

Lecture 6

Occupational diseases from exposure to chemical factors.

(2 hours)

Scientific and methodological substation of the topic

Social and economic development of the society envisages improvement of labor conditions, as well as decrease of the level of general and occupational diseases. As to occupational diseases, their structure, character and progress have changed. Nowadays there is almost no severe forms of acute intoxication by industrial poison (nitric oxide or carbon oxide, hydrogen sulphide, aromatic nitrocompound or Oilsperse), as well as pronounced forms of chronicle poisoning with lead, tetraethyl lead, mercury, manganese, benzol, or other toxic matters. However, radically changing the work character, scientific and technological progress brings up new factors of production environment, which have negative effect onto the employees. In some spheres, there is a threat of the impact of existing production problems due to intensification of production processes. First of all, this concerns the expansion of the production of plastics, synthetic resins, leather, caoutchouc, organic dyes, chemical fertilizers, pesticides, as well as medicinal drugs.

Literature

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Methodical support

1. Media presentation

Lecture time calculation

№	Questions	Time (min)
1.	Occupational diseases with predominant affection of the blood system	5
1.1.	Intoxication with aromatic hydrocarbon (benzol).	15
1.2.	Intoxication with carbon monoxide.	15
1.3.	Intoxication with lead.	15
2.	Occupational diseases with major affection of nervous system	10
	2.1 Intoxication with Mercury (Mercurialism). 2.2 Intoxication with Tetraethyl Lead.	Students' self-studying 30

OCCUPATIONAL DISEASES, CAUSED BY CHEMICAL FACTOR IMPACT

1. Occupational diseases with predominant affection of the blood system

Among occupational diseases of the blood system, four main pathogenetic groups can be defined nowadays (Table 1).

Table 1

Classification of occupational diseases in the blood system

Pathogenetic grouping	Main clinical form	Etiological factor
Diseases, conditioned by toxic affection of marrow	Hypoplastic and aplastic states	Benzol, xylol, toluol, and ionizing radiation
Diseases, conditioned by the change of blood base	Acute methemoglobinemia, acute carboxyhemoglobinemia	Amido- and nitrocompounds of bezol (aniline, nitrobenzol, and trinitrotoluene) and carbon oxide
Disease, conditioned by hemolytic action	Acute toxic anemias, conditioned by intravascular hemolysis and chronic toxic anemias, conditioned by intracellular hemolysis	Arsenious hydrogen and phenylhydrazine
Diseases, connected with the disorder of the hemoglobin synthesis	Chronic sideroachrestic anemia and disorder of porphyrinic exchange	Lead

1.1 Intoxication with aromatic hydrocarbon

One of the simplest representatives of aromatic hydrocarbons is **benzol**. It is a colorless liquid with peculiar pleasant smell. It evaporates well at the room temperature. It is badly dissolved in water, but well in alcohol, ether and chloroform.

Benzol is widely used in various spheres of the industry: in rubber, chemical, pharmaceutical, polygraphic, paintwork, in the production of synthetic caoutchouc, explosive and medicinal matters. It is used as a solvent for fats and caoutchouc. The

allowed concentration of benzol in the air of the work zone is 5 mg/m³.

Under production conditions, benzol gets into the body mostly in the form of vapors through respiratory organs and undamaged skin.

Benzol is discharged partially in the unchanged state through lungs, partially, it oxidizes to hydroxyl compounds - phenol and dihydroxybenzene, which are discharged via urine together with sulphuric acid or gluconic acid. Benzol belongs to poisons with general toxic polytropic action; but its well-known action is the action onto the haematogenous system. This conditions listing of benzol with the group of "Blood poisons". In the result of the action of benzol, both acute and chronic intoxications can be observed.

Pathogenesis. With acute poisoning, the action of benzol is mostly obvious in the central nervous system and it progresses according to the type of poisoning with narcotic poisoning.

Mostly, pathogenesis of chronic poisoning is in the inhibition of haemopoiesis - affection of proliferation of progenitor cells on haemopoiesis. Obviously, from the intensiveness (concentration of benzol vapors in the air of production territories) and the duration (number of work years in contact with benzol) impact, as well as from individual properties of the organism and its haematogenous organs (inherited inclination and previous diseases, which influence the blood system) depends the depth and the stage of affection of the marrow.

With the great intensiveness of toxic impact, the deepest affection of haematogenous organs is possible. In such cases, total inhibition of haemapoiesis, disorder in proliferation of stem haematogenous cells and partially - predecessor of haemapoiesis take place. Also, ability of these cells to differentiate can be affected. The result of such deep disorder of haemapoiesis is progressing pancytopenia.

Less intensive toxic impact onto the marrow is accompanied by the inhibition of proliferation of differentiated blood cells (myeloblasts, erythroblasts and megacaryoblasts). Prevalent affection of granulocytopoiesis is possible here (progressing leukopenia) or thrombopoiesis (thrombocytopenia or hemorrhagic syndrome). Affection of germ of haemapoiesis can be assisted by pathologic changes or the impact onto a corresponding germ of haemapoiesis (fibromyoma, prolonged and excessive menses, gastric achylia, toxic impact onto the leucopoiesis of some medicinal drugs).

It has been stated that the toxic impact onto haematogenous cells are caused by not only benzol, as its transformations (phenols), which are created in the marrow, where benzol is accumulated. Thus, mutation in the chromosomal apparatus of haematogenous cells and the disorder of mitosis are conditioned by toxic impact of phenols.

Pathologic and anatomic pattern. Phenomenon of asphyxia is characteristic for acute intoxication with aromatic carbohydrates. Plethora of internal organs and spot hemorrhages in lungs, pleura, epicardium and mucous tunic of gastrointestinal tract; swelling, plethora of brain and its membranes as well as fine hemorrhages are observed.

At toxic intoxication with benzol, changes mostly take place in the

haemopoiesis system. Hemorrhages into skin, mucous and serous tunics, internal organs, soft brain membranes, matter of cerebral hemispheres, and its ventricles. The permeability of walls of blood vessels increases; perivascular intermediate sclerosis. Marrow has mucus-like consistency and it is pink-yellow. On the microscopic level, hypoplasia of marrow is noticeable; more rarely, atrophy and aplasia of the panmyelophthisis take place. All the shoots of marrow are affected. Sometimes, some areas of haemopoiesis stay. Together with the inhibition of haemopoiesis processes, there are cases with marked hyperplasia of marrow, up to leukemic pattern. Spleen is reduced, with phenomena of hemosiderosis. Liver is increased, and has signs of fat degeneration, hemosiderosis, intermediate sclerosis, and infiltrates with lymphoid and plasmatic cells. There are regenerated changes of epithelium of twisted channels in kidneys; ulcer on the mucous tunic, also much fat deposits in the hypodermic cellular tissue can be observed.

Acute intoxications under production conditions can be observed rather rarely. They belong to accidental situations due to violation of safety rules. In the clinical pattern, changes in the central nervous system can be observed.

With *light poisoning*, general weakness, headache, dizziness, nausea, vomiting, noise in ears and jiggling when walking are observed. However, other transformations from the side of other organs and systems are not observed. Sometimes, it is possible to notice some leukocytosis with stab shift, which passes fast.

With more *marked intoxications*, conditioned by the impact of significant concentrations of benzol, loss of consciousness and pupil change reaction can be observed. Intense respiration is slowed down, pulse is increased, and weak filling and arterial pressure are decreased. At the same time, marked leukocytosis can be often observed.

In case of provision of the corresponding assistance, recovery takes place comparatively fast. There are cases of sudden death from the paralysis of higher nervous centers with the action of high concentration of benzol (cleaning of tanks where benzol was).

Chronic intoxication develops fast with prolonged impact of subtoxic concentrations of benzol. The severity and character of phenomena, which develop with poisoning, depend on work conditions (character of production processes, the temperature of the environment, concentration of benzol in the air, as well as duration of staying under these conditions), and from the organism state.

There are mild, mean and severe forms of chronic poisoning with benzol.

In *mild cases* of chronic poisoning, the most characteristic sign is the decrease of the number of leukocytes. At first, transitory leucopenia is observed, then the decrease of the number of leukocytes is stable enough, and reaches the level 4.0-10⁹ per liter and lower. At this background, the decrease of the share of neutrophilic granulocytes with toxigenic grain, hypersegmentation of nuclears, and increase of the number of stab neutrophilic granulocytes can be observed.

From the central nervous system, neurasthenic syndrome prevails. Signs of hypertension are observed.

Chronic benzol poisoning of the *mean degree* of severity is characterized by further decrease of the number of leukocytes (up to $2.8 - 2.0 \cdot 10^9$ per liter). It is also accompanied by thrombocytopenia, the number of thrombocytes decreases to $120 - 80 \cdot 10^9$ per liter. From the side of the central nervous system, asthenovegetative syndrome can be observed, which is manifested through headache, dizziness, general weakness, adynamy, increased irritability, sleep disturbance and hyperhidrosis. There can be changes in the peripheral nervous system according to the type of vegetative multiple neuritis, especially among those who has contact with benzol through arm skin.

Changes of the state of the cardiovascular system are characterized by hypertensia, liability of cardiac activity, hypertension, and moderately marked myocardium degeneration.

Patient's functions of stomach towards hyposecretion are in disorder, digestion process gets worse and the acidity of digestive juices reduces. The liver is moderately increased, and its function is in disorder. The number of γ -globulin and sometimes, P-globulins is a little increased. Albuminoglobulin ratio is decreased.

Hemorrhagic syndrome (skin hemorrhages, epistaxis and menamenorrhagias), as well as positive symptoms of tourniquet and cuff takes place. The duration of hemorrhage increases; thromboplastic activity decreases; fibrinolysis is intensified, and the retraction of blood clot is in disorder.

In the marrow, various manifestations of a mild form of hypoplastic state with the intensification of proliferate activity of myelocariocytes.

With the *severe form* of poisoning, marked anemia is observed; the number of erythrocytes decreases down to $1.0 - 10^{12}$ in one liter; thrombocytopenia achieves the level of $30 - 35 \cdot 10^9$ per liter; the duration of bleeding increases to 15 - 20 min, and resistance to infections decreases. The following is characteristic: intense general weakness, drowse, noise in ears, dizziness, blackout, paleness of coverlets, and systolic noise in the upper part of the heart. Profuse hemorrhage appears (nasal, gastrointestinal and uterine hemorrhages). They are often accompanied by infectious complications (pneumonia, necrotic tonsillitis and septicopyemia). The latter can cause the death of patients.

The forecast in case of presence of a severe form of chronic intoxication with benzol can be rather unpleasant.

The described pattern of the chronic intoxication with benzol and the progress of hematological changes are rather conditioned. Thus, if in the air of the work zone where a worker is, the concentration of benzol is rather small, the pattern of poisoning is different. At first, anemia can take place, which later on is accompanied by leucopenia and thrombopenia. In some cases, blood transformation starts with thrombopenia, and then the number of leukocytes and erythrocytes decreases.

Prolonged action of benzol can cause the development of chronic leucosis, which does not differ much according to its clinical pattern from the non-occupational one. Mostly it is chronic myeloid leucosis, sometimes - lymphoblastic leucosis and arethmia.

Treatment. With acute poisoning, it is necessary to terminate contact with

benzol and stay outside as much as possible. In case of irritation of the mucous tunic of eyes, it is necessary to rinse them with 2 % of sodium bicarbonate, if respiratory tracts are irritated, then dionine is prescribed (0.015 g) or codeine phosphate (0.03 g two or three times a day). Good effect is provided by inhalation with the solution of baking soda; more severe forms of acute poisoning are the indication to prescribe oxygen. Together with it, hypodermic injections of 20 % of the solution of sodium caffeine-benzoate are prescribed in the amount of 1 to 2 ml or cordiamine of 2 ml. If in the future, changes in the liver take place, confinement to bed is prescribed; 15 to 20 intravenous injection 20 ml each of 40 % solution of glucose, 1 to 2 ml of 5 % solution of ascorbic acid. It is also possible to recommend a course (10 to 15) of intravenous injections of 10 % solution of calcium gluconate 10 ml each, which alternate with glucose injections (every other day). In addition, 20 pills three times a day are prescribed (total 15 to 20 days), vitamins B₁ and B₆.

With chronic intoxications with benzol, curing measures are determined by the character of main clinical manifestations of the poisoning and the degree of their definition.

With the presence of neurological symptoms, sedative drugs are to be prescribed (sodium bromide - 0.05 - 0.1 g two to three times a day; tincture of valerian - 6.0:200 ml - 1 table spoon three times a day; good result is provided by mild tranquilizers - meprobamate - 0.2 g or tazepam - 0.01 g two to three times a day). The duration of the course is two to three times. Together with it, it is recommended to administer 6 % solution of the vitamin B₁ with 1 ml intramuscularly during 15 to 25 days; 5 % solution of vitamin B₆ - 2 ml intramuscularly. The duration of the course is 1 to 1 / months.

In the clinical pattern of the blood affection, treatment should be conducted in a differentiated way with the consideration of current transformations. Hypoplastic state is the indication to prescribe pentoxile, which stimulates leucopoiesis and the production of antibodies. It is taken in after meals for 0.2 to 0.4 g three or four times a day, the course duration is 15 to 20 days. Leucopoiesis can be also stimulated by leucogen for 0.2 three to four times a day during a week.

Administering of vitamins B₁, B₂, B₆ and B₁₂, often shows good results. Sometimes, together with listed medicinal drugs, glucocorticoids, iron-containing drugs and transfusion of blood of the same type are prescribed.

In case of anemic syndrome, administering of hemostimuline is prescribed (0.5 g three times a day during meals).

Patients with toxic hepatitis are prescribed to take syrepar (intramuscularly - 2 ml during 30 days) and essentielle (2 capsules three times a day during meals).

Expertise of the ability to work. In case of acute poisoning with benzol of the mild degree, phenomena of intoxication pass fast (if further contact of the patient with benzol is terminated) and are not accompanied by the loss of the ability of the patient to work.

Recovery comes slower (on the fifth or seventh day) with the ointoxication of the medium degree, and a patient should receive a sick leave for this period. In the future, such patients are considered able to work on their occupation.

After a severe acute intoxication, stable outcomes of acute intoxication might

stay after the recovery in the form of some syndromes of affection of the nervous system. Such patients are considered to have limited ability to work and should be assigned to face the Expert Commission to receive the invalidism group in the result of the occupational disease.

Expertise of patients with chronic intoxication is conducted with the consideration of the character and the degree of the expression of hematological changes and the presence of other syndromes. With vaguely marked leucopenia ($4.0-3.0-10^9$ per liter) and the absence of other transformations of blood and normalization of the pattern of blood, temporary promotion to another position with easier conditions and beyond the action of benzol for the period of two months and a sick leave should be provided for this period. Later, it is possible to continue work according to the occupation under conditions of strict keeping to sanitary and hygienic norms.

With more marked hematological transformations (II phase), patients should terminate the contact with benzol and its homologues completely. Patients should be assigned to face the expert commission to receive III group of invalidism and temporary pension for the period of requalification due to the occupational disease.

With the severe form of intoxication, patients should be considered unable to work (II group of invalidism) due to their occupational disease.

Preventive measures. To prevent poisoning with aromatic hydrocarbons, it is necessary to carry out sanitary and hygienic supervision of technological processes (sealing-in of the equipment, and effectiveness of ventilation), connected with the utilization of benzol and its homologues.

When carrying out some types of work, it is necessary to use individual means of self-protection to protect respiratory organs. With this purpose, filtering respirator is used, and in some cases, it is possible to use isolating respirator.

Considering the possibility of the permeation of benzol through undamaged skin, it is necessary to consider inexpedient to wash hands and uniform with paint spots with benzol, as well as the contact of bare parts of the body with it.

Besides benzol, its homologues are widely used in industries (toluol and xylol) and chloral derivatives (chlorobenzene, dichlorobenzene, etc).

1.2 Intoxication with carbon monoxide

Carbon monoxide is a colorless gas, and in pure form, it has no smell or taste. It is lighter in weight than air; it does not dissolve in water and is well dissolved in the liquid ammonia.

Carbon monoxide is a constituent part of a number of gases, which are used or created in industries. Producer gas contains from 9 to 29 % of carbon oxide, and blast-furnace gas contains up to 30 %.

Under unfavorable sanitary and hygienic conditions, as well as if not to keep to rules of safety measures, occupational poisoning with carbon oxide at the industry can take place. Poisoning is possible in boilers, producer gas, blast furnace, open-hearth and foundry shops, as well as during testing of engines. Significant discharge of carbon oxide is possible during gunnery, bombardment and machine-gun fire, as well as in tank, armored cars and cartridge towers. The increased content of carbon

oxide can be observed in the air of some shops of ceramic, brick, cement, construction industry, as well as engine-rooms of diesel locomotives, cockpits, garages, auto machines, motor boats and in chemical industry during synthesis of some matters, output material for which is carbon monoxide. Due to the fact that the main part of carbon monoxide is carbon monoxide, it is necessary to consider the possibility of domestic poisoning.

The main way for carbon monoxide to get into a human organism is via respiratory organs. It can be discharged with air exhaling in an unchangeable state. Partial oxidation in the organism into carbon dioxide is possible.

Pathogenesis. According to toxic properties, carbon oxide is a strong poison, which impacts blood. High likeness of carbon oxide with bivalent iron to hemoglobin, which is almost 300 times higher than the likeness of hemoglobin to oxygen and it conditions its toxic action onto the body. Carbon oxide, squeezing oxygen from its compounds with hemoglobin, creates carboxyhemoglobin. Whereas a part of hemoglobin is inactive, what infringes the transportation of oxygen to tissues and leads to the development of hypoxia.

The number of created carboxyhemoglobin is proportional to partial pressure of carbon oxide and is inverse to the pressure of oxygen in the exhaled air. At the increased content of carbon, oxide in the exhaled air initiates the process of dissociation of carboxyhemoglobin, which is mainly over after 7 to 9 hours after single impact of carbon oxide. Such existing dependence is given in Table 2.

Table 2

Dependence between the stage of blood saturation with carboxyhemoglobin and clinical symptoms of intoxication with carbon monoxide

Content of carboxyhemoglobin in blood, %	Clinical symptoms of intoxication with carbon monoxide
Up to 10	Fatiguability at physical activity
10 - 20	Dizziness when moving, and headache
20 - 30	Headache, excitement, light fatigability, and fuddle consciousness
40 - 50	Headache, collapse and loss of consciousness
60 - 70	Unconsciousness and possible death
80	Fast death

Formation of carboxyhemoglobin is accompanied by the decrease of content of oxygen in the arterial blood with 20 to 12 %, arterial-venous difference up to 4-2 % (6 - 7 % in the norm), content of carbonic gas from 45 to 35 % (data in percentages are characterized with volumes of matters).

When poisoning with carbon oxide together with hypoxia, reduction of transportation form of iron in the blood takes place. Besides, at bigger concentration in blood carbon oxide has direct impact onto the cells of tissues, inhibits tissue respiration in the blood of brain, and carries out inhibitory impact onto the cytochrome-enzyme system.

Hypoxia and carboxyhemoglobin excites reflexes with carotid glomerules, have marked impact onto metabolism and the state of endocrine and vegetative system.

The boundary permitted concentration (BPC) of carbon oxide in the air of the industrial zone is 20 mg/m^3 . If working for not more than one hour, BPC can be up to 50 mg/m^3 ; if working for not more than 30 minutes

- it can be up to 100 mg/m^3 ; and if working for not longer than 15 minutes
- up to 200 mg/m^3 . Maximal single BPC in the atmosphere air is 6 mg/m^3 , and average daily one - 1 mg/m^3 . For residential facilities of BPC is 2 mg/m^3 .

Pathologic and anatomic pattern. In the pathologic and anatomic pattern of acute intoxication with carbon oxide are observed in the dissemination of vascular changes. In many organs and systems (skin, muscles and brain), plethora, small and large hemorrhages, as well as degenerated changes and necroses can take place.

A characteristic sign is a relative coloration of skin and mucous tunic, which gains pink coloration.

Clinics. The clinical pattern of the acute poisoning with carbon oxide is diverse and is characterized by mainly changes of blood systems, disorder of the activity of cardiovascular and central nervous systems. The coloration of mucous tunic and skin is bright pink and intensiveness usually corresponds to the degree of the severity of intoxication.

One of the syndromes, which have a decisive meaning in the diagnostics of acute intoxication with carbon oxide, is the change in the nervous system. At the action of some concentrations of carbon oxide take place passing symptoms of the disorder of the central nervous system, which are accompanied by a headache of pulsing character, mostly in the area of temples, nausea, vomiting, dizziness, general fatigability, weakness in legs, fast heart beating, and heart weakness.

At physical activity of a patient from the area, gas-laden with carbon oxide, and the provision of a corresponding assistance, all the listed above phenomena disappear gradually.

In case of prolonged action of significant concentration of carbon oxide, a severe form of poisoning develops, which is accompanied by the loss of consciousness and comatose state with complete inhibition of reflexes. When inhaling much carbon oxide, coma can take place immediately. During the coma, trismus or lockjaw can be defined, significant rigidity of muscles of the torso and limbs, dot cramps, pathological reflexes, disorder of cardiac activity and respiration. Depending on the severity of the intoxication, state of coma can last from several hours to several days. During growing disorders of cardiac activity and respiration (it becomes very rare and superficial), death can be caused by the respiratory center paralysis.

If the progress of toxic process is more favorable, then coma is replaced by a short-term period of movement excitement, in the basis of which there is the disorder of corticocortical activity, which appears on the background of external boundary dormancy, which is kept in the cortex. Patients jump, intend to run, become aggressive, and cannot orient in time or space. Excitement goes away, after what they gradually lose consciousness. However, complete renewal of the psycho activity does not take place immediately. For a long time, patients are in spellbound state, which can be characterized by dormancy of psycho processes, indifference to the environment, and disturbance of memory.

In the distant period after severe forms of poisoning, in particular after prolonged coma, stable affection of nervous system can be observed. They include phenomena of Parkinsonism, which can be clinically defined in several months after poisoning. Obviously, changes, which take place on the height of intoxication in extrapyramidal system, and for some time they can develop clinically compensated. At the progressing of the process, a corresponding clinical symptomatology develop: anemia, movement stiffness and rigidity of muscular system. Peripheral sectors of the nervous system at acute poisoning with carbon oxide suffer much more rarely. Cases of the progressing of neuritis and polyneuritis are described.

If the form of intoxication is severe, swelling of retina can take place; in the fundus of eye sudden expansion of veins can be observed, small hemorrhages along vessels, which can later cause atrophy of optic nerves. In some cases, complete loss of sight is possible, caused by the affection of central sectors of sight analyzer.

Severe acute poisoning with carbon oxide can be accompanied by trophic changes of skin and other organs. Patients, who have been under the impact of carbon oxide for a long time, often have affected skin. In the initial period, these changes of skin are more or less well-outlined erythema, which is pigmented further. In a number of cases, on the background of erythema, blisters of different sizes, filled with transudation of yellow color, which remind burns. Blisters are localized on the skin of chest, hips and limbs. They burst easily; in case of infecting, it can be complicated with purulent process.

Main pathologic processes, which are observed at acute poisoning with carbon oxide, include changes in the peripheral blood. Thus, at the light degree of intoxication, polycythemia, increase of the content of hemoglobin, sometimes, neutrophilic leukocytosis, increase of the blood viscosity and slowing down of ESR can take place. On the height of intoxication, determine carboxyhemoglobin is determined in blood.

Patients with acute intoxication with carbon oxide have changes in the cardiovascular system. They are characterized with the appearance of tachycardia, widening of heart boundaries, and tone dullness. Often, there are various types of arrhythmia can be met. On the height of intoxication, arterial blood pressure is increased.

The possibility of chronic poisoning with carbon oxide are denied by some researchers, but others consider them the result of numerous mild acute poisonings. Patients complain to have a headache, buzzing in the head, dizziness, increased fatigability, irritability, poor sleep, worsening of memory, short-term disorder of orientation, heart beating, dyspnea, states of unconsciousness, disorders of skin sensitivity, hearing and sight. Functional disorders of the central nervous system can be observed, like asthenia, vegetative dysfunction with angiodystonic syndrome, inclination to vessel spasms, and hypertension with further development of a hypertonic disease.

Chronic poisoning causes the development of arteriosclerosis. Possible disorders of a menstrual cycle, generative function among women, as well as unfavorable progress of pregnancy, and weakening of male sex functions.

The amount of hemoglobin and erythrocytes increase in the blood, and

moderate anemia and reticulocytosis can be observed.

First aid and treatment. A sick person should be immediately taken outside in the fresh air, and stay in calm state and be warmed up. Oxygen inhaling should be started as soon as possible.

At severe intoxications, urgent hyperbaric oxygen therapy is recommended for 1 to 1.5 hours, and in case of the necessity, this procedure should be repeated.

On the background of oxygen therapy, the rest of therapeutic measures should be taken. In mild cases, alcohol, tea, coffee can be used; in case of nausea - 0.5 % solution of Novocain can be used. Cordiamin and camphor can be administered hypodermically. During the first hours, 10 to 50 ml of chromosome, 20 ml of 5 % solution of ascorbic acid, 50 ml of 2 % solution of Novocain with 500 ml of 5 % solution of glucose and 1 or 2 ml of 5 % solution of pyridoxine can be administered intravenously. In case of brain swelling, the following lytic cocktail can be introduced intramuscularly: 2 ml of 2.5 % solution of aminazine, 2 ml of 2.5 % solution of Dimedrol, 2 ml of 2.5 % solution of promethazine, 1 ml of 2 % solution of promedol; 200 ml of 40 % solution of glucose (by drops intravenously) simultaneously with insulin- 10 units hypodermically can be administered. In case of cramps- enema with the solution of chloral hydrate (2 %, 100 ml) or barbamil (10 %, 5 - 10 ml), with disorders of respiration - 2.4 % solution of aminophylline 10 ml intravenously repeatedly, lobeline (1 %, 0.3 - 0.5 ml), and artificial respiration.

Verification of work ability. After treating of patients with acute poisoning of mean form in hospital, they are provided with an occupational sick leave and they stay under observation. Depending on the presence of severity of complications, their work ability can be limited, what conditions the invalidism of the occupational character.

Patients with initial signs of chronic intoxication are promoted to another job with the provision of an occupational sick leave for two months. In case of little effectiveness of the conducted treatment and preventive measures or marked symptoms, it is recommended to promote the patient to another job permanently with possible invalidism group on the occupational disease.

Preventive measures. Sealing-in of equipment and pipelines, where carbon oxide is possible to be emitted, full-time control over the concentration of carbon oxide in the air of facilities and fast withdrawal of the gas accumulated there, and automated alarm on unsafe concentration of carbon oxide.

Individual protection: if necessary, work in gas masks and respirators.

1.3 Intoxication with Lead

Lead is a soft, silvery-white or grayish metal. In the nature, it is mostly met in the form of sulphuric lead.

Poisoning with non-organic compounds of lead are more real in the mining and metallurgic industries, as well as in the production of lead paints and pigments, accumulators, during hardening of metal items in lead baths, in production of crystal, when soldering (utilization of lead solders), when cutting metal items, which are painted (red lead), as well as in polygraph enterprises.

Under production conditions, lead gets to the organism in the form of vapors

and aerosol mostly via respiratory tracts. A danger of the lead getting through a gastrointestinal tract only exists in case of failure to keep to sanitary and hygienic rules (contamination of hands and eating and smoking at work places). A low content of protein, calcium and iron in the meals of those, who work under conditions of the contact with lead, can assist to the increase of adsorption of lead in gastrointestinal tract. In the life, lead gets to the organism mostly through gastrointestinal tract with water, meals and in the result of contamination of hands.

The permitted concentration of lead in the air of the production zone is 0.01 mg/m³.

Lead circulates in blood in the form of highly dispersed colloidal phosphate or albuminate of lead. It is mostly extracted via a large intestine and kidney. It can be detected in all the secretions (saliva, digestive juices, bile-excreting and breast milk). In urine in the norm - from 0.04 to 0.05 mg/l of lead; in faeces - twice or three times as much. Lead mostly deposits in bones, then in the liver and kidneys. At the disorder of acidbase balance lead can leave in the form of readily soluble lead phosphate and circulate in blood again. Such unfavorable impact can cause trauma, infection and alcoholism.

Lead is an antiplasmatic poison with a wide spectrum of the action. It causes mostly changes in the nervous system and cardio-vascular systems; disorder of ferment reactions, which participates in the synthesis of hemoglobin and a vitamin exchange; and decrease of immunobiological reactivity of the organism.

Pathogenesis. Lead interacts in the organism with active groups of proteins - sulfhydryl, amine and carboxyl. In the result, the activity of much ferment is affected; first, they participate in porphyrin exchange including dehydratase 5-aminolevulinic acid and pherocheletase. The process of the transformation of tryptophan is affected. These changes slow down the formation of heme, and in the result of this and cytochrome, complicate the synthesis of pyridin nucleotides. In the result, energetic processes in cells are affected. Besides, under the impact of low concentrations of lead, the synthesis of RNA and DNA changes, and thus, plastic processes in cells are affected as well. It decreases adaptation opportunities of the organism and causes the increase of general sickness rate increases. The considered mechanisms are in the bases of syndromes, characteristic for the intoxication. The clinics of lead intoxication are given thought the connection merging of several syndromes.

Pathologic and anatomic pattern. At the lead intoxication in pathomorphological pattern, changes of nervous cells of anterior horns (*cornu ventrale*), where vacuolization, pigmentation, nuclear pycnosis, and dissolving of chromatophilic substance. Dystrophic changes in peripheral nodules can take place of the sympatic part of the vegetative nervous system and in general in periphery nerves. In cases of a severe affection in the brain and bone marrow, there are portions of hemorrhages and stases.

Clinics. Cardinal used to be characteristic for chronic intoxication with lead - lead border (dark gray, and sometimes, violet-flaky narrow line along the end of jaws) and the lead coloration (sallow gray color of a face) - now due to the improvement of the environment at the production, connected with lead; they lost

their diagnostic meaning. Chronic intoxication with lead can be characterized with mostly affection in the blood system, affection of the nervous system and gastrointestinal tract.

Changes of biochemical indications in the blood, caused by the intoxication with lead, comprise disorders of porphyrinic exchange; first of all aminolevulinate-dehydrase reacts when an increased amount of lead gets into the organism, the activity of which in erythrocytes decreases; the content of aminolevulinic acid, protoporphyrin and coproporphyrin increase in erythrocytes, which are considered the most reliable and specific signs of poisoning. The detected dependence of the expression of changes of porphyrinic exchange from the degree of the impact of lead, its content in blood and the severity of poisoning. Changes in the morphological pattern of blood - reticulocytosis, increase of the amount of basophile-grainy erythrocytes - refer to non-specific signs of saturnism, their diagnostic value is insignificant. Anemia at saturnism belongs to the group of hypochromic anemia, as its characteristic sign is hypochromia of erythrocytes at the increased content of iron in the blood serum (the so-called sideroachrestic anemia). In its development, a significant part is played by the direct impact of lead to erythrocytes, what leads to the reduction of the long term of their life. In the clinical pattern of the chronic lead intoxication, three stages can be distinguished:

Initial form of the chronic lead intoxication can be characterized by the absence of clinical signs and is determined based on the so-called laboratory symptoms of the intoxication. The content of aminolevulinic acid in the urine achieves 15 mg per one gram of creatine and coproporphyrin- 300 mkg per one gram of creatine. The level of lead in blood does not usually exceed 500 mkg/l, and in the urine - 100 mkg/l; reticulocytosis - up to 20 - 25 %, the amount of basophile-grainy erythrocytes increases up to 35 %.

Mild form of chronic lead intoxication is characterized by the joining of clinical symptoms. At this form of intoxication, the initial form of polyneuropathy can be diagnosed. Here, vegetative-trophic disorders can be diagnosed: pain, parasthesia, the feeling of numbness in limbs, especially at night at rest. Objectively at the neurological examination, the change of coloration of the skin on fingers can be observed (light cyanosis or paleness of the skin), hyperhydrosis, hypothermia, symmetrical distant disorders of the sensibility, first in the form of hypersthesia, and then - hypersthesia, muscular hypotonia, dormancy of dermatographism, labiality of arterial pressure, and tendency to bradycardia. The decrease of the excitement of olfactory, gustatory and visual analyzers can be observed.

Changes in gastrointestinal tract at the mild form of chronic lead intoxication are expressed through the affection of stomach secretion (increase or decrease), processes of adsorption into the intestines, intestinal mobility with the development of dyskinetic syndrome. Functional disorders of the liver are possible.

Disorders of biochemical indicators at this form of intoxication of the lead are more marked: the content of aminolevulinic acid and coproporphyrin in urine can increase up to 25 mg and up to 500 mkg per 1 g of creatine correspondingly, the content of lead in blood, as a rule, does not increase 800 mkg/l, and in urine it reaches up to 150 mkg/l; reticulocytosis - up to 40 %₀, and the number of

erythrocytes with basophile grains - up to 60 ‰. Some decrease of the content of hemoglobin is possible.

Marked form of chronic intoxication with lead is characterized by the development of marked polyneuropathy, at this with sensitive disorders, movement disorders can be observed, and asthenovegetative disorders.

The classical form of polyneuritis at the lead impact onto the body of a worker is the so-called antebrachial type of the paralysis. The syndrome is characterized by the major affection of extensors of hands and fingers. The process starts with the affection of bending extensor of fingers, and later it is accompanied by paresis of other finger extensors and hands, which stays in the position at right angle in a semi prone position. Fingers are bent; a thumb bends towards the palm (the so-called "hanging hand"). At the marked form of chronic intoxication with lead, the following can be observed very often: the so-called lead colic, which is expressed with fit-like pain in the abdomen, persistent constipation (the duration can be up to 10 - 14 days), which cannot be cured by laxative preparations; increase of arterial blood pressure, often with bradycardia, increase of the body temperature, as well as moderate leukocytosis and dark red color of the urine (due to the excretion of a big number of porphyrin). Sometimes, lead colic is accompanied by the affection of urinary tracts, and it develops as kidney colic. It is necessary to take into the consideration the possibility of the development of atypical vague forms of lead colic, progressing of which takes place during a long period of time in a wave-like form (from 3 to 4 months) and which are characterized by less marked clinic pattern and laboratory symptoms.

Recently, new data have been collected as to the mechanism of the development and progressing of lead colic. It is considered that at the action of lead onto the organism, autoantibodies are created, which, even before the appearance of clinical indications of the lead intoxication assist to the development of immune complexes. Autoantibodies appear in the result of changes of antigenic properties of erythrocytes due to metabolic disorders at the formation of heme or at the expense of creation of metal protein. These immune complexes, as well as erythrocytes with antigenic properties circulate in the peripheral blood, and first they affect normal blood provision in organs (at the expense of "plugging in" capillaries). It is caused by the disorder of microcirculation of organs and conditions a pain syndrome.

Nowadays under production conditions, lead colic starts gradually, with prodrome: increased fatigability in the end of a work day; general indisposition; pain in cortical bones, muscles and in the waist zone; loss of appetite, inclination to delaying of bladder emptying, irritability and sleep disorder. Sometimes, these phenomena appear together with pain in the stomach, which increase much and get cutting character.

For the marked form of chronic lead intoxication, the development of the anemic syndrome with the decrease of the level of hemoglobin lower than 130 g/l in men and 120 g/l in women is characteristic.

At the prologued contact with lead, affection of the determined portions of bones and limbs can be noted: appearance of homogeneous levelly darkened

intensive shadows in the metaphases in long cortical bones, which are much separated from the diaphyses of bones. Changes in the bone tissue at the intoxication with lead are not accompanied by the destructive processes, changes in periosteum are absent. Mostly, large and small cannon-bones, hip, shoulder, elbow and spoke bones, as well as ribs are affected.

Biochemical disorders at the marked intoxication with lead are the most expressed. The content of the aminolevulinic acid and coproporphyrin in the urine is over 25 mg and over 500 mkg per 1 g of creatinine correspondingly. The concentration of lead in blood achieves 800 mkg/l and higher, and in the urine 0 over 150 mkg/l; reticulocytosis is higher than 40 ‰; and the number of basophile-grain erythrocytes is over 60 ‰.

Treatment. The most effective therapeutic means at chronic intoxication with lead is complexing agents, which create strong nondissociating small toxic complexes together with lead, which can be easily taken out of the organism through kidneys. Mostly, 10 % solution of titacin calcium, which is administered intravenously once or twice a day for two to three days (20 ml in 500 ml of 5 % solution of glucose). Pentacin (especially at lead colic). Both preparations have high extracting activity regarding lead and are capable to terminate one of the most complex manifestation of saturnism - lead colic. Preparations are administered intravenously. Pentacin is administered in isotonic solution of sodium chloride or in 5 % solution of glucose - 200 ml once or twice a day, a daily dosage 2.0 to 4.0 g. The course of the treatment comprises three stages from 3 to 5 days of breaks between cycles. To treat intoxication with lead, D-penicillin is used in the daily dosage of 600 to 900 mg; it should be administered in 30 minutes after meals.

When treating patients with chronic intoxication with lead, which is accompanied by the neurological disorders, the following can be used: vitamins of group B; ascorbic acid; preparations, which have spasmolytic action, ganglionic blocker, and physiotherapeutic methods of treating.

If anemic syndrome is defined, the following is recommended: preparations of iron with hydrochloric acid, hemostimulin (hemostimulating agent, three times a day throughout a week); vitamin therapy - vitamin B₁₂ (100 mkg) every other day intravenously (15 injections), vitamin B₆ intramuscularly (10 injections).

In case of kidney syndrome, the following is recommended: diathermy of the area of the liver; intravenous injections of 20 ml of 40 % glucose solution, hypodermic insulin injection (5 units); 300 mkg of vitamin B₁₂ (10 to 12 injections); as well as vitamin K: 1 pill for five days.

Verification of the ability to work. The issue on verification of the ability to work at saturnism is solved depending on the expression of poisoning. At the initial form of intoxication, it is necessary to promote a person to another temporary workplace beyond the contact with lead for 1 to 2 months. In future, such patients can return to the same workplace (under condition of complete normalization of indicators of porphyrin exchange). In case of relapses of the intoxication, the worker has to terminate the contact with lead completely.

At the expressed form of intoxication, patients should be released from work with lead completely, even when complete disappearing of signs of saturnism can

be observed in the result of treatment.

Preventive measures. The most effective preventive measure is, certainly, replacing lead and its compounds with other non-toxic matters at corresponding productions.

Maximum mechanization of operations of processing of materials which contain lead; sealing-in of sources of dust discharge; equipping of production zones with rational ventilation, mechanical purification of work premises from dust. In premises with much dust, people should work in respirators or industrial filtering gas masks.

When working with lead and its compounds, it is necessary to keep closely to the rules of personal hygiene, prohibit eating at work places; smoking should be permitted only on specially equipped rooms. Significant role in prevention of intoxication with lead is on preventive eating products with pectin matters (fruit non-clarified juices and apples), as well as preliminary and periodic medical examinations.

2.OCCUPATIONAL DISEASES WITH MAJOR AFFECTION OF NERVOUS SYSTEM

Occupational intoxications, which develop with mostly the affection of the central nervous and periphery nervous system are called neurointoxication or neurotoxicosis.

Classical poisons, which mostly impact the nervous system include metal mercury, carbon bisulfide and tetraethyl lead. The neurotropic action is possessed by the many narcotic matters and hydrocarbon. Some chemical compounds can cause changes not only in the nervous system, but also in other organs and systems (lead, benzol, carbon oxide, fluoride, etc). Sometimes, the same matter in high concentration causes neurotropic effect, and in low concentrations, it has a different effect. For example, benzol at large concentrations has impact onto the nervous system (narcotic influence), and at low concentrations, it causes the change in the haemopoiesis system. Under the impact of high concentrations of phthalate plasticizers, irritation of the mucous tunic of eyes and nasopharynx take place, and at low concentrations, it can cause changes on the side of peripheral nervous systems.

Various sectors of the central and periphery nervous system are involved into the pathological process. There are changes in all the elements of the nervous system - vessels, cells, nervous fibers and neuroglia. Changes from the side of the nervous system at the action of toxic neurotropic poisons are non-specific. Some toxic matters differ by the selection of the impact onto various sectors of the nervous system: manganese - on the striopallidum's system, carbon oxide - onto basal ganglia; and tetraethyl lead - onto the thalamohypothalamic zone as well.

The mechanism of chemical matters onto the nervous system is variable. They possess blocking action onto the ferment system, mediators and biologically active matters. Inhibiting tissue respiration, they can cause hypoxia of tissues with changes of the nervous system. Narcotic matters block synaptic conduct of the excitement into the reticular formation of cerebral column, in the area of hypothalamus.

Clinics. Clinical pattern of acute neurointoxication is manifested by the

accumulation of psycho, neurological, somatic and vegetative symptoms. At severe intoxications, consciousness is in disorder, toxic coma or acute hypoxication psychosis develops.

At chronic intoxications, changes on the side of the nervous system can be manifested through syndromes of the vegetative and vessel dystonia (dysfunction), asthenovegetative and asthenoneurotic ones. In the later stage of toxic process, there are organic changes of the nervous system - toxic encephalopathy. Disorder of peripheral sectors of the nervous system can be manifested in the form of movable, sensitive and mixed forms of toxic polyneuropathies. There is also a vegetative-sensitive form of the latter.

Along the progress of neurointoxication there are two stages - functional disorder of the nervous system, which is manifested in earlier terms of the impact of poison and is characterized by the reversibility of changes, and the stage of limited changes in the central and peripheral nervous systems. Organic symptoms develop in case of long work period under unfavorable work conditions and are characterized by stable and long progressing even under conditions of the termination of the contact with the matters.