Thanatology

- Thanatology (Greek *thanatos*: death) is the scientific study of death in all its aspects including its cause and phenomena. It also includes bodily changes that accompany death (postmortem changes) and their medico-legal significance.

- *Death occurs in two stages:*

i. Somatic, systemic or clinical.
ii. Molecular or cellular.

- **Somatic death:** The question of death is important in resuscitation and organ transplantation.

- **Skin and bone** remains metabolically active for many hours and these cells can be successfully cultured days after somatic death.

- During early 20th century, irreversible cessation of circulatory and respiratory functions was sufficient basis for diagnosing death

- **Molecular death** occurs Initial changes occur due to metabolic dysfunction and later from structural disintegration.

- Nervous tissues die rapidly, the vital centers of the brain in about 3–7 minutes (min), but muscles survive upto 1–2 hours (h)

Differentiation 8.1: Somatic death and molecular death[3,4]

S.No.	Feature	Somatic death	Molecular death
1.	Definition	Complete and irreversible cessation of function of brain, and stoppage of the circulation and respiration	Progressive disintegration of body tissues with death of individual tissues and cells
2.	Onset	Precedes molecular death	Succeeds somatic death (1–2 hours after stoppage of vital functions)
3.	Tissues and cells of body	Alive and functioning	Dead and non-functioning with no metabolic activity
4.	Response to external stimuli	Muscle responds to thermal, electrical or chemical stimulus	Does not respond
5.	Confirmation	Flat ECG and EEG, and absent breath sounds	Rigor mortis, algor mortis, postmortem staining, putrefaction
6.	Resemblance	Suspended animation, coma, hypothermia	Does not resemble any condition

- Cornea can be removed from the dead body within 6 h (opacity occurs within 2 h of death, but the changes are reversible),
- skin in 24 h, bone in 48 h
  and blood vessels within 72 h for transplantation. Kidneys within 45 min,
- heart within 1 h,
- Lungs and liver within 15 min.

Types of transplants

- **Autograft**: Tissue transplanted from one part of the body to another in the same individual. It is also called *autotransplant or homologous transplantation*.

- **Allograft**: Organ or tissue transplanted from one individual to another of the same species with a different genotype. It is also called *allogeneic graft* or *homograft*

- **Isograft**: Organs or tissues are transplanted from a donor to a genetically identical recipient (such as an identical twin).

- **Xenograft**: Organs or tissue transplanted from one species to another, e.g. grafting of animal tissue into humans.

- **Split transplants**: Deceased-donor organ (specifically the liver) may be divided between two recipients, especially an adult and a child.

Cause, Mechanism of Death

Cause of death is any injury or disease producing physiological derangement, briefly or over a prolonged period and which results in the death of the individual, e.g. a gunshot wound to the abdomen, a stab wound to the chest, adenocarcinoma of the lung or coronary atherosclerosis.

Mechanism of death is the physiological derangement produced by the cause of death that results in death, e.g. hemorrhage, septicemia, metabolic acidosis or alkalosis, ventricular fibrillation or respiratory paralysis.

- **A particular mechanism of death can be produced by multiple causes of death and vice versa.** Thus, if an individual dies of hemorrhage, it can be produced by a gunshot wound or a stab wound or a malignant tumor of the lung eroding into a blood vessel. A cause of death, e.g. a gunshot wound of the abdomen can result in many possible mechanisms of death, like hemorrhage or peritonitis

Manner of death

Manner of death explains how the cause of death came about. Manner of death can generally be categorized as natural (death due to disease), homicide, suicide, accident or undetermined.

- **A cause of death may have multiple manners of death.** An individual can die of massive hemorrhage (mechanism of death) due to stab wound of heart (cause of death), with the manner being homicide (someone stabbed him), suicide (stabbed himself), accident (fell over the weapon) or undetermined (not sure what happened).

- For some deaths, the manner may be undetermined because the circumstances are unclear; for e.g. whether drowning was accidental or suicidal.

- Deaths from alcohol and drug abuse are difficult to classify and are sometimes described as 'unclassified'.

- **Agonal period** is the time between a lethal occurrence and death.

Flow chart 8.1: Manner of death

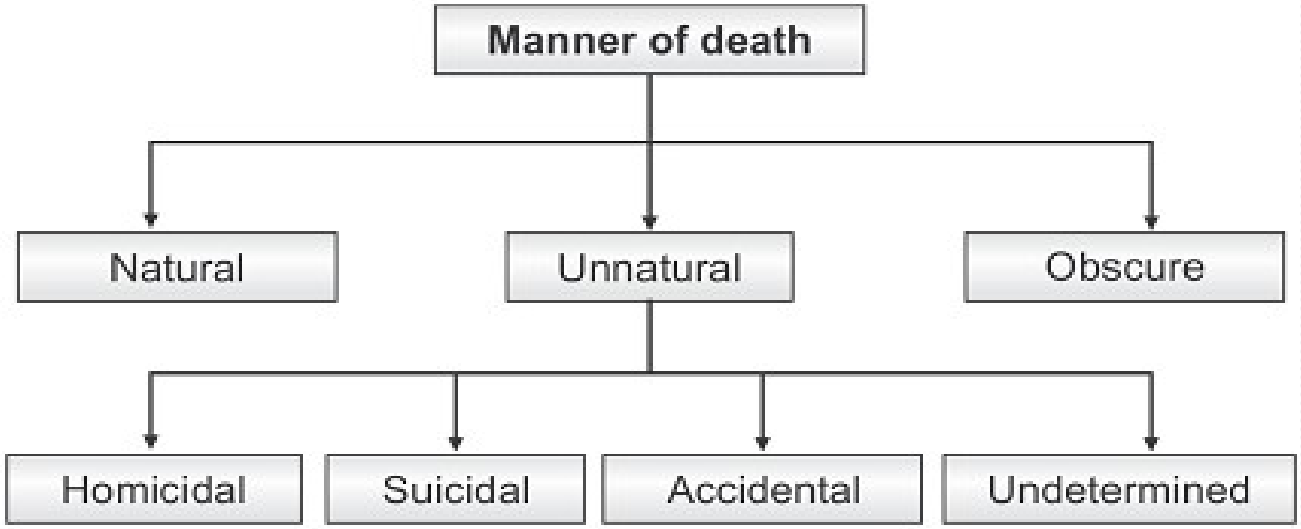

Table 8.1: Description of manners of death

Manner	*Definition*
Natural	Death resulting from disease
Homicide	Death resulting from the deliberate action of another
Suicide	Death intentionally self-inflicted
Accident	Death as a result of an environmental influence

Table 8.2: Cause, mechanism and manner of death

Cause of death	*Mechanism of death*	*Manner of death*
• Hemoperitoneum, as a consequence of – Laceration of the aorta, as a consequence of – Blunt thoracic trauma	Hemorrhagic shock	Accident
• Bronchopneumonia, as a consequence of – Stab wound of thorax	Septicemia	Homicide
• Cardiac tamponade, as a consequence of – Gunshot of thorax	Cardiac dysrhythmia	Homicide

Anoxia

- Anoxia means complete lack of oxygen, which ultimately leads to cardiac failure and death.

- (The term ‘hypoxia’ is used commonly, which is shortage of oxygen in blood.

- *Anoxia is classified into four types:*

1. Anoxic anoxia
2. Anemic anoxia
3. Histotoxic anoxia
4. Stagnant/ischemic anoxia

Anoxia

Anoxic anoxia It occurs due to defective oxygenation of blood in the lungs and may be due to:

- Breathing in a rarefied atmosphere, as in high altitude climbing or fling, or inhalation of carbon dioxide or sewer gas.
- Mechanical interference to the passage of air into the respiratory tract, e.g. smothering, hanging, strangulation, throttling, gagging, choking or drowning.
- Prevention of normal movements of the chest, e.g. strychnine poisoning or traumatic asphyxia.
- Cessation of the respiratory movements, as in paralysis of the respiratory center, e.g. electric shock and bulbar palsy, or poisoning with morphine or barbiturates.

Anoxia

Anemic anoxia: It occurs due to reduced oxygen carrying capacity of the blood, **e.g. hemorrhage, poisoning by carbon monoxide or nitrites**.

Histotoxic anoxia: It means inhibition of oxidative processes in the tissue which cannot make use of oxygen in the blood, e.g. **cyanide poisoning**.

Stagnant/ischemic anoxia: In this type, impaired circulation results in reduced oxygen delivery to the tissues, **e.g. shock, congestive cardiac failure or heat stroke.**

Signs of Death
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The accurate determination of time of death is important due to its role in explaining possible criminal acts and determination of appropriate civil repercussions.

The changes which occur after death that are helpful in estimation of the approximate time of death (and to differentiate death from suspended animation) can be classified into :

- Immediate changes (Somatic Death)
- Early changes (Molecular Death)
- Late changes (Decomposition & Decay)

Table 9.1: Changes after death

Immediate changes[1]	*Early changes*	*Late changes*
Irreversible cessation of:	• Loss of elasticity of the skin, and facial pallor	• Putrefaction
• Function of brain	• Primary relaxation of the muscles	• Adipocere formation
• Circulation	• Contact pallor and flattening	• Mummification
• Respiration	• Changes in the eye	
	• Algor mortis	
	• Livor mortis	
	• Rigor mortis	

Immediate Changes (Somatic Death)

A. Irreversible cessation of the function of brain including brainstem.

B. Irreversible cessation of respiration

C. Irreversible cessation of circulation

Immediate Changes (Somatic Death)

A. Irreversible cessation of the function of brain including brainstem:

- This is the **earliest** sign of death with stoppage of functions of the nervous system. There is insensibility عدم ادراك , and loss of both sensory and motor functions. There is loss of reflexes, no response and no tonicity of the muscles. Pupils are widely dilated.

This condition is sometimes seen in:

- ✓ Prolonged fainting attack
- ✓ Vagal inhibitory phenomenon
- ✓ Epilepsy, mesmeric trance, catalepsy, narcosis or electrocution.

Immediate Changes (Somatic Death)

B. Irreversible cessation of respiration:

Complete stoppage of respiration for > 4 minutes (min) usually causes death. The stoppage of respiration can be established by the following tests:

- ✓ Inspection: No visible respiratory movement.
- ✓ Palpation: No respiratory movement can be felt.
- ✓ Auscultation: Breath sounds cannot be heard from any part of the lungs.
- ✓ Feather test, mirror test and Winslow's test are no longer utilized.**

Respiration may stop briefly without death as in:

- ✓ Voluntary breath holding
- ✓ Drowning
- ✓ Cheyne-Stokes respiration***
- ✓ Newborns

Immediate Changes (Somatic Death)

C. Irreversible cessation of circulation:

Stoppage of heart beat for > 3–5 min is irrecoverable and results in death.

The following tests may be performed to test circulation:

- ✓ Radial, brachial, femoral and carotid pulsations will be absent, if the circulation has stopped.
- ✓ *Auscultation of heart:* Absence of the heart beat over the whole precordial area and particularly over the area of the apex.
- ✓ *ECG:* In case of cessation of circulation, the ECG curve is absent and the tracing shows a flt line without any elevation or depression.
- ✓ *Other tests:* Various tests, like diaphanous, magnus, I-card, pressure, cut and heat tests are now obsolete. **

Early Changes (Molecular Death)

A. **Changes in the skin and facial pallor**

B. **Primary relaxation or flaccidity of the muscles**

C. **Contact flattening and pallor**

D. **Changes in the eye**

E. **Cooling of the Dead Body (Algor Mortis)**

F. **Postmortem Staining (Livor Mortis)**

G. **Rigor Mortis**

Tache noire (French, black line): If the eyelids remain open for 3–4 h after death, there is formation of two yellow triangles (base on the limbus, apex at the lateral or medial canthus and sides are formed by the margins of the upper and lower eyelids) on the sclera at each side of the iris, which become brown and then black.

- **Cause:** Drying/desiccation, and deposition of cellular debris, mucus and dust on the exposed conjunctiva and the sclera underneath.

- *Changes in the retina:* The blood in retinal vessels appears fragmented or segmented **(cattle trucking or shunting)** within seconds to minutes after death, and persists for about an hour (**Kevorkian sign**). This occurs all over the body due to loss of blood pressure, but it can be seen only in retina by an *ophthalmoscope*.

Algor Mortis

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