

DEATH & PM CHANGES

Definition:

Death is the one inevitable event in everyone's life. Until recently medical dictionaries defined death as the cessation of life. Emphasis was placed on the cessation of respiration and cardiovascular function, but it was expected that all systems would fail quickly after one of the "vital functions" had stopped this unified concept of death remained unchallenged until quite recent times when medical care advances had made it possible to maintain some of the "vital functions" of a patient but not all.

The whole body does not die simultaneously except in the rare event of cataclysmic incineration, perhaps in a nuclear explosion. Therefore, somatic death must be differentiated from cellular death.

- **Somatic Death**: irreversible failure of the organism as an integrated mechanism.
- **Cellular Death**: Cessation of respiration & metabolism of the body tissues, which is soon followed by autolysis.

Diagnosis & Early PM Changes :

A) Traditional Signs Of Death: *Diagnosis of death based on :*

1- Permanent cessation of both circulation and respiration:

- Death defined as the complete and persistent cessation of both circulation and spontaneous respiration for at least 5 min..
- Absent Palpation of the pulse.
- Absent Auscultation is a more reliable method.
- Electrocardiography, if available, will settle the diagnosis by flat ECG.
- Cessation of spontaneous breathing.

2- C.N.S: Flat E.E.G and must be repeated to exclude barbiturate coma.

3- Ocular Changes:

- Pupils fail to react to light , the eye balls rapidly become soft due to loss of intraocular tension and, of course, the corneal reflex is immediately lost.
- If the retina can be viewed with an ophthalmoscope , the columns of blood in the vessels may be seen to be broken up into segments called "trucking".
- Loss of intraocular tension; during life the tension vary between 14-25g, when heart ceased to beat the tension felt not exceed 12g, within 1/2h the tension reduced to 3g, at end of 2h it was nil.

4- Primary flaccidity and contact flattening: -

- Immediately after death, the body undergoes a condition of loss of muscular tone resulting in flaccidity. This is termed "primary" to distinguish it from the "secondary flaccidity" which flows the disappearance of the body stiffness, one or two days after death.
- The elasticity of the muscles is lost too, resulting in the flattening of the convex parts of the body on pressure "contact flattening".
- This is to be seen in the buttocks, shoulders and calves of the dead body kept in the supine position. it may be used as available indication of alteration of the position of the body after death , as in case a dead body is hanged sometime after death to stimulate suicide.

B) Early Changes After Death: (Sure Signs Of Death)

When cardiorespiratory function fails, the collapse of blood pressure and supply of oxygenated blood to the brain leads to complete loose of cerebral function unconsciousness is accompanied by cooling of the body, hypostasis, and rigor mortis.

1- Cooling Of The Body:

Following death, heat production stops, and body starts to loss temperature to surroundings.

- The rate of cooling will vary under the influence of the following factors: -
 1. The atmospheric temperature or rather the difference between this and the body temperature at the moment of death.
 2. The surrounding of the dead body also affect this rate to great extent.
 3. The surface area of the body in the relation to its weight: it is well known that bodies of infants cool faster than these of adults.
 4. The subcutaneous fat: fat bodies as obese females lose their heat more slowly.
 5. The cause of death.

2- Hypostasis (P.M. Lividity):

Definition:

- Pink or bluish discoloration of the body skin caused by the cessation of circulation. The flowed blood begins to gravitate down the dependent veins and capillaries, thus causing this filled up with blood. Although the gravitation of blood starts immediately after the stopped of the circulation the staining in the skin starts to appear only one or two hours later when a good amount of the veins and capillaries are filled with blood. The blood continues to gravitate inside the vessels till the force of gravity cannot exert any other visible effect on it, & to 10 hours later.

The amount And Extent Of Hypostasis: depend on:-

- 1- The amount of blood left in the circulation after death, therefore, hypostasis is least marked in cases of death from loss of blood or haemorrhage. And most extensive in cases of death from congestive heart failure.
- 2- The period of fluidity: in death from asphyxia, blood remains fluid for more time.
- 3- The colour of hypostasis: pale in hemorage, red in CO, cyanide and cold exposure, brown in meth-HB.

D.D. of Hypostasis & Bruise.

Hypostasis	Bruise
Only present in dependent parts of the body or front of neck	May occur any where in the skin.
Covered with intact skin.	Usually skin shows abrasions

Absence of well marked edges or swelling.	Accompanied by swelling and having well marked edges.
Only showing one color.	May show a play of colors.
Caused by fluid blood that comes it by cutting over it.	Blood firmly clotted in the tissues.
Can be washed under the tap after cutting.	Can not be washed due to firm clotting of blood.

The Distribution of Hypostasis:

Depends on the position of the body at time of death and for some time after wards. In most dead bodies kept in supine position, hypostasis occur on the back, sparing only the points of pressure e.g. shoulder buttocks, calves

It also found in viscera and internal where it may be mistaken for antemortem congestion of these organs.

In bodies dying in water or even those thrown into the water shortly after death, hypostatic coloration occurs in the face, shoulders and front parts of chest, because the body usually floats on water prone with the head lower most.

Hanged bodies or those suspended shortly after death show the lividity most marked in lower limbs, forearms and lower parts of the abdominal wall.

MLI:

Changing the position of the body a short time after death is usually accompanied by changes in the distribution of hypostasis corresponding to the new position . But if these change is made after full formation of lividity, it can't change from its first distribution .

3- Rigor mortis or (P.M. Rigidity):

Most dead bodies become stiff at a variable time after death, this latter passing off to allow secondary flaccidity.

The Physicochemical Basis:

It is due to an irreversible combination of actin and myosin within skeletal, cardiac and involuntary fibres.

Rigor mortis starts to appear about 2 hrs after death & gradually spreads till it completely stiffens all body musculature in about 12 hrs about 24 hrs after death the body rigidity gradually gives way to secondary flaccidity which appears in the same order of appearance of rigor.

Factors Affecting R.M.:

1- Effect of Temperature:

The lower the atmospheric temperature the slower is the onset of rigor and the more prolonged is its duration. This goes on till the temp reaches about 3-5°C rigor mortis is completely inhibited. If temp drops still lower, the body shows another form of rigidity due to freezing.

Exposure of the body to a very high temp also hinders or prevents the occurrence of rigor. It is replaced by another form of stiffening "heat stiffness".

2- Effect of Muscular Development:

Rigor is more rapid in onset and lasts for a shorter duration in the less developed body musculature e.g. infants , females , aged individuals , debilitated bodies .

3- Effect of Muscular Activity:

Rigor is more rapid in onset and lasts for a shorter duration in bodies dying after muscular activity than bodies dying at rest.

N.B.:

1. *Rigor mortis usually fixes the position of the body at the time of death or a short time after word.*
2. *Rigidity affects involuntary muscular tissue and the heart in the same way as voluntary muscles .*

Cadaveric Spasm:

It is a special form muscle stiffness usually accompanied by severe mental & nervous excitation which occurs only in some types of death, It affects some groups of muscles. The stiffness occurs as a continuation of the active muscular contraction during life .

A man holding an automatic pistol and firing at his own head , Keeps his hold on the pistol after death until secondary flaccidity sets in. In rare cases cadaveric spasm may affect the majority of the body as in cases of death , during the wars .

The never occurs in the heart, nor does it affect the involuntary muscles of the viscera which always show the stage of primary flaccidity.

Its medico legal important, it records the last act of life, the presence of cadaveric spasm in hands of the body extracted from water causing them to be firmly clenched on some aquatic weeds or mud is taken to be sure sign of death by drowning .

R.M.	Cadaveric spasm
Found in all dead bodies.	Found only in some types of death.
2- Affects all voluntary involuntary and cardiac muscles.	2- Affects only some group of voluntary muscle.
3- Sets in some time after death and gradually spreads in the body.	3- Starts immediately with the occurrence of death in its full form .

C) Late Post Mortem Changes: (Post Mortem Decomposition):

1- Putrefaction:

This is the terminal changes that take place in the dead body. It comprises the total decomposition of the organic material in soft tissues, their transformation into liquid substances & evaluation of a mixture of gases.

It is due to activity of different types of microorganisms which were present in the dead body at the moment of death or reached the body after death from surrounding atmosphere. Large volumes of various gases are evolved, the main ones being, hydrogen, methane, sulphurated & phosphoretted hydrogen, CO₂ and ammonia, some of these have an offensive putrid odour.

The earliest external appearance of putrefaction starts about 24 hrs after death in summer while in winter they may only appear after 1½ to 2 days. Then the greenish discoloration appears in the skin of the anterior abdominal wall opposite the right iliac fossa.

Factors Modifying The Rate Of Putrefaction:

- 1- **Environmental temperature:** Optimal temp, 21-28°C and is retarded when temp falls below 10°C or when exceed 38°C .
- 2- **Air:** most putrefactive organisms are aerobic, thus the process is delayed in bodies submerged under water, and bodies kept in sealed, coffins as Christian do.
- 3- **Moisture:** putrefaction accelerated in oedematous bodies and delayed in dehydration.

- 4- **Bloody organs** : as liver rapidly putrefies , The gravid uterus putrefies more rapidly than non gravid uterus as the blood is a good media for growth of organisms .
- 5- **Newly born infants** putrefy slowly(few intestinal organisms).
- 6- **The Cause of death**: in septicaemia putrefaction is rapid while in arsenic poisoning putrefaction delayed due to dehydration and arsenic hinder the growth of bacteria.

The putrefaction is replaced by other PM changes as mummification. adipocere formation, and maceration.

2- **Mummification**:

In dry hot weather especially aided by currents of dry air as in desert, will prevent bacterial decomposition and thus prevent putrefaction. A progressive drying of tissue resulting in leathery hardening and shrivelling and the skin become tight over the bone. Moulds, Moths, and Beetles may hasten the powdery disintegration of the tissues.

▪ **MLI**:

- 1- The body can be identified for many years after death .
- 2- The estimation of time pass since death can be estimated by the extent of dryness and shrinkage of tissue .
- 3- The cause of death can be known .

3- **Adipocere Formation**:

It is a post-mortem condition which replace the putrefaction in case of long submersion under water. The non saturated body fat {Palmitic, oleic}⇒ Hhydrogenation ⇒ Saturated {stearic} fats which bind to ca to form adipocere occurs instead of putrefaction. The resulting material named adipocere is a stable yellow greasy material with characteristic odour.

The presence of fat is essential for adipocere formation . It takes between 3 weeks-6 months to develop. Only the parts of body immersed under water will go to adipocere formation while exposed parts undergoes putrefaction.

▪ **MLI**:

- 1- It denotes long submersion under water.
- 2- It gives an idea about time pass since death.
- 3- It helps in personal identification.
- 4- The cause of death can be known.

4- **Maceration**:

It is a P.M. change replacing putrefaction in case of intrauterine foetal death where aseptic autolysis occurs provided the foetus remains enclosed in the amniotic sac. The foetus becomes brown, oedematous with abnormal mobility of skull bones.

▪ **MLI:**

- 1- The presence of maceration exclude infanticide.
- 2- In case of a female alleging abortion after kicking the abdomen, The presence of maceration indicates death before expulsion.

Recently diagnosis of death based on:-

The concept of “brain death” has been accepted recently, where organ transplantation is an option, there are three types of brain death:

- ***Cortical or cerebral death:*** with an intact brain stem, this leads to a vegetative state in which respiration survives, but there is total loss of sentient activity. Cerebral hypoxia, toxic conditions, or widespread brain injury can lead to this state.
- ***Brain Stem Death;*** where the cerebrum may be intact, though cut off functionally by the stem lesion, cranial nerve function is lost, including the respiratory outflow. Head injury and subarachnoid haemorrhage. account for the majority of cases.
- ***Whole Brain Death;*** combining the two above is also common.

Diagnosis of Brain Stem Death:

To diagnosis brain stem death, the patient must be deeply in coma [the cause of coma must be known i.e. not under the effect of drugs e.g. CNS depressants, the body temp. not below 35C and no metabolic or endocrinal disturbance]. The patient must be maintained on a ventilator.

The following tests should be performed: though further investigations such as E.E.G. and even cerebral angiography or cerebral blood flow measurements are required clinical testing is sufficient evidence of brain stem death:

1. All brain stem reflexes are absent with fixed pupils, non reactive to light. Corneal reflexes is irrelevant in the diagnosis of brain-stem death.
2. Vestibuloocular reflex negative when ice water is introduced into the ears.
3. No motor responses in any cranial nerves on responses to painful stimuli.
4. No gag reflex to a catheter introduced into the larynx and Trachea-
5. No respiratory movements when the patient is disconnected from the ventilator, with the arterial PCO₂ level in excess of 50 mm mercury as a stimulus to breathing.

6. Testing must be carried out with a body temperature not less than 35C, to avoid hypothermia stimulating brain-stem damage.
- **M.L.I:**
 - Different tissues and organs die at widely different rates, usually because of their vulnerability to oxygen deficiency as just stated, skin, bone, muscle and many of the structural, connective tissue elements of the body can survive hypoxia for a long time.
 - On the other hand, nervous tissue is very vulnerable to hypoxia and the neurones of the cerebral cortex will die after die after only 3-7 minutes of complete oxygen deprivation.
 - *Nerve cells lower down the CNS are more resistant, but still die within a relatively short time after cardio-respiratory failure.*
 - This leads to the concept of brain death, which is of great importance both legally, ethically and in relation to organ transplantation.

Estimation of the Time Passed since Death

Estimation of the time of death is the source of a greater deal of debate both in and out of the court, it is an area where extreme care must be taken not to over interpret what one see, and not to make dogmatic, unsupportable and potentially inaccurate statements.

- Within a **few minutes** of death the changes which will be noted are as follows:
 - 1) Pallor and loss of elasticity of the skin
 - 2) Ocular signs (Look before).
 - 3) Flaccidity of the muscle.
- Other changes which appear **during the first 12 hours** after death:

1) Cooling Of The Body:

Immediately after death, the body temperature falls progressively until it reaches the atmospheric temperature within 12-18 hours.

As an average, the body loses 1.5C/hour in 1st 6-8 hours and then 1C/hour till reaching the atmospheric temperature from 12-18 hours. .

2) **Extent of Hypostasis** (Look before).

3) **Distribution of Rigidity** (Look before).