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ACUTE POISONING
(Tutorial)

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Владикавказ

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The manual is intended for senior students, including foreign students studying in English, residents, graduate students.

ACUTE POISONING

INTRODUCTION

Overdose and acute drug poisoning are an important public health problem. Every year, in Russia, the number of patients requiring hospitalization for poisoning reaches 214,000 (about 1% of the total number of patients), which creates a serious burden on emergency departments. The World Health Organization estimated that 346,000 people worldwide died from unintentional poisoning in 2014. The death of a million people, in a significant number of cases associated with poisoning, occurred as a result of deliberate harm to one's health. The most common form of intentional self-harm is drug overdose, which can complicate therapy. However, most of these patients are young, relatively healthy, and fully recover with adequate treatment.

DEFINITION AND STRUCTURE OF ACUTE POISONINGS

Poisoning is an acute pathological process that occurs as a result of exposure to the body of toxic substances of various origins coming from the environment.

The main groups of toxic substances that cause acute poisoning are drugs (up to 63.1% of cases), alcohol and surrogates (up to 49.3% of cases), cauterizing poisons up to (21.8% of cases).

In acute exogenous poisoning, 2 main stages of the process are distinguished: I - toxicogenic, when a toxic substance exerts its effect on biochemical processes and manifests itself in a number of pathological syndromes (shock, asphyxia, coma, bleeding); II - somatogenic, occurring after the removal of a toxic substance, in the form of the consequences of a lesion, manifested by gross violations of homeostasis and a change in the structure or function of various organs and systems of the body.

There are the following ways of getting poison into the body:

1. Oral - ingestion of poisons through the mouth. The average rate of development of clinical signs (from hours to days). This is the most common way of poisoning.

2. Inhalation - inhalation of toxic gases, which may be toxic products of combustion of various materials, carbon monoxide, hydrogen sulfide, etc. The high rate of developed clinical signs (from minutes to hours) often poses a danger to those providing assistance.
3. Percutaneous - penetration of toxic substances through the skin. Slow rate of development of clinical signs (from hours to several days).
4. Parenteral - injections, ingress of toxic substances into the cavity, insect bites, snake bites. High rate of development of clinical signs (minutes), often have an iatrogenic etiology.

BASIC PRINCIPLES OF TREATMENT

In overdose, many drugs (eg, opiates, tricyclic antidepressants, and benzodiazepines) can cause mental depression and cardiorespiratory problems. Emergency management should include rapid assessment and restoration of airway, respiration, and circulation. Careful history taking and examination in many cases allow us to assess the likely severity of an overdose and determine the tactics of subsequent therapy. The main principles of treatment are aimed at reducing the intake and accelerating the elimination of the toxin and include general care measures, and, if necessary and available, the use of specific antidotes. If there is any doubt in determining the degree of risk or treatment tactics, it is strongly recommended to contact the Acute Poisoning Center.

ANAMNESIS

It is necessary to collect detailed and reliable information about the drug or drugs taken. It should include the name, quantity, dosage form, time of administration of the drug, and clarification of the fact of the joint use of alcohol or drugs, which may affect the patient's condition or the rate of elimination of the drug. The presence of tablets in the vomit should be noted shortly after poisoning, but this does not exclude severe intoxication. Social, psychiatric, life history and knowledge of the medications taken by the patient will help identify high-risk patients and determine the tactics of further treatment. Due to the fact that patients may not be critical of the severity of their condition or are unable to provide relevant information, it is necessary to collect in parallel

supporting data from available sources, such as the packaging of the drug, the testimony of the ambulance team, witnesses, a note from the patient when attempting suicide.

INSPECTION

The first priority is to assess the airway, respiration and circulation and conduct appropriate therapy. In case of violation of the airway or breathing, it is necessary to carry out measures aimed at maintaining the patency of the respiratory tract - the use of air ducts, auxiliary ventilation or tracheal intubation. The patient's level of consciousness may indicate the degree of overdose, the risk to the respiratory tract, and the amount of respiratory support needed. It can be assessed on the Glasgow scale. A score equal to or less than 8 (or only the presence of a response to painful stimuli) indicates a high risk of respiratory disorders. In this case, if a rapid improvement in the patient's condition is not expected, tracheal intubation is indicated. Increased attention should be paid to the state of respiratory function, especially when poisoned with sedatives. Respiratory rate, tidal volume and SpO_2 should be assessed. A low respiratory rate with a decrease in saturation may indicate hypoventilation, but it should be remembered that normal saturation does not exclude hypercapnia or true hypoxia in carbon monoxide poisoning. When in doubt, arterial blood gases should be assessed. Tachypnea has been observed in metabolic acidosis (eg, tricyclic antidepressants, methanol), anxiety, psychostimulant overdose, and as an early symptom of salicylate poisoning (respiratory alkalosis). Oxygen insufflation through the face mask should be provided from the first stages of therapy in accordance with the readings of the pulse oximeter (taking into account the above limitations). Many drugs are cardiotoxic in overdose (eg, β-blockers, digoxin, lithium salts), which may present with hypotension and cardiac arrhythmias. Monitoring of heart rate, blood pressure and ECG should be established, venous access and adequate infusion therapy should be provided. A general examination may confirm the ingestion of a significant amount of the drug or give clues in case of poisoning with an unknown substance. Many drugs (selective serotonin reuptake inhibitors, phenothiazines) have serotonergic or anticholinergic effects, manifested by pupillary dilation, extrapyramidal disorders, while opioids lead to sedation and the development of miosis (pinpoint pupils). It should also Many drugs (selective serotonin reuptake inhibitors, phenothiazines) have serotonergic or anticholinergic effects, manifested by pupillary dilation, extrapyramidal disorders, while opioids lead to sedation and the development of miosis (pinpoint pupils). It should also Many drugs (selective serotonin reuptake inhibitors, phenothiazines) have serotonergic or anticholinergic effects, manifested by pupillary dilation, extrapyramidal disorders, while opioids lead to sedation and the development of miosis (pinpoint pupils). It should also

measure body temperature, glucose concentration (will be low in case of poisoning with β-blockers, ethanol) and body weight. Knowledge of body weight is important in calculating the toxic dose of a drug and can be used to guide therapy, such as paracetamol overdose. An examination can help identify injuries (accidental or intentional) that may require treatment, or the use of certain substances, such as alcohol.

ADDITIONAL RESEARCH

The minimum list of laboratory biochemical analyzes should include the concentration of urea, electrolytes and blood glucose. An analysis of the gas composition of the blood will allow you to quickly identify the presence of violations of the acid-base balance, as well as assess the adequacy of ventilation in patients with a reduced level of consciousness. If rhabdomyolysis or serotonin syndrome is suspected, creatine phosphokinase (CPK) activity should be measured. If indicated, a blood test should be taken to assess the content of medicinal substances (for example, paracetamol, salicylates, lithium), indicating the time of sampling. In case of poisoning with paracetamol, if possible, it is necessary to evaluate the concentration of this drug in the blood, this applies to all unconscious patients. In many emergency departments, the concentration of paracetamol is examined in all patients with suspected poisoning, since this poisoning has no early clinical signs. There is no need to routinely measure the concentration of salicylates in conscious patients who refuse to take drugs containing salicylates and who do not have signs of poisoning with these compounds. The concentration of salicylates should be investigated in patients who are unconscious or suspected of poisoning with a drug in this group.

Urine screening for drug use is commonly performed on poisoned patients, but there are no standard screening tests.

TREATMENT

Therapy for cardiorespiratory and neurological disorders is carried out in the ICU. It is no longer recommended to induce vomiting and is contraindicated in the case of volatile and caustic substances. Absorption of drugs can be reduced by the use of activated charcoal administered orally or via the nasogastric route.

probe. A single dose (50 g in adults, 1 g/kg in children) is given if less than an hour has passed since a significant amount of the toxin (i.e., an amount capable of causing moderate or severe poisoning) has been ingested. After this time interval, adsorption decreases. For adsorption and more effective elimination of some toxins, administration of several doses of activated charcoal should be considered. However, a number of substances (including alcohols, iron salts and lithium) are poorly adsorbed on activated carbon, and therefore its use is not indicated. Unprotected airways are an absolute contraindication to the use of activated charcoal due to the risk of aspiration pneumonitis. At this point, there is insufficient evidence in the existing literature for the use of gastric lavage. Flushing should be considered in patients with less than 1 hour exposure to the toxin who have taken sufficient amounts of the substance with a high risk of death. Gastric lavage is contraindicated in unprotected airways, as well as in case of hydrocarbon poisoning (risk of aspiration and chemical pneumonitis) and caustic substances! If, despite correction of hypoxia and adequate fluid therapy, persistent metabolic acidosis persists after poisoning, intravenous sodium bicarbonate should be considered. Prompt correction of acidosis is especially important in the presence of prolongation of the QRS or QT intervals on the ECG. In adults, an initial dose of sodium bicarbonate of 50 mmol can be administered with the possibility of repeated administration (under the control of arterial blood gas analysis). taking a sufficient amount of a substance with a high risk of death. Gastric lavage is contraindicated in unprotected airways, as well as in case of hydrocarbon poisoning (risk of aspiration and chemical pneumonitis) and caustic substances! If, despite correction of hypoxia and adequate fluid therapy, persistent metabolic acidosis persists after poisoning, intravenous sodium bicarbonate should be considered. Prompt correction of acidosis is especially important in the presence of prolongation of the QRS or QT intervals on the ECG. In adults, an initial dose of sodium bicarbonate of 50 mmol can be administered with the possibility of repeated administration (under the control of arterial blood gas analysis). taking a sufficient amount of a substance with a high risk of death. Gastric lavage is contraindicated in unprotected airways, as well as in case of hydrocarbon poisoning (risk of aspiration and chemical pneumonitis) and caustic substances! If, despite correction of hypoxia and adequate fluid therapy, persistent metabolic acidosis persists after poisoning, intravenous sodium bicarbonate should be considered. Prompt correction of acidosis is especially important in the presence of prolongation of the QRS or QT intervals on the ECG. In adults, an initial dose of sodium bicarbonate of 50 mmol can be administered with the possibility of repeated administration (under the control of arterial blood gas analysis). Gastric lavage is contraindicated in unprotected airways, as well as in case of hydrocarbon poisoning (risk of aspiration and chemical pneumonitis) and caustic substances! If, despite correction of hypoxia and adequate fluid therapy, persistent metabolic acidosis persists after poisoning, intravenous sodium bicarbonate should be considered. Prompt correction of acidosis is especially important in the presence of prolongation of the QRS or QT intervals on the ECG. In adults, an initial dose of sodium bicarbonate of 50 mmol can be administered with the possibility of repeated administration (under the control of arterial blood gas analysis). Gastric lavage is contraindicated in unprotected airways, as well as in case of hydrocarbon poisoning (risk of aspiration and chemical pneumonitis) and caustic substances! If, despite correction of hypoxia and adequate fluid therapy, persistent metabolic acidosis persists after poisoning, intravenous sodium bicarbonate should be considered. Prompt correction of acidosis is especially important in the presence of prolongation of the QRS or QT intervals on the ECG. In adults, an initial dose of sodium bicarbonate of 5

Carrying out forced diuresis is indicated for hydrophilic poisoning and is ineffective for intoxication with hydrophobic compounds. The technique for performing forced diuresis is as follows: a liquid load (500-1000 ml) is preliminarily given; o a diuretic is administered intravenously (lasix 40 mg or more, or osmodiuretics - urea or mannitol at a dose of 1-1.5 g / kg for 10-15 minutes);

In the case of severe poisoning, hemodialysis may be indicated for extracorporeal removal of the toxin and treatment of acute renal failure.

POISONING WITH INDIVIDUAL POISONS

Alcohol. The concentration of ethanol in the blood can indicate the time of exposure, but it cannot be called reliable due to the individual characteristics of metabolism. With an increase in blood concentration, symptoms progress, starting with ataxia,

dysarthria and nystagmus, reaching hypothermia, hypotension, stunning and coma. In severe cases, seizures, respiratory depression, cardiac arrhythmias, and acidosis may develop.

Specific hazards include aspiration of vomit, hypoglycemia, and rhabdomyolysis.

Alcohol is rapidly absorbed from the intestine, making methods of elimination from the gastrointestinal tract practically useless. To prevent the development of Wernicke's encephalopathy, thiamine (vitamin B_{one}) intravenously. This must be done prior to administering glucose to correct hypoglycemia. Hypoglycemia should be treated as quickly as possible by oral administration of glucose if the patient is conscious, or by intravenous infusion of 5% or 10% solutions. If the concentration of ethanol in the blood is above 5 g/l, the pH of the arterial blood is below 7.0, and if the condition worsens despite the measures taken, it is necessary to consider the possibility of hemodialysis.

Opioids. The action of endogenous and exogenous opioids is due to binding to one or more opioid receptors. Naloxone, nalmefene, and natrexone are competitive opioid receptor antagonists that bind to mu, kappa, and delta receptors and competitively prevent endogenous and exogenous opioids from binding to these receptors. The duration of action of naloxone is 15 minutes 90 minutes. After intravenous administration, naloxone rapidly penetrates the central nervous system. In patients with opioid poisoning, breathing improves within 1-2 minutes and consciousness is restored. The purpose of naloxone administration is to restore respiratory function. Miosis, inhibition of baroreceptor reflexes, laryngospasm and decreased motility of the gastrointestinal tract are also eliminated. Naloxone can reverse toxicity caused by drugs that are not opioids such as clonidine, angiotensin-converting enzyme inhibitors and sodium valproate. Naloxone should be given to all patients with altered mental status or coma of unknown etiology.

Paracetamol. At therapeutic doses, the main pathway of paracetamol metabolism - conjugation with the formation of inactive metabolites. Oxidation by cytochrome P450 enzymes to form Nacetylpbenzoquinone imine (NAPQI) is a backup metabolic pathway. When taking large doses of paracetamol, a significant amount of NAPQI is formed, while the reserves of glutathione in the liver are depleted and NAPQI binds to cellular proteins of the liver, leading to cell damage. Adoption

even 150 mg/kg orally (75 mg/kg in high-risk patients) is potentially fatal. Clinical signs. Mild nausea, vomiting, and lack of appetite may develop, but, as a rule, the first four hours after taking paracetamol are asymptomatic. After 24–36 hours, pain in the right hypochondrium, jaundice, vomiting, and acute liver failure develop. Confusion and encephalopathy may manifest after 36 to 72 hours. Specific hazards Hepatocellular necrosis peaks 3-4 days after taking paracetamol and may be accompanied by hypoglycemia, bleeding, encephalopathy, and be fatal.

Treatment. An alternative antidote for paracetamol poisoning is methionine, but its use is only recommended if acetylcysteine is not available (animal studies have shown it to be less effective). The antidote of choice is acetylcysteine administered intravenously. For maximum effectiveness, it is necessary to start administration within 8 hours after poisoning, however, there are indications that acetylcysteine can improve outcome even in patients with encephalopathy. 24 hours after poisoning, paracetamol in plasma is almost impossible to detect, even with severe overdose.

Tricyclic antidepressants (TAD). The toxic effect of TAD is due to the anticholinergic effect on the nerve endings of the autonomic nervous system and brain, blockade of sodium channels and α_{one}adrenergic receptors. Symptoms of intoxication include tachycardia, dry skin, dry mouth, and dilated pupils. From the side of the nervous system, ataxia, nystagmus, convulsions, drowsiness and coma are observed. Increased muscle tone and hyperreflexia may also be noted. The ECG reveals prolongation of the PR, QRS and/or QT intervals, which, together with the presence of metabolic acidosis, increases the risk of developing ventricular arrhythmias. Rarely, skin blisters occur and should be treated like burns.

Treatment. The introduction of activated charcoal (50 grams) orally or through a nasogastric tube is indicated in patients admitted within the first hour after poisoning. The initial treatment of arrhythmias should be to correct hypoxia and acid-base disturbances. The introduction of sodium bicarbonate changes the binding of TAD to the myocardium. In an adult patient with ECG changes or arrhythmias, intravenous administration of 50 mmol NaHCO3 solution is indicated, even in the absence of acidosis. If the cardiotoxic effect of TAD is refractory to sodium bicarbonate,

consideration should be given to the introduction of a fat emulsion (Intralipid). Initially, a dose of 1.5 mg/kg 20% Intralipid is given as an intravenous bolus followed by an infusion at a rate of 0.25-0.5 ml/kg/min over 30-60 minutes to a maximum volume of 500 ml. Convulsive syndrome should be stopped by the appointment of diazepam or lorazepam. Consider intravenous glucagon 1 mg repeated every three minutes for persistent hypotension and myocardial depression.

Salicylates. Ingestion at a dose of 500 mg/kg is potentially fatal. The mechanism of the toxic action of salicylates is complex and includes direct stimulation of the respiratory center, inhibition of the Krebs cycle, uncoupling of oxidative phosphorylation, and increased metabolism of fatty acids. Clinical signs Nausea, vomiting, tinnitus, drowsiness and dizziness may occur in mild poisoning (usually oral intake less than 125 mg/kg body weight). In case of moderate poisoning (more than 250 mg/kg of body weight), dehydration, anxiety, sweating, vasodilation and hyperventilation develop. Less common are vomiting of blood, renal failure, hyperthermia. Adults usually develop respiratory alkalosis and metabolic acidosis. Assessment of the severity of poisoning, the concentration of salicylates in plasma more than 350 mg / l indicates poisoning.

Treatment. Assign activated charcoal if the patient has taken salicylates orally at a dose exceeding 125 mg/kg during the last hour. If metabolic acidosis is present and the potassium concentration is normal, give intravenous sodium bicarbonate, which will increase the rate of excretion of salicylates. If the potassium concentration is low, correct it before prescribing bicarbonate. You should not use forced alkaline diuresis, as its use significantly increases the risk of developing pulmonary edema. In severe poisoning with the development of heart or kidney failure, hemodialysis is the method of choice.

Ethylene glycol (antifreeze, coolant, brake fluid). Ethylene glycol is rapidly absorbed from the gut, with peak plasma concentrations occurring 1 to 4 hours after ingestion. The lethal dose for an adult weighing 70 kg is 100 g. Inhalation and absorption through the skin do not pose a serious health hazard. Toxicity is due to glycolic, glyoxylic and oxalic acids, which are metabolic products of ethylene glycol. Glycolic acid is largely responsible for the metabolic acidosis seen in severe poisoning. The onset of initial symptoms is very rapid. In the first 12 hours after consumption, the patient's condition is similar to intoxication,

but it doesn't smell like alcohol. Nausea, vomiting, ataxia, and dysarthria appear, followed by convulsions, coma, and severe metabolic acidosis. Between 12 and 24 hours after consumption, heart failure, arterial hypertension, respiratory failure and renal failure with oliguria progress. If left untreated, death occurs due to multiple organ failure between 24 and 36 hours after poisoning. Calcium oxalate crystals precipitate, leading to cerebral edema and kidney failure (the detection of calcium oxalate crystals in the urine is diagnostic of ethylene glycol poisoning). Due to the increased calcium intake, hypocalcemia develops.

Treatment. Consider gastric lavage if patient presents within one hour of poisoning. The introduction of activated carbon is not shown, since it is not able to adsorb a significant amount of ethylene glycol. The mechanism of action of both antidotes of ethylene glycol - ethanol and 4methylpyrazole - is in the competitive interaction with ethylene glycol for alcohol dehydrogenase, which is responsible for the conversion of ethylene glycol into its toxic metabolites. Both are also antidotes for methanol poisoning. Correct metabolic acidosis with intravenous sodium bicarbonate. Hypocalcemia should be corrected by intravenous administration of 10-20 ml of 10% calcium gluconate only if the QT interval on the ECG is prolonged or a convulsive syndrome is present.

Carbon monoxide (carbon monoxide, CO). Carbon monoxide toxicity is due to impaired oxygen delivery and subsequent cellular hypoxia. Clinical signs: headache, nausea, irritability, agitation and tachypnea progressing to impaired consciousness and respiratory failure. In severe poisoning, metabolic acidosis, cerebral edema, and multiple organ failure may develop. Recommendations for treatment: 1. Isolate the patient from the source of carbon monoxide. 2. Give oxygen in the highest concentration. 3. If the acidosis is severe or persists, it can be corrected with sodium bicarbonate. 4. Expediency of using hyperbaric oxygen therapy.

Organophosphorus compounds Organophosphorus compounds (OPs). They are a heterogeneous group of chemicals used for a variety of purposes, including insecticides, nerve gases and anthelmintic drugs. organophosphorus compounds can

enter the body through the skin, lungs or if swallowed. Poisoning causes nicotinic (muscle weakness, fasciculations and weakness of the respiratory muscles) and muscarinic (hypersecretion, bronchospasm, vomiting and diarrhea, urinary incontinence) effects and disorders of the central nervous system (irritability, convulsions, coma). Recommendations for treatment. 1. Avoid skin contact with toxins. Wear protective clothing when in contact with a sick person. 2. Prevent further absorption of the poison by removing its sources, including contaminated clothing. 3. Wash the patient with soap and water. 4. Consider gastric lavage for poisoning within the past hour. 5. Avoid intubation if necessary destination succinylcholine due to the prolongation of its action. 6. Give atropine 2 mg IV every 10 to 30 minutes until adequate atropinization is achieved. Benzodiazepines should be given to relieve agitation and seizures.

ANTIDOTES(Royal College of Emergency Medicine and National Poisons Information Service Guideline on Antidote Availability for Emergency Departments January 2017)

Antidotes (Drug)	**Poisons (Indication)**
Acetylcysteine	Paracetamol
Activated carbon	Most oral poisons
Atropine	Phosphorus organic or carbamate insecticides; Bradycardia.
Calcium chloride	Blockers calcium channels; hydrofluoric acid
Cyanide antidotes Dicobalt edetate Hydroxocobalamin sodium nitrite Sodium thiosulfate	Cyanide The choice of antidote depends on the severity of the poisoning, the certainty of the diagnosis, and the cause of the poisoning/source of cyanide. - Dicobalt edetate is the antidote of choice in severe cases where there is high clinical suspicion of cyanide poisoning, such as after exposure to cyanide salt. - Hydroxocobalamin (Cyanokit®) should be taken in individuals who have severe lactic acidosis. - Sodium thiosulfate is commonly used as an adjuvant to other antidotes.
flumazenil	Benzodiazepines
Glucagon	Preparations blocking beta-adrenoreceptors.

Intralipid 20%	Systemic intoxication local anesthetics
methylene blue	Methemoglobinemia
Naloxone	Opioids
Dantrolene	malignant hypertension
Sodium bicarbonate 8.4% and 1.26% or 1.4%	Tricyclic antidepressants (TAD)
Digibind	Digoxin
Desferrioxamine	Iron
fomepisol or ethanol	Ethylene glycol, diethylene glycol, methanol
Protamine sulfate	Heparin
Pralidoxime chloride	Organophosphorus compounds
Unithiol	Heavy metals (especially mercury)

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The main groups of toxic substances that cause acute poisoning are medicines (up to 63.1% of cases), alcohol and surrogates (up to 49.3% of cases), cauterizing poisons (up to 21.8% of cases).

In acute exogenous poisoning, there are 2 main stages of the process: I - toxicogenic, when a toxic substance has its effect on biochemical processes and is manifested by a number of pathological syndromes (shock, asphyxia, coma, bleeding); II - somatogenic, which occurs after the removal of the toxic substance, in the form of consequences of the lesion, manifested by gross violations of homeostasis and changes in the structure or function of various organs and systems of the body.

There are the following ways of entering the poison into the body:

1. Oral-ingestion of poisons through the mouth. The average rate of development of clinical signs (from hours to days). This is the most common method of poisoning.

2. Inhalation - inhalation of toxic gases, which can be toxic gorenje products of various materials, carbon monoxide, hydrogen sulfide, etc. A high rate of developed clinical signs (from minutes to hours), often pose a danger to caregivers.

3. Percutaneous-penetration of toxic substances through the skin. Slow rate of development of clinical signs (from hours to several days).

4. Parenteral injections, ingestion of toxic substances in the cavity, insect bites, snakes. High rate of development of clinical signs (minutes), often have iatrogenic etiology.

BASIC PRINCIPLES OF TREATMENT

When overdosed, many medications (such as opiates, tricyclic antidepressants, and benzodiazepines) can cause depression of consciousness and cardiorespiratory disorders. Emergency therapy should include rapid assessment and restoration of airway patency, respiration, and circulation. A thorough medical history and examination in many cases allows you to assess the likely severity of an overdose and determine the tactics of subsequent therapy. The main principles of treatment are aimed at reducing the intake and accelerating the elimination of the toxin and include general care measures, and, if necessary, the use of specific antidotes. If there are doubts about determining the degree of risk or treatment tactics, it is strongly recommended to contact the Acute Poisoning Center.

ANAMNESIS

It is necessary to collect detailed and reliable information about the drug or drugs taken. It should include the name, quantity, dosage form, time of taking the drug and finding out the fact of joint use of alcohol or narcotic substances, which may affect the patient's condition or the rate of elimination of the drug. The presence of tablets in the vomit should be noted shortly after poisoning, but this does not exclude severe intoxication. Social, psychiatric history, life history, and knowledge of the medications taken by the patient will help identify high-risk patients and determine the tactics of further treatment. Due to the fact that patients may be uncritical of the severity of their condition or unable to give relevant information, it is necessary to simultaneously collect supporting data from available sources,

INSPECTION

The primary task is to assess the paency of the respiratory tract, respiration and blood circulation and conduct appropriate therapy. In case of violation of the patency of the respiratory tract or breathing, it is necessary to carry out measures aimed at maintaining the patency of the respiratory tract - the use of air ducts, auxiliary ventilation or tracheal intubation. The patient's level of consciousness may indicate the extent of the overdose, the risk to the respiratory tract, and the amount of respiratory support needed. It can be rated on the Glasgow scale. The sum of points equal to or less than 8 (or only the presence of a response to pain stimuli) indicates a high risk of respiratory disorders. In this case, if a rapid improvement in the patient's condition is not expected, tracheal intubation is indicated. Special attention should be paid to the state of respiratory function, especially in cases of sedative poisoning. Respiratory rate, respiratory volume, and SpO2 should be evaluated. Low respiratory rate with reduced saturation may indicate hypoventilation, but it should be remembered that normal saturation does not exclude hypercapnia or true hypoxia in carbon monoxide poisoning. In case of any doubts, the gas composition of arterial blood should be evaluated. Tachypnea is observed in metabolic acidosis (eg, tricyclic antidepressants, methanol), anxiety, psychostimulant overdose, and as an early symptom in salicylate poisoning (respiratory alkalosis). It is necessary from the first stages of therapy to provide oxygen insufflation through the facial mask in accordance with the indications of the pulse oximeter (taking into account the above restrictions). Many drugs in overdose are cardiotoxic (for example, beta-blockers, digoxin, lithium salts), which can be manifested by hypotension and cardiac arrhythmia. Heart rate, blood pressure and ECG monitoring should be

established, venous access and adequate infusion therapy should be provided. A general examination may confirm ingestion of a significant amount of the drug or give clues in case of poisoning with an unknown substance. Many drugs (selective serotonin reuptake inhibitors, phenothiazines) have serotonergic or anticholinergic effects, manifested by pupil dilation, extrapyramidal disorders, while taking opioids leads to sedation and the development of myosis (pinpoint pupils). You should also measure your body temperature, glucose concentration (it will be low if you are poisoned with beta blockers, ethanol), and body weight. Knowledge of body weight is important when calculating the toxic dose of a drug and can be used when prescribing therapy, for example, for an overdose of paracetamol.

ADDITIONAL RESEARCH

The minimum list of laboratory biochemical tests should include the concentration of urea, electrolytes and blood glucose. The analysis of the gas composition of the blood will allow you to quickly identify the presence of violations of the acid-base balance, as well as to assess the adequacy of ventilation in patients with a reduced level of consciousness. If rhabdomyolysis or serotonin syndrome is suspected, the activity of creatine phosphokinase (CK) should be measured. If there are indications, you should take a blood test to assess the content of medicinal substances (for example, paracetamol, salicylates, lithium) with an indication of the time of sampling. In the case of paracetamol poisoning, if possible, it is necessary to assess the concentration of this drug in the blood, this applies to all patients who are unconscious. In many emergency departments, the concentration of paracetamol is examined in all patients with suspected poisoning, since this poisoning does not have early clinical signs. It is not necessary to routinely measure the concentration of salicylates in conscious patients who deny taking drugs containing salicylates and who have no signs of poisoning with these compounds. The concentration of salicylates should be investigated in patients who are unconscious or suspected of poisoning with a drug of this group. It is not necessary to routinely measure the concentration of salicylates in conscious patients who deny taking drugs containing salicylates and who have no signs of poisoning with these compounds. The concentration of salicylates should be investigated in patients who are unconscious or suspected of poisoning with a drug of this group. It is not necessary to routinely measure the concentration of salicylates in conscious patients who deny taking drugs containing salicylates and who have no signs of poisoning with these compounds. The concentration of salicylates should be investigated in patients who are unconscious or suspected of poisoning with a drug of this group.

Urine screening tests for the detection of narcotic substances are usually performed in patients with poisoning, but there are no standard screening studies.

TREATMENT

Therapy of cardiorespiratory and neurological disorders is carried out in the ICU. It is no longer recommended to provoke vomiting and is contraindicated in the case of volatile and caustic substances. The absorption of medicinal substances can be reduced by the use of activated charcoal, administered orally or through a nasogastric tube. A single dose (50 g in adults, 1 g / kg in children) is administered if no more than an hour has passed since the ingestion of a significant amount of the toxin (ie, an amount that can cause moderate or severe poisoning). After this time interval, the adsorption decreases. For the adsorption and more effective elimination of some toxins, the administration of several doses of activated carbon should be considered. However, a number of substances (including alcohols, iron salts and lithium) are poorly adsorbed on activated carbon, and therefore its use is not indicated. Unprotected airways are an absolute contraindication to the use of activated charcoal due to the risk of aspiration

pneumonitis. At this point, there is insufficient evidence in the existing literature for the use of gastric lavage. The need for flushing should be considered in patients with a toxin exposure of no more than 1 hour, who have taken a sufficient amount of the substance with a high risk of death. Gastric lavage is contraindicated in unprotected airways, as well as in case of poisoning with hydrocarbons (risk of aspiration and chemical pneumonitis) and caustic substances! If, despite the correction of hypoxia and adequate infusion therapy, persistent metabolic acidosis persists after poisoning, the question of intravenous administration of sodium bicarbonate should be considered. Rapid correction of acidosis is especially important if there is an extension of the QRS or QT intervals on the ECG. In adults,

Forced diuresis is indicated for hydrophilic poisoning and is ineffective for intoxication with hydrophobic compounds. The procedure for performing forced diuresis is as follows: a pre-load of liquid (500-1000 ml) is given; a diuretic (lasix 40 mg or more, or osmodiuretics - urea or mannitol at a dose of 1-1. 5 g/kg for 10-15 minutes) is administered intravenously.);

In the case of severe poisoning, hemodialysis may be indicated for extracorporeal removal of the toxin and treatment of acute renal failure.

POISONING WITH INDIVIDUAL POISONS

alcohol. The concentration of ethanol in the blood may indicate the time of exposure, but it can not be called reliable due to the individual characteristics of the metabolism. With increased blood concentrations, symptoms progress, starting with ataxia, dysarthria, and nystagmus, reaching hypothermia, hypotension, stun, and coma. In severe cases, seizures, respiratory depression, cardiac arrhythmias, and acidosis may develop.

Specific hazards include aspiration of vomit, hypoglycemia, and rhabdomyolysis.

Alcohol is quickly absorbed from the intestine, which makes the methods of removal from the gastrointestinal tract almost useless. To prevent the development of encephalopathy, Wernicke should be given thiamine (vitamin B1) intravenously in patients with chronic alcohol disease. This should be done before the appointment of glucose for the correction of hypoglycemia. Hypoglycemia should be stopped as quickly as possible by oral administration of glucose, if the patient is conscious, or by intravenous infusion of 5% or 10% solutions. If the concentration of blood ethanol is higher than 5 g/l, the pH of arterial blood is lower than 7.0, as well as if the condition worsens despite the measures taken, it is necessary to consider the possibility of hemodialysis.

Opioids. The action of endogenous and exogenous opioids is caused by binding to one or more opioid receptors. Naloxone, nalmefene, and natrexone are competitive opioid receptor antagonists that bind to mu, kappa, and delta receptors and competitively prevent endogenous and exogenous opioids from binding to these receptors. The duration of action of naloxone is from 15 minutes to 90 minutes. After intravenous administration, naloxone quickly penetrates the central nervous system. In patients with opioid poisoning, breathing improves within 1-2 minutes and consciousness is restored. The purpose of naloxone administration is to restore respiratory function. Myosis, inhibition of baroreceptor reflexes, laryngospasm and decreased

motility of the gastrointestinal tract are also eliminated. Naloxone can eliminate toxicity caused by drugs that are not opioids, such as clonidine, angiotensin converting enzyme inhibitors, and sodium valproate. Naloxone should be prescribed to all patients with altered mental status or coma of unclear etiology.

paracetamol. At therapeutic doses, the main pathway of paracetamol metabolism is conjugation with the formation of inactive metabolites. Oxidation by cytochrome P450 enzymes to form Nacetylpbenzoquinonimine (NAPQI) is a fallback pathway of metabolism. When taking large doses of paracetamol, a significant amount of NAPQI is formed, while the reserves of glutathione in the liver are depleted and NAPQI binds to the cellular proteins of the liver, leading to cell damage. Ingestion of even 150 mg/kg (75 mg/kg in high-risk patients) is potentially fatal. clinical signs. Mild nausea, vomiting and lack of appetite may develop, but, as a rule, the first four hours after taking paracetamol, the course is asymptomatic. After 24-36 hours, pain in the right hypochondrium, jaundice, vomiting and acute liver failure develop. Disorientation and encephalopathy can manifest after 36-72 hours. Specific hazards Hepatocellular necrosis reaches a maximum of 3-4 days after taking paracetamol and can be accompanied by hypoglycemia, bleeding, encephalopathy and leading to death.

treatment. An alternative antidote for paracetamol poisoning is methionine, but its use is recommended only if acetylcysteine is not available (animal studies have shown that it is less effective). The antidote of choice is acetylcysteine administered intravenously. For maximum effectiveness, it is necessary to start the administration within 8 hours after poisoning, but there are indications that acetylcysteine can improve the outcome even in patients with encephalopathy. 24 hours after poisoning, paracetamol in the plasma is almost impossible to detect, even with a severe overdose.

Tricyclic antidepressants (TADs). The toxic effect of TAD is due to the anticholinergic effect on the nerve endings of the autonomic nervous system and the brain, the blockade of sodium channels and a1adrenergic receptors. Symptoms of intoxication include tachycardia, dry skin, dry mouth, and dilated pupils. On the part of the nervous system, ataxia, nystagmus, convulsions, drowsiness and coma are observed. There may also be an increase in muscle tone and hyperreflexia. The ECG shows an elongation of the PR, QRS, and/or QT intervals, which, together with the presence of metabolic acidosis, increases the risk of ventricular arrhythmias. In rare cases, blisters occur on the skin, which should be treated as burns.

treatment. Administration of activated charcoal (50 grams) orally or through a nasogastric tube is indicated in patients admitted within the first hour after poisoning. The initial treatment of arrhythmias should be reduced to the correction of hypoxia and acid-base disorders. The introduction of sodium bicarbonate changes the binding of TAD to the myocardium. An adult patient with ECG changes or arrhythmia is indicated to administer 50 mmol of $NaHCO_3$ solution intravenously, even in the absence of acidosis. If the cardiotoxic effect of TAD is refractory to sodium bicarbonate, the introduction of a fat emulsion (Intralipid) should be considered. Initially, an intravenous bolus dose of 1.5 mg/kg of 20% Intralipid is administered, followed by an infusion at a rate of 0.25-0.5 ml/kg / min for 30-60 minutes to a maximum volume of 500 ml. Convulsive syndrome should be stopped by the appointment of diazepam or lorazepam. Consider intravenous administration of 1 mg of glucagon with a repeat of this dose every three minutes for persistent hypotension and myocardial depression.

Salicylates. Ingestion of 500 mg/kg is potentially fatal. The mechanism of toxic action of salicylates is complex and includes direct stimulation of the respiratory center, inhibition of the Krebs cycle, uncoupling of oxidative phosphorylation, and increased fatty acid metabolism. Clinical signs In mild poisoning, nausea, vomiting, tinnitus, drowsiness and dizziness may occur (usually oral intake of less than 125 mg/kg of body weight). With moderate poisoning (more than 250 mg / kg of body weight), dehydration, anxiety, sweating, vasodilation and hyperventilation develop. Less often there is vomiting of blood, kidney failure, hyperthermia. Adults usually develop respiratory alkalosis and metabolic acidosis. Assessment of the severity of poisoning the concentration of salicylates in the plasma of more than 350 mg / l indicates poisoning.

treatment. Prescribe activated charcoal if the patient has taken salicylates orally at a dose exceeding 125 mg / kg within the last hour. If there is a metabolic acidosis, and the potassium concentration is normal, enter intravenous sodium bicarbonate, which will increase the rate of elimination of salicylates. If the potassium concentration is reduced, correct it before prescribing bicarbonate. Do not use alkali forcedne diuresis, as its use significantly increases the risk of developing pulmonary edema. In severe poisoning with the development of heart or kidney failure, the method of choice is hemodialysis.

Ethylene glycol (antifreeze, coolant, brake fluid). Ethylene glycol is rapidly absorbed from the intestine, with the peak concentration in the plasma being reached in the period from 1 to 4 hours after consumption. The lethal dose for an adult weighing 70 kg is 100 g. Inhalation and absorption through the skin do not pose a serious health hazard. Toxicity is caused by glycolic, glyoxylic and oxalic acids, which are products of the metabolism of ethylene glycol. Glycolic acid largely causes the metabolic acidosis observed in severe poisoning. The onset of the initial symptoms is very rapid. In the first 12 hours after drinking, the patient's condition is similar to intoxication, but it does not smell of alcohol. Nausea, vomiting, ataxia, and dysarthria appear, followed by seizures, coma, and severe metabolic acidosis. Between 12 and 24 hours after use, heart failure, hypertension, respiratory failure, and renal failure with oliguria progress. If left untreated, death occurs due to multiple organ failure between 24 and 36 hours after poisoning. Calcium oxalate crystals precipitation, leading to brain edema and kidney failure (the detection of calcium oxalate crystals in the urine is a diagnostic sign of ethylene glycol poisoning). Due to increased calcium intake, hypocalcemia develops.

treatment. Consider gastric lavage if the patient is admitted within one hour of poisoning. The introduction of activated carbon is not indicated, since it is not able to adsorb a significant amount of ethylene glycol. The mechanism of action of both ethylene glycol antidotes-ethanol and 4methylpyrazole - consists in a competitive interaction with ethylene glycol for alcohol dehydrogenase, which is responsible for the conversion of ethylene glycol into its toxic metabolites. Both are also antidotes for methanol poisoning. Correct metabolic acidosis by intravenous administration of sodium bicarbonate. Hypocalcemia should be corrected by intravenous administration of 10-20 ml of 10% calcium gluconate only if the QT interval on the ECG is prolonged or if there is a convulsive syndrome.

Carbon monoxide (carbon monoxide, CO). Carbon monoxide toxicity is caused by impaired oxygen delivery and subsequent cellular hypoxia. Clinical signs: headache, nausea, irritability,

agitation, and tachypnea, progressing to impaired consciousness and respiratory failure. In severe poisoning, metabolic acidosis, cerebral edema, and multiple organ failure may develop. Recommendations for treatment: 1. By isolating the patient from the carbon monoxide source. 2. Give oxygen in the highest concentration. 3. If the acidosis is severe or persists, it can be corrected by the administration of sodium bicarbonate. 4. The feasibility of using hyperbaric oxygenation.

Organophosphorus compounds Organophosphorus compounds (FOS). They are a heterogeneous group of chemicals used for various purposes, including as insecticides, nerve gases, and anthelmintic drugs. Organophosphate compounds can enter the body through the skin, lungs, or if swallowed. Poisoning causes nicotine (muscle weakness, fasciculations and weakness of the respiratory muscles) and muscarinic (hyperscretion, bronchospasm, vomiting and diarrhea, urinary incontinence) effects and disorders of the central nervous system (irritability, convulsions, coma). Recommendations for treatment. 1. Avoid getting toxins on your skin. Wear protective clothing when in contact with the patient. 2. Prevent further absorption of the poison by removing its sources, including contaminated clothing. 3. Treat the patient with soap and water. four. Consider gastric lavage for poisoning during the past hour. 5. If intubation is necessary, avoid prescribing succinylcholine due to the prolongation of its action. 6. Administer atropine 2 mg intravenously every 10-30 minutes until adequate atropinization is achieved. To relieve agitation and convulsions, benzodiazepines should be prescribed.

ANTIDOTES(Royal College of Emergency Medicine and National Poisons Information Service Guideline on Antidote Availability for Emergency Departments January 2017)

Antidotes (Drug)	**Poisons (Indication)**
Acetylcysteine	paracetamol
Activated Charcoal	Most oral Poisons
Atropine	Organophosphate or carbamate insecticides; Bradycardia.
Calcium chloride	Calcium channel blockers; hydrofluoric acid
Cyanide antidotes Dicobalt edetat Hydroxocobalamin sodium nitrite sodium thiosulfate	cyanide The choice of an antidote depends on the severity of the poisoning, the reliability of the diagnosis, and the cause of the poisoning / source of cyanide. - Dicobalt edetate is the antidote of choice in severe cases where there is a strong clinical suspicion of cyanide poisoning, such as after exposure to cyanide salt. - Hydroxocobalamin (Cyanokit ®) should be taken in persons with severe lactic acidosis. - Sodium thiosulfate is commonly used as an adjuvant to other antidotes.
Flumazenyl	Benzodiazepines
Glucagon	Drugs that block beta-adrenergic receptors.
Intralipid 20%	Systemic intoxication with local anesthetics

Methylene Blue	Methemoglobinemia
Naloxone	Opioids
Dantrolene	Malignant hypertension
Sodium Bicarbonate 8.4% and 1.26% or 1.4%	Tricyclic Antidepressants (TAD)
Digibind	Digoxin
Desferrioxamine	iron
Fomepizole or Ethanol	Ethylene Glycol, diethylene glycol, methanol
Protamine sulfate	Heparin
Pralidoxime chloride	Organophosphate Compounds
Unithiol	Heavy metals (especially mercury)

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