

Ministry of Health of Belarus
Gomel State Medical University

Department of Orthopedic, Trauma and military field surgery
with the course of Anesthesiology and Critical Care Medicine

Head of the department, MD, Doctor of medical sciences, Julia Cherniakova

SUBJECT: "intensive care in Toxicology"

Educational and methodical development for students
4th year medical faculty

Author:

Assistant Alekseeva L.A.

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Methodical development is designed for self-study. It provides:

1. Background.
2. The purpose of training (skills and knowledge).
3. Basic sections.
4. Suggested Reading.
5. Questions for self-preparation.
6. Topics UIRS.
7. Teaching tools for organization of independent work of students
8. Training Material
9. Self-study.
10. Clinical problems and test control.

Relevance of the topic

Poisons are very common in nature as human habitat. With the development of society and its productive forces, chemistry, engineering, technology, there is a constant increase in the number of toxic substances. The total number of synthetic chemical compounds to date, more than 10 million. Steadily increasing number of acute and chronic poisoning mortality rates in the workplace and at home. All this testifies to the high relevance of the problems of recognition, treatment and prevention of acute poisoning.

Purpose of the lesson

The development of the general issues Toxicology: Classification, toxicokinetics and toxicodynamics poisons, the basic principles of general treatment of poisoning.

The student should know:

- classification of poisons;
- types of poisoning;
- stages of poisoning;
- toxicokinetics poisons;
- toxicodynamics poisons;
- clinical syndromes of acute poisoning;
- general principles of treatment of acute poisoning.

The student should be able to:

- diagnose acute poisoning;
- to assess the severity of poisoning;
- Identify patient management of acute poisoning;
- provide emergency assistance in the event of vital signs;
- Conduct a full range of therapeutic measures in acute poisoning.

Sections studied before and needed for the session

- basic pharmacology of drugs
- biochemistry of carbohydrate, protein and lipid metabolism
- pathophysiology physiology of the central nervous system, cardiovascular system, respiratory and

excretory systems

- clinic, diagnosis, treatment of respiratory, cardiovascular, renal, hepatic failure

Recommended Reading

Textbooks pathophysiology, pharmacology, biochemistry, internal medicine for medical students.

Suggested Reading on lessons

Main Reading

1. Dale, OA Anaesthesia and Intensive Care. / O. Valley. - M., 1998. - S. 508-522.

Further Reading

1. Epiphany, VF Clinical diagnosis and emergency treatment of acute poisoning. / VF Epiphany, IF Epiphany. - M., 2002. - S. 3-29.
2. Malyshev, V. Intensive care. Resuscitation. First aid. / VD Malyshev. - M., 2000. - S. 437-444.
3. Kattsung, Bertram G. Basic and Clinical Pharmacology: in 2 vols 2. / Bertram G. Kattsung. - M., 2000. - S. 487-528.
4. Luzhniki, EA Acute poisoning. / EA Luzhniki. - M., 1999. - S. 5-241.
5. Sumin, SA Emergency conditions. / SA Sumin. - M., 2004. - S. 428-436.

6. Online Resources

Questions for self-

Questions on basic knowledge

1. Classification of poisons.
2. Types of poisoning.
3. Toxic damage of the CNS, cardiovascular, respiratory and other systems.

Questions about the topic studied

1. The concept of toxicology, as a science. Toxicokinetics, toxicodynamics, biotransformation, lethal synthesis, half-life.
2. Exogenous intoxication. Classification of poisoning.
3. Toxigenic and somatogenic stages of poisoning.
4. General principles of treatment of acute poisoning. Stimulation of elimination (GI cleansing, forced diuresis, therapeutic hyperventilation).
5. Stimulation of biotransformation (HBO, protection of hepatocytes, phospholipids, vitamins), antidote therapy (chemical, biochemical, symptomatic antidote immunotherapy).
6. Methods of artificial (in vitro), detoxification (sorption, dialysis, ultrafiltration, plasma exchange).

Topics UIRS

1. Features of acute poisoning in young children.
2. Modern methods of extracorporeal detoxification.

Teaching tools for organization of independent work of students

1. Computer database.
2. Slides: extracorporeal detoxification methods.
3. Objectives, test control.
4. Tables: peritoneal dialysis.

5. Thematic sick.
6. Patient records.
7. Bank jobs for self-study.

Training Material

Toxicology (toxicon - poison, logos - teaching) is studying acute and chronic poisoning and solves a wide range of problems involving many related natural sciences (chemistry, physiology, immunology, etc.).

Poisoning - a pathological condition that develops as a result of the interaction of a living organism and poison, which can be any substance turns out to be harmful, or even lead to death. Poisoning caused by the arrival of the poison from the environment, are called exogenous, unlike endogenous intoxications toxic metabolites.

Classification of exogenous poisoning and poisons.

Classification of diseases as poisoning chemical etiology is based on three major principles: etiopathogenic, clinical and nosological.

Etiopathogenic classification:

By origin:

1. Random
 - Household;
 - Production;
 - Health.
2. Intentional
 - attempted murder;
 - Demonstration suicide;
 - software suicide.

By way of receipt of poison:

1. Oral.
2. Inhaled.
3. Percutaneous.
4. Parenterally.

Clinical classification:

Adrift:

- Acute poisoning ..
- Subacute poisoning.
- Chronic poisoning.

Acute and subacute toxicity occur immediately upon receipt of the poison in the body, or after a certain latent period, depending on the amount of the toxic substance and the condition of the body. Chronic poisoning develop at a slow acting poison, it comes into the body in small doses over a long time.

By severity:

- mild.
- High degree.
- severe.
- Deadly.

Nosological classification: based on the names of individual chemicals (eg, poisoning, methanol, carbon

monoxide, etc.).

Classification of toxic substances:

On the practical application:

1. Industrial poisons.
2. Pesticides used to control pests / crops.
3. Medicines.
4. Household chemicals.
5. Biological plant and animal poisons.
6. Chemical warfare agents.

By selective toxicity:

Heart poisons (cardiac glycosides, tricyclic antidepressants, blockers, calcium channel blockers, hellebore).

Neurotoxic venoms (psychotropic substances, FOS, isoniazid derivatives, alcohol and its surrogates).

Hepatotoxic poisons (chlorinated hydrocarbons, mushrooms, phenols, aldehydes).

Renal toxins (heavy metals, ethylene glycol, chlorinated hydrocarbons, oxalic acid).

Hemic poisons (carbon monoxide, nitrates, arsenic carbon fenatsitin, aniline).

Gastrointestinal toxins (acids and alkalis, salts of heavy metals, arsenic).

Pulmonary poisons (oxides of nitrogen and chlorine, chemical agents).

For toxicity:

- Highly toxic - lethal dose <15 mg / kg
- Highly toxic - lethal dose of 15-150 mg / kg
- Moderately toxic - lethal dose of 150-1500 mg / kg
- Low-toxic - lethal dose > 1500 mg / kg

Toxicokinetics poisons

Transport of toxic substances across cell membranes

Inflow of foreign substances in the body, their distribution between the organs and tissues, biotransformation and excretion suggest their penetration through a number of biological membranes, which are mobile structures made of protein-phospholipid complex with limited permeability.

There are 4 basic mechanisms of passage of substances through the membrane: passive diffusion, facilitated diffusion, active transport, filtration.

Damage to the cell membrane structures is one of the pathogenetic mechanisms in a variety of pathological conditions. Many toxic substances act primarily on cell membrane structure.

There are several mechanisms of membrane damage. In acute poisoning, the most common cause membrane damage is lipid peroxidation in mitochondrial membranes and liposomes, which leads to an increase in membrane permeability to ions. This can result in osmotic effects and rupture of membranes with the release of enzymes, including cytochrome c. Further oxidation of lipids leads to complete destruction of membranes and cell death.

General principles for the distribution of toxins in the body

Distribution of toxic substances in the body is through the blood, where it usually comes regardless of the route of penetration into the body. Toxic substances and their metabolites are transported by blood in different forms:

- due to plasma proteins, primarily to albumin;
- in the red blood cells (90% of arsenic and lead in circulating red blood cells);
- in the dissolved form (the liquid part of the blood).

One of the key toxicological indicators is the volume of distribution, ie characteristic of the space in which distributed this toxic substance.

The volume of distribution depends on the water solubility, fat-soluble and the ability to dissociate. Knowing the volume of distribution allows to compare the rate of excretion of the poison from the body at a rate of decrease in its plasma concentration and resolve the issue, proceed as if the new batch of poison in the body from the gastrointestinal tract.

Biotransformation of toxins

Biotransformation of poisons is on two main areas: metabolic decomposition reaction (oxidation, reduction, hydrolysis) and the conjugation reaction (connection with proteins, amino acids, glucuronic and sulfuric acids). The meaning of these reactions - non-toxic hydrophilic compounds that can be more easily excreted from the body excretory organs.

In the metabolism of foreign poisons focus is on hepatic cells with high enzymatic activity. Home detoxification enzyme reaction in the liver - the oxidation of xenobiotics by cytochrome P-450.

Sometimes the chemical reactions in the tissues leads to the fact that non-toxic or low toxic substance into a more toxic compound than the original. These metabolic processes are called "lethal synthesis". A striking example of this kind of transformation - the metabolism of methyl alcohol, the toxicity of which is completely determined by its oxidation products: formaldehyde and formic acid. The severity of ethylene glycol poisoning is directly proportional to the degree of oxidation of oxalic acid. Thus, the processes of conversion of foreign compounds in the body can not be considered only a "detoxification". In many cases, the body itself synthesizes the poison, and a blockade of such a "lethal" metabolic conversion can prevent chemical injury.

Elimination of toxins from the body

Ways and means of removing foreign compounds from the body are different. The practical value, they are as follows: kidney intestine → → → light skin.

Isolation of toxins through the kidneys is by filtration and active transport (secretion).

Removal through the intestines are substances which are not absorbed into the blood when administered orally, releases the bile from the liver to the intestine and received through his wall.

Most volatile nonelectrolytes excreted largely unchanged in the expired air or in the form of water and carbon dioxide produced by a biotransformation process in the body.

Through the skin, sweat glands secrete many toxic substances are nonelectrolytes (ethyl alcohol, acetone, phenols, chlorinated hydrocarbons), but the total number removed so toxic substance is small and does not play a significant role in its total clearance.

An important parameter is the elimination half ($t_{1/2}$) - this is the time in which the concentration of the toxic substance in the blood plasma is reduced by 50%.

Toxicokinetic characteristics of oral poisoning

The most common toxic substances enter the body orally. The absorption of substances in the gastrointestinal tract is affected by:

1. Acidity (pH) - better absorbed in the stomach acid, and in the gut - the base.
2. The existence and nature of food - toxic substances in the stomach can sorb food masses, diluted

them, resulting in contact with the mucous membranes of poisons will be difficult.

3. Peristalsis - deceleration motility increases the contact time with the absorptive surface.

4. The intensity of the blood flow in the gastrointestinal mucosa - a sharp slowdown in local blood flow and deposition of venous blood in the bowel in exotoxic shock leads to the equalization of local concentrations of toxins in the blood and intestinal contents, which increases the local toxicity.

Thus, the delay of toxic substances in the gastrointestinal tract in oral poisoning, which depends on the physical and chemical characteristics of the poison and the functional state of the stomach and intestines, requires thorough cleansing the gastrointestinal tract.

Toxicokinetic features inhalation poisoning

Absorption of toxic compounds through the respiratory system provides the most rapid intake of them. This is due to the very large surface area of absorption in the lung alveoli, the small thickness of the alveolar membrane, intensive blood flow to the pulmonary capillaries and no delays poisons.

The absorption of substances from the lungs is affected by:

1. Physico-chemical properties of poisons.

2. Physiological state of the body (respiration and circulation).

3. Solubility coefficient of toxic substances in the water - the greater the ratio, the more stuff out of the air into the blood.

4. The size of respirable particles - the larger the particle, the more they are deposited in the upper respiratory tract and are removed from the sputum.

Toxicokinetic features percutaneous poisoning

Penetration of toxic substances through the skin occurs mainly in the working environment and comes in 3 ways: through the epidermis, hair follicles and sebaceous glands ducts.

Diffuse through the epidermis-soluble substance. Keep in mind that some metal salts, combining with fatty acids and sebum, can be converted into soluble compounds and to penetrate the barrier layer of the epidermis.

Mechanical damage to the skin, thermal and chemical burns promote the penetration of toxic substances in the body.

Toxicodynamics poisons

Poison can be local, reflex and resorbative. Local action is manifested in the form of chemical burns of varying severity, skin irritation, mucous membranes, a reflex - a lightning reaction to the effects of the poison in the form of respiratory and cardiac activity; resorbative - in contact with the poison in the blood.

Cumulation - an accumulation of poisons in the body. It can be physical (body weight of poison) and functional (the accumulation of pathological changes).

Habituation (tolerance) - is decrease in sensitivity to a chemical, which occurs under the influence of its long-lasting, that can manifest weakening or complete disappearance of the symptoms of poisoning. To explain the mechanism of addiction to chemical environmental influences proposed several theories:

1. Metabolic theory that long-term effects on the body of matter become a permanent member of tissue metabolism, and thus lose their alien features. Accordingly lost defensive reaction to them.

2. According to the theory of enzyme in the body can synthesize special or induced enzymes that quickly break down the various xenobiotics.

3. Immunological theory is based on the ability of the body to produce antibodies to various foreign substances.

Stage of acute poisoning

Latent period - from the moment they take the poison before the first symptoms resorbtive action. It is absent when the penetration of the poison through the skin, mucous membranes, lungs, and under the influence of local irritation and damaging substances.

Toxigenic stage. Acute poisoning in the pathogenic aspect should be considered as chemical injury. All impacts associated only with specific effects on the body of toxic substances that are toxigenic effects of chemical injury. At this stage of the toxic agent is present in the body at a dose that could have a specific action associated with dysfunction of the membrane receptor proteins and other toxicity. This period depends on the distribution of poison in the body of its ability to cumulation and ways of elimination.

Somatogenetic stage - comes after the removal or destruction of a toxic agent. At this stage, the symptoms of poisoning are combined with clinical complications. In addition to the specific pharmacological action, the poison acts as a trigger factor, causing damage to the central nervous system (CNS), heart, lung, kidney, liver, or multiple systems. The final forecast is determined not only by the degree of intoxication, but the severity of secondary complications: acute renal failure (heavy metals, hemolytic poisons, etc.), hepatic failure (mushroom poisoning, etc.), etc.

The recovery period is characterized by a significant reduction in symptoms of resorbtive action and compensation somatogenic damage.

Diagnosis of poisoning.

Diagnosis of poisoning is based on the history, clinical examination and the results of chemical and toxicological studies of biological media. At the initial examination is often difficult to assess the severity of acute poisoning and to predict its outcome, a final assessment of the severity of dynamic monitoring is carried out at a hospital.

The main clinical symptoms of acute poisoning

Central nervous system (CNS). Impaired consciousness due to the effect of the poison on the cerebral cortex (poisoning hypnotics, alcohol, opium and its preparations, chlorinated hydrocarbons, ethylene glycol, etc.) or the onset of cerebral hypoxia (poisoning by carbon monoxide, hydrogen sulfide, nitrate, etc.).

Disorders of consciousness may be of varying degrees: sopor, toxic coma, mental disorders (delirium, psychosis), convulsions.

The defeat of the respiratory system. On the respiratory center to very many poisons. Acute functional and morphological changes in the respiratory system may be caused by irritating and suffocating poisons. Types of breathing disorders:

- bradypnea (depression of the respiratory center);
- tachypnea (in violation of the acid-base status);
- apnea (often as a result of irritation of the respiratory tract);
- pathological types of breathing (Kussmaul - at different coma, poisoning, leading to an increase in blood acidity, Cheyne-Stokes respiration is observed in cases of poisoning with toxins, depresses the respiratory center);

Pulmonary edema may develop in lesions of the cardiovascular system, or inhalation of toxic fumes, bronchospasm occurs by inhalation of toxic dust and gases that irritate the bronchial tubes.

Hypoxia and asphyxia may develop acutely or gradually, with the growth of lung function and hemodynamic disorders due to violations of the act of swallowing (the tongue, paralysis of the tongue), airway obstruction by mucus, vomit, they are under the influence of poisons stenosis suffocating and systemic toxicity .

The defeat of the cardiovascular system (CVS). Disorders of the cardiovascular activity can occur under the influence of toxic substances on the centers of the brain stem, directly on the heart muscle and blood vessels. Acute circulatory failure manifested acute heart failure and / or acute vascular insufficiency of the type of syncope, collapse and shock. Perhaps the development of arrhythmias, up to fibrillation, asystole.

Lesions of the gastrointestinal tract. Toxic substances are often caught in the gastro-intestinal tract. In this case, there is vomiting, which is a defensive reaction - the body tries to get rid of toxic substances. Vomiting in case of poisoning FOS also associated with increased motility of the gastrointestinal tract. When receiving irritating chemicals (metilsalitis acid, sodium salicylate, iodine) into developing acute gastritis, accompanied by nausea, vomiting, pain, belching. Intake of caustic substances (acid, alkali) causes deep burns of the esophagus and the stomach, which is accompanied by severe pain and causes shock. Burns can cause extensive bleeding and perforation.

Acute liver failure occurs when hepatotoxic poisoning toxins (arsenic, antifreeze, ethylene dichloride). Damaged hepatocyte, leading to degeneration of the liver up to necrosis. Jaundice, vomiting, weakness. In severe cases develops hepatic coma.

Renal failure occurs in poisoning hemolytic (vinegar essence, arsenic) and hepatotoxicity (antifreeze, mercuric chloride, dichloroethane) poisons (hepatorenal syndrome). In its development is of great importance to toxic substances in the nephron. It may be due to hemodynamic (shock, collapse).

The skin may be pale poisoning (sympathomimetics, insulin, FOS, antihelminthic, etc.), ashy-gray or cyanotic (aniline, nitrites, sulfonamides, salicylates, etc.). Flushing of the skin seen with atropine poisoning, cyanide, botulinum toxin, diphenhydramine, carbon monoxide.

Ocular symptoms. Wide pupil may be caused by taking anticholinergics, sympathomimetics, cyanide, tricyclic antidepressants, xanthine. Pupils are narrow (like point) when poisoning by opioids holinomimetikami, sympatholytic, FOS, barbiturates (early stage). Distortion of perception of light can cause cardiac glycosides and carbon monoxide. Methyl alcohol leads to partial or complete loss of vision.

Basic principles of treatment of acute poisoning

Regardless of the agent, the treatment of acute intoxication by the following principles:

1. Assessment of vital functions and correction of the violations.
2. Cease the poison in the body.
3. Removing free poison.
4. The use of antidotes.
5. Removing grown deep poison.
6. Symptomatic therapy.

1. Assessment of the conduct by the algorithm "ABCD".

"A" - the restoration of the airway.

"B" - effective ventilation. If necessary to assisted ventilation, or if necessary, artificial ventilation (AV) through an endotracheal tube.

"C" - assessment of blood circulation. Assess skin color, blood pressure (BP), heart rate (HR), oxygen saturation (SpO₂), data of electrocardiography (ECG) and urine output. Produce venous catheterization and staging of urinary catheter, if necessary - the appropriate medical treatment.

«D» - assessment of the level of consciousness. Depression of consciousness - the most frequent complication of poisoning. The oppression of the mind to perform tracheal intubation, as it is often associated with depression of respiration. In addition, inhibition of cough and gag reflexes may lead to aspiration.

The presence of marked agitation, seizures also require medical treatment.

In the presence of impaired consciousness should be carried out differential diagnosis of CNS trauma, hypoglycemia, hypoxemia, hypothermia, CNS infections, even if the diagnosis is obvious.

"E" - re-evaluation of the patient and the adequacy of actions performed. Spend its by every system of organs after each manipulation.

2. Warning contact poison in the body are at the stage of first aid. You need:

- Remove the victim from the atmosphere, caused by poisoning;
- When the poison through the skin (gasoline, FOS) wash skin with running water and soap. (The OP poisoning can be treated skin 2-3% solution of ammonia or 5% solution of baking soda (sodium bicarbonate), then 70% ethanol and re-running water and soap). Avoid rubbing the skin.
- In case of poison to the mucous membrane of the eye is recommended to flush the eye with isotonic sodium chloride solution.

3. Removing free poison. The main way to remove the poison from the gastrointestinal tract - gastric lavage. However, in cases of poisoning mushrooms, berries, preparations in the form of large tablets initially (before gastric lavage) is reasonable cause vomiting (if not) by pressing on the tongue to remove large fragments. Contraindications to induce vomiting reflex: poisoning substances damage the mucosa, convulsive readiness and seizures, impaired consciousness and coma.

Gastric lavage is an integral part of medical care, washed stomach irrespective of the poison exposure. Absolute contraindications for this method no. In cases of poisoning by certain poisons wash procedure has some limitations. So poisoning cauterizing poisons wash only possible for the first time since in the future, this procedure can lead to perforation of the gastrointestinal tract. When barbiturate poisoning gastric lavage is performed in the first 2-3 hours, then the tone of smooth muscles is reduced, possibly opening the cardiac sphincter and regurgitation, so in the future is only the aspiration of gastric contents.

Patients unconscious gastric lavage performed after tracheal intubation, as possible aspiration. Lavage performed through a catheter, which produce oral formulation, allowing a thicker tube. The depth of the state is determined by the distance from the edge of the teeth to the xiphoid process. For washing use cool tap water, a single fluid volume in adults is not > 600 ml in children under 1 year - 10 ml / kg, after 1 year - 10 ml / kg + 50 mL for each subsequent year. Stomach contents drained and sent for toxicological testing. The total volume of liquid - not < 7 L (10-15 L), washed to clean washing water. If poisoning lipophilic toxins (FOS, Analgin, morphine, codeine) are desirable repeated washing after 2-3

hours, as possible hepatoenteric recycling. Repetition of the procedure is also necessary in case of poisoning with oral forms, as their remains may be in the folds of the stomach 24-48 hours.

After washing the stomach to enter the stomach sorbents: activated carbon - 0,5-1,0 / kg in the form of powder. Re-appointment of activated carbon is carried to interrupt the enterohepatic circulation.

Along with coal usually recommended laxatives - vaseline 0.5-1 ml / kg, the application of 10-20% solution of magnesium at a dose of 250 mg / kg Their need is due to the fact that the sorbent toxin binds only 2-2.5 hours and then split off, so you need as quickly as possible to bring this complex.

Contraindications for laxatives: poisoning with iron, alcohol, lack of peristalsis, recent surgery on his intestines.

To remove the poison from the intestine free may conduct intestinal lavage, setting high siphon enemas.

4. Specific (pharmacological) treatment by antidote.

Radical neutralization and elimination of the poison of its action in many cases can be achieved with antidotes. Antidote - a drug that can eliminate or reduce the specific effect of the xenobiotic by its immobilization (eg, chelating agents), reducing the penetration of the poison to the effector receptor by decreasing its concentration (eg, adsorbents) or resilient receptor (eg, pharmacological antagonists).

Universal antidote does not exist (except - activated carbon - a nonspecific sorbent).

Specific antidotes exist for some toxicants. the use of antidotes - not a safe event, some of which have serious side effects, so the risk of giving antidotes must be comparable to the effect of its application.

Appointing an antidote should be guided by the basic principle - it is used only in the presence of clinical signs of poisoning by the substance for which it was designed antidote.

Classification of antidotes:

1) Chemical antidotes affect the physical and chemical state of the material in the gastrointestinal tract (activated carbon) and humoral environment of the organism (unitiol).

2) Biochemical (toxicokinetic) antidotes provide favorable change in the metabolism of toxic substances in the body, or the direction of biochemical reactions in which they participate, without affecting the physical and chemical state of the toxic substance (Reactivation cholinesterase poisoning FOS, methylene blue poisoning ethanol at methanol poisoning).

3) Pharmacologic (symptomatic) antidotes have a therapeutic effect by pharmacological antagonism of the action of the toxin on the same functional systems of the body (atropine poisoning with organophosphorus (OP), Neostigmine poisoning atropine).

4) Antitoxic immunotherapy is most popular for the treatment of poisoning animal poison bites of snakes and insects as antitoxic serum (against snakes - "antigyurza", "antikobra" or polyvalent serum; against karakurtpoison serum; Antidote therapy remains effective only in the early, acute phase toxicogenic poisoning, the duration of which vary according to the features of the toxicokinetics of toxic substances. Antidote therapy plays an important role in the prevention of irreversible states in acute poisoning, but has no therapeutic effect in their development, particularly in somatogenic phase of these diseases. Antidote therapy is highly specific, and therefore can be used only when significant clinical and laboratory diagnosis of this type of acute intoxication.

5. Removing grown deep poison amplify the natural and the artificial use of detoxification, as well as with the antidote detoxification.

Stimulation of natural detoxification is achieved by stimulating the excretion, biotransformation, and immune system activity.

Stimulation of hatching.

Forced diuresis is quite universal way of accelerating the removal of the body of toxic substances excreted in the urine. Forced diuresis reduces the concentration of the compound are excreted in the distal segment of the tubules, thereby reducing its reabsorption and increases excretion. The effectiveness of diuretic therapy significantly reduced due to the strong link of many chemical substances introduced into the body with proteins and lipids levels.

The method of forced diuresis provides preliminary water load, the introduction of a diuretic and replacement infusion of electrolyte solutions. This method of treatment should be under constant supervision major hemodynamic (blood pressure, heart rate, central venous pressure (CVP)) and hourly urine output, as Forced diuresis associated with water and electrolyte load placing increased demands on the cardiovascular system and the kidneys.

During the 1 hour intravenous 10-20ml/kg (1.5-2m) of saline or 5% glucose solution of potassium chloride, then entered osmодиuretiki type mannitol rate of 1-1.5 g / kg (in 15 -30 minutes) or saluretiki such as furosemide 1mg/kg (40-90mg). Daily infusion volume during forced diuresis is DGP (fluid maintenance) × 2-5, until a diuresis 2-5ml/kg/chas. For adults, this volume is not less than 5 liters.

Contraindications to forced diuresis:

- Lack of circulation, shock.
- Renal failure.
- convulsions.
- Pulmonary edema and / or swelling of the brain.

Complications:

- hydration and swelling of the brain.
- Pulmonary edema.
- Hyposodiemia.

Alkalization (alkalization) of urine increases urine output and improve elimination of toxins, if the toxic substance - lye. This is achieved by the use of sodium bicarbonate: 50-70ml of sodium bicarbonate in combination with a subsidy of 40-60 mmol of potassium chloride per 1 liter of infusion (children's dose of sodium bicarbonate can be calculated by the formula: dose (mg) = body weight (kg) × 3).

Acidification of the urine with acid poisoning can be achieved using ammonium chloride, as well as ascorbic acid, calcium chloride. Acidification of the urine is less effective compared to alkalinization.

Other methods include the removal of stimulation cleansing the gastrointestinal tract (see above) and therapeutic hyperventilation. Therapeutic hyperventilation is effective in acute poisoning with toxic substances, which are largely removed from the body through the lungs, besides normalizing blood gases in respiratory failure contributes to the normalization of metabolic processes in the body.

Stimulation of biotransformation:

Regulation of enzyme activity of hepatocytes. To accelerate the biotransformation of toxic substances may conduct the induction of microsomal liver enzymes by physico-chemical (ultraviolet, laser hemotherapy) and pharmacological (phenobarbital) methods. To inhibit the enzyme systems may use cimetidine, chloramphenicol. Given the important role of the liver in detoxification provision is necessary to protect hepatocytes, poisoning hepatoprotectors use (N-acetylcysteine (paracetamol poisoning) silibinin and lipoic acid (poisoning death cup) preparations containing silymarin, essential phospholipids, etc.), antioxidants , vitamins.

Hyperbaric oxygen therapy (HBOT) is used in cases of poisoning by carbon monoxide. During the HBO session at the pressure 3atm half-life of carboxyhemoglobin is reduced to 23m., And a 15-fold increase in the amount of oxygen dissolved in the plasma, which creates conditions for them to supply tissue than hemoglobin.

Therapeutic hypothermia is performed to reduce the intensity of the metabolic processes and increase resistance to hypoxia.

Stimulation of the immune system - by using immunomodulators and extracorporeal methods (ultraviolet and laser irradiation of blood, magnetic blood)

Methods of artificial extracorporeal detoxification.

Extracorporeal detoxification methods in acute poisoning is used for the following indications:

1. signs of progressive deterioration, despite ongoing therapy
2. poisoning potentially lethal dose of the agent (even in the absence of symptoms)
3. potentially hazardous concentrations of toxic substances in the plasma of patients
4. malfunction elimination of toxic substances (eg, acute renal failure)
5. development of serious complications: coma, respiratory distress syndrome, etc.

Extracorporeal detoxification methods are divided into:

Afferents methods:

- Plasmapheresis.
- Limfaferez.
- Hemoferez

Dialysis methods (extra-and intracorporeal)

- Hemodialysis.
- Ultrafiltration.
- Hemofiltration.
- Peritoneal dialysis.

Sorption methods (extra-and intracorporeal)

- Hemosorption.
- Limfosorbtsiya.
- plasmasorption.
- Enterosorption.

Affereticheskie methods.

Plasmapheresis called extracorporeal blood correction method based on the replacement of the patient's blood plasma components, blood products and (or) blood substitutes.

Plasmapheresis performed by centrifuge and / or membrane (filter) technology.

Centrifuge technology can do the two options detoxication plasmapheresis: a step-phased (discrete) and continuous manual method (hardware) using devices - blood separators. A hard method of separating plasma in the separating chamber, essentially representing the centrifuge and reinfusion of red blood cells a patient in the closed perfusion system, which avoids the major circulatory complications discrete plasmapheresis and combine techniques hemocorrection with sorption in a perfusion circuit.

When plasmapheresis membrane technology enables the separation of the main components of blood by filtering the pressure gradient through the device, containing impermeable blood cell membrane - plasma filter (Plasmafiltration)

The main indications for plasmapheresis:

- severe decompensated stage endotoxemia various origins (after wounds and injuries, thermal injuries, poisoning, radiation damage, etc.);
- severe generalized forms of infectious diseases;
- chronic autoimmune diseases (asthma, systemic connective tissue diseases, hematological diseases, etc.);
- endotoxemia chronic diseases of the liver, kidneys, lungs,
- total hemolysis or myolysis for poisoning hemolytic poisons, compartment syndrome, and others, poisoning toxins, tightly bound to proteins

Dialysis methods.

The concept of hemodialysis (from the Greek for "dialysis" - branch, and "hem" - blood) - the active cleansing blood of the endo- and exotoxins by passing the blood through a device (dialyzer) with semipermeable membrane between the blood and the dialysis fluid. The method is effective in acute poisoning with methanol, ethylene glycol, salts of heavy metals, etc., acute and chronic renal failure. The principle of operation of any unit of hemodialysis (HD) is based on the diffusion of small molecules on the osmotic gradient and the concentration gradient of the extracorporeal blood back. Blood is passed through a special device - dialyzer containing permeable membrane on the other side of which runs dialysis solution, in which diffusion occurs. Due to this process of elimination by DG from the blood of toxic substances of low molecular weight by means of diffusion, osmosis, and partly convection. Each of the units for DG consists of two main parts, the circuit of extracorporeal blood purification: dialyzer, where the blood purification process itself, and the monitor, to monitor and regulate the course of the DG: the flow rate of blood and dialysate, the temperature and composition, size and transmembrane pressure ultrafiltration, the integrity of the dialysis membrane, and a number of other factors.

Using special techniques (regulation of hydrostatic pressure in the perfusion circuit system) can achieve a certain amount of ultrafiltrate removal of blood plasma, and then replacing it with solutions of electrolytes. Ultrafiltration is an important component in almost every dialysis. It is used to remove excess fluid from the body and can be performed simultaneously or sequentially with hemodialysis. Indications hemofiltration may also be poisoning water soluble poisons. When using low-flow dialyzers and ultrafiltration volume to 5 liters it is not isolated as a separate operation. In the application of a high-volume filter dialyzers and exceeding 5L, we are talking about a completely different operation, called hemodiafiltration.

The main indications for hemodialysis:

- end-stage renal disease;
- acute renal failure of any origin;
- hyperkalemia due to renal insufficiency, adrenal, excessive use of aldosterone antagonists or potassium-solution after failure of conventional therapy;
- decompensated metabolic acidosis or alkalosis after failure of conventional therapy;
- azotemia in deficiency of kidney function;
- acute alcohol poisoning, technical liquids, bromides, salicylates, mercury salts, barbiturates, arsenic, toxins, fungi, etc.

Contraindications:

- The presence of severe disease often leads to complications in the treatment of hemodialysis.
- People with diabetes can not tolerate hemodialysis.
- Uncompensated hemodynamic disturbances due to hypovolemia or impaired myocardial metabolism.
- Do not stopped bleeding internally.
- intracranial or intracerebral hemorrhage.
- Acute respiratory failure.

The main indications for hemofiltration:

- Organ dysfunction of any origin to the development of edema, accompanied by unstable hemodynamic or hypotension after failure of conservative measures.
- dehydration if not properly plasm substitution accompanied by unstable hemodynamic or hypotension after failure of conservative dehydration.
- Acute renal failure of any origin, especially in the presence of sepsis and organ failure has been consistently developed and expressed in the presence of chronic disease or manifestation of complications from heart and circulatory system.
- Complications of chronic dialysis therapy, not be corrected with standard hemodialysis.

Sorption methods:

Hemosorption (HS) - a method of blood correction, based on the excretion of toxic substances blood endogenous or exogenous nature by extracorporeal perfusion through its sorbent.

Hemosorbent used to remove a wide range of low and medium molecular weight, gram-negative bacterial flora and endotoxin from the blood of patients.

Use 4 of sorbents: coal (actively absorb ammonia, bilirubin, urea, etc.), ion exchange resins (sorb metals and ammonium); immunosorbents (mechanism of action is based on the complement fixation reaction is removed from the blood of proteins or protein-bound substances, antibodies, allergens, etc.), agents for external application on the basis of fiber.

The main indications for hemosorption:

- withdrawal syndrome in drug addiction, drug addiction, alcoholism;
- manic and depressive states in mental diseases and conditions;
- acute poisoning with soporific drugs, chlorinated and organophosphorus compounds, alkaloids, salicylates, heavy metals;
- intoxication endotoxins.

Contraindications:

- all types of bleeding;
- violation of the blood coagulation system;
- lack of BCC;
- persistent hypotension;
- electrolyte disorders;
- hemodynamic instability;
- cardio-pulmonary insufficiency;
- severe liver and kidney damage.

Detoxification limfosorption based on the removal of the body lymph (3-5l/sut) with subsequent recovery of losses plasmocorrect fluids.

Xenoperfusing - extracorporeal blood correction method, based on a modification of the blood (plasma)

in contact with living xenogeneic tissue (body part body, xenogenic cells). To eliminate the use of substances and biotransformation hepatoperfusing.

6. Symptomatic therapy

Detoxification therapy may be insufficiently effective. This is possible due to the uncertainty regarding the harmful factor, its pathogenesis, often late onset, and insufficient its implementation, development of acute poisoning, including violations of the rheological properties of blood, hypovolemia, SGL, coma, coagulopathy, metabolic disorders, etc.

Relief of symptoms of acute respiratory failure, cardiovascular, renal and hepatic failure and other syndromes performed by conventional methods.

Self-study

Task number one

A patient 17 years old enrolled in the emergency room in an unconscious state with a diagnosis of acute drug poisoning amitriptyline. Was caused by resuscitation. According to relatives at home teenager found unconscious beside him found empty packages of pills amitriptyline (the last time his mother saw him about 6 hours ago). It also turned out that the patient was emotionally labile, frequently reported depression. OBJECTIVE: level of consciousness - coma (7 points on the Glasgow Coma Scale). D = S pupils dilated, RGU saved. Spontaneous breathing, clinically adequate (BH - 16 per minute, SpO2 95%). BP 180/110 mm Hg, heart rate 60 per minute.

- Define your tactics to the patient.
- What are the necessary additional tests to confirm the diagnosis.
- In what ways and under what conditions you will wash the stomach.
- How and what volumes (single and total) to clean the stomach.
- What drugs will you use to accelerate the elimination of the poison nevsosavsheysya explain their mechanism of action.
- Explain whether in this situation repeated washing.
- What methods of artificial detoxification preferable in this case, justify your choice.

Clinical problems

Objective number one

SMP team brought to the emergency department emergency hospital patient 34 years with a diagnosis of acute drug poisoning phenobarbital, diazepam, amitriptyline. Assistance provided in the prehospital setting: gastric lavage through a tube (total volume of about 3 liters), activated carbon 10 tablets of 0.5. Objectively: the level of consciousness of 6 points on the Glasgow coma scale. Pupils D = S, broad, RGU sluggish. Pale skin, cyanotic. Breathing shallow, auscultation dramatically weakened on 2 sides, dry and wet scattered rales, BH 32 per minute, SpO2 84%.

What mistakes are committed in providing pre-hospital care?

What complications developed in the patient, measures to prevent it?

Solution: gastric lavage in patients unconscious conducted only after endotracheal intubation. The total volume of liquid to wash - at least 7 liters. The dosage of activated charcoal in acute poisoning - 0.5-1.0 g / kg.

Most likely the patient developed aspiration syndrome. Prevention - intubation before gastric lavage.

Test control

1. Mark steps to reduce the intake of toxins from the digestive tract:

- 1) gastric lavage. *
- 2) Entering into charcoal. *
- 3) Appointment of stimulating the vital functions.
- 4) Forced diuresis.
- 5) laxative. *

2. Which diuretics prescribed for forced diuresis?

- 1) Triamterene.
- 2) hydrochlorthiazide.
- 3) Furosemide. *
- 4) sale. *
- 5) Spironolactone.

3. Hemodialysis is effective:

- 1) If the poisoning substances, little binding to proteins. *
- 2) If the poisoning substances are largely associated with malnutrition.
- 3) If any substance poisoning.

4. To speed up the excretion of the drug in the class of weak acids should be given the means, causing:

- 1) Increasing the pH of urine. *
- 2) Lowering the pH of urine.

5. Mark steps to reduce the concentration of the poison in the body:

- 1) Forced diuresis. *
- 2) Antidotherapy. *
- 3) Appointment of stimulating the vital functions.
- 4) Extracorporeal detoxification methods. *
- 5) Treat symptomatically.

6. It is extremely toxic poisons are substances lethal dose of:

- 1) <10 mg / kg.
- 2) <15 mg / kg. *
- 3) 15-150 mg / kg.
- 4) 150-1500 mg / kg.
- 5) > 1500 mg / kg.

7. The stomach is better absorbed:

- 1) Weak base.
- 2) Weak acid. *

8. Single gastric lavage volume of fluids in adults:

- 1) Not more than 600 ml. *
- 2) 800-900 ml.
- 3) No more than 1000 ml.
- 4) Not more than 300 ml.

9. Through intact skin diffuse well:

1) The hydrophilic substance.

2) lipophilic substances. *

3) Any substance.

10. Distinguish the following stages of acute poisoning:

1) Step imaginary being.

2) toxigenic stage. *

3) somatogenno stage. *

4) Stage of stunning.

* - Correct Answers