Theme 2

FORENSIC MEDICAL THEORY OF DEATH. PROBABLE AND ABSOLUTE SIGNS OF DEATH

Lecturer
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Thanatology is a theory of the dying processes of a body starting with initial manifestations and ending with a complete decomposition of a corpse.

Death is an event that represents the permanent cessation of all biological functions that sustain a living organism. Phenomena which commonly bring about death include old age, predation, malnutrition, disease, suicide, murder and accidents or trauma resulting in terminal injury. Bodies of living organisms begin to decompose shortly after death.

Characteristic terminal state:

- Lack of oxygen leads first to compensatory-adaptive and then to pathologic changes in organs and tissues.
- Thus blood circulation centralization aiming at maintaining first and foremost the brain functions results in microcirculation disorders in the periphery.
- This causes structural and functional derangement of parenchymatous organs.
- As a result of progressing disintegration of the brain function, energetic metabolism both in the central nervous system and in parenchymatous organs is switched over to anaerobic glycolysis leading to lactic acid accumulation.
- Under the conditions of growing hypoxia there develops a "false circle" that causes increasing acidosis.
- Bioactive substances penetrate into blood causing paresis and paralysis of the microcirculation vessels, increasing vascular permeability and blood clotting, stases, punctated haemorrhages, formation of thrombi.
- The paralysis of peripheric vessels causes decrement of contractile myocardium function, which may lead to stops of heart.

Dying means the transition from life to death. Such a process can be rapid or slow. If a person died rapidly, it signifies, from the point of forensic medicine, acute death. If the process of dying lasts for a long period of time, it indicates agonic death. It is so important to establish how the person died because it helps to suggest a reason and cause of death. A forensic expert may confirm the type of dying according to the morphological features found in the body.

Phases the terminal state:

1) preagony;
2) terminal pause;
3) agony;
4) clinical death;
5) biological death.

- ***Preagony*** - falling of arterial pressure, loss of consciousness, decrease of metabolism;
- ***Terminal pause*** - arterial pressure and breathing are reduced, functioning of the central nervous centers becomes chaotic;
- ***Agony*** - further fall of the blood pressure, cessation of breathing and a sudden return to life (the last spark of life), steep reduction of all vital functions after;
- ***Somatic (Systemic or Clinical) death*** - is the reversible cessation of vital functions of the brain, heart and lungs. Life ceases in the body but persists in component parts, the tissues and cells.
- ***Molecular (biological) death*** - is the death of the tissues & cells individually. It signifies the loss of life in the component parts of the body.

After acute death subsequent changes occur in blood – first there appear loose blood clots which dissolve within the first 1 or 2 hours after death and blood completely loses capacity of secondary clotting. That is why a forensic medical examination of corpses of people who died rapidly with no signs of agony reveals fluid blood in the heart and vessels as a result of fibrinolysis.

Besides, at rapid dying one observes:

- cyanosis of face;
- ecchymosis in conjunctiva;

- intense and widely spread death spots (post-mortem lividity, Cadaveric Lividity, Post-mortem Staining, Livor Mortis);
- urinary and faecal excretion;
- as well as pink mucus in respiratory ducts;
- considerable venous hyperaemia of internal organs;
- the right half of the heart overfilled of blood;
- punctated haemorrhages on the surface of heart and lungs, occasionally in other organs.

If death is preceded by agony, one finds dense clots in the heart and vessels – red at short agony and yellow white or white – at long one. This is connected with fibrin precipitation rate. Thus in case of short agony fibrin fibres precipitate rapidly and red blood cells are contained in them.

In case of long agony the process of intravital fibrin formation is extended in time. That is why cellular blood elements manage to accumulate in the lowest vessel parts and the plasma without red cells forms together with fibrin light grey clots.

After the main vital functions of the body are stopped, there gradually develop changes that allow to establish certainly the fact of death – the absolute (reliable) signs of death which depending on the time of occurrence are divided into early and late.

Early absolute signs of death include
(occur within 1.5-24 hours after death):

- death spots (livores mortis),
- cadaveric rigidity (rigor mortis),
- cooling,
- desiccation of some parts of skin and mucous tunics,
- autolysis.

Death spots

After cardiac arrest blood circulation in vessels gradually stops. Due to gravity blood begins to accumulate in the lowest body parts. As a result, 30 min to 1 hour after death spots begin to appear. The term of their appearance depends upon the mechanism of death coming.

Death spots appear only in those parts of the body which have no tight contact with the surface on which the body lies. The parts where there is such a contact have no death spots.

Occasionally on the background of death spots there maybe imprints of objects on which the body lay. The changes in death spots depend on the prescription of death coming and occur in phases.

Three phases of the development of death spots are singled out:

1) hypostasis;
2) stasis;
3) imbibition.

To check whether lividity has fixed or not, we apply thumb pressure. If the pressed area of Death spots disappears completely and returns to its previous color in first two stages.

Hypostasis:

I phase of Death spots restored of 1 min. - up to 8 hours;
II phase of Death spots restored of 5-6 min. - 8-16 hours;

Stasis:

I phase of Death spots restored of 10-20 min. – 16-24 hours;
II phase of Death spots restored of 30-60 min. – 24-48 hours;

Imbibition:

do not change color - from the moment of death was more than 48 hours.

Cadaveric rigidity (rigor mortis)

2-4 hours after death specific changes in muscular tissue begin to develop which are referred to as cadaveric rigidity. First of all cadaveric rigidity can be found in the muscles of the lower jaw, then in the muscles of the neck, the body and the extremities. It becomes most intense 24 hours after death. Such a state of muscles is observed for 1 or 2 days, after that cadaveric rigidity gradually decreases. It disappears completely (secondary relaxation) in the same sequence 3 or 4 days after death.

After death the quantity of ATP decreases gradually due to its degradation and lactic acid accumulates in muscles. Actin and myosin irreversibly convert into gel. As a result muscles become hard and dense.

Muscular tissues of the decedent pass through the following stages after death:

- Primary relaxation.
- Rigor mortis.
- Secondary relaxation.

Primary relaxation - immediately after death, there is the relaxation of the general muscular tone and all muscles become soft.

Rigor Mortis is a condition characterized by stiffening and shortening of the muscles, which follows the period of primary relaxation.

The decedent shows persistent rigor mortis with the right and left arm defying gravity.

Cadaveric rigidity is established at corpse examination on the scene by way of establishing muscle density or relaxation and checking the possibility of passive movements in the joints of extremities. On the basis of the dynamics of cadaveric rigidity development one can establish the approximate time of death. In practice the degree of cadaveric rigidity is compared with the body temperature and the phase of death spots.

Cooling of the corpse

Metabolic processes in the body go together with the generation of heat as a result of which human body has a certain temperature. After death the regulatory systems stop functioning, metabolic activity slows down abruptly and heat generation stops. As a result body temperature gradually decreases.

At normal room temperature a corpse is being cooled in the first 6 hours after death 1 degree per hour, then the cooling rate slows down and equals 1 degree per 1.5-2 hours of the post-mortem period.

Desiccation of the corpse

A few hours after death the process of desiccation begins to manifest itself gradually. It is caused by the evaporation of liquid from the dead body. First of all such desiccation occurs in the tissues which are wet in living condition. If the eyes of a corpse were open, then after 5-6 hours on average brown yellow desiccation spots appear on the sclera according to how wide the eye lids are open. They are the shape of a triangle located on the iris and its top is directed toward the eye corner. These are Larche spots.

Autolysis

Since the reaction of the body's inner medium becomes acid after death, the hydrolytic enzymes are activated and they affects on the tissues digesting them. This process is called autolysis and is characteristic of living beings. At autolysis the cellular structure is deranged, cells swell up, lose their nucleuses and grow turbid. Further on organs and tissues grow soft, flaccid and get infiltrated with blood plasma. The terms of autolysis development in internal organs are first of all connected with their enzymatic saturation.

Cadaveric changes occurring on the 2nd and 3d day after death are considered late (follow about one day and more).

They are of two kinds: destructive and conservatory.

To the destructive changes belong:

-putrefaction,

-corpse damaging by plants and animals.

To the conservatory:

-adipocere, mummification,

-peat tanning, artificial conservation;

-and preservation of a corpse in certain mediums (cold, salty or other solutions).

Late signs (destructive):

Putrefaction

Characteristic features of putrefaction:

- Color changes
- Gas production
- Pressure effects of putrefactive gases

The first sign of putrefaction is a bad smell which is noticed within 20-30 hours after death. First color changes can be seen at the right iliac fossa in 2- 3 days after death. The skin at this site becomes greenish. It is explained by the following: the bowel, at the above mentioned area, is more liquid and full of bacteria. The microorganisms in the

bowels produce hydrogen sulphide, which reacts with the haemoglobin liberated from the haemolysed blood cells due to bacterial action, resulting in the formation of sulph-met-haemoglobin. Later, 4- 5 days after death, the green coloration spreads over the entire abdomen, genitals, extremities, face etc. The whole body of the deceased is discolored within approximately 1-2 weeks.

Early decompositional changes are manifested by green discoloration over the abdomen.

Gases collect in the intestines in 3 to 5 days, and the abdomen becomes tense and distended. Due to this, the diaphragm is forced upwards, compressing the lungs and heart. Blood-stained froth exudes from the mouth and nostrils (post-mortem purge). The compression of the stomach by the gases may force food outside (post-mortem vomit). Sometimes, the great pressure of gases results in post-mortem delivery of a fetus. When 5-7 days have elapsed after death the subcutaneous tissues become emphysematous and even a thin body appears obese (cadaveric emphysema is formed). The gas formation in the blood vessels may force blood stained fluid, air or liquid fat to form small blisters between the epidermis and dermis. These gradually enlarge, unite and rupture, exposing large areas of dermis (post-mortem bubbles). It takes place during 1,5-2 weeks after death.

Mummification

Mummification is a modification of the putrefaction in which there is dehydration or total dessication of the body. The skin becomes dry, shrunken, leathery and rusty brown. The body is odorless. The soft parts shrivel up, but retain their natural appearances and features. Internal organs become a dried mass. Free circulation of air, high temperature and the absence of moisture are the main factors affecting mummification. Required time for mummification is around 2-3 months (in the conditions mentioned above).

- ***Contents of the Stomach and bowels***.

Milk, tea, coffee leave stomach fairly rapidly (15-20 min.) mixed diets (meat, vegetables) exit the stomach in 4- 5 hours. Conditions like fear, shock or coma delay the emptying rate and power of digestion.

- ***Super-vital reactions.***

The dead tissue of the human body are proved to react to the actions of some mechanical and chemical stimuli. All those reactions can be detected during a limited time period. That is why they can be used for calculating the post-mortem interval.

- ***Mechanical stimulation.***

An impact of a neurological hammer in the point of the radial bone, 4-5 sm. below the elbow joint, causes extension of hand; and takes place in the body within 1-1.5 hours since death. Impacting m. biceps brachii produces a muscular contraction and idio-muscular stiffening is formed, which can be revealed within 6-8 hours after death.

- ***Electric stimulation.***

Electrical stimulation of facial muscles by the medium of a portable source of static current, results in their contraction within 6-10 hours after death.

- ***Chemical stimulation.***

An action of sol. atropine 1% into the eyes of the deceased dilatates the pupil, and suggests post-mortem interval is no more than 5-6 hours.