

FORENSIC MEDICINE Q & A

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.

VIOLENT DEATH

The scenario describes a **violent death**, the questions may relate to:

- the **scene of death** and
- what **post-mortem changes** could be expected.
- You may be required to explain **why the death is unnatural/natural**.

Deaths due to violence to the body

- a. **PHYSICAL** (stab- & gunshot wounds / poisoning / infected blood transfusion / lightning / electricity / fire / steam / hot fluids / suffocation / hyper- & hypothermia / throttling / strangling / hanging / drowning) - section 56 of Health Professions Act (anaesthetic death)
 - b. **TRAUMA** - nature related events (snake- & spider bites / bee- & scorpion sting)
 - c. **CONDITIONS** – Infection following injury caused by animal – tetanus / rabies
- The incidence of violent deaths: The incidence South Africa is alarmingly high. No fewer than 38,77% of all cases of unnatural death in 2005 were due to violence/homicide.
 - Alcohol & Violent Death: During 1980 the blood of 1 617 bodies was sampled. Of these 1 510 had died a non-natural death, and blood-alcohol tests in respect of 61% were positive.

The scene of death: First responder: **ADAPT** (Assess scene, Detain witnesses, Arrest perpetrator, Protect scene, and Take notes).

It is important to inspect the scene of death for:

- evidence of passion, provocation, signs of struggle, locality & position of body
- other sexual practices such as bondage, transvestism and fetishism.
- In most cases of SIDS - the scene of death is not investigated, as the parents will rush the child to the hospital for resuscitation.

If the victim is apparently dead, determine if they are really dead and/or attempt resuscitation. Here's

The legal signs of death:

- no respiration
- no pulse
- eyelids don't close when lifted
- no heartbeat
- fingernails don't flush when pressed
- no pupil dilation to light

Identity of the victim - determine at the scene (if possible)

Canvass the area and interview all cooperative, suspicious-looking, and even random, disinterested bystanders.

All victims of sexual assault, whether living or dead, should be examined in the same manner as for live victims of rape. The physical evidence that is most useful in a sexual assault case involves DNA, fingerprints, semen, hairs, fibres, and blood - collection & photography.

Violent crime: DNA, fingerprints, semen, hairs, fibres, debris, blood, rope with knots (hanging); combustible materials; toxic materials / substances, firearms, bullets, cartridges, physical evidence - collection & photography.

Post-mortem changes:

The post-mortem changes can be divided according to the changes taking place in the **first few hours** or days, and those taking place at a **later stage**:

Changes taking place early after death are:

1. cooling of the body, so-called algor mortis
2. post-mortem muscle changes, namely stiffening or so-called rigor mortis, followed by secondary muscle flaccidity
3. post-mortem colour changes, also known as hypostatic changes, lividity or livores mortis

Changes taking place later are:

1. decomposition, including autolysis and putrefaction
2. mummification
3. adipocere-formation (wax-like organic substance)
4. maceration (softening and breaking down of skin) & lividity - pooling of blood under skin
5. skeletalisation

(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

(20) **Post-mortem muscle changes** **Muscles of body go through 3 phases after death -**

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

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 due to chemical reactions in muscles of body
 - Decreased [ATP \(Adenosine triphosphate\)](#) levels + [changed pH levels](#) result in RM
 - RM ± sets in [3 to 6 hrs after death](#) → 1st observed in smaller muscles (hands & face)
 - RM [spreads throughout body after ±10 to 12 hours](#) & [disappears after ±36 hours](#)
 - generally accepted that RM disappears in same sequence in which it has set in
 - RM - [NOT associated with muscle contractions](#) → limbs do not bend or flex under influence of RM
 - Individuals with [low muscle mass](#) (babies) → hardly any or no RM may develop
 - RM [not necessarily indication of posture/position of body at moment of death](#)
 - [represents position in which body was at time of development of rigor mortis](#)
 - [Paradoxal RM observed](#) → leg sticks out over bed without touching floor → 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](#) → 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: condition - excess of watery fluid collecting in the cavities or tissues of the body.

COLOUR of HYPOSTASIS CAN BE INDICATION of POSSIBLE CAUSES of DEATH ^{(Part of (18))}

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)

This is affected by ambient temperature (warmer temperature means faster onset), level of glycogen stores (struggling before death means faster onset).

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) small joints (fingers, toes, jaw) first, then large joints, stiffen.
	8 to 36 hours	Body cold & stiff- small joints start to loosen after 18 hours.
	After 36 hrs	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.

NATURAL vs UNNATURAL DEATH

DEATH BY NATURAL CAUSES: Is primarily attributed to an **illness or an internal malfunction** of the body **not directly influenced by external forces**. (an internal disease process or normal deterioration of the body) For example, a person dying from complications from influenza (an **infection**) or a heart attack (an **internal body malfunction**) would be listed as having died from natural causes.

Old age is not a scientifically recognized cause of death there is always a more direct cause although it may be unknown in certain cases and could be one of a number of **aging-associated diseases**.

SUDDEN ONSET OF DEATH:

Determination of cause of death in natural deaths, particularly when the death occurred suddenly, unexpectedly, or in the young, is an important part of forensic medicine.

The term *sudden death* is usually taken as being synonymous with *unexpected death*. It is usually taken to exclude unnatural causes of death.

Sudden death can occur in infants and is described in the separate article [Sudden Infant Death Syndrome](#) (SIDS). Sudden death can also occur in adults, from a variety of causes, usually cardiac or with an underlying diagnosis of [epilepsy](#). Whatever the age or cause of the sudden death, to some extent the circumstances of the death will have a bearing on whether primary care doctors become involved or not. A dramatic [collapse](#) from cardiac disease on the sports field will result in the ambulance and emergency services being called. The discovery of an elderly patient dead in bed one morning is less likely to initiate such a response from relatives, but they may well call their GP rather than the police or emergency services.

Epidemiology: Unexpected death may occur at home or in a public place.

Presentation: An unexpected death may be reported to the GP and it is important to ascertain quickly what response is appropriate. It is most important first to establish whether death has occurred, or is likely to have occurred beyond all reasonable doubt.

Why is SUDDEN & UNEXPECTED death treated as UNNATURAL DEATH?

- Person dies suddenly & unexpectedly - **not obvious** whether death result of natural / unnatural causes
- Important to **exclude any unnatural causes** before death is treated as natural death
- For this reason - **routine practice** to treat as unnatural deaths & perform post-mortem examination
- If **cause of death is diagnosed** at post-mortem & no obvious visible signs of violence to body during post mortem, these deaths can then be further dealt with as natural.
- Done for BABIES (sudden infant death syndrome SIDS / Cot death) & YOUNGER PERSONS (younger than 50±60 y) who suddenly & unexpectedly die without significant pre-existing medical history.

DEATH BY UNNATURAL CAUSES

Unnatural death is a category used by [coroners](#) or [Medical Examiners](#) and [vital statistics](#) specialists for classifying all human deaths not properly describable as [death by natural causes](#). Hence it would include events such as:

- accident
- execution
- homicide / criminal act - assault etc
- misadventure
 - being attacked by insects, reptiles, fish, carnivorans, or other wildlife
 - adverse outcome of surgery (note that this is not failure of surgery)
- suicide
- terrorism
- war
- abortion

Unnatural deaths can be grouped as follows:

- **Deaths due to violence and the consequences of the injuries that result in death.** This could be cases of homicide (murder or culpable homicide), suicide or accidents (including motor vehicle accidents). Consequences of injuries that may result in death include infections such as lung infections, blood clots to the lungs and tetanus or rabies after a dog bite.
 - **When an anaesthetic was administered** or the person had a surgical procedure shortly before death. It includes all types of anaesthetic (local or general) from for example deaths after administration of local anaesthetic for tooth extraction to administration of a general anaesthetic for large surgical procedures such as heart surgery.
 - **When a person dies suddenly without pre-existing illness** or if the death is unexplained. These deaths could happen in babies the so-called cot deaths or in adults.
 - Any death, including deaths that would otherwise be classified as being "natural" where it is suspected that the **death was due to an act of neglect** by any person including medical staff.
-