

First aid for poisoning

Regardless of the nature and circumstances of poisoning, first aid consists of several general principles:

1. Poison removal from a place of its contact with an organism (rinsing of the skin, mucous membranes).
2. Prevention of poison absorption with an aid of drugs, its neutralization and removal from the stomach (sorbents, precipitants, enveloping agents, astringents, and laxative drugs).
3. Neutralizing of already absorbed poison (injection of antidotes of different nature, such as glucose, sodium thiosulfate etc).
4. Enhancing of poison excretion or stimulation of liver detoxicative function (decrease of concentration of a poison in blood and tissues due to increased fluid load).
5. Treatment of the consequences of a poisonings, symptomatic therapy (regulation of vital functions, which were impaired by poison).

First aid measures, when poison hasn't been absorbed yet

In the case of skin or mucous membranes exposure to irritative or burning substances they should be rinsed by large amounts of clear water.

If poisoning is due to an oral ingestion of a poison, it's necessary to promptly remove it from the stomach. It can be made with an aid of emetic drugs or gastric lavage with water and sorbents (activated charcoal). In the case of soluble barium salts poisoning the toxic substance should be converted into an insoluble one. To achieve this, patient has to take magnesium or sodium sulfate solution orally; precipitate, barium sulfate, is then removed by rinsing.

In the case of silver nitrate poisoning sodium chloride solution is used for gastric lavage; the product of this reaction, precipitate of silver chloride, is then removed by rinsing.

For some alkaloid poisoning (morphine, strychnine etc) potassium permanganate (1:2000) is added during gastric lavage. It is able to oxidize alkaloids and convert them into non-toxic compounds. In cases of poisonings with other alkaloids, tanning agents which precipitate these substances are used (0.5% tannin solution, strong tea).

It is possible to prevent absorption with the use of sorbents (activated charcoal), which are able to absorb ethyl alcohol, phenol, arsenic, strychnine, and heavy metal salts.

In the case of heavy metal salts poisoning special antidotes can also be used, for example Strzhyzhevski antidote, that contains stabilized hydrogen sulfide water. Sodium and magnesium salts are added to the solution to stabilize hydrogen sulfide. Gastric lavage must be performed in 10 minutes after administration of this drug.

Chemical antagonism can also be used for prevention of absorption of a poison. For instance, in the case of acid poisoning gastric lavage is performed with mild alkaline solution (magnesium oxide, sodium bicarbonate). Similarly, in the case of alkali poisoning mild organic (acetic, citric, succinic) acid solutions are used.

Non-absorbed poison can be removed with emesis.

After poison removal from stomach one should perform measures to remove it from intestines too. Laxative drugs (magnesium sulfate) can be prescribed for this purpose.

First aid measures, when poison has been already absorbed

An antagonism is used for neutralization of poison in an organism. There are physiological and functional types of an antagonism between poison and antidotes. Antidotes help in recovering functions of tissues, organs, and systems (normalization of cardiac rhythm with atropine in muscarine poisoning).

Acetylcholine and tubocurarine interaction is an example of competitive antagonism between substances of similar structure, but with opposite action. Tubocurarine inhibits effects of acetylcholine, because it blocks neuromuscular junction. Accumulation of acetylcholine in neuromuscular junction after administration of anticholinesterase agent (neostigmine) leads to restoring of skeletal muscle contractility.

An antidote must comprise such a substrate, with which poison binds stronger and with less dissociation, than with tissues of an organism. For instance, mercuric, bismuth and arsenic compounds bind with thiol groups of enzymes and inhibit them. Unithiol is used for the treatment of such poisonings. It can be substituted by sodium thiosulfate. Both substances have labile sulfhydryl groups, which interact with heavy metal salts and liberate thiol groups of enzymes. It leads to clinical improvement.

Glucose facilitates detoxication of poisons in the liver. After an oxidation of glucose in tissues a large amount of energy is released, tissues become enriched with macroergic compounds. The latter provides energy for synthetic processes in the liver. Hypertonic glucose solution has osmotic action, due to which blood volume increases, as well as myocardium functioning, and synthesis and flow of lymph are stimulated. Water reabsorption in renal tubules increases, with diuretic effect taking place as a consequence. Glucose facilitates a relaxation of smooth muscles of blood vessels and internal organs, as well as full catabolism of lipids, which leads to stimulation of excretion of insufficiently oxidized products of metabolism.

Task / Example of poison	Poison removal	Antidote therapy	General detoxication	Symptomatic therapy
1. Direct cholinomimetics / Pilocarpine hydrochloride	Gastric lavage with a tube and colonic washing, saline laxative drugs, 1.0–2.0 g of chloral hydrate in an enema	Injection of 1 ml of 0.1% atropine sulfate or other atropine-containing drugs, until mucous membranes become dry	Injection of prednisolone or hydrocortisone and Polyglucin or Reopolyglucin	Seizures are treated with 10 ml 25% magnesium sulfate, 20 ml 20% glucose, 2 ml of 5% ascorbic acid. Intramuscular injection of 2–4 ml of 0.5% lipoic acid. Administration of hepatotropic drugs

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2. M-cholinoblockers / Atropine sulfate	Gastric lavage with a tube (a tube should be oiled) with potassium permanganate solution (1:1000), saline laxative drugs	Repeated subcutaneous injections of 1 ml of 0.05% neostigmine (Proserin), until improvement occurs	Forced diuresis in the case of severe intoxication and an absence of contraindications (refractory collapse, kidney damage with oliguria, azotemia, and elevated creatinine). Perform urinary alkalinizing. Intravenous injection of glucose and ascorbic acid	Motor excitement is treated with intravenous injection of 2–4 ml 0.5% diazepam or 10 ml of 20% sodium oxybutyrate
3. Organophosphate compounds / Various pesticides and war gases	Gastric lavage with a tube with 5% sodium bicarbonate or water with an activated charcoal and administration of saline laxative drug before extraction of a tube, siphon enema, forced diuresis	M-cholinoblockers (atropine sulfate, tropacin), cholinesterase reactivators (dipiroxim, isonitrosin)	Intravenous infusion of 500–1000 ml of 4% sodium bicarbonate. Forced diuresis, hemisorption, removal of bronchial mucous, and artificial ventilation are indicated in the case of severe poisoning	Hypertension and seizures are treated with 1 ml of 2.5% benzhexonium or 1 ml of 5% azamethonium bromide (Pentamin) and 2 ml of 0.5% diazepam or 10 ml of 25% magnesium sulfate
4. Myorelaxants – competitive blocking agents / Tubocurarine chloride		Intravenous injection of 3 ml of 0.05% neostigmine (Proserin) with 0.5–1 ml of 0.1% atropine sulfate (decurarization). Decurarizing effect of Proserin is enhanced by intravenous injection of sodium chloride or calcium gluconate (5–10 ml of 5% solution)		Artificial ventilation with oxygen supply should be initiated immediately

Task / Example of poison	Poison removal	Antidote therapy	General detoxification	Symptomatic therapy
5. Alcohol / Ethanol	Removal of mucus and saliva (vomit) from oral cavity, throat, and nasal passage. Intubation of trachea, if airways are still obstructed. Gastric lavage with a tube		Enhanced ethanol oxidation is carried out with intravenous infusion of hypertonic fructose solution (10–20%) with insulin and vitamin drugs (ascorbic acid, drugs of B-group vitamins)	Cardiovascular symptoms of different severity are treated with intravenous injection of 0.5 ml of corglycon, caffeine, or nicetamide (Cordiamin). Prolonged collapse is treated with intravenous infusion of 2 ml of 0.2% norepinephrine (noradrenaline) hydrochloride in 400–500 ml of 5% glucose or isotonic sodium chloride solution. Acidosis is treated with intravenous infusion of 500–1000 ml of 4% sodium bicarbonate. Bronchial secretion is reduced by intramuscular injection of 1 ml of 0.1% atropine sulfate
6. Opioid (narcotic) analgesics / Morphine	Gastric lavage with potassium permanganate solution, regardless of route of administration and time interval poisoning (morphine is able to be secreted by stomach mucosa with subsequent absorption), saline laxative drugs (magnesium sulfate)	Provide adequate ventilation and inject 1 ml of 0.5% nalorphine hydrochloride	Injection of 10 ml of 20% glucose, 1 ml of 10% sodium benzoate	Injection of 1 ml of 10% caffeine-sodium benzoate, bladder catheterization, rewarming, correction of metabolic disorders (hypoglycemia)

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7. Bromides / Sodium bromide		4.0 g of sodium chloride orally every 4 hours	Intravenous infusion of isotonic sodium chloride solution, injection of 5.0 g of ammonium chloride per day	Administration of caffeine, bemegride, or ethimizole
8. Cardiac glycosides / Digoxin	Oral administration of an activated charcoal ; gastric lavage with potassium permanganate or tannin solution; saline laxative drugs	Intravenous injection of 5 ml of 5% unithiol for recovery of Na/K-ATPase action	Intravenous infusion of 500 ml of 0.4% calcium chloride. Hemodialysis in the case of severe intoxication	Tachyarrhythmias are treated with intravenous injection of phenytoin (Diphenin), 5 ml of 1% xycaine (Lidocaine), cardioselective beta blockers, or ajmaline. Bradycardias are treated with injection of 1 ml 0.1% atropine sulfate. Oral administration of Panangin or Asparcam
9. Direct anticoagulants / Heparin		Slow intravenous injection of 5 ml of 1% protamine sulfate, after 15 minutes repeat injections of 1 ml for every 100 IU of heparin, if necessary		Hemorrhages are prevented by strict bed rest

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10. Indirect anticoagulants / Warfarin	Gastric lavage and saline laxative drugs	Repeated intravenous or intramuscular injections of 1 ml of 1% menadi-one (Vikasol); phytomenadione orally (capsules with 0.1 ml of 10% solution)	Acute bleeding is treated with blood transfusion (250 ml repeatedly); in severe cases blood substitution, forced diuresis, or fresh frozen plasma transfusion are prescribed	Intravenous infusion of 100 ml of 5% aminocaproic acid, 10 ml of 10% calcium chloride, 5 ml of 10% ascorbic acid, and 10–20 ml of 40% glucose. Coagulopathy is treated with fresh frozen plasma transfusion in the dose of 15 ml/kg
11. Mercury salts / Mercuric chloride	Proteins (raw eggs) and milk (as an astringent) orally	Injection of unithiol; time interval for the best efficacy – 1–2 hours after poisoning	Hemodialysis in the case of severe renal failure	Supportive therapy, treatment of shock. Infections are prevented by antibiotics
12. Bases (burn) / Sodium hydroxide	Gastric lavage (time interval for the best efficacy – first 4 hours after poisoning). For this procedure one should use approximately 10 liters of warm water or 1% solution of acetic or citric acid		Inhalation of warm procaine (Novocaine) solution in the case of rough breathing. A warm compress, applied onto throat area, is also an option.	Metabolic alkalosis is prevented by intravenous injection of up to 1500 ml of 4% solution of sodium bicarbonate. Burn shock is treated with intravenous injection of 2 ml of nicetamide (Cordiamin), 2 ml of 10% caffeine and infusion of 500 ml of 5% glucose. Severe pain is treated with opioid an-

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