extensive tissue necrosis. The electrical current exits the body with greater force than it enters leading to extensive damage. In high-voltage current, the exit often appears as a 'blow-out' type wound.
- Joule burn at the site of entry is diagnostic
- Lightning injury Lichtenberg is pathognomonic
- The mode of death in electrocution is syncope.
- The most common cause of death is arrhythmias.
- The manner of death is accidental

Asphyxia

The classical stages of asphyxia:

1. Stage of dyspnea; stimulation of respiratory center due to lack of oxygen in blood.
2. Stage of convulsions; cerebral irritation due to anoxia and hypercapnia.
3. Stages of paralysis; irreversible brain damage.

External signs :

- Facial edema and petechial hemorrhage (Tardieu's spots)
- Dark blue hypostasis.

Internal signs :

- Petechial hemorrhage "Tardieu's spots"
- Salivary spots: shiny grey spots appear sub-pleural due to increased intra-alveolar pressure during convulsion phase >> rupture of the superficial unsupported sub-pleural alveoli.

Smothering

- Manual obstruction of the external respiratory orifices (mouth & nose) by hands or soft object.
- Semilunar nail abrasions & bruises at external respiratory orifices.
- Mechanism of death : Mechanical anoxia.

Chocking

- Blockage of the internal respiratory passages at level of pharynx, larynx, or trachea.
- Foreign body in air passages , In an epileptic, tongue may show bite marks or bruising.
- Mechanisms of deaths : Asphyxia

Gagging

- Fabric or adhesive tape occludes the mouth, nasal opening remain patent but later blocked by mucus and/or edema may lead to death.

Suffocation

- Reduction of the oxygen concentration in the atmosphere
- The classical signs of asphyxia are almost always absent with negative autopsy findings.
- Mechanism of death : Hypoxia

Throttling

- Neck is constricted forcibly by the hands.
- Pressure must be applied for at least 2 minutes to cause death.
- Semilunar nail abrasions & bruises on the front & sides of the neck.
- The most significant internal sign : extravasating of blood in subcutaneous tissue underneath the external marks.
- The most diagnostic finding : inward compression fracture of hyoid bone
- Damaged larynx and fracture or split of the thyroid cartilage.
- Fracture of cricoid cartilage.
- Mechanism of death : Mechanical anoxia (chief cause)

Strangulation

- Neck is constricted by a rope or any ligature
- Ligature marks : Transverse & complete circle , Below laryngeal prominence
- Fracture of thyroid cartilage and hyoid bone with inward displacement
- Scratches and abrasions on either side of the neck as a sign of resistance.
- Mechanism of death : Mechanical anoxia

Hanging

- Suspension of the body from the neck by a ligature.
- The constricting force is produced by the body weight
- Hypostasis of the lower parts of the body (gloves and stocking hypostasis)
- Ligature marks : Incomplete circle, oblique, Located high up in neck, Asymmetrical
- Dribbling of saliva due to pressure on the submandibular gland.
- Transverse untimely rupture of carotid arteries
- Outward fracture of the hyoid bone or posterior horn of the thyroid cartilage.
- Fracture dislocation is most common between C2-C3.

Based on degree of suspension :

- Complete : The body does not touch the ground at any point.
- Incomplete : If any part of the body touches the ground, almost always homicidal.

Based on knot position :

- Typical : the knot is centrally located over the occiput.
- Atypical : the knot is anywhere other than on the occiput.

Mechanism of death :

- Cerebral anemia (the commonest cause)
- mechanical asphyxia
- Tearing of the medulla (following fracture dislocation of the cervical vertebrae. Common with "Judicial hanging" due to the long drop of more than two meters)

Traumatic

- Fixation of the chest and abdomen by external mechanical compression preventing respiratory movements.
- Blue congestion of the face, neck and upper chest & pallor at compression site
- Conjunctiva is congested and hemorrhagic.
- Local bruises and abrasions of chest wall, may be with fractured ribs or sternum / ruptured heart or lungs
- Lungs are dark with Tardieu's spots
- Mechanism of death : Mechanical asphyxia.

Ligature mark	Strangulation	Hanging
1- Site	Low below larynx	High above larynx
2- Shape	Complete circle	Incomplete circle (except running noose/ double turns).
3- Direction	Transverse	Oblique
4-Compression	Symmetrical	Asymmetrical

S.No.	Feature	Antemortem hanging	Postmortem hanging
1.	Salivary dribbling mark	Present	Absent
2.	Fecal/urinary stains	May be present	Absent
3.	Ligature mark • Direction • Continuity • Level in the neck • Parchmentization • Vital reaction	Oblique Non-continuous Above thyroid Present Present	Circular Continuous At or below thyroid Absent Absent
4.	Knot	Single, simple, on one side of neck	Multiple, granny or reef type on occiput/chin
5.	PM staining • Above ligature mark • In lower limbs • Glove-stockings like	Present Present Present	Absent Absent Absent
6.	Evidence of injury • Self-inflicted • Struggle • Tear of carotid artery intima • Imprint abrasion	Present Absent Present Present	Absent Present Absent May/may not be present
7.	Elongation of neck	Present	Absent
8.	Cyanosis	Deeply positive	Absent or faintly present
9.	Emphysematous bullae on lungs	Absent	Present
10.	Point of suspension	Compatible with self-suspension	Not so
11.	Histochemistry of ligature mark	Increased serotonin and histamine	Not so