


# Post Mortem Changes

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# Types of death

- ▶ Somatic death (clinical death)
  - Irreversible loss of:
    - Sentient personality
    - Unable to be aware of environment
    - Unable to appreciate any sensory stimuli
    - Unable to initiate any voluntary movementreflexes may still be present, respiratory may still persist with help of artificial support
- ▶ Cells and tissues are still alive and functioning apart from damaged tissues

# Cellular death

- ▶ Following ISCHEMIA and ANOXIA, tissues and constituents are dead due to cardiorespiratory failure
  - ▶ Takes place 1–2H after death
  - ▶ No longer have aerobic metabolic activities
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# Brain death

- ▶ Cortical death
- ▶ Brainstem death
- ▶ Combination of both

# Cortical death

- ▶ Due to period of hypoxia, trauma or toxic insult,
  - Higher cerebral activities are lost
  - Brainstem is preserved, therefore cardiopulmonary functions are maintained
  - Mostly pt will be in vegetative state
  - Pt can be in deep coma for indefinite time, sometimes for years

# Brainstem death

- ▶ Loss of vital centres that control respiration and RAAS system (loss of spontaneous breathing and consciousness)
  - Without medical intervention, hypoxic cardiac arrest inevitably follows within minutes
  - Cardiac may still function with help of mechanical assisted ventilation
  - majority of brainstem-dead patients suffer a cardiac arrest within 48-72 hours
- ▶ Already dead in somatic sense, but not yet dead in cellular sense

# Signs of death

- ▶ Unconsciousness
- ▶ Loss of all reflexes
  - Pain stimuli, cornea reflex, gag reflex, light reflex
- ▶ Muscle flaccidity
  - Rarely, there may be post mortem coordinated muscle group activity up to 1 hour after death
- ▶ Cessation of heart and respiratory movement

# Mode vs Cause of death

## ▶ Mode:

- Abnormal patophysiological state
- No info on underlying pathological condition
- Eg: Coma, Congestive Heart Failure, APO, Syncopal attack

## ▶ Manner:

- The way death has occurred
- Eg: Suicidal, homicidal, natural



# Post Mortem Changes

- ▶ Immediate:
  - Loss of voluntary power
  - Cessation of respiration and circulation
- ▶ Early:
  - Pallor and loss of skin elasticity
  - Eye changes (tache noire)
  - Primary flaccidity
  - Rigor mortis
  - Hypostasis
  - Cooling of the body
- ▶ Late (decomposition):
  - Putrefaction
  - Adipocere
  - Mummification

# Early changes

Tache  
noire

Primary  
flaccidity

Rigor  
mortis

Livor  
mortis

Algor  
mortis

# Tache noire



# Primary Flaccidity

- ▶ Flaccid period starts immediately after death
- ▶ All the muscles begin to relax.
  - Lower jaw begins to fall
  - Eyelids loose tension
  - Joints are flexible
- ▶ Extends 3–6 hours after death before stiffening occurs
- ▶ Muscle irritability and response to electrical or mechanical stimuli still persist

# Rigor Mortis

- ▶ Stiffening of muscles (voluntary and involuntary muscles), sometimes slight shortening of muscle fibres
- ▶ Stiffness first apparent in smaller joints
  - Lower jaw
  - Facial muscle, neck
  - Wrist, ankle
- ▶ Happens simultaneously through all the muscles

- ▶ Onset of rigor mortis generally 6–12 hours, and may persist from 18–36 hours
- ▶ Mechanism:
  - Muscle fibres -actin + myosin = actomyosin
  - $\text{ATP} \rightarrow \text{ADP} + \text{lactic acid} + \text{glycogen} + \text{energy}$
  - ATP plays role in elasticity and plasticity of muscles
  - In death, level of ATP falls. Rigor starts when ATP < 15% and reaches maximum when ATP < 85% (Batesmith, 1949)



# Factors affecting Rigor Mortis

- ▶ Age
  - Occurs rapidly in children and old age
- ▶ Nature of death
  - Diseases causing exhaustion and wasting (eg: cholera, cancer, TB) or violent death (eg: electrocution) onset of rigor is early and duration is shorter.
  - In asphyxial death, onset is delayed
  - Widespread bacterial infection (eg sepsis) onset is very rapid



## ▶ Muscular state

- When muscle is at rest and healthy prior to death, onset is slow and duration is long.
- When muscle is exhausted (eg: exercise prior to death) onset is more rapid.

## ▶ Atmospheric conditions

- Cold weather: onset slow and duration is longer
- Hot weather, onset is rapid due to increased breakdown of ATP

## ▶ Hot stiffening

- When exposed to temperature  $>65^{\circ}\text{C}$ , rigidity is produced (more than marked in rigor mortis)

## ▶ Cold stiffening

- Upon exposure to freezing temperature, tissues are frozen and stiff, body fluids are freezing.
- Once replaced in a warm temperature, stiffness will vanish, flaccidity occurs and not long after that rigor mortis occurs

# Cadaveric spasm

- ▶ In midst of intense emotional;/physical activity, failure of normal relaxation occurs
- ▶ Affects only small number of group muscle
  - Flexor of one arm
- ▶ Eg. Fall from cliff into cold water, suicidal gunshot to the head



*Cadaveric spasm, an instantaneous form of rigor, in the victim of a fall into water. grass from the river bank firmly clutched in the hand.*

# Hypostasis

- ▶ Lucidity, staining, cogitation
- ▶ Occurs when circulation ceases → no arterial propulsion or venous return → stagnant blood
- ▶ Gravity pulls the blood into its lowest accessible area
- ▶ Visible at skin as bluish-red discoloration



- ▶ Hypostasis starts at 30mins – 4 hours after death, and reaches maximum at 6–12 hours
  
- ▶ Pattern/distribution of hypostasis
  - Depends on posture after death
  - Supine: hypostasis over back area **in exception** of shoulder, buttock, calves (pressed against surface compressing vascular channel)
  - Vertical: hypostasis over feet, leg, distal part of hand and arm









- ▶ Colours of hypostasis
  - Usually bluish-red
  - CO<sub>2</sub> poisoning: cherry red
  - Cyanide poisoning: dark blue-pink
  - Aniline, nitrite & chlorate poisoning: brownish red
  - Phosphorus poisoning: dark brown
  - Anaerobic septicaemia: bronze

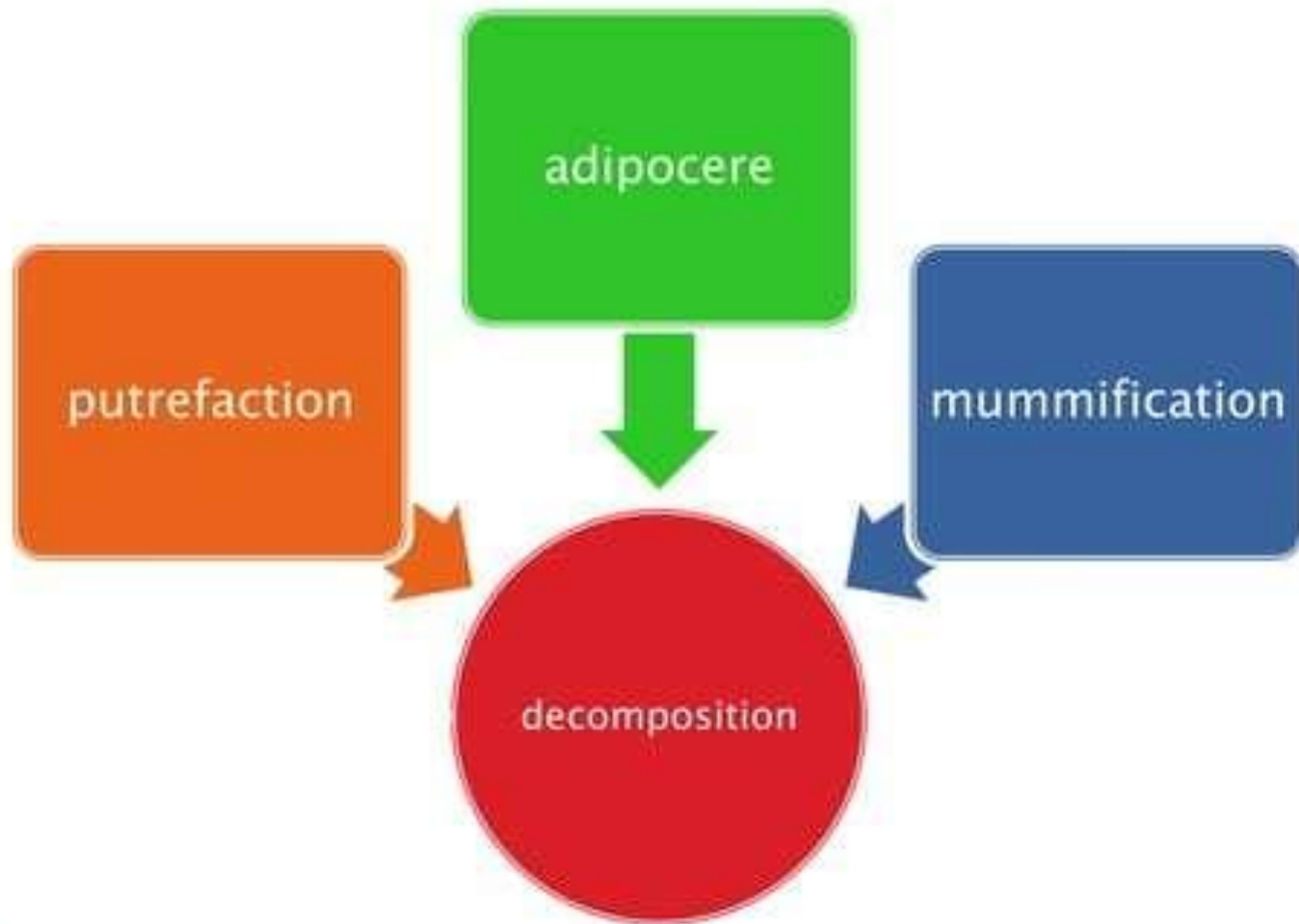
- ▶ Hypostasis in organs:
  - Intestine: discontinuous marked discoloration of jejunum and ileum
  - Lung: dark blue in posterior edges, pale over anterior edges
    - Fluid/congestion/edema will be more apparent @ posterior part
  - Myocardium: dark patches in posterior wall
  - Esophagus: hemorrhage behind esophagus
- ▶ How to differentiate between hypostasis and contusion?

# Hypostasis vs. Bruises (*Ecchymosis*)

Hypostasis	Bruises
Dependant areas	Any where
Well defined edges	Ill defined edges
Blood is retained in intact capillaries	Blood escapes through ruptured capillaries
Superficial	Deep into skin
Same level on surface	Raised
Pale over pressure areas	Red
Incision: blood flows from the cut vessel (washable)	Incision: blood coagulates in tissue
No swelling	May be with swelling



# Late changes




# DECOMPOSITION

- ▶ Mixture of process
  - Autolysis of individual cells by chemical breakdown
  - External process of bacteria/predators/maggots
- ▶ Divided into:
  - Putrefaction
  - Adipocere
  - Mummification

# Putrefaction

- ▶ Caused by bacterias largely originating from intestines and lungs
- ▶ Starts approximately 3 days after death
- ▶ Starts simultaneously, however visually observed first at abdomen, usually RIF
  - Due to bacterias in caecum that lies superficially
- ▶ Then spreads to abdomen wall (gas distension)



- ▶ Face and neck becomes reddish and swollen
  - ▶ Skin from blisters a upper epidermis is loosened
  - ▶ Scrotum and penis may swell
  - ▶ Tissue liquefaction from orifices such as nostrils, anus, vagina, mouth
  - ▶ After several weeks, reddish green colour will turn black or dark with heavy maggots infestation
- 







- ▶ After several months, soft tissue and viscera progressively disintegrates
- ▶ 12–18 months → skeleton + tendons
- ▶ 3 years → skeleton

# Adipocere

- ▶ Waxy substance derived from body fat
  - caused by hydrolysis and hydrogenation of adipose tissues
- ▶ Contains primarily palmitic, oleic and stearic acid + glycerol
- ▶ Requires moist environment
  - Mostly occur in wet graves, damp vaults, cold water
  - Clostridium perfringens said to be assisting in hydrolysis and hydrogenation process

- ▶ Importance of Adipocere:
  - Once formed, it may preserve body for decades or centuries
  - Hence preserving marks of injuries (eg: bullet holes)
- ▶ Total time required is 3-12 months





*The body was exhumed after 3 years' burial and was found to consist of a hollow shell of stiff adipocere with the skeletal elements loose within.*





# Mummification

- ▶ Drying of tissues in place of liquefying putrefaction
- ▶ Can co-exist with other form of decomposition, or form at some parts of the body
- ▶ Mostly occurs in dry and hot environment → evaporation from body surface
  - Hot desert, closet, cupboards, closed room, beneath floors
- ▶ Skin and tissues will be hardened due to drying




*Mummification in a man  
dead in a locked room for 10 weeks.  
The corpse is dry and leathery, with  
very little moist putrefaction.*







- ▶ Decomposition in immersed body has slower rate of decomposition
    - Reduced temperature
    - Protection against insects/maggots
  
  - ▶ Decomposition in buried bodies is slower than body immersed in water or in room air
    - Reduced temperature
    - No predators
    - Low oxygen level
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# Maceration

- ▶ **Aseptic autolysis** of a fetus, which has died in utero and remained within the closed amniotic sac
- ▶ occurring as early as 6 hours of death and most definitely within 12 hours
- ▶ With slippage of the epidermis from the dermis, the dermis takes on a red color



- ▶ If the fetus is retained in utero for 7 to 10 days, color changes to a purple to brown
- ▶ Typically within 2 to 3 days of death in utero the fetus will lose firmness of its tissues, which manifest by a generalized softness on palpation.
- ▶ At the 7 to 10 day mark the skin has a slimy-like feel. The limbs are very loose, which in some cases will easily separate from the trunk

- ▶ There are occasions, however, in which the putrefaction process will override the maceration process.
  - amniotic membranes rupture
  - chorioamnionitis



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# Predators

- ▶ Types of predator varies with
  - Geography
  - Season
  - Indoor/outdoor
- ▶ Canine/rodent → local removal of flesh with evidence of teeth marks
- ▶ Rats and cats → crenated edge with clean cut wounds. No bleeding or inflammation marginal zone

- ▶ Most common: maggots (bluebottles and flies)
  - Lay eggs in moist areas such as wound, eyelid, nostrils, lips
  - Initially explores natural passage, then burrowing under tissues excreting proteolytic enzymes making tunnels and sinuses



*A body recovered from the Baltic Sea with numerous superficial skin defects on the face and neck due to postmortem predation, probably by the crustacean *Saduria entomon**



*The old lady was found locked in with a cat, having died from a gastric haemorrhage. The wound has not bled, the margins are not reddened and tooth crenations can be seen round its edge.*





# Cooling of body (Algor Mortis)

- ▶ Cooling of body is a complex process. The rate of cooling is **not same** in every different body
- ▶ Body cools more rapidly on the surface, and slowly in the interiors
- ▶ Body heat loss is via conduction, convection and radiation



# Factors affecting cooling of body

- ▶ Initial body temperature
  - ▶ Body dimension
    - Mass vs surface area
  - ▶ Posture upon death
    - Straight vs curled position
  - ▶ Clothing and coverage
    - Type of clothing, clothing material
  - ▶ Ambient temperature
    - Surrounding temperature
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- ▶ Air movement and humidity
    - Increased air movement increases heat radiation
  - ▶ Medium around body
    - Water vs air
  - ▶ Hemorrhage
    - Blood loss reduces body mass and heat
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# Time of death estimation

- ▶ Most popular used: Glaister equation


$$2 + \frac{[98.4 \text{ F} - \text{measured rectal temperature (F)}]}{1.5} = \text{Hour}$$

or

In celcius

$$2 + [(36.9\text{c} - \text{measured rectal temperature}) \times 1.2]$$

# Post mortem chemistry

- ▶ Many natural chemical substances rapidly distorted by post mortem autolysis
  - ▶ Serum urea/creatinin are stable with little variation up to 100 hours
  - ▶ Most commonly taken is vitreous humor
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- ▶ Glucose level in VH drops dramatically within hours
  
- ▶ According to Loe, 1993:
  - Nitrogen: PM serum and VH levels are stable
  - Sodium: reduced in serum after death whereas stable in VH in early PM
  - Chloride: decreases in serum after PM but only slightly reduced in VH
  - Potassium: very high in serum after death but increases in VH in a linear fashion THUS
  
- $5.26 \times K$  (mmol/l) – 30.9 (Madea, 2002)

THANK YOU