



Lecture title: **Forensic Pathology
Toxicology**

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Summary:

- Toxicology is the study of adverse effects of chemical substances on living organisms and their environment.
- Forensic toxicology is defined as the application of toxicology for the purposes of the law. The veterinary pathologist working in a diagnostic environment will inevitably be presented with forensic animal poisoning cases.
- Toxicology requires interactions between biology, chemistry, medicine, veterinary medicine, pharmacy and environmental science. Poison is defined as any substance (solid, liquid or gaseous) which when administered in living body through any route (Inhalation, Ingestion, surface absorption) will produce ill-health or death.
- Toxic agent is anything that can produce an adverse biological effect. It may be chemical, physical, or biological in form. For example, toxic agents may be chemical (such as cyanide), physical (such as radiation) and biological (such as snake venom).



Sources of Poison

1. Domestic or household sources In domestic environment poisoning may more commonly occur from detergents, disinfectants, cleaning agents, antiseptics, insecticides, rodenticides.
2. Agricultural sources different insecticides, pesticides, fungicides.
3. Industrial sources In factories, where poisons are manufactured or poisons are produced as by products.
4. Drugs and medicines due to wrong medication, overmedication.
5. Food and drink contamination in way of use of preservatives of food grains or other food material.
6. Miscellaneous sources snakes bite and venom poisoning.

Factors Affecting the Activity of Toxicants

- 1- Dose or quantity of toxins: A high dose of poison acts quickly and often resulting in fatal consequences. A moderate dose causes acute poisoning. A low dose may have sub-clinical effects and causes chronic poisoning on repeated exposure. Very large dose of Arsenic may produce death by shock without symptoms.
- 2- Route of administration: There are four routes by which a toxin can enter the body: inhalation, topical, ingestion, and injection.
- 3- Chemical form of toxins: The chemical nature of a toxicant determines solubility,



which in turn influences absorption. Chemically pure arsenic and mercury are not poisonous because these are insoluble and are not absorbed. But arsenic oxide and mercuric chloride are deadly poisonous.

4- Physical form of toxins: The physical state (Gas, liquids, powders and solids), some poisonous vegetable seeds may pass through the intestinal canal ineffective when taken intact due to their impermeable. But when taken crushed, they may be rapidly fatal.

5- Condition of the stomach: food content presence of foodstuff acts as diluent of the poison and hence protects the stomach wall. Dilution also delays absorption of poison. Empty stomach absorbs poison most rapidly.

6- Age and health status: some poisons are better tolerated in some age groups. Opium is tolerated better by large animals but badly by young animals. State of body health, a well built animal with good health can tolerate the action of poison better than a weak animal.

7- Idiosyncrasy: some persons may react adversely to a particular drug though the general population tolerates the drug well.

8- Species: species react differently to a particular toxicant because of variations in absorption, metabolism, or elimination. Species unable to vomit can be intoxicated with a lower dose of some agents.



Diagnosis of Poisoning

In the Living

1. History (CNS signs before death, number of animals exposed/sick/dead, age)
2. Signs and Symptoms)Sudden anxiety and twitching, fever, racing heart rates, heavy breathing, vomiting and diarrhea(
3. Laboratory investigation Various samples can be collected for laboratory diagnosis (Vomitus, Excreta, Stomach wash, Scraps from stains, Blood)

In the Dead

1. History According to police/owners
2. Post-mortem Examination (external and internal).
3. Chemical Analysis Detection of poison in the body fluids
- 4- Preservation of viscera and other material for lab. examination.

❑ Samples to be analyzed in forensic toxicology

- Urine. Common for drug testing and easy for live and dead animals.
- Blood. Provides the toxicologist with a profile of the toxic substance.
- Hair sample. Is capable of recording medium to long term or high dosage substance abuse.
- Oral fluid. Saliva is used commonly, and Provides the toxicologist with recent drug use.
- Other body fluid. Gastric fluid which can be useful for detecting pills or liquid.



❑ Treatment of Poisoning

- 1- Preventing further absorption of the poison by administering specific antidotes.
- 2- Washing with soap and water can usually prevent further absorption of poisons on the skin.
- 3- For some poisons that have been ingested, vomiting may be induced in dogs and cats.
- 4- If the animal is unconscious, the stomach may be flushed with a stomach tube, or surgery on the stomach may be needed.
- 5- Laxatives and medications used to empty the bowels to help remove the poison from the gastrointestinal tract.

❑ Classification of Poisoning

- I- Corrosives are the poisons that erodes the surface with which it comes in contact.
 - 1- Strong acids (nitric, hydrochloric, carbolic, oxalic, acetic, salicylic).
 - 2- Strong alkaline (Hydrate/ Carbonate of sodium and potassium).
- II- Irritants they causes inflammation on the site of contact (GIT, skin).
 - 1- Inorganic [Non-metallic (P, Cl, Br) and Metallic (As, Sb, Pb)].
 - 2- Organic [Herbal (castor seed) and Animal (snake venoms)].
 - 3- Mechanical (Diamond dust and Grass powder).
- III- Systemic which involves toxic effect on a particular system.
 - 1- Cerebral [CNS depressants(opioids) and CNS stimulants (caffeine)].



2- Cardiac (cyanide).

☐ Medications Poisoning

1- Antibiotics Poisoning:

Antibiotics are commonly used in veterinary medicine to treat bacterial infections in animals. When antibiotics are ingested in toxic amounts, it can result in mild to severe signs ranging from gastrointestinal signs.

(drooling, vomiting, diarrhea, discolored teeth), metabolic signs (skin lesions, liver failure, kidney failure) to central nervous system signs (tremors, seizures, death).

2- Sulfa Poisoning

Sulfonamides are the oldest and remain among the most widely used antibacterial agents in veterinary medicine. Acute toxic manifestations may be seen after too rapid IV administration or if an excessive dose is injected. Clinical signs include muscle weakness, ataxia, blindness, and collapse. GI disturbances, in addition to nausea and vomiting, may occur when sulfonamide concentrations are sufficiently high.

☐ Insecticides Poisoning

- Insecticides are commonly used to keep pests and fleas away from plants and pets. Though insecticides are safe when used correctly, an incorrect usage or accidental consumption can lead to poisoning.

- Many insecticides can cause poisoning after being swallowed, inhaled, or absorbed through the skin.

- Symptoms may include eye tearing, coughing, heart problems, and breathing



difficulties.

- The diagnosis is based on symptoms, blood tests, and a description of events surrounding the poisoning.
- Several drugs are effective in treating serious insecticide poisonings. The properties that make insecticides deadly to insects can sometimes make them poisonous to humans and animals. Most serious insecticide poisonings result from:-

- 1- **Organophosphates**, include malathion, parathion, fenthion, dursban, diazinon, chlorpyrifos, and sarin. Some of these compounds are derived from nerve gases.
- 2- **Carbamates**, include aldicarb, carbaryl, carbofuran, fenobucarb, and oxamyl.
- 3- **Pyrethrins and pyrethroids**, which are other commonly used insecticides, are derived from flowers.

❑ Toxic plants Poisoning

Poisonous plant are the plants possessing toxic principles which when introduced into the body may cause impairment of the body function, even leading to death.

Poison produced by poisonous plant is called phytotoxin.

1. **Atropine** containing plants Plant containing atropine include:
2. **Nicotine** , Nicotine poisoning is a real concern anywhere that a pet may find cigarettes, cigarette butts, chewing tobacco, or even nicotine gum, patches. The toxic dose for nicotine in pets is 0.5-1mg/kg of pet body weight while the lethal dose is 4 mg/kg of pet body weight. •Signs begin as quickly as one hour post-ingestion. Symptoms:



include: tremors, constricted pupils, excitement, vomiting and diarrhea and high blood pressure but at higher doses there is a circulatory collapse.

3- Strychnine

Strychnine is an indole alkaloid obtained from the seeds of the Indian tree

Strychnos nux-vomica. Strychnine is highly toxic to most domestic animals. Its oral LD50 in dogs, cattle and horses is 0.5–1 mg/kg, and in cats is 2 mg/kg. The onset of strychnine poisoning is fast. After oral exposure, clinical signs may appear within 30–60 min. Early signs, consist of nervousness, tenseness, and stiffness. Vomiting is possible but uncommon. Severe tetanic seizures may appear spontaneously or may be initiated by stimuli such as touch, sound, or bright light.

4- *Digitalis purpurea* •

Is an attractive biennial plant that is cultivated in Canada and is naturalized in several provinces. Upon ingestion, this plant can cause toxic reactions that lead to severe sickness and death in animals and in humans. Several important pharmaceutical drugs such as digitalis and digoxin are derived from this plant.

- Symptoms of digitalis poisoning in dogs: weakness, collapse, nausea, abdominal pain, frequent urination, vomiting and diarrhea.

5- Opium

Opium is a narcotic depressant derived from the seedpod of an opium poppy. As a primary source of morphine and codeine, it is commonly used as an analgesic painkiller. The cardiovascular, gastrointestinal, respiratory, and central nervous systems are all affected by opium, slowing down breathing and heart rate. Opioid and opiate poisoning can occur from accidental ingestion of human medication and accidental overdose from giving the wrong dosage. The most common signs of



toxicity are severe drowsiness, slow breathing and heart rate, seizures, and vomiting.

❑ Animal toxins

Animals toxins are divided into:-

- Poisons is toxic substance distributed through the tissues of the animals, so in the poisonous animal the whole body is a toxic (frogs, jellyfishes).
- Venom is toxic substance produced and stored by a very specific set of organs, and delivered by stinging or biting (spider, snakes)

Type of venom:-

- Proteolytic venom (phospholipases and cardotoxins) dismantles the molecular surrounding and including the bite.
- Hemotoxic venom act on the heart and cardiovascular system.
- Neurotoxic venom acts on the nervous system and brain.
- Myotoxic venom the venom contains peptides that destroy the muscle fiber protein.

-Symptoms of Venom and Poisons(Animal toxins) in animals:-

- Vomiting.
- Bleeding at the site of the wound.
- Swelling and bruising at wound site.
- Pain.
- Rapid breathing pattern and other respiratory abnormalities.
- Urination and defecation, with large amounts of urine (polyuria).

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- High volume of salivation.