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**MLS 512**

1. **Poisons** are [substances](https://en.wikipedia.org/wiki/Chemical_substance) that cause death, injury or harm to [organs](https://en.wikipedia.org/wiki/Organs), usually by chemical reactions or other [activity](https://en.wikipedia.org/wiki/Activity_%28chemistry%29) on the [molecular](https://en.wikipedia.org/wiki/Molecular) scales, when an organism absorbs a sufficient quantity.

Poisoning can be either acute or chronic, and caused by a variety of natural or synthetic substances. Acute poisoning is exposure to a poison on one occasion or during a short period of time. Symptoms develop in close relation to the exposure. Absorption of a poison is necessary for systemic poisoning. Poisoning can be caused by excessive consumption of generally safe substances, as in the case of [water intoxication](https://en.wikipedia.org/wiki/Water_intoxication). Chronic poisoning is long-term repeated or continuous exposure to a poison where symptoms do not occur immediately or after each exposure. The patient gradually becomes ill, or becomes ill after a long latent period. Chronic poisoning most commonly occurs following exposure to poisons that [bioaccumulate](https://en.wikipedia.org/wiki/Bioaccumulate), or are [biomagnified](https://en.wikipedia.org/wiki/Biomagnification), such as [mercury](https://en.wikipedia.org/wiki/Mercury_%28element%29), [gadolinium](https://en.wikipedia.org/wiki/Gadolinium), and [lead](https://en.wikipedia.org/wiki/Lead).

**CLASSIFICATION OF POISONS**

Poisons can be classified based on the following:

* Based on their toxic effects in the body as:

 Poisons which cause death by anoxia

 Poisons which make haemoglobin incapable of transporting oxygen
e.g. Carbon monoxide, nitrites

 Poisons which inhibit cellular respiratory enzymes
e.g. Cyanides

 Poisons which destroy haemopoietic organs
e.g. Radioactive substances

 Poisons, which on contact cause irritation or corrosiveness of the organs (skin) or damage the organ through which they are excreted (GI tract, respiratory tract, urinary tract) e.g. Irritant gases, alkaline corrosives, corrosive inorganic acids, corrosive organic acids and heavy metals

Poisons, which damage protoplasm or parenchyma. These poisons produce local irritation and after absorption cause damage to the cells and capillaries e.g. [Phosphorus](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=71948) and carbon tetrachloride

Poisons, which affect the nerve cells and fibres e.g. Hypnotics, narcotics, anesthetics, alcohol, some alkaloids and glycosides

* Based on their chemical and physical nature as,

 organic poisons, e.g rotenone, carbamates

 inorganic poisons, e.g cadmium, thallium, lead

 gaseous poisons, e.g carbon mono oxide, hydrogen sulphide, nitrogen dioxide, phosgene

 nitrogenous, e.g ammonia

 non-notrogenous e.g

* Based on their behaviour during separation procedures as

volatile poisons, e.g chlordane, heptachlor

non-volatile, e.g halides, dichromate, azides

metallic poisons e.g lead cadmium, nickel, arsenic

miscellaneous poisons e.g terodotoxin, cigaurtoxin

* Based on their origin as

plant poisons, e.g *Abrus precatorius, Acotinium* spp., *Adenium obesum*

toxins, e.g muscarin, bufotoxin, sarin, tetanus, mycotoxins

venoms, e.g from snakes and spiser

* Based on their use as

antimicrobials,

anticoccidials,

anthelmintics,

anaesthetics e.g

* Based on the source as

naturally occurring, e.g strychnine

man-made e.g brodifacoum, cyanide, amatoxin

1. Fate of a substance refers to the processes which occurs during the intake of the substance until it gets to its site of action and leaves the body i.e. the entry in to the body, the absorption, distribution and excretion of the substance.

A hydrophobic (water hating) substance is an uncharged, non-polar substance, it is also known as lipophilic which means “lipid loving”, because of its lipid diffusing nature it can pass through the brain blood barrier and the brain uterine barrier. When a hydrophobic substance is administered orally it can be easily diffused into the biomemebranes as the biomembranes are made up of lipids so they pass directly into the cell, the more blood supply to the tissues the more the substance is distributed to the tissues. Lipophilic substances are excreted poorly as they are reabsorbed in the kidney, they get in the enterohepatic system, metabolized in the liver, excreted into bile and eliminated from the body.

b. While a hydrophilic (water loving) substance is polar substance, it is also known as lipophobic “lipid hating”, it is aqueous diffusing. When a hydrophilic substance is administered orally, it is unable to diffuse into the cell membrane because it of its lipophobic nature. It is absorbed enterally into the portal circulation, transported to the liver via the blood stream. In the liver, the drugs are partially metabolized, this is known as the **first pass effect**, it is usually done so the substance can be converted to its pharmacologically active form. As part of biotransformation, drug molecules in the liver are either conjugated and excreted via the bile or converted a less lipophilic form and excreted by the kidney.

1. An antidote is a drug, chelating substance, or a chemical that counteracts (neutralizes) the effects of another drug or a poison.

There are hundreds of different antidotes; however, some can only counteract one drug, while others (such as charcoal) may be helpful in reducing the toxicity of other medications. Most antidotes are not 100 percent effective and even though an antidote has been given, fatalities can still occur. Some poisons and their antidote examples include:

|  |  |  |  |
| --- | --- | --- | --- |
| **S/N** | **Poisons** | **Antidotes** |  |
| 1. | Benzodiazepines | Flumazenil |  |
| 2. | Bupivacaine | Intralipid |  |
| 3. | Cyanide | Cyanocbalamin/ Sodium thiosulphate |  |
| 4. | Digoxin | Fab |  |
| 5. | Ethylene glycol | Ethyl alcohol, Fomepizole |  |
| 6. | Isoniazid | Pyridoxine |  |
| 7. | Methanol | Ethyl alcohol, Fomepizole |  |
| 8. | Organophosphate | Atropine, pralidoxime |  |
| 9. | Opiates | Naloxone |  |
| 10 | Lead | Dimercaprol, BAL |  |
| 11. | Valproate | Carnitine |  |
| 12. | Warfarin | Vitamin K |  |
| 13. | Clonidine | Naloxone |  |
| 14. | Magnesium | Calcium |  |
| 15. | Methotrexate | Folinic acid |  |
| 16. | Antimuscarinic agents | Physostigmine |  |
| 17. | Tricyclic antidepressants | Sodium bicarbonate |  |
| 18. | Paraquat | Fuller's Earth, bentonite clay |  |
| 19. | Dystonic crisis due to classical antipsychotics | Benztropine |  |
| 20. | Carbon monoxide | Oxygen, potentiall+A6:B29y even hyperbaric oxygen |  |

**3b**. In other to study the clinical effects of poison in the body the following laboratory tests can be done, many conventional laboratory tests increase within the “normal” range in proportion to toxin load:

 a. Complete blood count (CBC), which includes a red blood cell (RBC) count, white blood cell (WBC) count, platelet count, hemoglobin, and basophilic stippling;

b. Liver enzymes, including aspartate aminotransferase (AST), alanine aminotransferase (ALT), and GGTP;

c. Inflammatory markers, including C-reactive protein (CRP); (4) lipids, including low-density lipoprotein (LDL), oxLDL, and triglycerides;

d. Blood sugar, including insulin, fasting blood sugar (FBS), and 2-hour postprandial (2-h PP) blood sugar; and

e. Metabolites (bilirubin, uric acid, and 8-OHdG).

**CBC**:  These can be early indicators of toxin exposure. Another useful indication from the standard CBC is basophilic stippling of the RBCs, which occurs in both arsenic and lead poisoning.  The WBC count decreases in proportion to body load of polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) and other poisonings. Chronic low-level exposure to solvents decreases platelet to 14% (216 000 versus 252 000 per mL) and “normal” is 150 000 to 450 000

### Liver Enzymes: Liver enzymes are typically measured to detect hepatitis. Many liver enzymes play important roles in detoxification and are induced as needed.

ALT increases in a dose-dependent manner with body load of blood cadmium, lead, mercury, and PCBs within and above the normal range Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) concentrations begin to rise within 24 hours after an acute ingestion and peak at about 72 hours. In severe overdose, transaminase elevation can be detected as early as 12-16 hours post-ingestion. Toxicity is defined as serum AST or ALT concentrations greater than 1000 IU/L. A rapid progression of transaminase values to 3000 IU/L or greater reflects severe hepatotoxicity. Include bilirubin and alkaline phosphatase concentrations. Gamma glutamyl transeferase levels increases with alcohol poisoning

### Inflammatory Markers: Most environmental toxins increase inflammation and oxidative stress.

### Blood Sugar: Certain poisons bring about hypoglcaemic effect such as salicylates, quinine, acetaminophene while others bring about hyperglcaemic effect such as niacin, dopamine, carbamates

**Metabolites**: Serum uric acid increases in proportion to body load of polyfluorinated hydrocarbons (PFOA, or perfluorooctanoic acid; and PFOS, or perfluorooctane sulfonate).

The harmful effect of these substances can also be studied by:

1. Behavioural study: Some poisons can cause some behavioural changes in an individual for example, Exposure to lead can have a wide range of effects on a child's development and behaviour. Children with greater lead levels may also have problems with learning and reading, delayed growth, and hearing loss. At high levels, lead can cause permanent brain damage and even death. Some hard drugs can also give some false sense of happiness when poisoned in an individual.
2. Immunological effects: Some individuals usually carry out mithridatism in poisoning,
Mithridatism is the practice of protecting oneself against a [poison](https://en.wikipedia.org/wiki/Poison) by gradually self-administering non-lethal amounts. mithridatism is not effective against all types of poison (immunity generally is only possible with biologically complex types which the immune system can respond to) and, depending on the toxin, the practice can lead to the lethal accumulation of a poison in the body. Results depend on how each poison is processed by the body, ie, on how the toxic compound is metabolized or passed out of the body. In some cases, it is possible to build up tolerance against specific non-biological poisons. This involves conditioning the liver to produce more of the particular enzymes that metabolize these poisons (for example alcohol). However, this method (metabolic tolerance) isn't very reliable as too much generally causes accumulation of the reduced toxicity compound that the original poison was metabolized into, slowly damaging the liver. With alcohol this generally leads to conditions such as alcoholic fatty liver disease
3. Teratogenic effects: Some poisons can lead to deformity in the foetus and can also be fatal to the foetus
4. Mutanogenic effect: poisons can cause mutation in the body in gene coding which in turn affects the part of the body which the gene codes for
5. Carcinogenic effect: Most poisons are known to cause cancer due to their mutagenic effect as they alter normal cell differentiation
6. Molecular effect