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Forensic Significance of Blood Poisoning

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Abstract: In addition to the main effect, most poisons also affect the blood to some extent. Substances whose effect on the composition and properties of blood is primary are called hemotropic poisons. They are divided into substances affecting hemopoiesis (benzene, lead compounds, cytostatics), causing hemagglutination (ricin, phasin), affecting blood coagulation (snake venoms, dicumarin), causing hemolysis (arsin, amanitohemolysin) and changing hemoglobin (hemoglobinotropic). In the practice of forensic medicine, poisoning with hemoglobinotropic substances is more common. Hemoglobinotropic poisons are manifested in practice mainly with carbon monoxide and methemoglobin-forming substances.

Keywords: blood poisons, forensic medical examination.

Carbon monoxide (CO) poisoning. Carbon dioxide is formed during improper combustion of organic matter and is colorless and odorless. Poisoning usually occurs in cases of fire, using faulty heating stoves, operating internal combustion engines in poorly ventilated buildings. These types of poisonings are mostly accidental and sometimes suicidal, depending on the details of the incident.

The basis of the toxic effect of is gas is its formation of a stable compound with hemoglobin - carboxyhemoglobin. As a result, hemoglobin loses its ability to transport oxygen and hypoxia develops. In addition, carbon dioxide affects the iron-retaining biochemical systems (cytochrome, cytochromoxidase, catalase, peroxidase, myoglobin) and disrupts tissue respiration, especially in the brain, due to the decrease in their activity. A large concentration of carbon monoxide has a paralyzing effect on the central nervous system, increases the permeability of capillary walls.

Carbon dioxide is not metabolized in the body and is excreted through the lungs. When poisoned people are taken out to fresh air, the gas is completely removed from the body within a few hours.

Symptoms of carbon monoxide poisoning usually develop gradually. Initially, there is a headache, noise in the ears, nausea, vomiting. The face turns red, the pulse quickens, blood pressure drops. Muscle weakness, breathing is disturbed. Later, a state of coma develops, accompanied by loss of consciousness and convulsions.

One of the severe, serious complications of acute carbon monoxide poisoning is toxic swelling of the brain, and hyperthermia of central origin is the first sign of this complication.

When the concentration of carbon dioxide in the environment is very high (more than 1%), the lightning form of poisoning develops. In this case, there is a rapid loss of consciousness, isolated convulsions in some muscles, and death occurs from respiratory arrest for a few seconds. In

these cases, carboxyhemoglobin can be detected only in blood taken from the initial sections of the left ventricle of the heart and the aorta.

The first signs of intoxication are detected when the concentration of carboxyhemoglobin in the blood exceeds 25-30%. When the concentration of carboxyhemoglobin exceeds 60%, death occurs due to paralysis of the respiratory center. In some cases (eg, ischemic heart disease, cerebrovascular disease), death can be observed at lower concentrations of carboxyhemoglobin. Women are more resistant to carbon monoxide poisoning than men, and babies are more resistant than adults. It causes death within 20-30 minutes when the concentration of Is gas in the air is 0.4%.

Because carboxyhemoglobin and carboxymyoglobin have a pinkish-red color, at autopsy, cadaver stains, muscles, heart cavities, liquid blood in blood vessels, internal organs, and sometimes skin and mucous membranes are this color. Fullness, small hemorrhages are observed in the tissue of internal organs and brain. Similar hemorrhages can be detected under the serous membranes, in the mucous membranes of the stomach and small intestine. In cases of prolonged poisoning, symmetrical ischemic necrosis planes are observed in the subcortical nuclei of the brain, dystrophic and necrotic changes in the heart, liver, and kidneys.

The presence of carboxyhemoglobin in the blood can be determined using preliminary tests. For example, when 33% solution of sodium or potassium alkali (Goppe-Zeyler test) or formaldehyde solution (Libman test) is added, the color of normal blood becomes brown, brown-black due to the formation of alkaline hematin or formalin hematin. In the case of carboxyhemoglobin, the color of the blood does not change.

Spectroscopic testing can also be used. Spectroscopy is characterized by the presence of two absorption bands in the yellow-green part of the spectrum for oxy- and carboxyhemoglobin. When a reducing agent (sodium hydrosulfite) is added to normal blood, the absorption channel becomes one due to the formation of reduced hemoglobin, while in blood containing carboxyhemoglobin, two absorption channels remain unchanged.

It should be noted that complex equipment and facilities are not required for conducting the preliminary tests mentioned above and they can be used not only in the process of autopsy, but also in clinical conditions in case of necessity.

To confirm the diagnosis of carbon monoxide poisoning, it is necessary to conduct a quantitative spectrophotometric examination of carboxyhemoglobin in the blood. In some cases, a critical approach to the results of these investigations is required. In particular, when death occurs quickly as a result of the direct impact of high concentrations of is gas on the brain, or when the victim is in fresh air before death, the amount of carboxyhemoglobin in the blood may be much lower or the test result may be negative. Therefore, when the victims are brought to medical institutions, a blood sample for carboxyhemoglobin testing should be taken as early as possible.

Poisoning with methemoglobin-forming poisons. This group includes salts of nitric and nitrite acids, nitrogen-containing aromatic compounds (nitrobenzene, aniline), potassium chlorate (Bertole's salt), hydroquinone. These substances are used in the production of rubber, paint, canned meat, and medical practice. In recent times, poisoning with them is relatively rare and is generally considered an accident.

Methemoglobin is a derivative of hemoglobin and has a brown color. In it, trivalent iron is stably bound to the hydroxyl group, and as a result, hemoglobin loses its ability to bind oxygen and transport it to tissues. The weakening of the osmotic resistance of erythrocytes by methemoglobin in large concentrations leads to hemolysis, and as a result, anemia and methemoglobinuria develop.

The first signs of poisoning appear when the concentration of methemoglobin exceeds 30%. When this indicator exceeds 70%, the victims die.

In the clinic of poisoning, symptoms related to hemic hypoxia are mainly determined - shortness of breath, cyanosis, headache, dizziness, collapse. Aniline, hydroquinone affects the central nervous system and paralyzes the respiratory center. Due to the effect of nitrites on the vascular center, blood vessels expand paralytically, the permeability of vessel walls increases, blood pressure decreases and collapse develops. Nitrates have the ability to form methemoglobin only when they are converted into nitrites under the influence of intestinal microflora, and therefore they have a weaker effect than nitrites.In cases of long-term poisoning, symptoms typical of hemolysis-related liver (yellowing of the mucous membranes and skin, liver enlargement) and kidney (oliguria, anuria) damage are more evident.

On the first day, death occurs from acute hemic hypoxia. In the following days, death occurs from acute kidney failure. Therefore, after 1-2 days, if the victims have symptoms of anemia, nephrosis with hemoglobinuria, methemoglobin may not be detected in the blood. In cases of severe poisoning, methemoglobin can be found in the blood for 5-6 days.

In the examination of the corpse, the stains of the corpse are bluish-gray, bluish-brown, brown, and the internal organs and relatively condensed blood are brown. The liver is enlarged, with dystrophic changes, the kidneys are also enlarged, their layers are not clearly differentiated. Microscopic examination of the kidneys reveals symptoms of nephrosis with hemoglobinuria. In case of poisoning with nitrobenzene, the body cavities and internal organs smell of bitter almonds, and in case of poisoning with aniline - a specific aromatic smell.

In the diagnosis of this type of poisoning, in addition to the details of the event, clinical and morphological changes, qualitative and quantitative determination of methemoglobin in the blood (by spectrophotometric, gas-chromatographic methods) is important.

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