

FORENSIC MEDICINE

Notes compiled by PJ Louw for LLB from the UNISA Study Guide & other material. Whilst care has been taken to ensure accuracy you are advised to also verify facts independently.

POST MORTEM CHANGES

CELLULAR DEATH = cell / organ / tissue activity stops due to low / non-existent levels of **oxygen**

SOMATIC DEATH determined when -

1. Discontinuation of respiration
2. Discontinuation of circulation – heart stops / no pulse detectable
3. Loss of all reflexes
4. Loss of muscular tone (primary muscle flaccidity)
5. Changes in eyes – blood congestion / drying out

Aspect:

1. that part of a surface viewed from a particular direction.

2. the look or appearance.

anterior aspect that surface of the human body or a body part viewed from the front. Called also ventral aspect.

dorsal aspect posterior aspect.

posterior aspect that surface of the human body or a body part viewed from the back. Called also dorsal aspect.

ventral aspect anterior aspect.

dorsal aspect that surface of a body viewed from the back (human anatomy) or from above (veterinary anatomy).

ventral aspect that surface of a body viewed from the front (human anatomy) or from below (veterinary anatomy).

Hypostatic - pertaining to an accumulation of deposits of substances or congestion in a body area that results from a lack of activity

(30) Deceased lying on back – body cold to touch – RM established in all muscle groups.

Examination shows hypostatic changes over anterior aspect (front) incl. abdomen.

Body lies in position that 1 leg (knee joint) extends straight over edge of bed –

interpret post-mortem findings

(20) Post-mortem changes - divided 2 stages - **EARLY CHANGES AFTER DEATH**

1. Cooling of the body (algor mortis)

Body in veld - still warm on contact - but RM has already developed. How long do you estimate POST-MORTEM INTERVAL to be? What factors may affect rate of cooling of body (algor mortis)?

» **As rule of thumb → may be assumed that person died 3 to 8 hours earlier**

(8) Factors which may influence rate of cooling during post-mortem period -

- (a) initial **body** temperature
- (b) **environmental** temperature
- (c) **bodily characteristics**
- (d) **posture** of the body
- (e) **movement** of **air & humidity**
- (f) clothes & other **coverings**
- (g) **medium** in which body is found

- » Body surface cools off / Core temperature maintained → Metabolic processes in liver & muscles continue for some time after death - producing heat
- » Heat spreads through body by circulation → then lost during different processes
- » Except where external temperature is at freezing point → body temperature seldom reaches external temperature, due to production of heat by bacteria involved in decomposition process

2. Post-mortem muscle changes (rigor mortis) followed by secondary muscle flaccidity

Post-mortem muscle changes: Muscles of body go through 3 phases after death

1. **Primary muscle flaccidity**
2. **Rigor mortis**
3. **Secondary muscle flaccidity**

Adenosine triphosphate (ATP) is the biochemical way to store and use energy. For your muscles -- in fact, for every cell in your body -- the source of energy that keeps everything going is called **ATP**.

pH stands for power of hydrogen, which is a measurement of the hydrogen ion concentration in the body. The total **pH** scale ranges from 1 to 14, with 7 considered to be neutral. A **pH** less than 7 is said to be acidic and solutions with a **pH** greater than 7 are basic or alkaline.

Livor mortis is a settling of the blood in the lower (dependent) portion of the body, causing a purplish red discoloration of the skin. When the heart stops functioning and is no longer agitating the blood, heavy red blood cells sink through the serum by action of gravity.

1. **Primary muscle flaccidity** immediately at death due to loss of muscle tone (EXCEPT - cataleptic stiffness)

2. **Rigor mortis** (post-mortem stiffness) follows a.r.o chemical reactions in muscles

- Decreased ATP (Adenosine triphosphate) levels + changed pH levels result in RM
- RM \pm sets in 3 to 6 hrs after death \rightarrow 1st observed in smaller muscles (hands & face)
- RM spreads throughout body after \pm 10 to 12 hours & disappears after \pm 36 hours
 \rightarrow generally accepted that RM disappears in same sequence in which it has set in
- RM - NOT associated with muscle contractions \rightarrow limbs do not bend or flex under influence of RM
- Individuals with low muscle mass (babies) \rightarrow hardly any or no RM may develop
- RM not necessarily indication of posture/position of body at moment of death
 \rightarrow represents position in which body was at time of development of rigor mortis
- Paradoxal RM observed \rightarrow leg sticks out over bed without touching floor
 \rightarrow body apparently moved after RM developed - otherwise leg would have bent at knee under effect of gravity & become fixed in position
- If RM is broken \rightarrow will not set in again (IN handling of corpse - clothes are removed)

Factors which influence appearance & disappearance of rigor mortis

- » **TEMPERATURE**
 - High external temperature → accelerate onset of rigor mortis & shortens duration
 - Low external temperature → inhibits onset of rigor mortis & lengthens duration
- » **MUSCLE CONDITION at TIME of DEATH** - Strenuous pre-death exercising decreases ATP content of muscles & accelerates onset + subsequent disappearance of rigor mortis
 - Mechanism relevant in deaths caused by electrocution / after convulsions (increased muscle activity)

Specific manifestations of rigor mortis

CATALEPTIC STIFFENING (cadaveric spasm)

rare form of rigidity sets in when person dies during stressful period & somatic death sets in rapidly

- Usually affects only 1 muscle group (ex. hand muscles)

Body of person drowned person retrieved. Tree-branch tightly gripped in hand. How will you interpret this?

- **EXAMPLE of CATALEPTIC STIFFENING** → sometimes occurs when person dies during severe stressful period → **Indication that person was still alive when fell into water** (grabbed branch in survival effort)

RIGIDITY due to HEAT → proteins in muscles break up & solidify causing shortening of muscles

- Flexor muscles dominate extensor (stretch) muscles & body takes on typical posture of boxer
- Heat stiffening / Boxer posture = **post-mortem phenomenon** & **NOT indication of body position at time of death**

RIGIDITY due to COLD - sets in when body is exposed to temperatures under 3,5 °C

- Babies / Young children / Obese people - thick layer of fat → cold rigidity more prominent / ○ When body later heats up true rigor mortis will set in

3. **Secondary muscle flaccidity** commences when muscles relax finally & permanently

(18) 3. **Post-mortem lividity** (colour changes / hypostatic changes / livores mortis / death spots / post-mortem discoloration)

- (1) ±1 hour after death → blood becomes permanently fluid & blood cells gravitate to lowest parts of body
- (2) Gravity dependent movement of blood → discolours skin + internal organs to reddish-blue colour (Body in hanging position - hypostasis will appear in hands/forearms/feet/lower legs)
- (3) Plasma → gravitates to lesser extent & causes oedema & later even skin blistering
- (4) Usually maximally developed 12 hours after death
- (5) Time for hypostasis to develop varies → sometimes already visible before death (e.g. terminally ill)
- (6) Colour of complexion determines visibility of hypostasis on skin
- (7) Person who was bled out before death → hypostasis will be less obvious
- (8) Hypostasis does NOT develop in areas where there is pressure on the body
 - **SUPINE POSITION** (on BACK) → NO hypostatic changes over buttocks / shoulders / parts in contact with surface on which it lies / will NOT develop where garment or buckle is tightly pressed against body
 - **PRONE POSITION** (on FRONT)
- (9) Hypostasis NOT indication of position in which person died → only indication of position of body when hypostasis set in → of assistance to confirm whether corpse was moved after death when hypostasis is contradictory to position in which body was found
- 10) Initially → hypostasis can shift to other parts of body if body is moved after hypostasis had developed

11) In time → hypostasis fixed (even if body is moved) → hypostasis will develop in new dependent areas.

Oedema: excess of watery fluid collecting in the cavities or tissues of the body.

COLOUR of HYPOSTASIS CAN BE INDICATION of POSSIBLE CAUSES of DEATH

Cherry Red	Carbon monoxide poisoning
Bright rose colour	Cyanide poisoning Cold temperature (body in refrigerator/cold water or hypothermic death)
Green	Hydrogen sulphide
Rust brown / chocolate brown	Potassium chlorate poisoning Nitrite poisoning
Grey bronze (with bad odour)	Clostridium perfringens septicaemia / Clostridium perfringens is a Gram-positive, rod-shaped, anaerobic, spore-forming bacterium of the genus Clostridium.

Conditions to be **DISTINGUISHED** from hypostasis

Female dies day after severe assault by spouse. During post-mortem exam - blue or reddish blue marks present over back. Pathologist convinced only due to hypostasis.

How should this case be managed?

- » **BRUISES** - **location & shape of discoloration** can distinguish it from hypostasis
- » **INFLAMMATORY CHANGES** - Inflammation as result of increased blood circulation in affected tissue
- » **DURING AUTOPSY** → location & shape of discoloration can distinguish BRUISES from HYPOSTASIS
 - **Indisputable evidence** → **SKIN INCISED BRUISE** - blood diffused into tissue (extravasated) [**blood extravasation** - the leakage of blood from a vessel into tissues surrounding it; can occur in injuries or burns or allergic reactions]
 - **Incisions in skin** will confirm presence of blood outside blood vessels & help to differentiate between contusions or bruises & hypostatic changes
 - **Microscopic examination** may confirm presence of red blood cells in tissue → outside blood vessels

IMPORTANT - contusions do NOT develop post mortem (Req blood circ to develop)

LATER CHANGES POST MORTIM (After Death)

1. **Decomposition (putrefaction)**
2. **Mummification** (Namib desert / Mount Everest)
3. **Adipocere-formation** (Wax-like substance)
4. **Maceration** (process of AUTOLYSIS = spontaneous disintegration)
5. **Skeletisation** (all soft tissue has been destroyed due to exposure to elements – bleaching)

Adipocere formation: also known as corpse, grave or mortuary wax, is a wax-like organic substance **formed** by the anaerobic bacterial hydrolysis of fat in tissue, such as body fat in corpses. In its **formation**, putrefaction is replaced by a permanent firm cast of fatty tissues, internal organs, and the face.

Maceration is defined as the softening and breaking down of skin resulting from prolonged exposure to moisture (Anderson, 1998). It was first described by Charcot in 1877.

Maceration is caused by excessive amounts of fluid remaining in contact with the skin or the surface of a wound for extended periods

1. Decomposition (putrefaction)

- » **Sets in immediately** → Due to breakdown of body by enzymes → condition only visible at later stage

ENZYMES AUTOLYSIS can be from body itself.

(**Autolysis** - the destruction of cells or tissues by their own enzymes, especially those released by lysosomes).

HETEROLYSIS can be from other organisms: (**Heterolysis** - is the process of a body's soft tissue destruction by micro-organisms (bacteria, fungi and protozoa) and results in the catabolism of tissue into gases, liquids and simple molecules. (apoptosis induced by hydrolytic enzymes from surrounding cells)

- » **Environmental temperature plays important role** → refrigerator - suppress process / warmth – accelerate process

2. **Mummification** → Namib desert / Mount Everest)

- Occurs in → dry hot + cold climates / → body lying in environment with high acid content
- Body of new-born - concealed in cardboard box (microbiologically sterile & putrefaction very slow)

3. **Adipocere-formation** (Wax-like substance)

- Water binds with body fat → transformation of body fat into soap
- Develops over long period & suppresses further decomposition of body → preserve wounds.

4. **Maceration** (process of AUTOLYSIS = **spontaneous disintegration**)

- Foetus dies intra-uterine → Contents of uterus is sterile → NO putrefaction
- (1) **skin softens**
- (2) **large fluid-blisters appear**
- (3) **skin strips away**
- (4) **at same time - internal organs soften** (5) **bones loosen from attachments**

5. **Skeletisation** (After all soft tissue has been destroyed due to exposure to elements – bleaching)

- Skeleton useful for identification of deceased & determining how long person has been dead

DETERMINATION of POST- MORTEM INTERVAL

TIME OF DEATH

- ENTOMOLOGY
- STOMACH CONTENTS
- DECOMPOSITION
- PUTREFACTION in SUBMERGED BODY

» Important to determine time of death

- Immediately / soon after death often easy
- difficult after putrefaction sets in (many factors come into play)

TABLE = General rules to apply when examining corpse in 1 st few hours after death.	First 3 hours	Body warm & flaccid (primary muscle flaccidity)
	3 to 8 hours	Body warm & stiff (rigor mortis has set in)
	8 to 36 hours	Body cold & stiff
	After 36 hours	Body cold & soft (flaccid) (2 nd dary muscle flaccidity has set in)

ENTOMOLOGY

- Type of insects & phases of life cycles found on body (e.g. eggs / maggots) (Insects)
- Different insects found in different geographic areas

STOMACH CONTENTS

- **NOT indication to post-mortem interval** - digestive processes end after death

Stomach contents can reveal following info at post-mortem examination -

- (a) what person ate before death
- (b) approx. how long he lived after eating

- Stomach contents digestion & emptying vary considerably & can be unpredictable

DECOMPOSITION / PUTREFACTION in SUBMERGED BODY

Slower in liquid medium than in air

- » **Rate of putrefaction in submerged body determined by -**

1. [Temperature of medium](#)

→ Putrefaction more rapidly in warm than cold medium

2. [Nature of medium](#)

→ Putrefaction more rapidly in sewage water (warmer) than in fresh water (colder)

→ Putrefaction more rapidly in fresh water than in seawater.

3. [Movement of liquid](#)

→ Putrefaction more rapidly in stagnant water.

3.4.5 Post mortem: observation and interpretation of artefacts

<p>Post-mortem dehydration</p>	<p>The eyeballs lose pressure and the cloudy corneae and dry skin can create the impression of ante-mortem dehydration.</p> <p>Babies' lips are soft and delicate and dry, with a reddish brown colour indicating possible bruising.</p> <p>The skin of the scrotum dries out, creating the impression of bruising.</p>
<p>Hypostasis (livores mortis)</p>	<p>Petechial haemorrhages and even bigger blood blisters can form and be confused with ante-mortem causes of petechial bleeding, eg asphyxia and bleeding tendencies.</p> <p>It must be distinguished from ante-mortem contusions or bruises as mentioned above.</p>
<p>Post-mortem muscle changes</p>	<p>Rigor mortis of the heart can give the impression of hypertrophy (heart enlargement).</p> <p>The pupils can be uneven in size.</p> <p>Secondary flaccidity of the body can cause the anus to appear dilated and raise a suspicion of possible anal interventions; other changes such as bruises, etc, must be looked for.</p> <p>Post-mortem emission of semen can occur as a consequence of rigor mortis of the muscles of the male sexual canal (eg seminal vesicles).</p>
<p>Changes due to decomposition</p>	<p>Production of gas by organisms can imitate air embolisms.</p> <p>Gastromalacia as discussed above.</p> <p>The bloodstained body fluids which leak from the body orifices in the process of decomposition can imitate haemorrhaging.</p> <p>Biochemical changes, such as the production of alcohol after death.</p> <p>Ants eat the top layers of the skin, and this can look like abrasions. The marks have an irregular outline and they especially appear where the body is not covered with clothes (fig 3.10A and B) (photo 15). Snails can also cause wounds (photo 14).</p> <p>Animals like dogs, dingoes, etc, can eat parts of the body and even scatter them about and bury them.</p> <p>Rodents destroy the soft tissue around the eyes or elsewhere leaving a "cookie cutter" (fig 3.11) serrated edge. Marine life, such as crabs and crayfish, also remove soft tissue (see also fig 3.12)</p>

<p>Changes caused by resuscitation</p>	<p>Areas looking like impression abrasion wounds on the thorax where the defibrillator pads were applied.</p> <p>Injuries to the tongue, teeth and neck tissue due to intubation.</p> <p>Fractures of the bones of the thorax (ribs and sternum) as well as injuries to the liver and other abdominal organs. The latter is mainly observed when resuscitation has not been applied correctly.</p> <p>Haemorrhages around infusion lines or even in body cavities.</p>
<p>Changes caused during the handling and dissection of corpses</p>	<p>Rigor mortis can be “broken” during the handling of the body and can thus be absent in a limb.</p> <p>Bones can be fractured if the body is handled roughly. Especially elderly people often have osteoporosis and the bones fracture easily. This includes the hyoid or tongue bone (please see bloodless field dissection in chapter 8).</p> <p>The death shroud can sometimes leave an impression mark around the neck that looks like an abrasion (photo 2).</p> <p>Dissection of the neck is important in (especially) cases of strangulation. A bloodless field dissection is performed to prevent the artificial extravasation of blood which present as bruises.</p> <p>The process of embalming and reconstruction of the body causes numerous changes, including the removal of gunpowder marks on the skin, the creation of new “wounds” during shaving and where embalming solutions are infused. The latter also contain colouring material and other chemicals.</p>