



DEATH & POSTMORTEM CHANGES

Forensic Medicine

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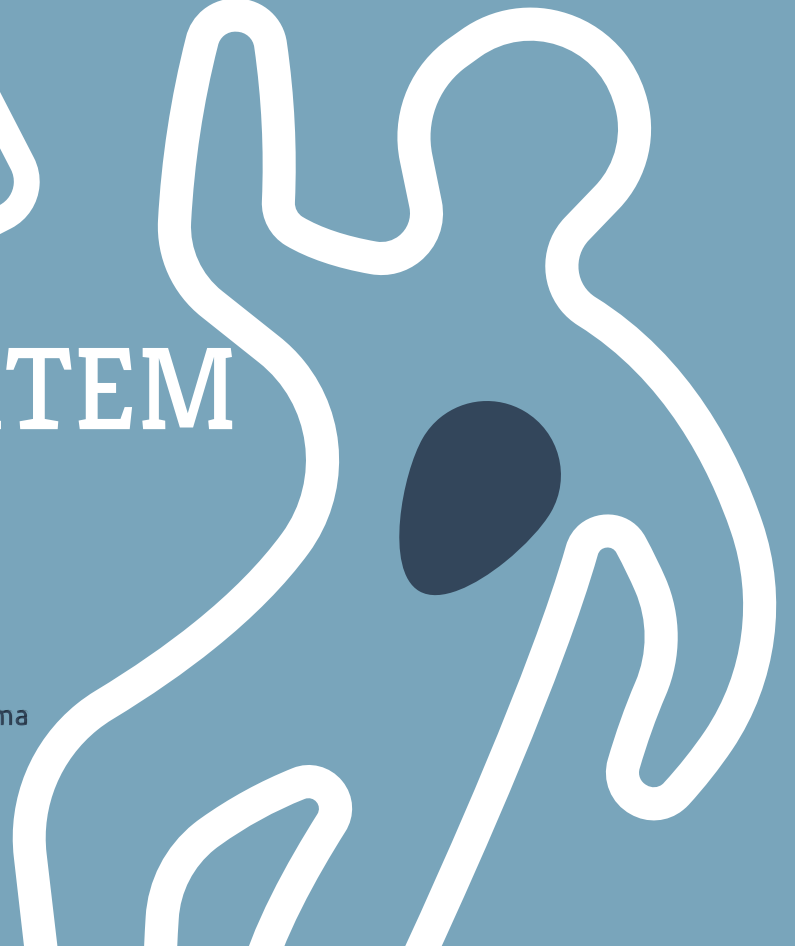


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01

Definition of Death



Definition of Death

Death as a Biological Process

- Death is **Not instantaneous**; after the **oxygen** and **circulation** stop, various tissues and organs **die at varying rates**. While other tissues, like skin or muscle cells, may survive for hours, the brain, and particularly the cerebral cortex, is among the first to sustain irreversible damage within minutes of oxygen deprivation, thus death is **not a specific event** it is a process (process means that not all cells die together).
- **Irreversibility:** The irreversible **Termination of Vital Physiological Processes** is **the hallmark of death**, especially as indicated by permanent **stoppage of the heart** (cardiovascular system), **respiration** (respiratory system), and **higher brain function** (neurological system).

Definition of Death

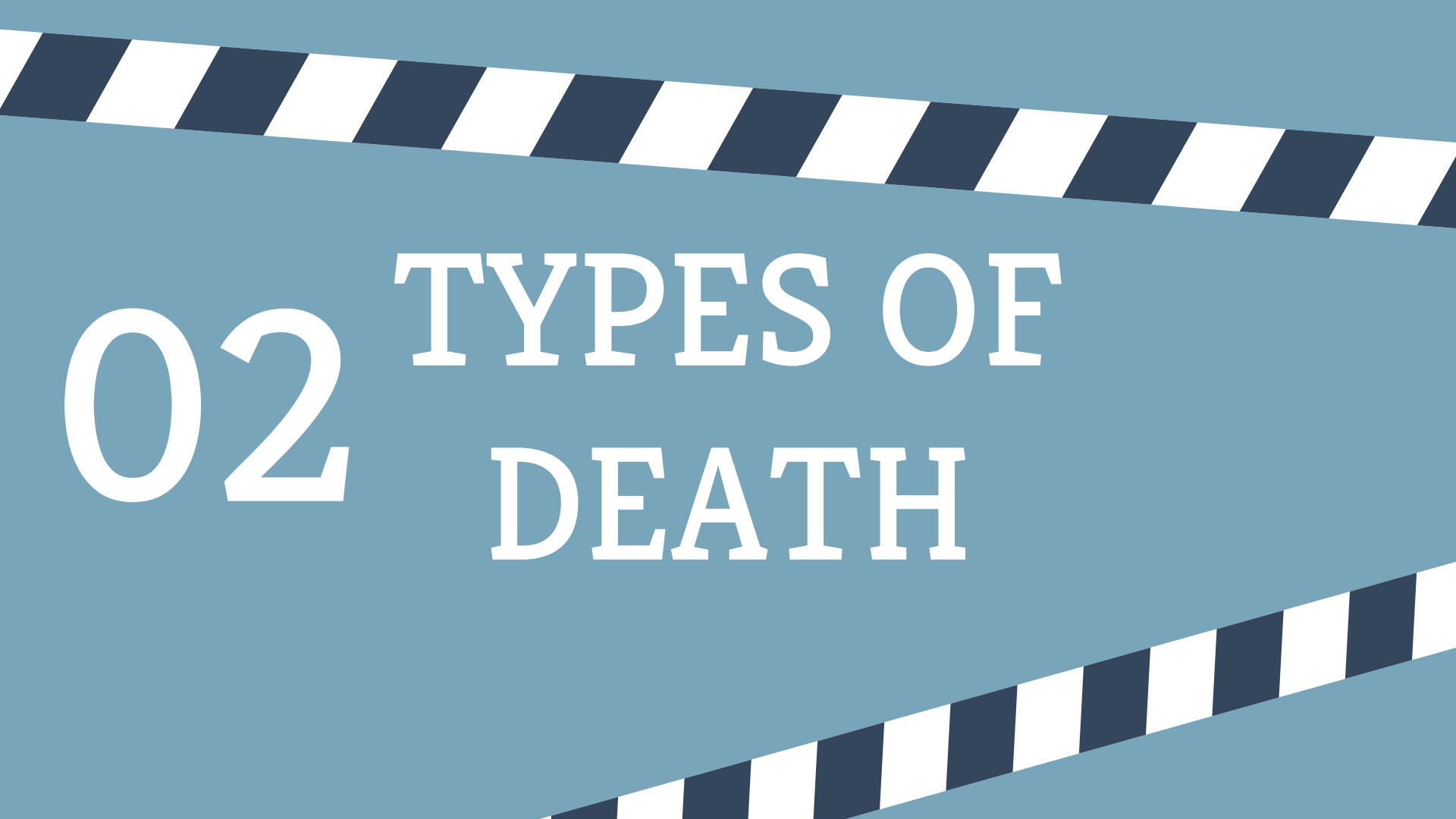
The Seven Life Processes (MRS GREN)

Biology traditionally defines life through 7 key processes:

1. **M**ovement – ability to change position or location.
2. **R**eproduction – ability to produce offspring.
3. **G**rowth – increase in size or cell number.
4. **R**espiration – energy release from food (cellular metabolism).
5. **N**utrition – intake and use of substances for energy and repair.
6. **E**xcretion – removal of metabolic waste products.
7. **S**ensitivity (Responsiveness) – ability to detect and respond to stimuli.

When all these processes are permanently absent, the organism is considered **dead**.





02 TYPES OF DEATH

TYPES OF DEATH

Somatic Death



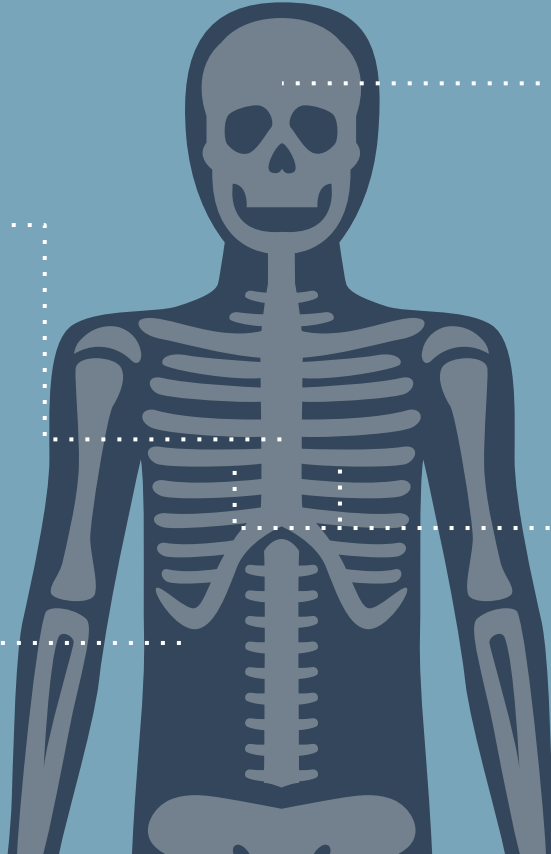
Brain Death



Cellular Death



Clinical Death



TYPES OF DEATH

1. Somatic Death

Definition: The **permanent, irreversible** cessation of the organism as a whole.

Features:

- Loss of consciousness and awareness of person environment.
- **Irreversible** absence of personality, sensory appreciation to stimulators, and voluntary movement initiation.
- Represents the **death of the individual**, even if some cellular activity may continue for a limited time.

TYPES OF DEATH

2. Clinical Death

Definition: A stage of death derived **from the point of view of medicine** marked by **cessation of Heartbeat and Respiration**, resulting in Visible signs of the state of failure of the living organism actions such as heart beating, respiratory function or blood circulation.

Features:

- No cardiac output, no respiration.
- **Duration:** typically lasts **about 4 minutes** before irreversible brain injury begins (due to cerebral hypoxia).
- **Reversibility:** Life can be restored within this window by CPR, defibrillation, or advanced resuscitative measures.
- Beyond this period, permanent brain damage or progression to biological death occurs.

TYPES OF DEATH

3. Cellular Death

Definition: The **death of individual cells and tissues**, marked by loss of metabolic activity (especially aerobic respiration).

Features:

- **Timing Varies:** different tissues have different resistance to anoxia (the utilization of oxygen).
 - **Brain Cortex Neurons:** die within **few minutes** of Anoxia.
 - **Muscle, connective tissue, skin:** may survive **hours to days** post-circulatory arrest.
- **Explains the possibility of Postmortem Organ Transplantation** (e.g., cornea, skin, kidneys if harvested rapidly).

TYPES OF DEATH

4. Brain Death

A. Timeframe: The exact duration of Complete Anoxia needed to cause irreversible cortical damage is debated.

- Traditionally thought to be **~3 minutes**.
- More recent data suggests **7–9 minutes** may still cause irreversible cortical necrosis.
- After this window, the **cortex cannot be revived** with current medical interventions.

B. Persistent Vegetative State (PVS)

- Occurs when **higher cortical activity is lost** (above the Tentorium) either from a period of Hypoxia, Trauma, or Toxic insult.
- **Brainstem remains intact**, meaning:
 - Spontaneous breathing continues.
 - Cardiac function is maintained.
- The patient could be in Deep Coma, Unconscious, and Non-Communicative, **but NOT Brain-Dead**. Thus, No ventilator support is needed unless complications occur (life-support machines).

TYPES OF DEATH

4. Brain Death

C. Brainstem Death

- Represents the loss of the “Vital Centers” in the brainstem (under the Tentorium):
 - Respiratory Center → Spontaneous Breathing Stops.
 - Cardiac centers and Reticular Activating System → Irreversible Coma, Autonomic Failure.
- Features:
 - Patient becomes Ventilator-Dependent.
 - No Brainstem Reflexes (e.g., pupillary, corneal, gag, vestibule-ocular).
 - No Abnormal Posturing (decorticate or decerebrate) should be present.
- Legal and medical significance:
 - Almost all physicians and jurisdictions recognize Brainstem Death = Somatic Death.
 - However, Cellular Death has Not Yet Occurred → organs may still be viable.
 - This is the foundation of Cadaveric Organ Transplantation.

TYPES OF DEATH

4. Brain Death

Decorticate vs Decerebrate

Decorticate posturing

Upper midbrain damage
Decorticate posture

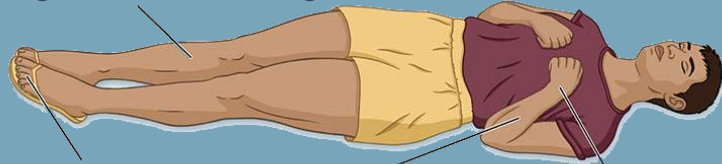


Rigid, Extended legs

Pointed and
turned in toes

Arms bent
toward center
of body

Curled wrists
and balled hands
against chest



Decerebrate posturing

Upper pontine damage
Decerebrate posture



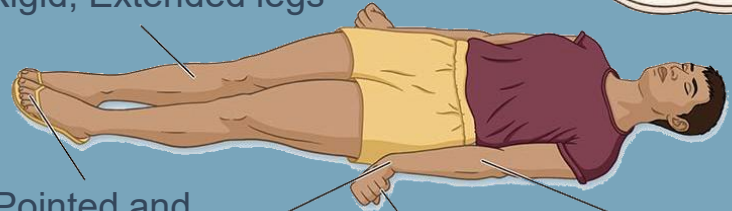
Rigid, Extended legs

Pointed and
turned in toes

Flexed
Wrists

Curled
Fingers

Straight, tense
arms parallel
to body



TYPES OF DEATH

4. Brain Death

D. Apparent Death (Suspended Animation)

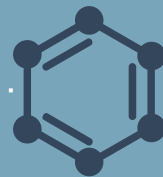
A **Reversible State** that mimics death, where Vital functions are severely depressed but **NOT Absent**.

- **Causes:**
 - Hypothermia, electrocution, drug overdose (barbiturates, opioids), drowning, sunstroke, head injury.
- **Diagnosis:**
 - Only Confirmed death should be declared using **ECG (asystole)** and **EEG (electrical silence)**, not by superficial examination.

Clinical pearl: “No one is dead until they are warm and dead” (especially in hypothermia).

03

Difference between Cause, Mode, and Manner



Difference between Cause, Mode, and Manner

Cause of Death

Definition

- Cause of death is the Disease, Injury, or Pathological Condition that Directly produces a Physiological Derangement leading to the *Death of the individual*.
- It is the Etiological Factor that starts the *Chain of events* resulting in death.

Cause of death ≠ mechanism of death.

- Cause: the disease/injury (e.g., myocardial infarction).
- Mechanism (Mode): the physiological/biochemical abnormality leading to death (e.g., arrhythmia, shock, hypoxia).
- **Manner of death** is different as well (e.g., natural, accident, suicide, homicide, undetermined).

Examples

Injury-related:

- Gunshot wound to the head → brain destruction → death.
- Stab wound to the chest → cardiac tamponade/hemorrhage → death.

Disease-related:

- Adenocarcinoma of the lung → widespread metastasis, respiratory failure → death.
- Coronary atherosclerosis → myocardial infarction → heart failure → death.

Difference between Cause, Mode, and Manner

Mechanism (Mode) of Death

Definition

- The **Physiological or Biochemical Abnormality** that occurs in the body **because of the Cause of Death** and Directly leads to death.
- It describes the **Final Common Pathway** by which the Cause **Exerts its Lethal Effect**.

Key Characteristics

- Secondary to the cause of death (e.g., myocardial infarction → arrhythmia → death).
- Non-specific on its own → many diseases or injuries can lead to the same mechanism.
- Should **Not** be listed as the Sole Cause of Death unless tied to an underlying pathology.

Examples

- **Coma** → caused by head injury, intracranial hemorrhage, or drug intoxication.
- **Congestive cardiac failure** → could result from ischemic heart disease, cardiomyopathy, or chronic hypertension.
- **Cardiac arrest** → final common endpoint of many causes (myocardial infarction, arrhythmia, trauma, hypoxia, etc.).
- **Pulmonary edema** → may follow acute myocardial infarction, poisoning, or renal failure.

Difference between Cause, Mode, and Manner

Manner of Death

Definition

- **Manner of Death** is the **Legal Classification** of the Circumstances under which Death Occurred.
- Unlike **Cause** (Etiology) and **Mechanism** (physiology), **Manner is Non-Medical** and is **Determined in a Medico-Legal or Forensic Context**.

Difference between Cause, Mode, and Manner

Manner of Death

Categories of Manner of Death

1. Natural

- Death due to disease processes or natural aging.
- Examples: Myocardial infarction from coronary atherosclerosis, stroke, cancer.

2. Accidental

- Death due to an unintended or unforeseen event.
- Examples: Motor vehicle collision, fall, accidental drug overdose, drowning.

3. Suicide

- Death as a result of a deliberate act by the deceased with the intention of ending life.
- Examples: Hanging, firearm self-inflicted wound, intentional overdose.

4. Homicide

- Death resulting from the **deliberate actions of another person**.
- *Legal note:* Homicide $\neq$ murder in medical terms. In forensics, “homicide” is a **neutral classification** meaning “death at the hands of another,” while the courts determine criminality (murder vs manslaughter).

5. Undetermined ($\approx$ 2–5% of cases)

When the available evidence is insufficient to classify death as natural, accidental, suicidal, or homicidal.
Example: Advanced decomposition, conflicting evidence, equivocal overdoses.

6. Pending Investigation

- Used provisionally when autopsy, toxicology, or further inquiry is required before a final determination can be made.

Just know the
categories without
the extra info

Difference between Cause, Mode, and Manner

Distinction

- **Cause of death** = what initiated the lethal process.
 - Example: Coronary atherosclerosis.
- **Mechanism of death** = How the cause produced death (pathophysiology).
 - Example: Ventricular fibrillation leading to cardiac arrest.
- **Manner of death** = classification of Circumstances under which death occurred.
 - Example: Natural, accidental, suicidal, homicidal, or undetermined.

Forensic Rule of Thumb :

- **Cause** tells us Why the person died.
- **Mechanism** tells us How they died.
- **Manner** tells us in What Context they died.



Difference between Cause, Mode, and Manner

Case Example

An individual is found dead with a gunshot wound to the chest:

Cause of Death:

Gunshot wound to the heart – the injury that directly produced the fatal physiological changes.

Mechanism (Mode) of Death:

Massive hemorrhage – the abnormal physiological state (severe blood loss leading to circulatory collapse) that resulted in death.

Manner of Death:

Depends on the surrounding circumstances:

- *Homicide* – if another person intentionally fired the weapon.
- *Suicide* – if the individual deliberately shot themselves.
- *Accident* – if the weapon discharged unintentionally (e.g., dropped or mishandled).
- *Undetermined* – if available evidence is insufficient to establish the circumstances.

04



Medico Legal Aspects

Medico-Legal Aspects of Death

Main Aims

The medico-legal investigation of death seeks to:

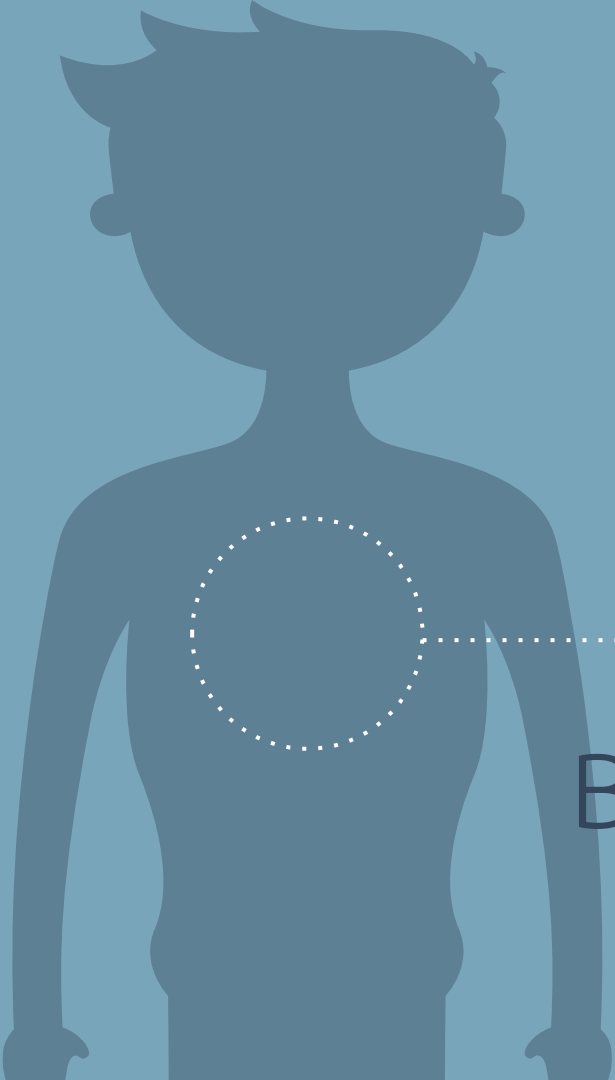
1. Establish the **identity of an unknown body**.
2. Determine the **Time of death** (postmortem interval).
3. Ascertain the **Cause of death** (disease, injury, or condition leading to death).
4. **Classify the Manner of death**:
 - **Natural**
 - **Unnatural**: Homicidal, Suicidal, or Accidental.

Medico-Legal Aspects of Death

Importance of Diagnosing Death (Medico-Legal Significance)

*Just know the
Highlighted yellow stuff*

1. To detect the **Cause of death** – essential for justice, public health, and medical accuracy.
2. To determine the **Time of death** – crucial in crime investigation and inheritance disputes.
3. For **Social reasons** – settling legal matters such as inheritance, insurance claims, and marital status.
4. For **Organ Donation** – ensuring accurate diagnosis of death (especially brain death) before organ retrieval.
5. To **Recognize Apparent Death** – differentiating true death from suspended animation (e.g., hypothermia, drug overdose).
6. For **Statistical reasons** – mortality records are essential for public health, epidemiology, and national databases.
7. For **Heritage and Succession reasons** – resolving legal matters such as transfer of property and lineage rights.

A dark blue silhouette of a person's upper body, including the head, shoulders, and arms. A dotted white circle is centered on the chest area. A horizontal dotted white line extends from the right side of this circle across the middle of the image.

05

Body Changes After Death

Body Changes After Death

Following death, the body undergoes a series of predictable changes. These changes occur in a sequence, Beginning at the Biochemical and Cellular level (Autolysis and Enzymatic Self-digestion) and progressing to **grossly visible alterations**.

Recognition of postmortem changes is crucial for:

- Know the Normal progress of Decomposition so that there is **No misinterpretation of normal changes for signs of an unnatural death.**
- Estimating the Postmortem Interval (PMI) – how long the individual has been dead.

Body Changes After Death

Timeline of Postmortem Changes

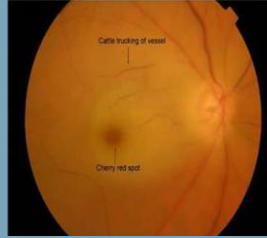
1. **Immediate Signs** (within minutes of death)
 - Permanent cessation of **respiration** and **cardiac activity**.
 - Loss of **consciousness** and **reflexes**
2. **Early** Postmortem Changes
 - Eyes, Pale skin, Muscles (primary flaccidity), Gastric relaxation of LES, and Regurgitation.
3. **Late** Postmortem Changes
 - Algor Mortis, Livor Mortis, Rigor Mortis.
4. **Very Late** Changes
 - Decomposition

Body Changes After Death

Timeline of Postmortem Changes

Early Postmortem Changes

- Eyes
 - Loss of corneal and pupillary light reflexes.
 - Mid-dilated Pupils; may be irregular (Anisocoria).
 - Loss of intraocular Tension (Soft Globe).
 - Retinal “trucking” or “shunting”: blood in vessels segments into columns.
- Eyelid
 - **Tache Noire**: If eyelids are Incompletely Closed, exposed sclera **Dries**, forming **Triangular Black Patches** on either side of the cornea.
- Muscles
- Skin
- Gastrointestinal Tract



TACHE NOIRE SCLEROTICA

Body Changes After Death

Timeline of Postmortem Changes

Early Postmortem Changes

- Eye
- Eyelid
- Muscles
 - **Primary Flaccidity:** complete loss of tone soon after death.
 - Muscles may remain briefly reactive to external stimulation for some hours after cardiac arrest.
 - Terminal Motor Neuron Discharges can cause **Focal Twitching**, which fades over hours.
 - **Sphincter Relaxation** → postmortem passage of urine and feces common postmortem phenomenon, useful in PMI estimation
- Skin
- Gastrointestinal Tract

Body Changes After Death

Timeline of Postmortem Changes

Early Postmortem Changes

- Eye
- Eyelid
- Muscles
- Skin
 - Pallor of skin, Mucous Membranes, and Conjunctiva due to the fall in blood pressure and cessation of circulation.
 - **Myth clarified:** Hair does Not grow after Death; beard may appear more prominent due to skin shrinkage.
 - **In Hypoxic/Congestive deaths:** face and lips may remain reddish or bluish.
- Gastrointestinal Tract

Body Changes After Death

Timeline of Postmortem Changes

Early Postmortem Changes

- Eye
- Eyelid
- Muscles
- Skin
- Gastrointestinal Tract
 - **Gastric Relaxation and Regurgitation:** gastric contents may be found in mouth or airways in ~25% of autopsies.
 - **Regurgitation** a **very common** feature of Terminal Collapse and it is a **common** complication of Resuscitation Attempts.

Caution: Regurgitated material **Does NOT** prove aspiration as cause of death unless confirmed by **Histology** or **Eyewitness accounts**.

Body Changes After Death

Timeline of Postmortem Changes

Late Postmortem Changes

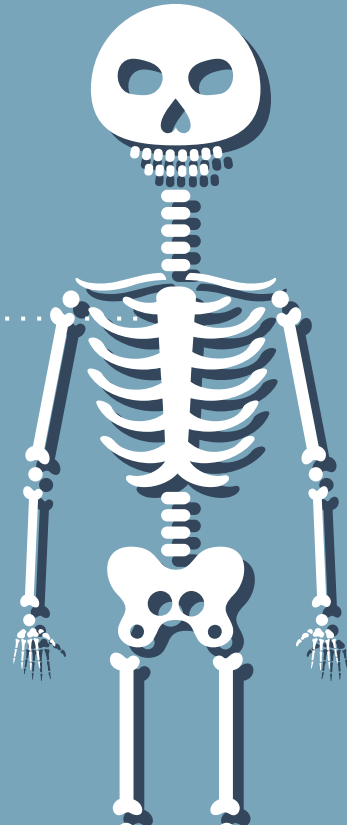
- **Algor Mortis** – cooling of the body.
- **Livor Mortis (postmortem lividity)** – gravitational settling of blood in dependent areas, visible as purplish discoloration.
- **Rigor Mortis** – stiffening of muscles due to ATP depletion and actin-myosin crosslinking.

Very Late Changes

- **Decomposition:** Putrefaction, Autolysis, and Bacterial Action Dominate.
- **Progression includes** Greenish discoloration of the abdomen, Bloating, Marbling of skin, Liquefaction of tissues, and Skeletonization over time.

06

Mechanisms of Algor
Mortis, Livor Mortis,
Rigor Mortis



algor mortis

coldness of death



Mechanism of Algor Mortis

Algor Mortis (Mechanism of Body Cooling)

After death, the body ceases to generate heat and loses the ability to regulate temperature. Consequently, body temperature gradually declines until it reaches equilibrium with the surrounding environment. This cooling process, known as **Algor Mortis**, is one of the most useful postmortem changes for estimating the time since death.

Normal Body Temperature

- Oral: 36–37.2 °C
- Rectal: 36.5–37.5 °C
- A rectal temperature below 24 °C is strongly suggestive of death.
- A rectal temperature below 21 °C is considered a certain sign of death.

Rate of Cooling

- Average Rate:
 - ~ 1 °C per hour in Summer
 - ~ 1.5 °C per hour in Winter
- The body temperature usually remains stable for about 1 hour postmortem, then begins to decline.
- Cooling is Not linear but follows a Progressive Curve.

Mechanism of Algor Mortis

Algor Mortis (Mechanism of Body Cooling)

Simple Formulas for Estimating Time of Death

Celsius method:

$$\text{Time since death (hours)} = \frac{37^{\circ}\text{C} - \text{Rectal temperature } (^{\circ}\text{C}) + 3}{\text{Cooling rate}}$$

Fahrenheit method:

$$\text{Time since death (hours)} = \frac{98.6^{\circ}\text{F} - \text{Rectal temperature } (^{\circ}\text{F})}{1.5}$$

 **Assumptions & Limitations:**

- Assumes the body temperature at death was normal.
- Assumes a constant rate of cooling (which is rarely true in reality).

Mechanism of Algor Mortis

Algor Mortis (Mechanism of Body Cooling)

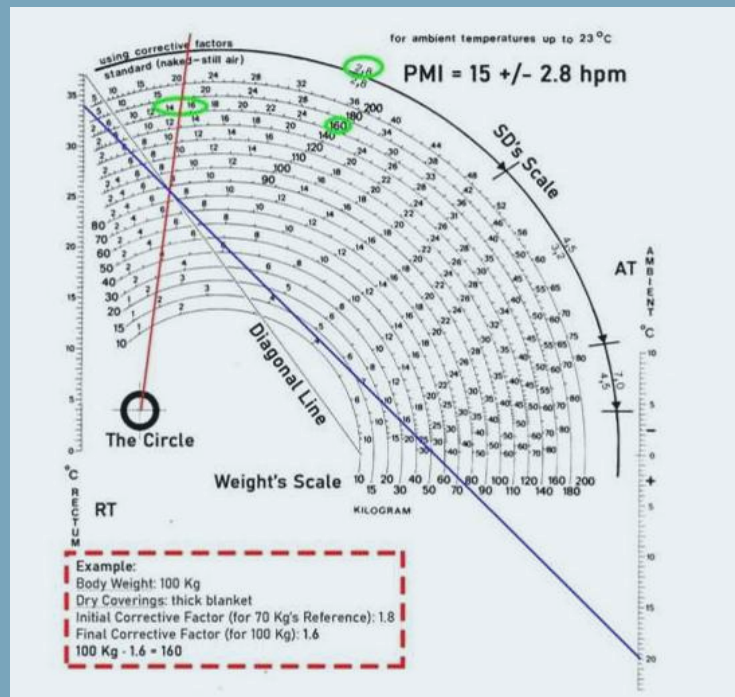
Henssge's Nomogram

The **Henssge Nomogram** is considered the Most Accurate Method for estimating the postmortem interval (PMI).

It takes into account:

- a. Body weight
- b. Rectal (core) temperature
- c. Ambient temperature

This method adjusts for environmental and individual factors, making it more reliable than linear formulas.



Mechanism of Algor Mortis

Algor Mortis (Mechanism of Body Cooling)

Variations in Body Temperature at Death

Low terminal body temperature:

- Cholera
- Prolonged exposure to cold
- Severe collapse or shock
- Congestive heart failure

High terminal body temperature:

- Carbon monoxide (CO) poisoning
- Coronary thrombosis
- Ruptured aortic aneurysm
- Heat stroke
- Pontine hemorrhage
- Severe infections (septicemia)
- Asphyxia
- Vigorous exercise before death

Mechanism of Algor Mortis

Algor Mortis (Mechanism of Body Cooling)

Factors Influencing Algor Mortis

1. Body Surface Area

- Large surface area (e.g., children, emaciated individuals) → Faster cooling.
- Edema may Slow cooling.

2. Body Weight

- Obese individuals → Slower cooling.
- Thin individuals → Faster cooling.

3. Clothing & Posture

- Heavy clothing retains heat.
- Spread-out posture increases heat loss.

4. Environment

- High humidity accelerates cooling.
- Air movement increases cooling rate.
- Cooling in **Water** is faster, especially in **Flowing water** compared to still water.

5. Infections

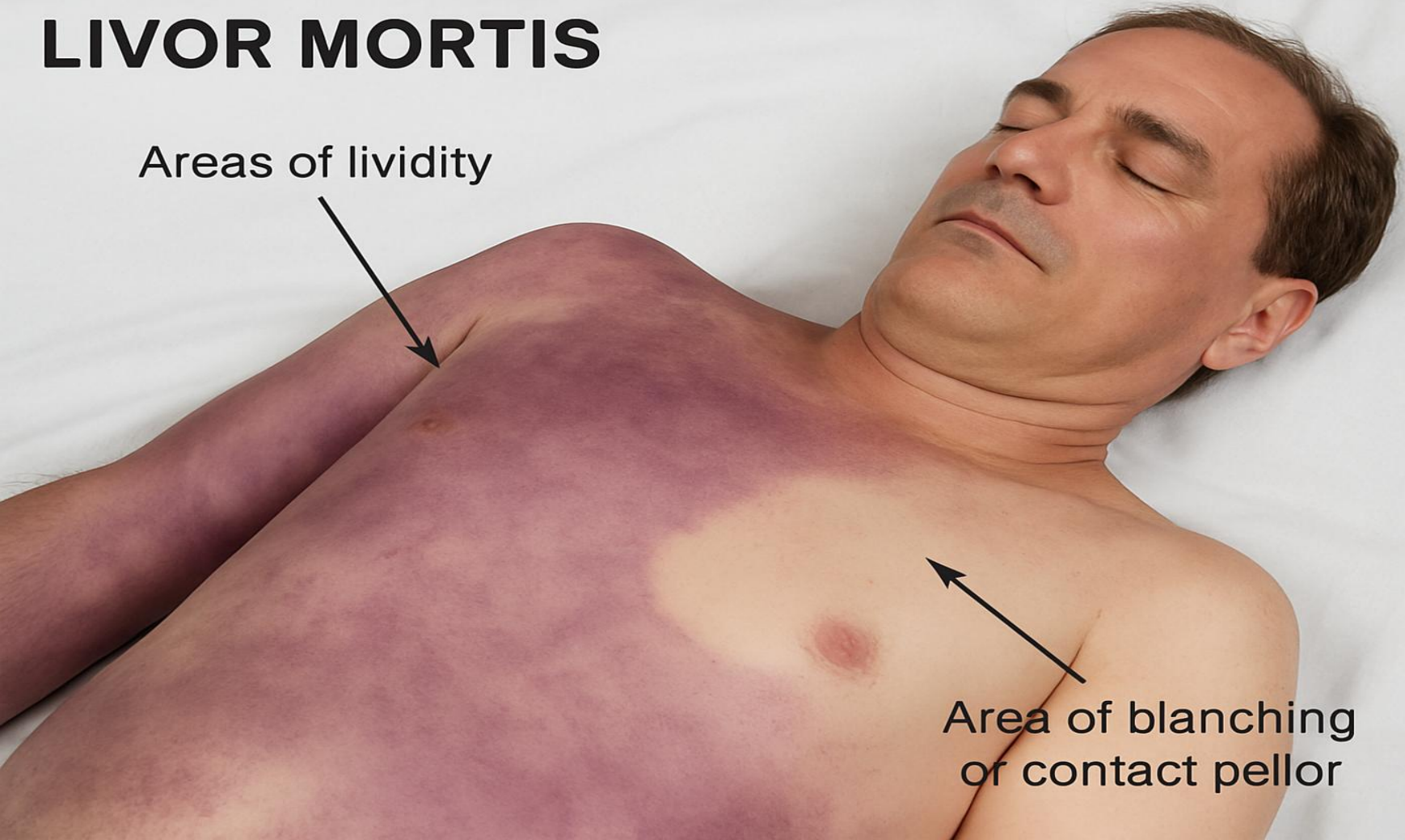
- In fulminant septicemia or systemic infections, body temperature may **rise for several hours after death**, delaying the onset of algor mortis.

LIVOR MORTIS

Areas of lividity



Area of blanching
or contact pector



Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

Livor mortis, also called **Hypostasis**, is the **Postmortem Settling of Blood** in the dependent portions of the body due to Gravity after the cessation of circulation. It is a key postmortem change used to confirm death and assess body position..

Mechanism

- After death, **Arterial Propulsion** and **Venous Return** Stop, and blood is No longer actively circulated through capillaries.
- Gravity acts on the Stagnant blood, causing **red blood cells** to settle in the Lowest Accessible Areas. The red cells are most affected, sedimenting through the lax network.
- **Plasma** also moves downward to a lesser extent, sometimes causing **Postmortem Dependent Edema**, which can contribute to **Early Postmortem Skin Blistering**.
- The Settling of Erythrocytes (RBC) under the skin produces a **Bluish-Red Discoloration**, visible as **Hypostasis**.
- Initially, Hypostasis appears as **Blotchy Patches**, later becoming more uniform in dependent areas.

Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

Distribution of Hypostasis

The pattern depends on **Body Posture at the time of death:**

Supine position:

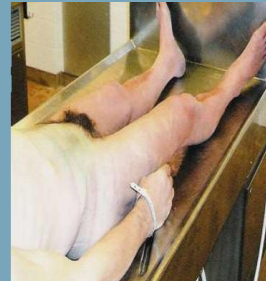
- Back of shoulders and neck (most common)
- Sometimes front of chest if congestive/cyanotic death

Prone position:

- Face-down areas (as in epilepsy), especially nose and lips whitening (drunken victims)

Vertical or hanging position:

Blood pools in feet, legs, and distal arms



Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

Internal Lividity

Hypostasis can also occur internally, sometimes mimicking pathology:

- **Heart:** may resemble myocardial infarction
- **Lungs:** may resemble pneumonia
- **Intestines:** may resemble hemorrhagic infarction



Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

Color Variations

The color of Hypostasis depends on **State of Oxygenation at death** and may be affected by **Skin Tone**, **Jaundice**, or **Dermatological Conditions**:

Colour	Cause
Dark Blue-Pink	Cyanide Poisoning
Brown	Methemoglobinemia
Cherry Pink	CO poisoning (carboxyhemoglobin/ Cold Temperatures)
Pale	Anemia, Hemorrhage (or Normal in Extremes of Age)

Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

Timing and Permanence

Hypostasis typically begins **30 minutes to Several hours after death**, it has no significant role in determining the time of death.

Duration Varies:

- Summer: **24–36 hours**
- Winter: **48 hours** or more
- Snow: **much longer**

Effect of Movement: If the body is moved, Hypostasis may:

- Remain fixed
- Move completely
- Partially move

Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

Medico – Legal importance

1. Sure sign of death
2. Assists in determining Cause of death
3. Indicates Body Position before and after death
4. Helps Determine if the body was moved after death

Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

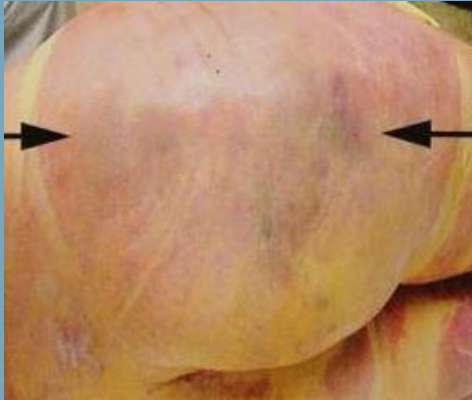
Differentiating Hypostasis from Bruises

Feature	Hypostasis	Bruises
Location	Dependent areas	Anywhere
Edges	Well-defined	ill-defined
Capillary involvement	Blood retained in intact capillaries	Blood escapes through ruptured capillaries
Surface level	Same level on skin	Raised
Color	Bluish-red	Red
Overlying pressure areas	Pale	—
Incision reaction	Blood flows from cut vessel (washable)	Blood coagulates in tissue

Mechanism of Livor Mortis

Livor Mortis (Hypostasis)

Differentiating Hypostasis from Bruises



Rigor Mortis



Mechanism of Rigor Mortis

Rigor Mortis

Rigor Mortis is a **Temperature-Dependent Physicochemical Change** that occurs in muscles after death, resulting in the **Stiffening of the body**. It develops because of **Oxygen Deprivation**, **ATP depletion**, and **Biochemical Changes in muscle fibers**.

- Rigor develops Uniformly throughout the body, but it is **first detected in smaller muscle groups** such as those around the eyes, mouth, jaw, and fingers.

Mechanism

After death:

1. **Respiration Ceases**, leading to Oxygen depletion.
2. **ATP production stops**, causing a Secondary Anoxic Process.
3. **Lactic Acid Accumulates**, lowering the pH of the cytoplasm (becomes more acidic).
4. Low ATP and Acidic Conditions cause **Actin and Myosin** to form rigid cross-bridges (**Actomyosin Complexes**).
5. Since ATP is required to break these cross-bridges, their **irreversible binding** results in **Persistent Muscle Contraction**—the **Hallmark of Rigor Mortis**.
6. As Decomposition progresses, **proteolytic enzymes** digest muscle tissue, leading to the resolution of rigor, known as **Secondary Flaccidity**.

Mechanism of Rigor Mortis

Rigor Mortis

Timeline of Rigor Mortis

- **Onset:** Start 2–3 hours after death (initiated when ATP falls to ~85% of normal).
- **First Appears:** in small muscle groups (eyes, mouth, jaw, fingers).
- **Fully developed:** within 6–12 hours.
- **Persists:** up to 36–48 hours.
- **Disappears:** in the same sequence it developed (Secondary Flaccidity).

Mechanism of Rigor Mortis

The decedent was found lying on his back with his head elevated under several pillows. He was in full rigor mortis



Mechanism of Rigor Mortis

Rigor Mortis

Factors Affecting Rigor Mortis

1. Environmental Temperature

- a. Cold and wet climates: slow onset, long duration (up to 48 hours).
- b. Hot and dry climates: rapid onset, shorter duration (24–36 hours).

2. Muscular Activity Before Death

- a. Rested muscles: slow onset, prolonged duration.
- b. Exhausted/fatigued muscles: rapid onset, shorter duration.
- c. Convulsions, electrocution, or intense activity: rapid onset and short duration.

3. Age

- a. Infants and Elderly: rapid onset.

4. Health

- a. Emaciated or Debilitated individuals: delayed or weak rigor.

5. Toxic and Pathological Factors (Others)

- a. Strychnine Poisoning: accelerates rigor due to convulsions.
- b. Fulminant infections: may alter onset due to metabolic changes.

Mechanism of Rigor Mortis

Rigor Mortis

Estimated Time of Death

(Based on Rigor and Temperature)

Body Temperature	Muscle Tone	Estimated Time Since Death
Warm	Flaccid	< 3 hours
Warm	Stiff	3–8 hours
Cold	Stiff	8–36 hours
Cold	Flaccid	> 36 hours

Mechanism of Rigor Mortis

Rigor Mortis

Localized Manifestations of Rigor Mortis

1. **Iris:** May cause Unequal Pupil Size (Anisocoria).
 2. **Heart:** Stiffening of the left Ventricle may mimic **Hypertrophy**.
 3. **Dartos Muscle of Scrotum:** Constriction Testes and Epididymis can cause apparent Expulsion of Semen (Rigor Dartos).
 4. **Erector Pili Muscles of Hair:** Cause "Goosebumps" and hair erection.
- **Note:** When testing rigor mortis, best test is to apply gentle pressure across a joint using one or two fingers. Excessive force may "break" rigor, making further evaluation unreliable.



Mechanism of Rigor Mortis

Rigor Mortis

Conditions Resembling Rigor Mortis

1. Heat stiffness:

Exposure of a body to Intense Heat (Burning, High Voltage Electrocution, etc.)-> Coagulation of Muscular Proteins Muscular Shortening.

2. Cold stiffness:

Exposure of the body to Extreme Cold ($< -5^{\circ}\text{C}$)-> solidification of subcutaneous fat and muscles, Freezing of Synovial Fluid in Joints.

Mechanism of Rigor Mortis

Cadaveric Spasm

Cadaveric spasm (also called *Instantaneous Rigor, cataleptic rigidity*) is a rare phenomenon involving immediate stiffening of muscles at the moment of death, persisting until regular rigor mortis develops.

Characteristics:

- **Onset:** Instantaneous at death.
- **Duration:** A few hours, replaced later by rigor mortis.
- **Cause:** Uncertain, but associated with Sudden Violent Deaths, often accompanied by intense emotion or physical activity.
- **Typical sites:** muscle groups (hands, forearms).



Forensic Significance:

Seen in **Drowning Victims**, where grass, weeds, or debris are clutched in the hands—indicating the victim was alive upon entering the water.

May preserve the Final Act or Gesture before death, thus carrying high Forensic value.

Cadaveric Spasm demonstrates the last activity one did prior to death and is therefore significant in forensic investigations

Mechanism of Rigor Mortis

Rigor Mortis vs Cadaver Spasm

Feature	Rigor Mortis	Cadaveric Spasm
Onset	Delayed (2–3 hours postmortem)	Immediate at death
Duration	Up to 36–48 hours	Few hours, until replaced by rigor mortis
Intensity	Moderate	Very strong
Mechanism of Formation	ATP depletion below critical level	Unknown (linked to emotion and muscle contraction at death)
Distribution	All muscles, gradually	Selected muscles which were active at time of death

07

Decomposition



Decomposition

Decomposition

Definition:

Decomposition is the postmortem process by which the body undergoes progressive destruction and disintegration of tissues. It involves both Autolysis (self-digestion by intrinsic enzymes) and Putrefaction (destruction by external microorganisms such as bacteria and fungi).

Decomposition is influenced by multiple factors—the Environment, Body Condition, Cause of death, and Local Flora and Fauna. It may progress differently from one body to another, or even between different regions of the same body.

Animal activity, from maggots to larger scavengers, also contributes to tissue destruction.

Types of Decomposition

1. Putrefaction
2. Adipocere formation
3. Mummification
4. Skeletonization

Decomposition

Decomposition

Types of Decomposition

Putrefaction

Putrefaction is the Normal and Final Stage of Death that begins at the cellular level immediately after death and becomes Visibly apparent within 48–72 hours.

It results from two main processes:

a) Autolysis

- Caused by digestive enzymes released from cells after death.
- Accelerated by Heat, slowed by Cold, and Halted by freezing or destruction of enzymes by high temperatures.
- Organs rich in enzymes (e.g., pancreas) autolyze faster than those with fewer enzymes (e.g., heart).

b) Bacterial Action

- Bacteria, primarily from the bowel (notably Clostridium species), invade tissues and cause fermentation and liquefaction.
- The First visible sign of putrefaction is a Green or greenish-red discoloration of the Right iliac fossa (due to intestinal bacterial activity).
- This typically appears within 24–36 hours, followed by Generalized Bloating at 60–72 hours.

Decomposition

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Types of Decomposition

Putrefaction (Cont.)

Progression of Putrefaction:

1. Early formation of yellowish, clear fluid-filled blisters that later turn green-brown and turbid.
2. Marbling: Bacterial decomposition of hemoglobin in superficial vessels produces branching brownish discoloration along vascular pathways.
3. Skin Slippage: Epidermis separates from the dermis, forming fluid-filled blisters that eventually rupture.
4. Gas formation: Internal gas buildup causes swelling of the Face, Abdomen, and Genitals.
5. Purge fluid: As internal pressure increases, blood-tinged fluid is forced out of the mouth and nose.
6. Within approximately One Week, the body cavities rupture, and tissues begin to liquefy and seep into the ground.

Order of Putrefaction of Organs:

1. Brain and Epithelial Tissues (Earliest affected)
2. Heart, Uterus, and Prostate (Most Resistant)

As decomposition proceeds, organ weight decreases due to tissue liquefaction and drainage.



Decomposition

Decomposition

Types of Decomposition

Adipocere Formation

Adipocere (also known as “Grave Wax”) results from the Hydrolysis and Hydrogenation of body fat, converting it into a Waxy, Soap-like compound. Moisture is essential for this process.

Optimal Conditions:

- Warm, moist environment (body’s own water may suffice).
- Bacterial activity, especially *Clostridium perfringens*.

Sites of Occurrence:

- Common in Subcutaneous Fat of the cheeks, breasts, and buttocks.
- May also develop in Internal Organs such as the liver, kidneys, and heart.
- Usually forms over Weeks to Months, often **partially**.

Stages of Adipocere Formation:

1. **Early:** Pale, greasy, semi-fluid material with a rancid odor.
2. **Intermediate:** Becomes more brittle and whitish.
3. **Fully formed:** Grey, firm, waxy substance that retains the body’s shape.

Medico-Legal Importance:

- a) Preserves body features, facilitating **identification** after long intervals.
- b) May help in **determining cause of death**.
- c) Indicates a **postmortem interval (PMI)** of at least **several weeks to months**.



Decomposition

Decomposition

Types of Decomposition

Mummification

Mummification occurs when a body is exposed to **Dry, Warm conditions** that **cause** **Rapid Desiccation of tissues** rather than putrefaction.

Mummification Features:

- The body becomes **Dry, Shriveled, and Leathery**, with a Brownish Discoloration.
- **No Bacterial Growth** occurs due to the absence of moisture.
- Often Partial, affecting exposed regions.

Medico-Legal Importance:

- The cause of death may still be determined.
- Deep tissue Pathology can often remain identifiable.
- Indicates Dry, Hot Environmental Exposure for an extended period.

Decomposition

Decomposition

Types of Decomposition

Skeletonization

Skeletonization is the **Final Stage of Decomposition**, where Soft tissues are lost, leaving only the skeletal remains.

Timeline (approximately) :

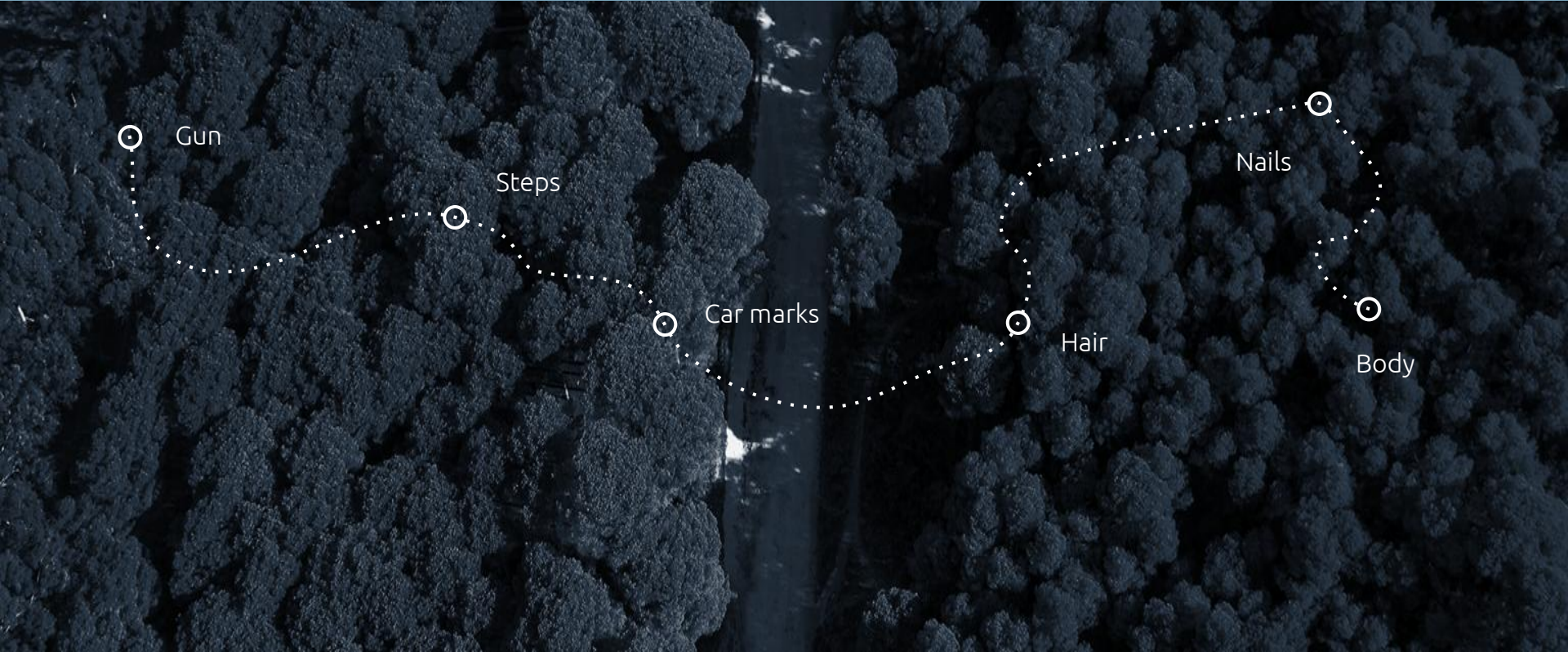
- **12–18 months:** Most Soft tissues absent.
- **3 years:** Bones exposed and disarticulated.
- **40–50 years:** Bone surfaces become Dry, Brittle, and Marrow Cavities Empty.

Environmental Influence:

- The **Environment** is more crucial than time.
- In **Temperate Zones**, bones may remain solid for years, and **Bone Marrow** in long bones can persist, allowing for **DNA analysis** even long after death.

08

Determination of Time of Death



Determination of Time of Death

1. **Core Body Temperature:** the best and the most used
2. **Rigor Mortis.**
3. **Hypostasis:** complete **after 6 hours.**
4. **Chemical changes in Vitreous.**
5. **Eye Pressure:** eyeballs become softer, and less fluid pressure **in the first 3 hours.**
6. **Gastric Emptying:** depend on Type of meal and Emotional status.
7. **The Entomology of Dead:** studying insects & their maggots which infest the dead body for estimating the probable time of death. Different types of insects infest the dead body at different stages after death occurs.
8. **Scene Markers:** though unscientific, it is often more accurate than determinations made by scientific means.

- Uncollected mail or newspapers.
- Whether the lights are on or off.
- How the individual is dressed.
- Any food that is out or dirty dishes in the sink.
- Sales receipts or dated slips of paper in the deceased's pockets.
- When the neighbor's last saw the individual or observed a change in his habits.



Thank You

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