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Industrial Poisons, Prevention of Occupational Poisoning

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Abstract: to familiarize students with the basics of industrial toxicology, the effects of industrial poisons on the body of workers and measures to prevent occupational diseases and poisoning, as well as to give an idea of sanitary and chemical methods for determining the content of harmful chemical substances (HCS) in the air; teach how to give a hygienic assessment of chemical air pollution.

Key words: chemical compounds, petrochemical, chemical-pharmaceutical, agricultural, pulmonary epithelium, hydrocarbons.

Many types of professional activities related to the production, processing of raw materials, production and use of industrial products are carried out under conditions of exposure to industrial poisons on the body. Currently, humanity knows about 10 million chemical compounds, of which more than 60 thousand are widely used in everyday life, medicine, production and agriculture. Their number continues to increase from year to year, according to some data by approximately 1,500 items annually.

The chemical factor is the main one in such industries as chemical, petrochemical, chemical-pharmaceutical, agricultural, etc. In the process of labor activity under unfavorable production conditions and disruption of the technological process, chemical substances can have a harmful effect on performance and health of workers, causing occupational poisoning and diseases of chemical etiology. The future doctor needs to have certain knowledge in the field of industrial toxicology, an understanding of the role and significance of chemical pollutants as etiological factors of many diseases for the correct approach when collecting anamnesis, for diagnosing and treating the patient.

The respiratory route of entry of poisons into the body. The pulmonary epithelium is a thin structure with a large surface (more than 100 m2), in close contact with a wide network of capillaries, so the absorption of foreign substances can occur here at high speed. The absorption of vapors and gases occurs partially in the upper respiratory tract and trachea. The patterns of sorption of poisons through the lungs have been established for two groups of chemicals. The first group consists of the so-called non-reacting vapors and gases, so named due to their low chemical activity; they do not change in the body or their transformation occurs more slowly than accumulation in the blood. These include vapors of all aromatic and fatty hydrocarbons and their derivatives.

At first, the saturation of the blood with gases or vapors occurs quickly due to the large difference in partial pressure, then it slows down and, finally, when the partial pressure of gases or vapors in the alveolar air and blood is equalized, the saturation of the blood with them stops. The removal of gases and vapors through the lungs also occurs quickly based on the laws of diffusion. If, with a constant concentration of gases or vapors in the air, acute poisoning does not occur for a short time, then it will not occur in the future, since when inhaling, for example, harmful substances with a narcotic effect (benzene, gasoline), the state of equilibrium of concentrations in blood and alveolar air is established instantly. The second group consists of reacting vapors and gases. Quickly dissolving in body fluids, they easily enter into chemical reactions and turn into new compounds. Such PNs include oxides of nitrogen and sulfur that easily react with water, ammonia and some other compounds.

The level and rate of blood saturation with gases and vapors for various compounds depends on the distribution coefficient (K), which is the ratio of the concentration of vapors in arterial blood to their concentration in the alveolar air (K = blood/air). Non-reactive non-electrolytes with high K (alcohol, acetone) take a long time to pass from the air into the blood. Low K compounds, such as hydrocarbons, quickly reach equilibrium concentrations between the blood and air. Knowing the distribution coefficient for each substance, it is possible to foresee the danger of rapid and even fatal poisoning. Gasoline vapors, for example (K = 2.1), at high concentrations can cause instant acute or fatal poisoning, since gasoline saturates the blood very quickly, and acetone vapors (K = 400) cannot cause instant, let alone fatal poisoning, because because they slowly saturate the blood. Therefore, when they are inhaled, based on the symptoms that appear, it is possible to prevent possible acute poisoning by removing the person from the danger zone.

In practice, the solubility coefficient is used, i.e., the distribution of the substance in water (Oswald solubility coefficient), which has approximately the same order of magnitude as the distribution coefficient, i.e., the substance is highly soluble in water, well also dissolves in the blood. Toxic and highly soluble aerosols that enter the lungs pose a great danger, since their resorption into the blood can begin throughout the entire area of the respiratory tract and lead to a rapid toxic effect on the body. With low toxicity of the substance, its aerosol acts on tissue mainly as a mechanical irritant. In this case, good solubility is a favorable factor facilitating the rapid removal of PN from all parts of the respiratory tract.

Absorption of poisons through the skin. The structure of the skin allows for rapid penetration of both fat- and water-soluble substances through the epidermis. These properties are fully possessed by aromatic and fatty hydrocarbons, their derivatives, organophosphorus, organometallic compounds, etc. The combination of high toxicity of substances with good water and fat solubility contributes to a significant increase in the risk of poisoning when ingested through the skin. It has been proven that salts of some metals (copper, lead, bismuth, arsenic, mercury, thallium, etc.) can penetrate the epidermis after they combine with the secretions of the sebaceous glands or fatty acids inside the stratum corneum to become fat-soluble compounds. Zinc and cadmium, forming protein complexes, also penetrate the skin. Factors that influence the penetration of substances through the skin include: the degree of hydration, pH value, temperature, surface area of contact with substances, blood supply, etc. Liquid organic substances with high volatility quickly evaporate from the surface of the skin , but if they are part of ointments, pastes, adhesives, they linger on the skin for a long time and penetrate into the blood. Superficial damage to the skin increases the penetration of toxic substances into the body.

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