Forensic Toxicology

Toxicology is studies about poison and poisoning.

Poison is a substance which after introduction to the organism ***in minimum doses***, operating a chemical or physical and chemical way, predetermines disorder of health or death ***at certain terms***.

Poisoning is a reaction of an organism which comes as a result of poison introduction.

Classification of poisons:

I. With local action (corrosive):

1) inorganic (mineral) acids; 2) organic acids; 3) caustic alkalis; 4) phenol and formalin.

Classification of poisons (continue):

II. With a general action (resorption):

1) destructive poisons;
2) blood poisons;
3) nervously-functional:

- general functional;
- cerebrospinal;
- general narcotic;
- alkaloid narcotic group;
- convulsive and hallucinogenic;
- encephalopathic and motor-paralytic;
- cardiac nervous poisons.

III. Pesticides (poisoning chemicals).

IV. Food toxins.

Types of poisonings:

1) acute; 2) subacute; 3) chronic.

Action of Poisons:

1) local;
2) general;
3) remote (specific and non-specific action);
4) combined - both local and remote.

The Factors which Specify the Action of Poisons

Dose:

1) indifferent dose (minimum dose);
2) therapeutic dose;
3) toxic dose;
4) lethal dose.

Form of poison:

1) physical state (gases, fluid, pills, powder);
2) chemical combination (synergism, antagonism (antidote));
3) mechanical combination.

Method of administration: enteral; parenteral; inhalation; introduction into natural orifices; external application.

State of the organism: age; state of health; sleep and intoxication.

Main syndromes of poisoning:

1 Psychoneurotic disorders in the form of mental.

2 Affection of respiratory apparatus.

3 Disorders of cardiovascular system more often are observed in the form of collapse.

4 Affection of gastrointestinal tract is usually accompanied by dyspeptic disorders (nausea, vomiting), gastrointestinal bleeding, gastroenterocolitis with dehidratation.

5 Disorders of liver and kidneys functions are declared by increasing of liver size, biliary colic, jaundice, hemorrhage diathesis, loin pains, swelling, oliguria, azotemia, coma.

General signs of poisoning with corrosive poisons are:

1. The rapid cooperating with tissues in the place of their contact (burns, necrosis of tissue).
2. Sharp pain in the oesophagus, stomach.
3. Nausea, vomit with blood.
4. Oedema of mucous tunic at the entrance a larynx.
5. Difficulty in breathing (pulmonary insufficiency).
6. Disorders of function of CNS, organs of blood circulation.

Acids The intentional poisoning of an adult man is possible, when he is in the helpless state. In similar cases caustic poisons are not swallowed, but go out from inside and spread on face forming chemical burns. Large burns appear and at an entrance in a larynx, in upper part of gullet, and in a stomach they can not appear.

Death in such cases comes from asphyxia as a result of considerable oedema of mucous tunic at an entrance in a larynx.

A mortal dose of acids hesitates from 5 to 20 grams and for the concentrated acids - 5-10 grams, for non-concentrated acids - 30-60 grams.

Signs of poisoning by concentrated acids:

1) presence around the mouth of parchment spots or strips;
2) greyish chemical burns in a larynx and along a oesophagus (coagulative necrosis);
3) in the stomach: considerable diminishing in volume; on its walls have are serous hemorrhages; in its cavity there is a bloody liquid with the fragments of the mucous tunic.

Caustic alkali Their action is caused by hydroxyl ions (anions) which melt and necrotise albumens (colliquative necrosis). At the same time alkalis cover fats with soap. Affected by alkalis tissue are slippery by touch, as though they are covered with soap. Then they gradually dim and a dark scab appears, and around it there are signs of inflammation.

The mortal dose of alkalis makes 10-20 grams.

Cause of death:

1. Shock. Circulatory collapse and collapse due to perforation of stomach.
2. Asphyxia (spasm or oedema of glottis).
3. Peritonitis.
4. Mediastinitis.
5. Arrosive haemorrhage.
6. Acut pneumonia.
7. Toxaemia.

Destructive poisons **Arsenic** is a metal, dissolve in water, and that is why non-poisonous, however when oxidizing, it forms poisonous oxides. A mortal dose makes 0.1-0.2 grams. Death comes, as a rule in 1-2 hours. Arsenic is saved in a dead body for a long time (in particular in bones and hairs).

Clinical signs of poisoning by arsenic:

1) jaundice; 2) rash; 3) transversal strips (strips of Mass) appear on nails, by their amount it is possible to set how many times a man accepted arsenic. They disappear in course of time.

Types of the acute poisoning with arsenic:

1) gastro-enteric;
2) paralytic (nervous) form is caused by acceptance of large doses of arsenic and develops without gastro-enteric displays.

The gastro-enteric form of poisoning reminds cholera, but at poisoning at first there is vomit, and at cholera at first - diarrhea, in 1-2 hours after acceptance of arsenic a victim begins to feel:

1) heartburn in a mouth with metallic taste; 2) nausea, with non-stopping vomit, thirst; 3) sharp pain in the stomach; 4) face of Hippocrates;

5) the skin is covered with sticky sweat; 6) there are cramps in muscles; 7) liquid, watery diarrhoea appears with pieces of mucus and white shreds of the torn away intestinal epithelium (reminds a rice-water, as at cholera);

8) the amount of urine diminishes; 9) the symptoms of collapse develop.

Mercury compounds

Sublimate (inorganic compound of mercury) is white small crystal powder which well dissolves in water, better in the presence of sodium chloride. In medical practice it is used as an antiseptic.

A mortal dose is 0.1-0.3 grams. Death comes in 2-3 - days.

Clinical symptoms of poisoning by sublimate reminds a dysentery and characterized by the triad of clinical - morphological displays:

1) mercury stomatitis; 2) mercury ulcerous colitis; 3) nephrosis and nephritis (sublimate kidney).

Clinical signs of poisoning by sublimate reminds:

1) metallic taste and burning pain in the mouth and along the gullet, stomach;
2) vomiting with blood;
3) bloody diarrhoea;
4) the pulse is frequent, threadlike;
5) the temperature the body goes down;
6) gums swell, from the mouth strong putrid smell is felt;
7) the increase of urine excretion, and then an hematuria and anury;
8) bloody diarrhoea with tenesmus and mucus in faeces (as at dysentery).

Medico-Legal Examination of Lethal Poisonings by Ethyl Alcohol

The term alcohol in popular use refers to ethyl alcohol (ethanol, C2HsOH), which is present in various fermented and distilled beverages. It is a transparent, colour less, volatile liquid having a specific spirit-like odor and burning taste. It is the active ingredient of many social beverages such as wines, beers, whiskeys, and brandies.

Alcoholism is a need for alcohol with its regular unlimited use and development of the Large Narcotic Syndrome: occurrence of mental, physical dependence and abstinent syndrome.

Following consumption of a single alcoholic drink, the combined effects of different factors affecting absorption, metabolism and excretion, result in a characteristic blood alcohol curve:

1. The alcohol concentration rises steeply to a distinct maximum (absorption phase or phase of euphoria).
2. There then follows an irregularly curved fall due to a period of diffusion within the tissues to equilibrium. This takes place over 15 to 30 minutes. The peak concentration is reached 45 to 90 minutes after ingestion, the majority after 60 minutes (phase of depression).
3. The Blood Alcohol Concentration then falls progressively in a linear fashion (elimination phase or phase of sleep paralysis). At very high levels (> 200 mg%) the decrease is not linear due to greater loss in breath and urine.

Stage of excitement (euphoria) (blood alcohol 30-100 mg%):

This is a feeling of well being and pleasure resulting from inhibition of the higher centers. The drinker converses well, laughs and smiles readily, or becomes angry easily. He may disclose secrets. He may behave in an obscene manner or talk in vulgar language. Sexual desire may be aroused.

Stage of incoordination (phase of depression) (blood alcohol 100-300 mg%):

There is incoordination of thought, speech, and action, which manifest as impaired judgment, confusion, slurred speech, and staggering gait. The drinker may suffer from hiccups and is untidy in his appearance. He may become morose, euphoric, or irritable depending on his inherent emotions. Nausea and vomiting are common. The pupils are dilated. Most offences are committed in this stage. Impaired judgment may lead to accidents, sexual excesses, violence, and crime.

Stage of narcosis (phase of sleep paralysis) (blood alcohol over 300 mg%):

The patient passes into deep sleep and responds only to strong stimuli. The pulse is rapid, temperature subnormal, breathing stertorous, and the pupils may be contracted. However, on pinching the neck or face, they dilate initially and slowly return to their original size. This is known as ***Macewan's sign*** and is helpful to differentiate alcoholic coma from other comatose conditions. If this stage lasts for more than 12 hours, death ensues from paralysis of the cardiac or respiratory centre or later from the effects of pulmonary oedema.

Stages of an Alcoholic Intoxication

<0.3 per mille - There is no influence
0.31-0.5 per mille - Insignificant influence of alcohol
0.51-1.5 per mille - Slight intoxication
1.51-2.5 per mille - Moderate alcoholic intoxication
2.51-3.0 per mille - Severe alcoholic intoxication
3.01-5.0 per mille - Grave alcoholic intoxication
5.01-7.0 per mille - Fatal alcoholic poisoning of not tolerant drinkers

7.01-10.0 per mille - Fatal alcoholic poisoning of tolerant drinkers

10.01-12.0 per mille - Maximally possible fatal alcoholic level

> 12.0 per mille - Casual pollution by ethanol of the investigated blood sample

There is a list of pathological processes and diseases which are caused by acute alcoholic intoxication and can be the immediate cause of death:

1. Alcoholic cardiomyopathy results in cardiovascular insufficiency.
2. Blockade of heart conducting system as a result of oedema and haemorrhages, in connection with the increased permeability of a vascular wall. The immediate cause of death - cardiac arrest.
3. Bronchopneumonia and lobar pneumonia are the commonest.
4. Acute forms of a pancreatitis, hemorrhagic pancreatonecrosis. The immediate cause of death - shock, functional insufficiency of organ, intoxication products of necrosis.
5. Alcoholic hepatitis (acute and chronic), caused hepatotoxic action of alcohol on hepatic cells, results to necrosis with the subsequent infiltration of necrotic zones by cellular elements, should finish with toxic hepatic dystrophy, hepatic insufficiency or complicated by an alcoholic (portal) cirrhosis of the liver.
6. Fatty hepatosis as the result of acute alcoholic intoxication results in hepatic insufficiency.
7. Haemoglobinurinal nephronecrosis can result to acute renal insufficiency in connection with that haemosiderin slags promote development of epithelium's necrosis of renal tubules.
8. Paralysis of the respiratory centre.
9. Mechanical asphyxia from aspirate of respiratory ways by food (vomit) masses as complication of a poisoning. Postural asphyxia: obstruction of the upper airway by the swallowed tongue during coma.

Taking into account a plenty concerning specific morphological changes at chronic alcoholic intoxication, allocate the basic markers of alcoholic disease:

1. alcoholic encephalopathy with fibrosis of pia mater of brain, atrophy of cerebral cortex and demyelinating changes;
2. alcoholic cardiomyopathy, shown by a non-uniform hypertrophy and lipofuscinosis of cardiac hystiocytes, non-coronary fibrosis and lipomatosis of a myocardium stroma;
3. alcoholic fatty hepatosis and an alcoholic hepatitis with fibrosis of the central veins, an impurity of neutrophils to inflammatory infiltration, bodies of alcoholic hyaline;
4. chronic bronchitis;
5. toxic indurative pancreatitis;
6. atrophic processes in digestive apparatus;
7. polyendocrinopathies;
8. atrophy of gonads.