LATE POSTMORTEM CHANGES

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Post-mortem changes

Immediate changes after death:

- Stoppage of function of nervous system
- Stoppage of respiration
- Stoppage of circulation

Early changes after death:

- Algor mortis (cooling of the body)
- Post-mortem hypostasis
- Rigor mortis

Late changes after death:

- Decomposition
- Adipocere formation
- Mummification

- Decomposition is normal fate of dead body. However, under certain specific environmental conditions, modified decomposition of the dead body occurs and in such cases instead of total destruction, dead body is preserved for considerable time.
- Such modified decomposition may occur in form of adipocere or mummification

DECOMPOSITION

- disintegration of body tissues after death

Mechanism:

Autolysis

Putrefaction

Attack by animals (undisposed bodies)

Autolysis

- self destruction of body tissues by the enzymes released from disintegrating cells
- aseptic chemical process
- complex organic body tissues are broken down into simpler compounds

  - prevented by freezing
  - ↑ by temperature

Autolysis is rapid in pancreas, gastric mucosa
(rich in hydrolytic enzymes)

Intermediate in heart, liver, kidney

Delayed in skeletal muscle and uterus, prostate

Features

External:

- skin slippage (loosening of epidermis from the dermis)

Internal:

- doughy consistency of organs
- gastromalacia, oesophagomalacia
- dead fetus in mothers womb - maceration

Begins: 3 – 4 hrs

Continues up to 2 – 3 days

PUTREFACTION

Destruction of the body by the action of bacteria and other microorganisms thriving on the body.

Organisms enter the tissues shortly after death, mainly from the alimentary canal, and less through the respiratory tract or through an external skin wound.

- The fall in the oxygen concentration and rise in hydrogen ion concentration after death favours bacterial growth.

- As the protective agencies of the body are absent, the bacteria spread through the blood vessels using the proteins and carbohydrates of the blood as culture media.

Bacteria responsible:

Clostridium welchii

Streptococci, staphylococci

B.Proteus, B.Coli

Anaerobic lactobacilli, diphtheroids

- The chief destructive bacterial agent is **Cl. welchii ,**causes marked haemolysis, liquefaction of postmortem clots, disintegration of tissue and produces gas .

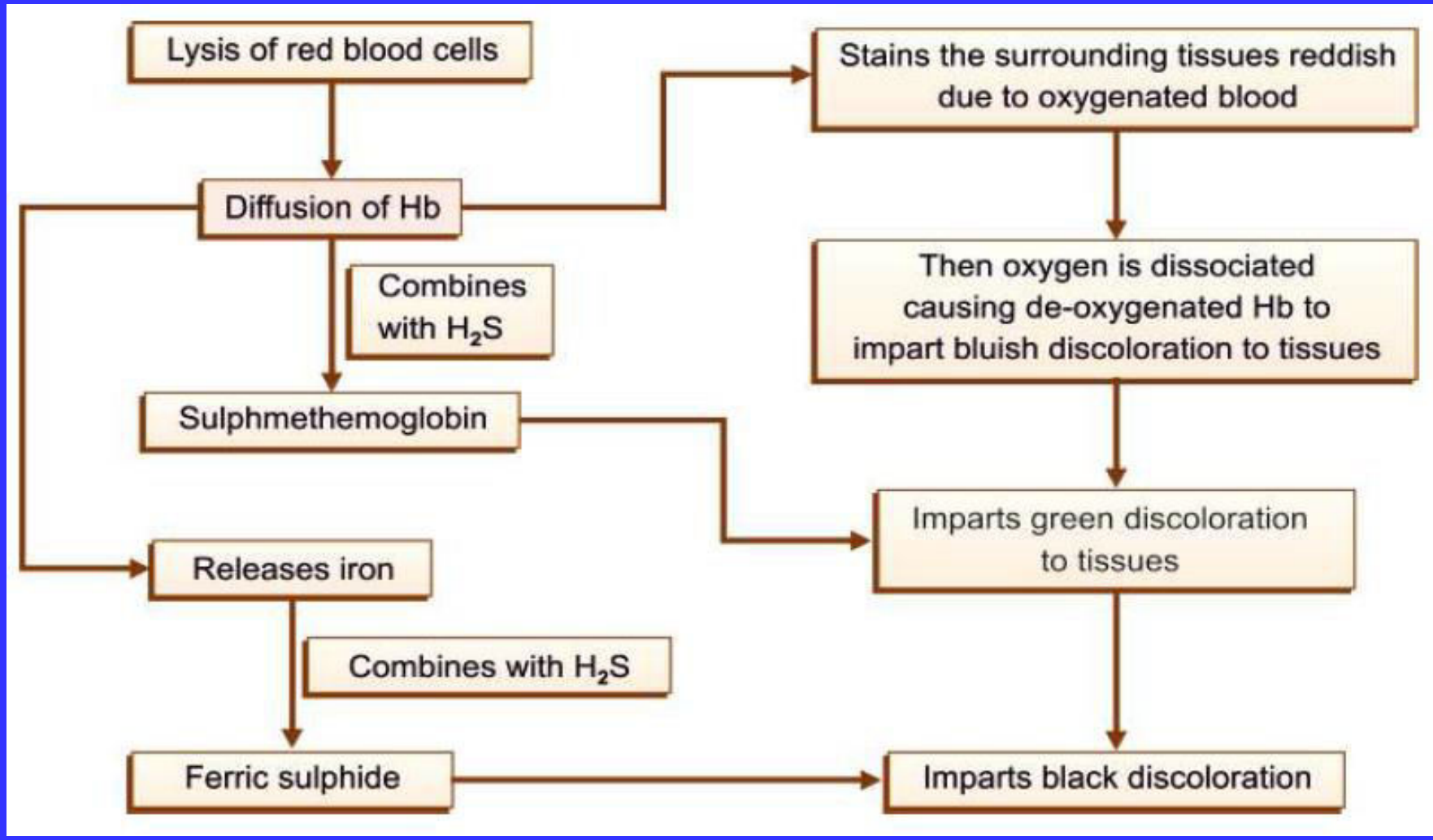
- Lecithinase produced by Cl. welchii hydrolyses the lecithin which is present in all cell membranes including blood cells.

- Number of **gases** are produced as a result of splitting of proteins and carbohydrates in to simpler compounds and due to bacterial action.
- **Hydrogen sulphide, CO_2, Methane, Ammonia, Mercaptans, etc**

The characteristic features of putrefaction:

- **Colour changes**
- **Liberation of gases**
- **Liquefaction of tissues**

Color changes



- The first external sign of putrefaction is greenish discoloration of Rt. Iliac fossa

$H_2S + Hb \rightarrow$ sulphmethemoglobin

12 – 18 hrs in summer

1 – 2 days in winter

Internally: under surface of liver

- discoloration extends to the whole body
- dark green or black in 3 – 4 days

Marbling:

- superficial veins over roots of limb, abdomen, shoulders, chest, neck are stained greenish brown

- mosaic pattern of the skin

- starts in 24 hrs, prominent in 36 – 48 hrs

- The earliest internal change is a reddish-brown discoloration of the inner surfaces of the vessels, especially of the aorta.

Liberation of gases:

H_2S, SO_2, CO_2, NH3, PH3, CH_4

Blisters:

- collection of gases and blood stained fluid between epidermis and dermis
- 18 – 24 hrs

From 18 to 36 hours after death, the gases collect in the tissues, cavities and hollow viscera and the features become bloated and distorted.

Ballooning effects of gases:

- bloating of features
- post-mortem purge (blood stained fluid exudes from mouth and nose)
- gaseous rigidity
- dispersion of P.M.lividity

Between 3 – 5 days:

- bursting open of abdomen and thorax
- teeth, hair, nails become loose, easily pulled out
- skin of hands and feet come off in a 'glove and stocking' fashion
- skull sutures of children are separated

- The gas leaves the tissues, usually by escaping as a result of damage to the structures or by drainage through a post-mortem wound.

- When the nutrient material is used up, the formation of gas stops, and the swelling gradually subsides.

Liquefaction of tissues:

- begins in 5 – 10 days

-tissues become soft, loose and converted into a thick, semi-fluid, black mass and separated from the bones and fall off.

Decomposition of internal organs

Decomposition of internal organs depends on:

- Firmness of organ
- Moisture content
- Blood content
- Proximity to source of bacteria

Organs which putrefy early:

- stomach, intestines, spleen
- brain
- liver
- gravid uterus

Organs which putrefy late:

- lungs
- heart
- kidneys
- esophagus
- bladder
- prostate, uterus

Factors affecting the rate of putrefaction:

External factors:

Temperature:

optimum: 21^0C – 43^0C

arrested: < 0^0 C and > 48^0 C

Moisture:

Clothing:

Manner of burial:

- shallow / deep
- soil
- water
- with / without coffin

Casper's dictum:

Rate of decomposition:

1 : 2 : 8

air water soil

Internal factors:

Cause of death:

Rapid: sepsis, anasarca, asphyxia

Slow: wasting diseases, anemia

poisoning: carbolic acid,
zinc chloride, phosphorus,
strychnine, Chr.heavy metals

Mutilation:

Condition of the body:

- fat bodies putrefy quickly

Age:

- new born not fed: slow
- old people: slow

Sex:

- no effect

Entomology of the cadaver

Fresh: flies deposit eggs

8 – 24 hrs: **maggots (larvae)**

3 – 6 days: maggots become pupae

Next 3 – 6 days: pupae become adult flies

Total period of life cycle:

5 – 6 days in summer

8 – 20 days in winter

Medico legal importance of decomposition:

Sign of death

Time since death

Bloating of features – difficulty in identification

Advanced decomposition may obliterate the cause of death

Skeletonization:

Time required for skeletonisation depends on:

- ambient temperature
- insect colonization of the body
- scavenger activity by animals
- shallow / deep burial, coffined/uncoffined
- type of soil

- 1 yr in a deep, uncoffined burial in India
- 1 month on exposure to air

Dis-articulation occurs from the head to downwards and from central to peripheral.

Neutral pH soil may not destroy the skeleton at all.

Acidic soil may cause decay in about 25 to 100 years.

ADIPOCERE

Adipocere / Saponofication

-modified form of decomposition characterized by formation of soft, waxy material in the dead bodies immersed in water or buried in moist places

Mechanism of formation:

Fat

↓ **lipase**

Fatty acids

↓ **hydrolysis**

Unsaturated fatty acids

↓ **hydrogenation**

Saturated fatty acids

- saturated fats + calcium and ammonium ions ➔ insoluble soaps

Cl.Welchii secretes lecithinase, proteases, phospholipases and produces ammonia-rich waste

-initially intrinsic water content is sufficient, but for the completion of adipocere, moisture or water in the environment is necessary.

Constituents of adipocere:

- hydoxy-palmitic acid
- oleic acid
- hydroxy-stearic acid, glycerol

Amount of fatty acids in the body:

0.5% - at the time of death

20% - in 1 month of beginning of adipocere formation

70% - in 3 months

Factors that influence adipocere:

- body fat
- moist or aquatic environment
- warm temperature (21^0 – 45^0C)
- intrinsic bacterial enzymatic action
- coffin

Properties of Adipocere:

Fresh: soft, greasy, whitish, translucent

Old: dry, hard, brittle, yellowish

Rancid odor

Floats in water, dissolves in alcohol, ether

Inflammable, burns with faint yellow flame

Features of the body are preserved

Adipocere inhibits putrefactive bacteria.

Distribution:

- cheeks, buttocks, breast, abdomen

Small muscles: dehydrated

Intestines, lungs: parchment-like

Liver: prominent

Time required:

3 weeks – 6 months (usually)

Adipocere may persist for years or decades, but finally degenerates or is removed by mechanical forces or by animals

Medico-legal importance:

- sign of death
- time since death
- identification
- cause of death (injuries)
- place of disposal of the body

MUMMIFICATION

MUMMIFICATION:

- modified form of decomposition characterized by drying and desiccation of tissues under the conditions of high environmental temperature, low humidity, good ventilation in which the body tissues are converted into dark, shriveled appearance.

Prerequisites:

- hot and dry atmosphere
- absence of moisture
- continuous action of dry air
- burials in shallow graves in dry, sandy soils

Mechanism:

- due to hot air and absence of moisture, body fluids evaporate and putrefactive bacteria cannot proliferate in that environment

Features:

Features of the body are preserved

Skin:

- shrunken, dry, brittle, leathery,
  blackish-brown, stretched, translucent

The entire body loses weight up to 60 to 70%,
becomes thin, stiff and brittle.

Internal organs:

- shrunken, hard, brownish-black
- become a single mass or disappears

A mummified body is odorless.

Distribution:

- begins in the exposed parts, then extends to the entire body

Time required for mummification:

3 months – 1 year

Fate of mummified body:

Protected: preserved for years

Not protected: broken in to fragments

Medico-legal importance:

- sign of death
- time since death
- identification
- cause of death (injuries)
- place of disposal

TIME SINCE DEATH

The time since death or post-mortem interval is the period between death and the actual performance of post-mortem examination.

Time since death:

Post-mortem cooling (1^0F /hr. on land; 1.5^0F/ hr in water)

Rigor mortis (starts 3 – 6 hrs., develops 6 – 12 hrs., remains 12 – 18 hrs., passes off 18 – 36 hrs.)

Post-mortem hypostasis (4 – 6 hrs., till decomposition)

Putrefaction

Entomology of the cadaver

Adipocere (3 weeks – 6 months)

Mummification (3 months – 1 year)

Time since death

Post-mortem changes	Time since death
Warm supple body, no patches of post-mortem lividity	With in 1 hour
Patches of lividity on the dependent parts, rigor mortis in the face muscles	2 – 3 hours
P.M. lividity well developed and fixed, rigor mortis in the upper part of the body, body cold	6 – 8 hours
Rigor mortis all over the body, with or without greenish discoloration over rt.iliac fossa, body cold	Around 12 hours
Body stiff, greenish discoloration over rt.iliac fossa, eggs of flies	12 – 24 hours
Body cold, rigor has receded, greenish discoloration over the abdomen and chest, distension of abdomen with evolution of gases	24 – 36 hours

Post-mortem change	Time since death
Marbling, distended abdomen and chest, presence of maggots, blisters	36 – 48 hours
Whole body bloated, face unrecognisable, nails and hair easily pulled off, grown maggots or pupae all over the body	3 – 5 days
Colliquative putrefaction (internal organs are reduced to unrecognisable black pultaceous mass)	1 week
Most of the soft tissues gone, prostate and non-gravid uterus recognizable	2 weeks
skeleton exposed bare	1 – 3 months