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Review of Early Post-Mortem Changes in the Human Body (3–24 Hours after Death)

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Abstract -Death is the irreversible cessation of all biological functions**,** body undergoes complex and intricate changes after death. Understanding the post mortem changes is important to estimate the time since death and cause of death. Early post mortem changes are associated with cellular death. They include changes in the eyes, changes in skin, cooling of body, post mortem lividity and changes in muscle. It's important to study the signs of post mortem condition which are changes or some factor influences the sign of death. This review article concludes all the condition or changes in the early signs of death.

Key words – Death, early signs, post mortem, Mortis, cellular.

Introduction-

Determining the time and cause of death is one of the most critical aspects of forensic medicine. In the early hours after death — specifically between 3 to 24 hours — the human body undergoes a series of characteristic changes. These changes, commonly referred to as early post-mortem changes, help forensic experts establish an approximate post-mortem interval (PMI), confirm death, and sometimes infer the manner or cause of death.

The changes appearing in the dead body after 3-24 hours of death.

- Changes in eyes
- Changes in skin
- Cooling of body
- P.M. lividity
- Changes in muscles

CHANGES IN EYES -

- Reflexes - abolition of pupillary & corneal reflexes.
- Cornea - loses its lustre dull, hazy, hard opaque and glistening lost
- Pupils–dilate at the time of death later become constricted.
  - 1-2 hours -respond to meiotic& mydriatrics.
  - 2-3 hours - any pressure on pupils, changes its shape to oval, triangular or polygonal.
- **Intra-ocular tension**-falls after death and the eyeballs become flaccid.
  - Normal -14-25 mm of mercury
  - Immediately -12 mmof mercury
  - 1/2 hour -3 mm of mercury.
  - 2 hours -0 mm of mercury.
- **Sclera-** deposition of dust on sclera, leading to brown pigmentation known as 'taches noires'
- **Retinal blood vessels**– 'trucking'
  - 1-2 hours after death - It becomes dotted.
  - 2-3 hours after death - It becomes segmented
  - More than 3 hours optic disc becomes pale.
- **Electrolytes** - there is increase in levels of Potassium & Ascorbic acid in vitreous humour.

CHANGES IN SKIN

1. Colour changes - the skin becomes greyish white in colour.
2. Loss of translucency- the skin loses its translucency and becomes opaque.
3. Loss of elasticity- there is loss of elasticity of skin
4. Lips-dry, hard & brown in colour.

POSTMORTEM COOLING - ALGOR MORTIS

Definition - The dead body loses its heat by conduction, convection, radiation & evaporation.

The progressive fall temperature is one of the most prominent early signs of death, the amount of cooling indicating the approximate time passed since death

No cooling of dead body occurs, if the atmospheric temperature is higher than that of body.

A fall in body temperature by more than 10°C is a sure sign of death.

Measurement of temperature in dead body

Temperature is recorded using chemical (laboratory) thermometer containing alcohol, being about 25 cm. long with graduation from 0 to 50^0 Celsius.

The preferred site for measuring the inner core body temperature is either the rectum or the abdominal cavity.

The thermometer may be kept in contact with the under surface of the liver through a slit made in the anterior abdominal wall and probe can be inserted in the auditory meatus or nostrils as deeply as possible.

Isothermic phase - When the body temperature is normal at the time of death, there is nofall in the rectal temp for about 45 minutes

Time since death= normal body temperature minus rectal temperature divided by the average rate of fall of temperature.

Rate of fall of temperature

1) Most widely accepted view is that the rate of cooling in India is 0.5 - 0.7°C /hr. so that body attains the atmospheric temperature in 16-20 hours after death.

2) As per another view, cooling is faster in initial period when the temperature difference between body & atmosphere is maximum.

In first 2-6 hours - Rate of cooling is 2-2.5°F /hr.

Next 6 hours - Rate of cooling is 1.5-2.0° F/hr.

& later on - Rate of cooling is 1°F/hr.

External surface cools in 12-15 hours, while interior takes 18-24 hrs. to cool.

3) As per another view, body cools by half of temperature difference between body & atmosphere - every 2 hours, and whole body cools in 12-15 hours.

4) At a particular place and at a particular time, rate of cooling of dead body can be known by taking two consecutive readings after one hour interval. The difference is the rate of cooling per hour.

Time required for cooling

Body starts cooling after 1-2 hrs. of death and attains the atmospheric temperature in 12-15 hrs. While internal body parts take 18-24 hrs. to cool.

Factors influencing cooling of dead body

1) Age - Body of small children & elderly cools faster.

2) General condition of body - lean body cools rapidly and fat bodies slowly

3) Sex - Usually body of male cools faster.

4) Clothes - A clothed body or body lying in bed cools slowly.

5) Atmospheric temperature - Rate of cooling is directly proportional to the temperature difference between body & atmosphere.

6) Type of death –

- In sudden death, cooling is slow.
- In death due to chronic diseases cooling is faster.

7) Surroundings

- Cooling is faster, if strong air currents are present.
- Cooling is faster in dry weather.
- Rate of cooling in water: air : buried; 4:2:1

Medico-legal importance of Algor Mortis-

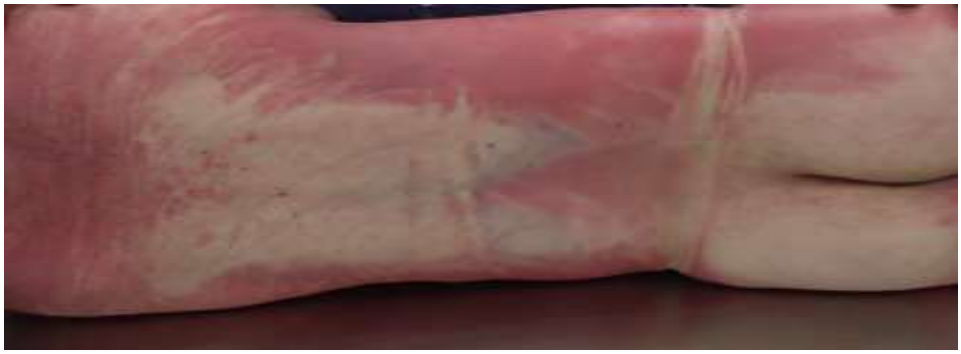
- Cooling of dead body is a sign of death.
- Time since death can be approximately known (better known in cold countries).
- In some cases P.M. Caloricity may result.

POST MORTEM CALORICITY

- Metabolic processes (anaerobic) or chemical processes continue after death, and liberate heat - known as exothermic processes.
- Bacterial or viral activity continuing after death - leading to heat production.
- Death had suffered violent muscular contraction e.g., convulsions, tetanus and strychnine poisoning.
- Heat regulating mechanism severely affected eg. Sun-stroke, pontine haemorrhage.
- Asphyxial death such as strangulation.
- Pontine haemorrhage.
- Septicemic deaths.
- Very high atmospheric temperature

POST MORTEM LIVIDITY

(Livor Mortis, PM Staining, Cadaveric lividity, Cadaveric staining. Hypostasis)



Definition-As dead body behave like an inert substance there-fore there is gravitational flow of blood to the dependent parts of body causing stagnation of blood in the toneless dilated capillaries, seen externally as patches of purple bluish discolouration through the skin.

Site PM Lividity-.

- In supine body- PM lividity is seen at posterior aspects of body
- In hanging- distal half of limb (hands,feet)
- In drowning - head being the heaviest part becomes the dependent part, therefore lividity is seen all around the upper half of body
- Running water- no fixed site.
- Sometimes haemorrhages haemorrhagic blisters may appear at of PM lividity
- No lividity is seen on pressure points
- Also no lividity occurs on parts tightly tied.
- Also no lividity occurs on scar as blood vessels are absent in scar.

Time required for P.M. staining - P.M. lividity commences appearing after about 1 hour of death, as small discoloured patches. During 2 to 3 hours these patches enlarge, coalesce with each other to finally form large areas of staining. After 6- 8 hours, P.M. lividity becomes unchangeable.

Fixation of P.M. lividity-

If the body is left undisturbed for certain length of time lividity becomes well developed and fixed.

Fixation of PM. lividity can be confirmed by pressing the discoloured part with thumb, when no blanching is seen. Fixation of lividity is due to stagnation of blood in toneless, dilated capillaries.

Before fixation, if the dead body is shifted or its position changed, the site of lividity will change.

Extent of PM. Lividity-

Extent of lividity depends upon amount of blood e.g.

- Lividity is more in CCF
- Lividity is less in death due to haemorrhage, anaemia or wasting diseases.

Colour of P.M. Lividity

Initially lividity is bluish pink, but after sometime it becomes bluish purple. The intensity of colour depends upon the amount of reduced haemoglobin.

In certain conditions, the colour of lividity maybe typical - e.g.,

carbon monoxide poisoning	Bright cherry red.
burns & cold	bright red
cyanide poisoning	bright red (brick
opium poisoning	almost black
hydrogen sulphide poisoning	bluish green
potassium chlorate poisoning	chocolate/coffee brown
phosphorous poisoning	dark brown
asphyxial deaths	dark bluish violet
haemorrhage	pale Purple

Effect of decomposition

- Site of lividity may change.
- Colour of lividity becomes dark brown & finally black.

Differential diagnosis

- Congestion of viscera
- Bruise/contusion

Medico-legal importance of P. M. lividity

- Is a sign of death?
- To know time since death.
- To know position or posture of dead body.
- If the body is shifted in first 6 hours, it can be known.
- Sometimes cause of death can be known.

CHANGES IN MUSCLES AFTER DEATH

- Primary relaxation or flaccidity.
- Rigor mortis or cadaveric rigidity.
- Secondary relaxation.

The muscles which are contracted or are in spasm at the time of death remain in spasm even after death, without the stage of primary relaxation-phenomenon is known as cadaveric spasm / instantaneous rigor.

A] PRIMARY RELAXATION

Characteristics of Primary relaxation

- Primary relaxation coincides with somatic death.
- Anaerobic enzymatic processes are still continuing.
- Muscles still respond to various stimuli,
- Pupils respond to drugs,
- At times peristalsis present.
- The reaction of muscles is alkaline.
- This stage lasts for 2-3 hours only i.e.till the molecular death does not occur.

B. RIGOR MORTIS

(Cadaveric rigidity, death stiffening)

Definition-

Rigor mortis is defined as contraction, stiffening,shortening and opacity of muscles after death.

Mechanism for rigor-

- A muscle mass is made up of a number of bundles of long fibres.
- Each muscle fibres in the bundles consist of densely packed myofibrils, which are the contractile elements of muscle
- These myofibrils are made up of two protein filaments - actin & myosin.
- In routine, actin and myosin filaments are present in interdigitating form separation of actin and myosin is responsible for extensibility and softness of muscle, during contraction of muscles, they come close to each other, during rigor, actin and myosin fuse with each other.

Muscles involved - All muscles of body e.g. involuntary & voluntary muscles

Sequence of muscle involvement

Involuntary muscles of respiration & heart go into rigor within 1-2 hours.
Voluntary muscles in the following sequence.Muscles of eyelids,face,jaw and neck,upper limbs,thorax abdomen,lower limbs and small muscles of hands & feet. (i.e.from top to bottom)
Effects of rigor Signs - Whole body becomes fixed & rigid, all joints become fixed, hair may stand out,testes are drawn up, Semen may be void, Heart may become empty and reaction of muscles is acidic.

Passing off of rigor

- Autolysis or decomposition
- If rigor is forcibly broken.

Time required-

Rigor mortis starts appearing 2-3 hours after death; becomes fully established after about 12 hours; stays on the body for the next 12 hours; and then slowly passes off the next 12 hours. This **rule of 12** also known as **March of rigor.**

Factors influencing rigor mortis

1) Age

- No rigor in foetus less than 7 months
- Rigor may be present in full term still born.
- Rigor appears early in children & elderly (less muscle mass).

3) Condition of muscles - Rigor appears slowly & stays longer in healthy & relaxed muscles.

4) Cause of death

- Rigor appears early in death due tochronic wasting diseases (less musclemass).
- Rigor appears almost immediately in deaths associated with convulsions e.g. tetanus & strychnine poisoning.
- Rigor appears immediately in death due to insulin injection (decreased glycogen)
- Rigor appears early in widespread bacterial infection e.g. gas gangrene.
- Rigor is delayed in death associated withparalysis, extensive haemorrhage& asphyxia.

5] Atmospheric temperature

Heat favours rigor (increased breakdown of glycogen & ATP utilisation), while cold delays rigor (almost by double). At temp, below 10°C, rigor mortis is rare.

Differential diagnosis of rigor mortis can be confused with

- Cold stiffening
- Heat stiffening
- Putrefactive (gas)stiffening
- Cadaveric spasm

4] Cadaveric spasm (Instantaneous rigor)

Definition: Instantaneous rigor is defined asthe condition wherein a group of muscles, which were in contraction or spasm at the time of death,continue to be in spasm even after death, without the stage of primary relaxation.Therefore, this stage preserves the attitude of the person at the time of death.

Preconditions

- Sudden somatic death
- A group of muscles in contraction / spasm (i.e., in extreme activity) at the time of death.
- Extensive physical & emotional activity at the time of death.

Muscles involved

Only the muscles, which were in activity at the time of death, go into spasm. Therefore spasm is usually present in hands, but rarely whole body may be in spasm. After 2-3 hours, cadaveric spasm changes into rigor, this disappears after decomposition

Breaking off of spasm

It is almost impossible to break cadaveric spasm.

Time required

Spasm results immediately on death.

Effects of cadaveric spasm

If the muscles of the hand get into instantaneous rigor, item held in hand at the time of death,remains tightly clenched in hand even after death, and it is almost impossible to remove it e.g.

- In a case of suicide the weapon remains tightly held in hand. even after death.
- In a case of homicide, involving struggle, the hair or a piece of cloth of the assailant remains tightly held in hand of victim.
- In case of death due to drowning, a plant, stone or sand may be tightly held in hands (At times sand present under the nails. Finger tips may be abraded).
- In a soldier killed in battlefield, spasm may be in whole of his body.

Medico-legal importance of cadaveric spasm

- To know the manner of death - i.e., whether suicide, homicide or accident.
- In case of homicide,identity of assailant can be known.

Medico-legal aspects of rigor mortis

- Is a sign of death?
- Time since death can be known.
- It can be known, if dead body was shifted.

C) SECONDARY RELAXATION

After autolysis, muscles are again relaxed - labelled as secondary relaxation

- Muscles & pupils do not respond to stimuli.
- Reaction of muscles is again alkaline (due to lysis of proteins and formation of ammonia).
- Other signs of decomposition are present.

Conclusion-

Early post-mortem changes are vital diagnostic tools in forensic medicine. Their careful observation, measurement, and interpretation allow forensic experts to estimate the post-mortem interval, reconstruct the circumstances of death, and preserve vital evidence for medico-legal investigations. Between 3 and 24 hours after death, a predictable series of ocular, cutaneous, muscular, and circulatory changes occur — influenced by environmental conditions, body characteristics, and cause of death. Mastery of these observations is essential for both forensic pathologists and law enforcement agencies, forming a cornerstone in the investigation of unexplained or suspicious deaths.

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