THIRD TUTORIAL

TOPIC:

OCCUPATIONAL DISEASES FROM PLASTICS, PESTICIDES, ORGANIC SOLVENTS

THESES

Academic 2021/2022

Occupational pesticide intoxications

Criteria that determine the severity and influence the course of intoxication

- physico-chemical composition of the substance
- the dose
- the place of entrance
- duration of exposure
- age
- the individual reactivity of the organism
- bad habits
- comorbidities

ORGANIC PHOSPHORIC PESTICIDE POISONING

Physico-chemical properties, general characteristics

Organophosphorus pesticides are one of the most commonly used agrochemicals in agriculture. Organophosphorus insecticides are the most common in plant protection. They are used for seed treatment, herbicides to control weeds, defoliants and disinsects (for defoliation and destruction of harmful shrubs and trees) , rodenticides (to control rodents) . The largest amounts of pesticides are released into the atmosphere during aviation applications or the use of ventilation sprinklers. One of the most commonly used organic phosphoric pesticides in practice are diacinon, demeton, metaphos, chlorophos, parathion, methyl parathion. In the United States, the most commonly used organophosphorus pesticide is malathion. They are liquids or crystals with good solubility in fatty solvents. They are metabolized in the body by oxidation, hydrolysis, desulfurization, demethylation and others. They are eliminated through the kidneys most often in the form of their metabolites and have a high cumulative capacity.

Toxic effect , pathogenesis of intoxication

They enter the body through the digestive and respiratory systems , skin and mucous membranes. They have a characteristic specific odor. Their toxic effect is associated with phosphorylation of acetylcholinesterase, blocking its functions and subsequent accumulation of undegraded acetylcholine in the area of synapses. The clinical picture of endogenous acetylcholine poisoning is developing.

Depending on the clinical course, there are acute and chronic poisonings.

Acute poisoning

They occur with a single exposure to organic phosphoric pesticide in toxic concentrations.

Clinical picture

There are three main clinical syndromes:

- **cholinomimetic** (muscarinic) - miosis, salivation, sweating, bronchospasm, pulmonary edema, bradycardia, nausea, vomiting, diarrhea, abdominal pain, respiratory paralysis
- **nicotine -like -** dizziness, lethargy, weakness of different muscle groups, with fibrillation, paresis of the respiratory muscles, coma, seizures.
- **cerebrotoxic -** clinical manifestations can vary in severity from headache, lethargy to coma in severe acute intoxications, in which seizures may be observed, especially in younger patients.

In severe forms of acute intoxications occurs central and peripheral respiratory paralysis, which can be overcome only by specialized respiratory resuscitation (intubation, oxygen therapy, mechanical lung ventilation).

Peculiarities in the course of intoxication

After ingestion , signs of poisoning occur rapidly within minutes with cholinomimetic syndrome . Fatal outcome in these poisonings is common and is associated with the development of toxic pulmonary edema and aspiration pneumonia . In the case of entry by inhalation or by cutaneous mucosa, the signs of poisoning in the first minutes and hours are mainly of the central nervous system - headache, fatigue, sweaty skin, twitching of muscle groups of the limbs, psychomotor agitation or depression of consciousness.

Muscarine-like and nicotine-like clinical signs are milder in degree, but with a longer duration in this type of entry.

Early and late toxic hepato- and nephropathies, as well as late paresis of the limbs can be observed / after 10 - 15 days from the beginning of the acute poisoning.

Diagnostic criteria:

■ Data from the anamnesis for acute single exposure in toxic concentrations / in the acute intoxication / or prolonged contact with a substance from this group / in chronic intoxications/

■ **S**pecofic clinical picture

■ Specific clinical symptoms determined by toxicological status

■ Identification of the toxic agent by toxo-chemical examination of biological materials / body fluids, blood, urine /

■ Determination and monitoring the dynamics of serum cholinesterase activity

Therapeutic algorithm in acute intoxication

■ **Cleansing detoxification**

√ Detoxification from the poison by gastric lavage, activated charcoal and saline cleansers / orally /

√ Purification of the blood from the poison by performing forced diuresis, and extrarenal methods for hemodepuration / hemodialysis, hemoperfusion /

■ **Specific antidotes**

√ The main antidote is atropine. It is a functional antagonist of acetylcholine **.**

In severe acute intoxications is administered in high doses in the range of 1-3 mg. every 15-30 minutes intravenously until atropinization of the patient, after which the doses are gradually reduced, adequate to the clinical picture and the values of serum cholinesterase.

√ Cholinesterase activators / toxogonine, obidoxime /

They can be use during the first 24-48 hours from the beginning of the intoxication, as they are practically ineffective at a later stage . They are administered intravenously in a dose of x 250 mg. every 4 hours.

■ Resuscitation

Atropine is not able to counteract the central and peripheral respiratory paralysis. It can be overcome only with the means and methods of specialized respiratory resuscitation, which includes intubation, oxygen therapy, mechanical lung ventilation. In paresis of the respiratory muscles , a tracheostomy is used .

■ Organ protective therapy

Cerebroprotective therapy is important because of the intoxication of the brain. Non-specific antidote-like cerebroprotective complex including nootropil, centrophenoxin, B-group vitamins is also used.

■ Prognosis

Acute poisoning requires long-term treatment, which is also necessary for the normalization of serum acetylcholinesterase values , as organophosphorus substances accumulate in fat depots and may periodically affect acetylcholinesterase.

Late paresis (mainly of the limbs), behavioral changes, disorders of memory, activity, etc. can be manifested as post-intoxication syndrome, in cases with acute poisoning.

Organophosphorus compounds are also used as toxic warfare agents.

Chronic poisoning

In case of prolonged contact with organophosphorus preparations, most often in occupational environment (greenhouses, warehouses for preparations, agricultural aviation, etc.). Clinical **cerebral** changes with headache, dizziness, insomnia, depression. chronic bronchitis, chronic hepatopathy.

Treatment

Symptomatic agents are administered after removal of the injured person from the environment with organophosphorus compounds.

Chronic occupational intoxications

Occupations at risk

In the conditions of professional exposure, from studies published so far there is evidence of a proven or suspected risk of toxic effects in the following contingents:

- workers directly involved in the production of organophosphorus pesticides;
- occupations related to the storage and transportation of pesticides;
- agricultural workers engaged in the use of preparations of this group;
- the workers in the areas treated with pesticides: sprayers, greenhouse workers, disinfectants, aviators, agricultural aviation technicians, field breeders;
- working on the destruction of large quantities stored in warehouses premises pesticides, after the expiration date for their use;
- working in areas treated with pesticides;
- chemists from the laboratories and research centers of the military industrial complex;
- ambulance drivers, doctors, medical professionals and paramedics,

professionally exposed to pesticides from direct contact with patients intoxicated with pesticides;

● laboratory assistants, chemists and other specialists working with pesticides in scientific research institutes and laboratories in the field of agriculture and others.

Characteristics of the adverse health effects of the impact of pesticides

Parameters of impact on the organism	Factors determining the nature and extent of the toxic effect on the body	Pathways of penetration
toxicity	chemical composition	inhalation
degree of volatility	exposure intensity	skin and mucous membranes
blastomogeneity	the dose	oral
mutagenicity	the statute of limitations and the rhythm of admission	
embryotoxicity	the individual sensitivity of the organism	
sensitizers properties	presence of concomitant diseases	

The most common in clinical practice systemic and organ damage from prolonged exposure to organophosphorus pesticides

1. **Impairments of the nervous - mental system**

● Chronic toxic encephalopathy
● Extrapyramidal symptoms
● Toxic cerebrastenia
● Distal motor-sensory polyneuropathy in the lower extremities with ascendancy and in the upper extremities + pyramidal symptoms (spastic paraparesis)
● Intellectual disorders
● Short periods of disorientation by the petit- mal type
● Depression
Attention Deficit and Hyperactivity Disorder
● Alzheimer's disease
● Schizophrenia and schizophrenia-like conditions

2. Damage to the cardiovascular system

● Decreased blood pressure;
● Bradycardia;
● Toxic cardiopathy.

3. Haematological disorders
● Toxic anemia with methaemoglobinaemia

4. Impairment of the gastrointestinal tract and liver
● Disorders of gastric secretion
● From functional liver disorders to chronic toxic hepatitis

5. Damage to the skin and mucous membranes
● Conjunctivitis
● Contact dermatitis

6. Damage to the respiratory system
● Irritant upper respiratory tract injuries
● Chronic bronchitis
● Bronchial asthma.

Factors determining the low detection rate of chronic organophosphorus intoxications:

- The non-specific clinical picture, which, especially in the early stage of chronic intoxication, could hardly be associated with pesticide exposure
- Workers in occupations that are in risk usually do not seek specialized medical care due to the respect of their employers.
- Employers themselves are not interested in timely and adequate diagnosis of health problems among workers exposed to pesticides
- Insufficient professional qualifications and lack of clinical experience among general practitioners and staff in occupational medicine services, to whom patients usually first turn for help
- The lack of appropriate medical equipment for toxico-chemical analysis and biological detection of toxic noxa, which hinders the early diagnosis of intoxication
- Imperfections in the model of hospital health care, where the diagnosis and treatment of occupational intoxications is regulated
  in clinical pathways, whose levels of competence and performance criteria do not allow the patient to be treated in the right place by the right specialists
- The chronic problems caused by the organization of the pre-hospital and hospital care of the risk contingents, which put the patient in the vicious circle

locked between his GP, otder doctors and specialized toxicological and occupational pathology care.

NITROGEN POISONING AND ITS COMPOUNDS

Physico-chemical properties

Nitrogen (N 3) is a colorless, odorless, and tasteless. Non-toxic. Its compounds are toxic .

■ Ammonia

Well soluble in water. It is used in refrigeration. It enters the body mainly through the respiratory system. With the liquid components of the mucous membrane of the respiratory tract forms an ammonium base, which has an irritating-corrosive effect on the respiratory tract and digestive system.

Toxo-allergic edema around these irritating-corrosive areas is especially specific for ammonia.

Clinical picture

Shortly after inhaling ammonia, **an acute pulmotoxic syndrome occurs:** eye irritation with profuse tearing, dry cough, pain behind the sternum, laryngeal edema, bronchitis, bronchiolitis, pulmonary edema, bronchopneumonia. Entrance through the mouth - **irritative-corrosive changes** in the mucosa of the esophagus and stomach.

Allergic swelling of the larynx to asphyxia and lethal outcome.

Treatment

removal from the environment, removal of clothing, cleaning the eyes with physiological serum or water, oxygen therapy, tracheostomy if necessary, respiratory resuscitation. Glucocorticosteroids, bronchodilators, inhalations with glucocorticosteroids and bronchodilators, analgesics. In oral form - protein water or anticorrosive mixture as an antidote .

■ Nitrous gases (nitrogen oxides: N O, NO 2, N 2 O 4, N 2 O 3)

They are formed when explosives explode, and can be found in the production of fertilizers, indoors when working with oxygen or acetylene devices. Their presence in unventilated storages including the ones for grain is possible. They dissolve easily in water, with the formation of nitric acid.

Entrance - the respiratory tract. With the alkaline components of the mucous membrane of the respiratory tract form nitrites with subsequent methaemoglobinaemia. The formed nitric acid have an irritating-corrosive effect on the mucous membrane of the respiratory tract.

Clinical picture

Pulmotoxic syndrome with catarrhal problems of the eyes, throat, trachea with short-term improvement. Latent period of 24-48 hours, followed by the **edematous period** of the pulmotoxic syndrome with: dyspnea, pulmonary edema, acute respiratory failure, hypoxic coma.

Treatment

Removal from the gassed environment, removal of clothes, ensuring absolute rest of the person a few hours after the attenuation of the initial catarrhal symptoms. Treatment with calcium supplements, antipyretics, glucocorticosteroids, cold eye compresses after rinsing

with water or saline.The pulmonary edema should be treated with active resuscitation of the lungs, diuretics, glucocorticosteroids, cardio tonic medications, antibiotic.

■ **Nitrites** (salts of nitric acid). White or yellowish crystals that are used in the textile, rubber and other industries. Sodium nitrite - lethal dose 4 gr, potassium nitrite, calcium nitrite, nitroprusside sodium, ammonium nitrite and others. Some are found in spring water from certain areas.

Entrance through the digestive system. Due to their strong oxidative action, they lead to the formation of reversible **methaemoglobin** (convert divalent iron in the hemoglobin molecule to trivalent), directly cause vascular muscle relaxation with vasodilation and collapse, especially specific fot the upper body, neck and face.

Clinical picture

Manifestations of methaemoglobinaemia with fatigue, dizziness, headache, nausea with cyanosis on the lips, face and fingers of the limbs. Methaemoglobin level in the blood above 0.5%.

Treatment

gastric lavage with charcoal, saline cleanser, anti-collapse cocktails with Effortil , glucocorticosteroids, infusion solutions, treatment of methaemoglobinaemia with Vit . C 1000 - 2000 mg i . v ., glucocorticosteroids 2 - 3 mg / kg.t. i . v ., neutral forced diuresis, exchange transfusion. 1% methylene blue solution with 20% glucose solution i . v .

■ **Nitrates** (salts of nitric acid)

Colorless crystals.Potassium nitrate, ammonium nitrate and others are more commonly used. They are used in the meat processing industry, chemical, metalworking.

Enters the body mainly through the digestive system. They impaired the body by the following mechanisms: irritating direct action on the intestinal mucosa, by converting them into nitrites under the influence of the intestinal flora and by importing potassium ions in potassium nitrate poisoning.

Clinical picture

Acute poisoning occurs with **gastrointestinal problems** with nausea, vomiting, diarrhea, mixed with blood, abdominal pain. **Methemoglobinemia. Toxic nephropathy** with hematuria, oliguria, acute renal failure. **Hyperkalaemia** with potassium nitrate.

Treatment

Gastric lavage with aqueous solution of medical charcoal, treatment of methaemoglobinaemia with glucose solutions, high doses of Vit . C 1000 - 2000 mg i . v ., metabolic transfusion, glucocorticosteroids 3-4 mg / kg.. for 24 hours, infusion resuscitation correction of hyperkalemia with the inclusion of sodium chloride solution 0.9% i . v ., if necessary hemodialysis.

The normal amount of methaemoglobin in the body varies from 0.5 to 1-2% is maintained by methaemoglobin reductase. The massive amount formed under the action of nitrites and nitrates (which under the action of the intestinal flora are converted into nitrites) methemoglobin, exceeds its activity and function and determines the clinical signs of these two poisonings - with the picture of methemoglobinemia.

CHLORINE POISONING AND ITS COMPOUNDS

Physico-chemical properties

Chlorine (Cl 2) is a yellow-green gas with a specific odor and high reactivity. Used in the First World War as a war poison.
Poisonings are occupational and domestic.

Entry route

By inhalation or oral route. Forms hypochlorous, perchloric and hydrochloric acid when in contact with the aqueous component of the respiratory mucosa, with irritating local effect. Chlorine compounds that cause oral poisoning are bleach - Natrium hypochloricum and Bertoletto's salt - Kalium chloricum - white powder with a toxic dose of 5 g and a lethal dose of 10 g. The toxic dose of chlorine is 0.2 mg / l., lethal - 2.0 g / l.

Pathomorphology

Irritant-corrosive changes in the mucosa of the digestive and respiratory systems. Swelling of the brain and meninges with multiple hemorrhages.

Clinical picture

Depending on the entry route , there are two forms of clinical course:

● INHALATORY FORM

immediately after inhalation without a latent period can be observed increased lacrimation, rhinorrhea, irritation behind the sternum with pain and dry cough, acute respiratory failure, dyspnea, cyanosis of the lips and fingers, laryngeal edema, toxic pulmonary edema, asphyxia.

Clinical course

In extremely severe stages - death in a few minutes at high concentrations of chlorine. In severe cases, progression of pulmonary edema in the following hours. Bronchiolitis, bronchopneumonia with greenish sputum mixed with necrotic particles of damaged mucosa. In severe poisoning long-term asthmatic bronchitis can be observed. Light forms of inhalation pass for a few days.

Treatment

Removal of the patient from the gassed environment (**enter with a gas mask!),** Oxygen supply, respiratory resuscitation - if necessary intubation, treatment of pulmonary edema with glucocorticosteroids up to 4 - 6 mg./kg . i . v ., furantril - 40 - 80- mg i . v . or 10 - 18% mannitol, cardiotonic medications. Inhalation with bronchodilators , glucocorticosteroids and.Antibiotic for prophylaxis is prescribed .

● ORAL FORM

Irritative-corrosive changes by type of coagulation necrosis. Bertoletto's salt causes methaemoglobinaemia and haemolysis, followed by acute renal failure.

Treatment

Protein water or anticorrosive mixture orally, analgesics, local treatment with Vit . A, Granofurin or other epithelial substitutes, glucocorticosteroids, early fibroesophagogastroscopy, parenteral nutrition. Dynamic monitoring by an otolaryngologist and surgeon. Threatment and laboratory tests as in corrosive acid poisoning.

Chronic poisoning

Impairment in the upper respiratory tract, possible perforation of the nasal septum, toxo-allergic skin lesions, asthmatic bronchitis, frequent bronchopneumonia are observed when working for a long time in conditions of chlorine exposure and non-observance of hygienic norms .

Treatment

Discontinuation of chlorine and chlorine compounds, symptomatic treatment.

CARBON OXIDE POISONING

Physico-chemical properties

Carbon monoxide (CO) is found wherever there are conditions for incomplete combustion of carbon-containing substances.

It is part of various gases: coke oven gas, gunpowder gases, exhaust gases from cars. Colorless gas without odor and color. Carbon monoxide have toxic effect.

Toxic effect

Causes **direct and indirect hypoxia** - with hemoglobin forms **carboxyhemoglobin.** Saturation of 66% of hemoglobin with CO is lethal. Affinity for cytochrome oxidase and myoglobin. It crosses the placental barrier and can cause fetal death or malformations.

Patients with acute CO poisoning retain pink color of the skin and mucous membranes !!

Pathomorphology

Scarlet red color of the venous blood. Redness and swelling of the soft meninges and brain, hemorrhage in the brain substance, degenerative changes in the brain ganglia.

Clinical picture

The main clinical symptoms are neuropsychiatric and depending on their manifestation there are 4 forms of clinical course:

 extremely acute form

It is characterized by rapid onset of asphyxia, coma, seizures and death

 severe form

occurs with altered muscle tone, impaired breathing, hypertension, hyperglycemia, infarct-like ECG image, retention of the coma for days.

 moderate form

It occurs with brief loss of consciousness, muscle pain, headache, dizziness, lethargy

 light form

For that form is typical **p**reserved consciousness with general toxic manifestations of headache, lethargy, neck muscle pain (carboxymyoglobin!), trismus of the neck muscles, nausea, vomiting, infarct-like ECG image, hyperglycemia.

Consequences of severe acute poisoning

Post - intoxication syndrome may occur after severe carbon monoxide poisoning **.**

The most typical is the cerebral manifestations : headache, insomnia, irritability, impaired memory and intellect .

Toxic polyneuritis and endocrine disorders have been observed as well .

Treatment

> Removing the patient from the environment with carbon monoxide

> Oxygen therapy,it is important to clean the mouth and upper respiratory tract of vomit before that

> Intubation in case of impaired breathing and active respiratory resuscitation!

> Hyperbaric oxygenation if possible as a method of choice for treatment.

> Control of cerebral and pulmonary edema with high-dose glucocorticosteroids up to 4 - 6 mg / kg. i . v ., Dexamethazone 4 - 8 mg i . v ., diuretics, hypertonic glucose solution - 20%, bronchodilators, calcium supplements.

> Exchange transfusion. Hemotransfusion.

Effects of gases emitted by fires -CO plus other gases

In the event of fires, in addition to CO and other gases, which are released depending on materials that burn (phosgene, hydrogen cyanide in plastics and other artificial materials, sulfur oxides, etc.), solid microscopic particles are released, which play the role of a mechanical factor in the composition of the fire gases. When inhaling smoke with CO, the main impairment is in the lungs - filling the interstitial space and alveoli and reducing the respiratory surface because of the solid particles.

Can be observed dyspnoea, abnormal breathing, cyanosis, shortness of breath with reduced respiratory motility, impaired breathing with bronchospasm, diffuse wheezing.

In severe cases - impairment of the lungs. In case of fires, the thermal and barofactors should not be neglected - burns of the upper respiratory tract, spontaneous pneumothorax and others are possible.

Treatment

Respiratory resuscitation, lavage of the bronchial tree several times, bronchodilators, glucocorticosteroids, inhalations with glucocorticosteroids and bronchodilators.

Chronic poisoning

Can develop during prolonged exposure to CO, most often in a occupational environment.

Main clinical symptoms

> neurological and neuropsychiatric **-** cerebrastenia, diencephalosis, polyneuritis, toxic Parkinson's syndrome, encephalopathy. After severe acute intoxication with CO impaired memory and intellect.

> Cardiotoxic - angina attacks

> hematological - pernicious anemia , polycythemia, splenomegaly

> endocrinological - thyrotoxicosis, impotence

Treatment

Medical history for acute poisoning, cessation of contact with CO, symptomatic treatment, cerebroprotective treatment with glucose-insulin infusions with Orozetam , Pyramem , B vitamins, enzyme preparations, Encefabol , physiotherapy procedures, rehabilitation - physical and mental.