

FORENSIC TOXICOLOGY

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Toxicology

- ▶ The word '**toxicology**' is derived from the Greek word "**toxicon**" which means poisonous substance smeared on arrowhead to inflict maximum damage.
- ▶ **Toxicology** is defined as branch of Science which deals with the study of Poisons in reference to their source, properties, action, signs & symptoms so on and so forth

FORENSIC TOXICOLOGY

- Toxicology is the combination of **chemistry** and **physiology** that deals with drugs, poisons, and other toxic substances and how these substances affect living organisms.

Forensic Toxicology deals with the medical and legal aspects of the harmful effects of chemicals on human beings.

Poison

- Is defined as a substance which when ingested, inhaled, applied or administered is capable of acting deleteriously(harmful) on the body i.e produces ill health or death.



LAW OF POISONS:

- ⦿ Drugs&Cosmetics Act 1940
- ⦿ Drugs&Cosmetic Rules 1945
- ⦿ Pharmacy Act 1948
- ⦿ Drugs Control Act 1950
- ⦿ Drugs&Magic Remedies Act 1954
- ⦿ Narcotics& Psychotropic Substances Act 1985(This act repeals 3 acts. Opium Act 1857,Opium Act 1878,Dangerous Drugs Act 1930.)
- ⦿ Prevention of Illicit Trafficking of Narcotic Drugs &Psychotropic Substances Act 1988

Legal

- ▶ IF A SUBSTANCE IS GIVEN **THERAPEUTICALLY** TO OVERCOME A DISEASED CONDITION, IT IS LAWFULLY ACCEPTED.
- ▶ IF THE SAME SUBSTANCE IS GIVEN, ADMINISTERED OR IN **OVERDOSAGE** TO KILL ONESELF OR ANOTHER IS LAWFULLY **PUNISHABLE**

CLASSIFICATION OF POISONS

CORROSIVES

- strong acids
- strong alkalis
- metallic salts

IRRITANTS

- agricultural
- inorganic
- organic

SYSTEMIC

- cerebral
- spinal
- peripheral
- cardiovascular
- asphyxiants

MISCELLANEOUS

- food poisoning, botulism

Classification Of Poison

CORROSIVE : ACIDS AND
ALKALIS, METALLIC SALTS

- a) Mineral acid (HCl , H_2SO_4 , HNO_3)
- b) Organic acid (oxalic, salicylic, carbolic, acetic acid)
- c) Vegetable acid (HCN)
- d) NaOH , KOH

SULPHURIC ACID

Oil of vitriol: It is a colorless, heavy oily liquid which emits no fumes when exposed to air, mixed with water it evolves much heat

- it chars, blackens the skin, cloth and any other matter.
- fuming sulphuric acid has a formula of $\text{H}_2\text{S}_2\text{O}_7$ and is used in the manufacture of indigo dye

Fatal dose: 5-10ml

Fatal period: 12-24hrs

Vitriolage: Throwing of Sulphuric acid on another individual is known as Vitriolage.

Lakshmi case: Case filed by acid attack survivor in Supreme court brought restriction to the sale of acid.

Nitric Acid

Aqua Fortis, Red Spirit of Nitre: Is a clear colourless, fuming heavy liquid and has a peculiar choking odour. In concentrated form, it combines with organic matter and produces an yellow discolouration of tissue due to the production of Picric Acid(Xanthoproteic Reaction). Greater abdominal distension owing to gas formation. Inhalation of fumes causes lachrymation, photophobia, irritation of air passages and lungs, producing sneezing, coughing, dyspnoea(difficulty in breathing) and asphyxia. Colour of urine is brown. FD and FP are same as that of Sulphuric Acid.

- Test: Blue litmus Red
- Ph paper test
- Brown Ring Test: Strong Ferrous Sulphate solution and Sulphuric Acid are added to a solution containing Nitric Acid, a brown ring is formed at the junction of the two fluids.

Case:

- In a acid throwing case, clothings of the victim was sent along with the container and skin portion.
- The skin was stained yellow due to precipitation of protein.
- On analysis, detected Nitric Acid.

Hydrochloric Acid:

- ⦿ Muriatic Acid: Is a pungent, colourless fuming acid. It is a natural constituent of the fluid of the Stomach and bowels. It is less corrosive than Sulphuric acid. It destroys the mucous membrane.
- ⦿ FD: 15 to 20 ml.
- ⦿ FP: 18 to 36 hrs.
- ⦿ Perforation of the Stomach is rare. Acute inflammation and oedema of respiratory passages and lung tissue are common.
- ⦿ Test: A solution of Silver Nitrate and Nitric acid produces a heavy curdy white precipitate of Silver Chloride.

Oxalic Acid:(Salt of Sorrel)

- Occurs as colourless, transparent prismatic crystals and resembles Magnesium Sulphate and Zinc Sulphate crystals. Used as a bleach to remove stains or to clean brass or copper articles or leather and for removing writing and signatures illegally.
- Systemic :a)Shock: Large doses cause rapid death from shock.
- b)Hypocalcemia: It readily combines with Calcium ions in the body tissues and causes it's withdrawal from them.
- C)Renal damage: Oxalate produces Tubular nephrosis or necrosis and cause uraemia in 2 to 14 days.
- FD:15 TO 20 Gms.
- FP:1 to 2 hrs.
- Treatment: Stomach washed with Calcium Lactate or Gluconate.
- 10%of 10 ml i.v. Calcium Gluconate administered.
- Dialysis for Renal failure.
- Demulcents.
- Symptomatic.
- Test: A solution of Barium Nitrate gives a white precipitate of Barium Oxalate which is soluble in Hydrochloric Acid or Nitric Acid'
- Excretion of Oxalate crystals in urine is called as Oxal Urea.

Carbolic Acid:Phenol:

- Carbolic Acid(Phenol): $C_6H_4 OH$: Consists of short, colorless, prismatic needle shaped crystals. Has a burning sweetish taste which turn pink when exposed to air. Commercial Carbolic acid is a dark brown liquid containing several impurities, chiefly Cresol.
- Acute Poisoning is called as” Carbolism”.Greyish white discoloration of skin, pain, tingling and numbness will be felt. Pupils constricted.
- Phenol will be metabolised in the liver and the metabolites Hydroquinone and Pyrocatechol are excreted in the urine. Urine turns green in colour on exposure to air due to these metabolites and this condition is called Carboluria.

- Color test for Phenol:

1) Ferric chloride test: Phenol gives a blue color.

2) Liebermann's Test: Violet color positive for Phenol.

- In a case, a child had consumed Phenol thinking it as milk. urine was deep green in colour. Detected Phenol in the stomach wash and urine samples received.

Alkalies:

- Commonly encountered alkalies are hydroxides of Sodium, Potassium, Calcium and Ammonium and Carbonates of Sodium, Potassium, Calcium and Sodium Hypochlorite.
- Most of these appear as white powders or colourless solutions.
- Ammonium Hydroxide :Used in paints, dirt remover and as refrigerant.
- Sodium Hydroxide(Caustic Soda):Used as drain cleaner and oven cleaner.
- Potassium Hydroxide(Caustic Potash):Used as drain cleaners and in hearing aid batteries.
- Sodium Carbonate(Washing Soda):House hold cleaner and detergent.
- Sodium Hypochlorite: House hold bleach.
- Usual fatal dose is 10 to 15 gms;15 to 20 ml for Ammonia.
- Mode of Action: Locally alkalies produce liquefaction necrosis and saponification of fats. Ulcer formation is common. Esophagus more vulnerable than Stomach.

Classification Of Poison

IRRITANTS: 1.Agricultural, 2.Inorganic, 3.Organic

Inorganic:

- ▶ a) METALS: AS, Hg, Pb, Cu, Cd, Cr, Mg, Mn, Zn, Se, etc.
- ▶ b) NON METALICS: Chlorine, Bromine, Iodine, Phosphorous, Carbon Tetrachloride
- ▶ c) Mechanical poisons – Powdered glass, Diamond dust, Hair

Organic:

- ⦿ a) Vegetable poison: Abrus, ergot, madar, castor oil, marking nut, Capsicum
- ⦿ b)Animal: Snake venom, Insect venom, Scorpion venom, Cantharides, Ptomaine

Irritant Poisons:

Agricultural Poisons:

- ① 1) Insecticides of Vegetable Origin: They are Nicotine, Pyrethrins and Rotenone.
- ② 2) Chemical Insecticides: Inorganic: They are Phosphorous and compounds of Antimony, Arsenic, Barium, Mercury, Thallium, Zinc and Fluorides.
- ③ 3) Synthetic Organic Chemical Insecticides: They are divided into Phosphate Esters, Carbamates, Chlorinated Hydrocarbons.

Organo Phosphorous Compounds:

They are Choline Esterase Inhibitors (Acetyl Choline-Neuro transmitters) they have 3 distinct toxic actions

- 1) Muscarine like effect which potentiates postganglionic parasympathetic activity.
- 2) Nicotine like Stimulation followed by Paralysis of Post ganglionic and somatic motor nerves.
- 3) Central Nervous System stimulation followed by depression.

Treatment:

- When the poison is ingested ,stomach should be washed with 1:5000 Potassium Permanganate solution. Activated Charcoal to be administered. Atropine Sulphate arrests Muscarine effects and CNS effects.
- Pupils will be constricted in OP Poisoning. Atropine should be administered till dilatation of the pupil takes place (Atropinisation). If its further administered ,it will result in death only.
- Example for OP compounds:
- Methyl Parathion, Ethyl Parathion, Malathion, Diazenon, TEPP (Tetra Ethyl Pyro Phosphate), HETP (Hexa Ethyl Pyro Phosphate).
- Choline Esterase is an enzyme that helps your nervous system the way it should.

Organo Chlorinated Compounds

- ⦿ They interfere with nerve impulse transmission. CNS is first stimulated and then depressed.
- ⦿ Symptomatic Convulsions should be controlled with Diazepam.
- ⦿ Example for OC compounds:
- ⦿ DDT, Gammaxene, Lindane and Endosulphan.

Case:

- As the husband had a paramour, the wife mixed unknown powder in curd rice. After eating, the husband started vomiting.
- When the gastric aspirate and vomit was tested, Gammaxine was detected.
- Gammaxine is an organo chlorinated compound. Used for treating lice, scabies and for killing ants.
- In another case, a group of people in a nearby field fainted. Examination of gastric aspirate revealed the presence of Endosulphan. Endosulphan vapors carried by the wind was responsible for their giddiness.

Carbamates:

They are also Anticholinergic and inhibit Carboxylic Esterase enzymes by Carbamylation. Atropine is the specific antidote. Pralidoxime improves respiratory functions and patients well being.

Example for Carbamates:

- Aldicarb, Aminocarb,
- Aprocarb(Baygon)Carbaryl,
Carbofuran(Furadon)

Cause of death: Paralysis of respiratory muscles, respiratory failure.

- Pyrethroids:
- They have enhanced insecticidal activity and low mammalian toxicity.
- They are being used as homicidal and suicidal poisoning.
- Permethrin, Cypermethrin, Deltamethrin and Fenvalerate are broad spectrum synthetic pyrethroid insecticides.
- All insecticides, pesticides can be identified by TLC, GC, GC-MS, HPLC.

Metallic Poisons:

ARSENIC:

Metal is not poisonous but when volatilized by heat, poisonous vapour of Arsenic Trioxide formed.

Compounds of Arsenic:

- Realgar: Yellow(As_2S_2)
- Orpiment: Red(As_2S_3)
- On heating, Arsenic sublimes to form Arsenic Trioxide, fine granular white powder known as White Arsenic.
- Copper Arsenite(Scheele's Green)
- Copper Acetoarsenite(Paris Green or Emerald Green)
- Arsine Gas(AsH_3)

Types of Arsenic Poisoning:1)Fulminant: Massive doses-3 to 5 gms causes death due to shock.

- 2)Gastroenteritis Type: Constriction of the throat burning and colicky pain in oesophagus, stomach and bowel occur. Stools colorless, odorless and watery resembling rice water stools of cholera. Garlicky odour of breath and faeces.

Napoleon and Arsenic

- It has been suspected for years that **Napoleon's death** was caused by arsenic poisoning. **Arsenic** loves to bind to **sulfur** and there is plenty of sulfur in your hair so basically your hair is a timeline .
- There is one fact...arsenic was found in Napoleon's hair.

Lead:

- ⦿ It's a heavy steel grey metal. The metal and all its salts are poisonous.
- ⦿ The principal salts are :
- ⦿ Lead Acetate-White crystals
- ⦿ Lead Carbonate-White crystalline powder
- ⦿ Lead Chromate-Bright yellow powder
- ⦿ Lead Monoxide-pale brick red or pale orange mass
- ⦿ Lead Tetroxide(Red Lead, Vermilion, Sindur)-Scarlet crystalline powder
- ⦿ Lead Sulphide-least toxic.
- ⦿ Lead is used in storage batteries, solders, paints, hair dyes, electric cable insulations, pottery, ceramic and petrol.
- ⦿ Test:Golden yellow spangles test:Test solution+Dilute Nitric acid+1 ml of Potassium Iodide gives rise to bright yellow precipitate.Boil,precipitate dissolves.on cooling,golden yellow spangles obtained.

Copper:

- ⦿ Copper as a metal is not poisonous. Copper compounds are powerful inhibitors of enzymes.
- ⦿ Copper Sulphate –Blue Vitriol-occurs as blue crystals.
- ⦿ Copper Subacetate-Verdigris-occurs in blueish green masses or powder.
- ⦿ Copper is a normal constituent of the body. Copper content of the body is 150 mg.It's absorbed through lungs, mucous membrane and raw surfaces. It is excreted more by bowels than kidneys.

PHOSPHOROUS:

Two main varieties are

- Yellow or White Phosphorous with garlicky odour. On exposure to air forms white fumes of Phosphorous Pentoxide and hence stored under water. It's highly combustible and ignites into flames at 34 degree centigrade. It's luminescence in dark is called "Phosphorescence".
- Red Phosphorous: Reddish, amorphous, odourless substance. It is insoluble and harmless.

- Uses: Red Phosphorous used in semi conductors, pyrotechnics, safety matches, smoke bombs in certain flame retardants.
- White or Yellow Phosphorous –Important ingredient in fertilisers, Vermin killers, insecticide, rodenticide, fireworks, gun powder, tracer bullets, smoke screens, air rescue flare, production of Phosphoric Acid, detergent, water treatment.
- Acute Phosphorous Poisoning:
- Mode of action: Phosphorous is a protoplasmic poison and is Hepatotoxic. Locally produces severe irritation of skin and mucosa.
- In large doses ,cause shock and cardio vascular collapse.

Mercury:

- ◉ Quick Silver is a liquid metal, bright silvery appearance, volatile at room temperature. Occurs as Mercuric-intensely poisonous and Mercurous-less poisonous.
- ◉ Poisonous compounds:
- ◉ Mercuric Chloride
- ◉ Mercuric Sulphide(Cinnabar)
- ◉ Mercuric Cyanide
- ◉ Mercuric Nitrite
- ◉ Mercuric Sulphate
- ◉ Mercuric Oxide
- ◉ Mercurous Chloride(Calomel)
- ◉ Organic compounds of Mercury.

- Mercury gets absorbed by alveolar membranes rapidly converted into mercuric ions .
- CNS acts readily on the cerebellum.
- Mercury is a nephrotoxin produces tubular necrosis.
- FD: 1 to 2 gm of mercury cl .
- FP : 3 to 5 days.
- Reinsch Test:A shiny ,silvery deposit on the Copper strip indicates the presence of Mercury.The Copper strip is washed in a gentle stream of water ,dried and heated in a Reinsch tube.Viewed under microscope.Shiny round metallic globules of Mercury seen.

Classification Of Poison

Systemic Poison

- ① 1) Cerebral
- ② a) CNS stimulants- eg. Amphetamine, Caffeine, Cyclic Anti Depressants
- ③ b) CNS Depressants: Alcohols, General Anaesthetic, Opioid analgesics, Sedatives, Hypnotics.
- ④ c) Deliriant: Datura, [8 D Rule], Atropa Belladonna, Cannabis, Cocaine.

Systemic Poison

2) **Spinal**: Strychnus nux vomica[opisthotonos- Body arched backwards, emprosthotonus-Body arched forward, pleurosthotonus- Body arched sideways]

3) **Cardio-Vascular**: Oleander, Aconite, Quinine, Tobacco, Cyanide.

4) **Asphyxiants**: Carbon monoxide, Carbon dioxide, Hydrogen sulphide.

5) **Peripheral**: Curare, Conium.

Cyanide: Cardio-Vascular Poisoning:

- Hydro cyanic acid or Prussic acid is a colorless, volatile liquid possessing characteristic odour similar to that of bitter almonds. It's soluble in water, alcohol and ether. It is a powerful protoplasmic poison and prevents the tissues from utilizing oxygen of the blood by interfering with the action of an enzyme "Cytochrome".
- These contain a crystalline glycoside name as Amygdalin. With large doses, the symptoms usually appears within a few second. Face bloated, eyes glassy and prominent with dilated pupils. Finger nails are blue or purple. Respiration becomes slow and stertorous .Tonic or epileptic convulsions followed by paralysis, cyanosis, cold clammy skin, foam on mouth, relaxation of sphincters. Death occurs due to respiratory failure.

- ⦿ Treatment for Cyanide poisoning:
- ⦿ Amyl nitrite inhalation for 15 to 30 minutes.
- ⦿ Sodium Thiosulphate 25 gms as 15% solution by slow iv over a period of 3 minutes is administered. It converts Cyanide into nontoxic Thiocyanate.
- ⦿ Hydroxy Cobalamine given.
- ⦿ Dicobalt EDTA acts by chelating Cyanide to form harmless compound and is excreted in urine.

● Test for Cyanide:

1) Silver Nitrate Test: Forms white turbidity due to the formation of Silver Cyanide.

2) Prussian Blue Test: To the distillate, add a few drops of 5% solution of NaOH followed by 5% solution of freshly prepared Ferrous Sulphate, 1 or 2 drops of 3% solution of

Ferric Chloride. Shake the solution well, allow to stand for a few minutes, warm gently and acidify with dilute Hydro Chloric Acid. A precipitate of Prussian blue is formed due to the presence of Cyanide.

- LTTE Case:subha and Sivarasan :Involved in Thiru.Rajiv Gandhi assassinatin case.When surrounded in Bangalore,they swallowed cyanide with the glass ampoule which they hung from the neck and died immediately.Cyanosis was observed.

Asphyxiant:

Carbon Monoxide Poisoning:

- CO is a colourless, tasteless non irritative gas ,insoluble in water. It has 200 to 300 times greater affinity for haemoglobin than that of oxygen. It displaces oxygen from it's combination with haemoglobin and forms stable Carboxyhaemoglobin. It acts as a chemical asphyxiant and produces death due to anemic anoxia(absence of oxygen).It's eliminated through lungs. It's a potent cellular toxin. Effect of CO are simply those of suboxia(concentration of oxygen very low)Rapid death from respiratory arrest.

Test for Carbon Monoxide:

- ⦿ Normal blood heated in a porcelain dish, color changes to brown black where as blood with Carbon monoxide will turn brick red.
- ⦿ Blood with Carbon monoxide remains pink on dilution with water.

- ⦿ Carbon dioxide:
- ⦿ Relatively inert, has no poisonous or cumulative effect.
- ⦿ Minimum fatal concentration is said to be 25 to 30%.
- ⦿ Ammonia:
- ⦿ Inhalation produces choking, coughing, pulmonary oedema, breathing difficulty.
- ⦿ Maximum permissible concentration is 100 parts per million.
- ⦿ My colleague inhaled Ammonia vapours directly resulting in giddiness and she started gasping for breath. So I acted quickly by giving her mouth to mouth respiration thus saving her life.

- Phosphine:
- Is a colourless, flammable, highly toxic gas with an odor of decaying fish. Affects central nervous system.
- A concentration of 2000 ppm is lethal.

Cannabis Sativa: Deliriant Poison:

- Active principles of ganja is Cannabinol, Cannabidiol, Tetrahydro Cannabinol.
- Other names are Pot, grass, dope, weed, hash, mary jone, hasish.
- Delta 9 THC is most toxic.
- Flowering tops of the female plant is called Ganja.
- Under microscope:
- Cannabis may be identified by the presence of retort shaped, short, unicellular Cystolithic hairs.

FD: Ganja 8 gms

THC 30 mgm/ kg

FP: Several days

Treatment: Stomach wash or emesis

100 ml of 50%Glucose,2 mgm Naloxone and
100 mgm Thiamine as i.v.

5 to 10 mgm Diazepam if the patient is violent
or aggressive Psycho Therapy.

- ⦿ **Bhang**: Dried leaves and fruit shoots constitute Bhang.
- ⦿ **Charas or Hashish**: Resin exuding from leaves and stems of the plant .Contains 25 to 40% of the active principle.
- ⦿ Dark Viscous liquid obtained from hashish by repeated extraction is called **Hashish Oil**.
- ⦿ Chronic poisoning leads to degeneration of the CNS System and insanity.

Opium: CNS Depressant:

- Is a somniferous poison-induces sleep.
- Alkaloids present are
- Morphine
- Codeine
- Thebaine
- Papaverine
- Narcotine.
- Naturally occurring Opium and the derivatives are called Opiates
- Example are
- Diacetyl Morphine(Heroin)
- Buprenorphine
- Pentazocine.



- ◉ Pure synthetic analogues are called as Opioids.
- ◉ They are: Pethidine(Meperidine)
- ◉ Methadone
- ◉ Tramadol
- ◉ Loperamide
- ◉ There are 3 stages of Opium toxicity:
- ◉ Stage of excitement
- ◉ Stage of Stupor
- ◉ Stage of Narcosis

Cocaine:

- Cocaine: Is an Alkaloid obtained from the leaves of *Erythroxylon Coca*. Cocaine crystals are colourless, odourless, bitter in taste, causes numbness of the tongue and mucous membrane. It's known as Coke, snow, Cadillac or white lady. CNS Stimulant followed by depression. Tongue and teeth are black in colour.
- **Magnan's Symptom or Cocaine Bugs:** Is characteristic in which there is a feeling as if grains of sand are lying under the skin or some small insects are creeping on the skin giving rise to itching sensation (Tactile Hallucination, Formication) leading to irregular scratches and ulcers.
- Treatment: Gastric lavage with activated charcoal, tannic acid
- Amyl Nitrite is an antidote-given by inhalation
- Airway and Circulatory stabilization
- Thiamine 100 mg i.v.
- Naloxone Hydrochloride 2 mg i.v.
- Symptomatic Treatment.

Causes: Toxins, i. Poisoning due to Bacteria and toxins eg.

Salmonella, Staphylococcal

ii. Poisons of vegetable origin: poisonous mushrooms, rye, oats, poisonous berries such as Atropa belladonna, solanine. iii. Poisons of animal origin: poisonous fish eg. Toad fish, cat fish, lion fish, dragon fish, balloon fish, puffer fish, sun fish, shell fish, stone fish, scorpion fish, box jelly fish. 2. Mussel

iv. Chemical: intentionally added such as flavouring agents in processed food, colouring agent, preservatives to accidentally added such as insecticides. 3. Products of food processing eg. Smoking of fleshy foods. 4. Radionuclides.

Eg. E. coli invade intestinal mucosa and elaborate enterotoxin.

Botulism:

CL Botulinum does not grow in body but produces neurotoxin. It is present in soil, dust, intestinal tract of animals and enters food as spores, especially fruits and vegetables.

Virus;

Noro-virus and Rota-virus commonly cause food poisoning.

Ptomaines: These are alkaloidal bodies which are formed as a result of bacterial decomposition of protein. When they are formed in dead tissues they are known as Cadaveric alkaloids.

- **Food poisoning:** a. *Lathyrus sativus* (kesari dhal) causes paralysis. Active neurotoxic principle is B(N) oxalyl amino-alanine (BOAA). The continued use of L-Sativus produces Neurolathyrism.

Depressants

- Medications that slow brain activity, which makes them useful for treating anxiety and sleep problems.

- Barbiturates

- :Phenobarbitone
- ,Amylobarbitone
- ,Secobarbitone
- ,Butabarbitone
- ,Pentabarbitone
- ,Diphenyl Hydantoin.

- Benzodiazepines:

- alprazolam ,
- chlorodiazepoxide,
- diazepam Nitrazepam,
- lorazepam , Oxazepam



- Marilyn Mandro-Actress died of

Michael Jackson

- ◉ Death in 2009- over dosage of anaesthetic **Propofol**
- ◉ Conrad murray –His Physician was accused of involuntary manslaughter .
- ◉ 4 year in jail- 2 years let out early for good behaviour and due to prison over crowding.



Anthony and Cleopatra

- ◎ Cleopatra Act V and scene II

Image of suicide of Cleopatra by asp (Egyptian cobra)

With thy sharp teeth this knot intricate
of life at once untie; poor venous fool

Be angry and dispatch.

2010-German historian-Christoph Schaefer &
toxicologist Dietrich Mebs –Cleopatra actually
used a mixture of hemlock(Conium),
wolfsbane(Aconitum) and opium to end her life.

ABRUS PRECATORIUS (JEQUIRITY, INDIAN LIQUORICE, GUMCHI OR RATI).

All parts of the plant are poisonous, the seeds are commonly used as poison.

The active principle is Abrin, a toxalbumin –(its actions resemble those of viperine snake bite)and Precatorin.

It is also used as Arrow poison.
Symptoms: Haemorrhagic gastritis and Cardiac manifestations.

FD:60 to 120 mg

Screening tests:Marquis Reagent Test:Pink color observed.

Treatment:Decontamination and supportive measures.

Accidental poisoning common in children as they are attracted towards the colour.

Sui Poison:Seeds are crushed and added with pastes of arsenic,lead,calotropis and made into injecting needles and used to kill the enemy by blowing using a bamboo stick.Also used as a cattle poison.

Strychnos Nux Vomica: Spinal Poison:

The ripe fruit contain Nux Vomica seeds which are poisonous. They are ash grey in colour, tough, having no odour but possessing a bitter taste. They yield two principal alkaloids:

Strychnine

Brucine

Besides the seeds contain to a small extent a glucoside named Loganin.

Strychnine: $C_{21}H_{22}O$:

This crystallises in colourless, inodorous, rhombic prisms having a intensely bitter taste.



- ◎ **Strychnine**: Is soluble in alcohol, benzene, chloroform but very sparingly soluble in water or ether. It's used to kill stray, unclaimed dogs, rats, mice and other vermin and forms the chief ingredient of several vermin killers.
- ◎ **Brucine**: $C_{23}H_{26}O_4N_2$: This occurs in colourless, prismatic crystals with an intensely bitter taste.

- ◎ **Brucine**: Is slightly soluble in cold water but more in boiling water and freely in alcohol, chloroform and amyl alcohol but not in ether. Its toxic effect is one tenth of that of Strychnine.
- ◎ Symptoms: During swallowing, bitter taste in throat, choking sensation. At first, clonic convulsions occur but eventually becomes tonic. Face cyanosed, pupils dilated.

- **Opisthotonos**: Body arched backward, the patient resting on his heels and occiput.
- **Emprosthotonos**: Spasm of the abdominal muscles may bend the body forward.
- **Pleurosthotonos**: Body may be flexed to the side.
- Death may occur from asphyxia or any subsequent attack or from exhaustion during intervals as a result of painful spasms.
- Strychnine poisoning has to be diagnosed from Tetanus.

- ⦿ Treatment: Universal antidote
- ⦿ Short acting Barbiturates or Diazepam to control convulsions
- ⦿ Amyl Nitrite inhalation
- ⦿ Artificial respiration
- ⦿ **Test for Strychnine:**
- ⦿ **Colour Test:**
- ⦿ Residue in Sulphuric acid+Small particle of Potassium Dichromate drawn through the mixture with the aid of glass rod, a play of colours will follow (blue to dark violet to reddish purple, red or orange finally to yellow.)
- ⦿ Physiological Test: Residue injected into dorsal lymph sac of a frog, tetanic convulsions occurs in a few minutes.

Forensic Significance:

- ⦿ Homicide is common
- ⦿ Accidental common in children
- ⦿ Suicidal rare
- ⦿ Used as an aphrodisiac
- ⦿ Cattle poison
- ⦿ Arrow poison.

Oleander:Nerium

Odorum:White Oleander:

All parts of the plant except root are poisonous in nature.

Cardiac Glycoside:Present are
Oleandroside(Oleandrin) and Nerioside(Nerin)

Symptoms:Abdominal pain,vomiting,profuse
frothy salivation,pupils dilated,lock-

jaw,drowsiness,coma,respiratory paralysis and
death occurs.

Treatment: Stomach wash
symptomatic.

Used mainly as suicidal poison.

Homicide rare. Cattle poison.

Cerebra Thevetia: Yellow Oleander: All parts of the plants are poisonous in nature.

Active

Principles: Thevetin, Thevetoxin, Nerifolin, Cerberin, Peruvoside, Ruvoside. All are Cardiac Glycoside.

Symptoms: Ingestion causes burning pain in the mouth, dryness of throat, tingling, vomiting, diarrhoea, dilated pupil, muscular ataxia, pulse rapid weak and irregular. Heart block, collapse and death from peripheral respiratory failure.

Treatment: Stomach wash

ECG Monitoring

IV Sodium molar solution and 5% Dextrose to combat shock.

Atropine 1 mg, Adrenaline 0.2ml and IV

Oleander:

Treatment: Stomach wash
Sodium molar Lactate
transfusion with glucose and 1
mg Atropine, 2 ml Adrenaline
and 2 mg Noradrenaline is
beneficial.

Symptomatic treatment.

Circumstances of

Poisoning: Commonly used as a
suicidal poison.

Also used as an abortifacient
and as a cattle poison.

Cleistanthus Collinus:Oduvan:

Oduvan: Cleistanthus Collinus:

Naidu and his associates have isolated a glucoside called Oduvin, $C_{22}H_{34}O_{12}$ to which the plant owes its poisonous properties. Oduvin is a yellowish-white crystalline substance sparingly soluble in water or ether but freely soluble in alcohol and chloroform. Symptoms: Nausea, violent vomiting, abdominal pain, diarrhoea, dilated pupils, cramps in the limbs, collapse and death.

Chemical Analysis:Oduvan:

Extraction by Stas-Otto Process.Filtrate rendered

alkaline by the addition of Sodium Carbonate and extracted with ether-chloroform mixture.Extract is evaporated to dryness.The residue contains Oduvin.

Residue+Con Sulphuric Acid:Blue colour turning to mauve.

Residue with Con Nitric Acid:Green colour becoming Brick Red.

Oduvan:

Residue when injected under the skin of frog causes paralysis and death.

Poison used for homicide and suicide purposes.

Leaves as paste and decoction :used for criminal abortion and as cattle poison.

Bark as fish poison.

SEMICARPUS ANACARDIUM

(Marking Nut)

- Marking Nut – Its juice is used by dhobis
- Active principles – Semecarpol
Bhilawanol
- Nut juice on the skin- vesicates – black blisters containing acrid serum which causes an eruption
- Treatment: Supportive measures.
- Juice used as an abortifacient and for producing artificial bruise, Conjunctivitis.



MADAR -CALOTROPIS FLOWERS

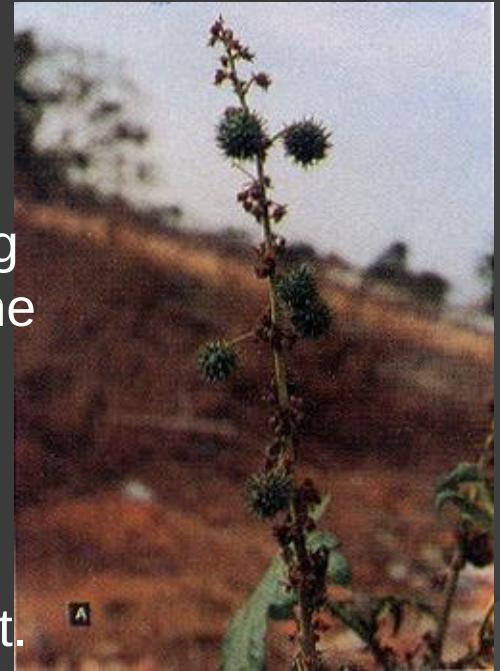
- ◉ There are two varieties
 - i) *Calotropis gigantea* – Purple flowers
 - ii) *Calotropis procera* – White flowers

- ◉ The three active principles
 - ◉ i) Uscharin
 - ◉ ii) Calotoxin & iii) Calactin
 - ◉ Some say that it contains Calotropin, Calotoxin and Uscharin.



RICINUS COMMUNIS (CASTOR PLANT)

The raw seed produce sever toxic effects.
The Active principle called Ricin –Tox albumin or Phytotoxin is a toxic protein.
It causes agglutination and lysis of red cells.
It is antigenic in nature and is capable of producing a specific antitoxin (antibody) when injected into the body.
Symptoms:vomiting,diarrhoea,abdominal pain,hypotension,dehydration,fever with chills,hemolysis and renal failure.
Castor oil is used as a purgative and as a lubricant.
Fatal dose:1mg/kg,5 to 10 seeds.
Treatment:Gastric lavage and activated charcoal.
Correct fluid and electrolyte imbalance.
Supportive measures.



CAPSICUM (Chillies)

- Capsicum fruits are powdered and
- Universally employed In India as a
- Condiment, the condiment being known as red pepper or Lal mirch. Chilly seeds are small, yellow, rounded, smooth, pungent in odour and taste. To be differentiated from Datura seeds which are large, brown, reniform in shape.
- The active principle – Capsaicin & Capsicin
- Applied to skin causes irritation
- and vessication.
- To the eyes – burning and lachrymation.
- Thieves spray chilly powder to avoid detection by police dogs.
- Treatment: Wash with vinegar or ice cold water.
- In case of ingestion, give ice cubes to suck or sips of ice cold water.
- Supportive measures.



(iii) Deliriants:

A temporary state of mental confusion and fluctuating consciousness

e.g :Datura,
Cannabis, Atropa belladonna.



Datura:

- ◉ Datura Alba, a white flowered plant and Datura Niger, a black or rather deep purple flowered plant.
- ◉ All parts of these plants are poisonous but the seeds and fruits are considered to be most toxic. They yield active principles:
 - ◉ Hyoscine
 - ◉ Hyoscyamine
 - ◉ Traces of Atropine.
- ◉ Datura is a stupefying poison.



Deliriant Poison:Datura:

8 D Rule:

Dryness of the mouth

Dryness of the throat

Dilated pupil

Diplopia(Double Vision)

Dryness of the skin

Dyspnoea(Difficulty in breathing)

Dysphagia(Difficulty in swallowing)

Delirium.

Death occurs from paralysis of heart or respiration.

Atropa Belladonna:(Deadly Night Shade)

All parts of the plant viz the leaves,berries and root are poisonous.

They contain 3 alkaloids:

Atropine

Hyoscyamine

Belladonnine.



Atropine: $C_{17}H_{23}O_3N$ is colourless, odourless prismatic needles and has a bitter taste. Sparingly soluble in water but freely soluble in ether, chloroform and alcohol.

Symptoms for Atropine :Closely resemble that of Datura.

FD:Variable

.FP:3 to 6 hours.

Physiological Test:Residue dissolved in water containing few drops of Sulphuric acid and 1 or 2 drops instilled into cat's eye.In a few minutes ,the pupil begins to dilate.

Test:Vitali's Test:Violet to red.

Gerrard's Test;Red color .

Snake:

Snake venom is saliva of the snake.

- 1) Elapids-Neurotoxic – Fangs are 4-6mm[eg.King Cobra, Kraits, Mambas]
- 2) Vipers –Vasculotoxic – Fangs are 12-15mm
- 3) Sea Snakes- Myotoxic- Fangs 2-4 mm

Cobra venom is faint transparent yellow and is slightly viscous.

- Russels viper: Venom is white or yellow in colour.
- Snake venom are proteolytic, hemolytic, cytolytic and are neurotoxic and cardiotoxic.
- Antivenin used for treatment.



Food Poisoning

- ① 1) Infection type: it is gastroenteritis due to mainly Salmonella group.(Bacteria)
- ② 2) Toxin type: Presence of enterotoxin (affecting intestine) formed by Staphylococcus- source tinned foods.
- ③ 3) Botulism: Clostridium botulinum multiplies in food and produce exotoxin(secreted by the bacteria)

Where are the best places to collect samples?

- Where the chemical enters
- Where the chemical concentrates
- Along the route of elimination

Best Tissues to Sample for Poisons

- **Blood** – most useful tool...will show chemical and its metabolites...blood levels show what was going on in the body at the time of death
- **Urine** – easy to obtain...high concentrations...kidneys are along the elimination route
- **Stomach contents** – digestion stops at the moment of death

Best Tissues to Sample for Poisons

- **Liver** – the toxin sponge of your body... can reflect levels of toxins that even the blood may not reveal
- **Vitreous Humor** – eyeball fluid...very slow to decay so will retain toxins even longer than most other organs
- **Hair** – chemicals take about 5 days to show up in the core of a hair shaft...nature's timeline
- **Insects** – toxins can accumulate (bioaccumulation) in the bodies of insects that feed off of decomposed bodies.

CEREBRAL POISON:

INEBRIANT POISON:

Alcohol(Ethyl Alcohol)

- The most commonly abused drug
- Blood-alcohol levels are directly proportional to the degree of intoxication

and are expressed in grams percent (# of grams of alcohol/100 ml blood)

Acts on the CNS favoring the brain

Blood carries alcohol to all cells of your body but mostly to the watery areas of your body.

Addiction to Alcohol is called Alcoholism. Chronic users will suffer from withdrawal symptoms if they stop intaking alcohol.

- Inebriant poisons produce intoxication. The term Alcohol refers to Ethyl Alcohol. It's a transparent, colourless, volatile liquid having a spirituous odour and a burning taste.
- Absolute Alcohol contains 99.95% alcohol.
- Rectified Spirit contains 90% alcohol.
- Industrial Methylated Spirit or Denatured Alcohol is a mixture consisting of Alcohol 95% and 5% of Wood Naphtha.

- Ethanol is produced by the fermentation of Sugar by Yeast.
- Proof Spirit: Is one in which at 10.5°C weighs 12/13 part of an equal measure of distilled water.
- Weaker Spirits are termed “Under Proof” and Stronger Spirits “Over Proof”.
- Proof is defined as twice the percentage of the alcohol content of the drink.

Alcohol Elimination

- 2 mechanisms for elimination:
- Oxidation
Takes place in the liver
Acetaldehyde
Acetic acid
(goes all over body)
 $\text{CO}_2 + \text{H}_2\text{O}$
- Excretion
Breath
Urine
Perspiration

Methanol Poisoning:

- ◉ Wood Alcohol: It is a colourless volatile liquid with a burning taste.
- ◉ Symptoms: Nausea, vomiting, abdominal cramps, head ache, neck stiffness, depressed cardiac action, photophobia
- ◉ Blurred or misty vision, complete blindness due to Optic Neuritis.
- ◉ Methanol is oxidized to Formaldehyde in the Liver which is 33 times more toxic than Methanol.
- ◉ Formaldehyde is further oxidized to Formic Acid which is responsible for metabolic Acidosis.
- ◉ Test: Chromotropic Acid Test:

Poisons –Constriction of pupil

- Opium
- Organo -phosphorous compounds
- Tobacco
- Carbolic acid
- Curare
- Anesthetic
- Alcohol(stage of coma)

Poisons – Dilatation of pupil

- Cyanide
- Datura
- Corrosives except carbolic acid
- Alcohol (initial stages)
- Digitalis
- Cannabis
- Atropa Belladonna
- Strychnine.

Poisons leading to characteristic manifestation in Stomach.

- ⦿ Sulphuric Acid – Black perforation
- ⦿ Nitric acid – Yellow.
- ⦿ Phenol – Leathery.
- ⦿ Copper Sulphate – bluish green contents.
- ⦿ Oxalic acid-cloudy deposition of calcium oxalate.
- ⦿ Iodine- mucous membrane brown-contents blue.

Poisons used as arrow poison

- ⦿ Abrus precatorius.
- ⦿ Aconite.
- ⦿ Strychnine.
- ⦿ Croton.
- ⦿ Snake venom.
- ⦿ Scorpion venom.
- ⦿ Curare.
- ⦿ Calotropis.

Poisons causing convulsion

- ⦿ Cyanide
- ⦿ Strychnine.
- ⦿ OP
- ⦿ Arsenic.
- ⦿ Aconite.
- ⦿ Cobra snake.
- ⦿ Opium.
- ⦿ Lead.

Universal Antidote.

- It can be used in all cases of poisoning especially when the nature of poison is not known.[ATM]

Activated Charcoal	2 parts	Adsorbs poison
Magnesium oxide	1 part	Neutralises acids
Tanin	1 part	Ppt metals ,alkaloids and glucosides

Techniques

- Specimen extracted
- Identification of substance

Screening procedures

- Gas chromatography
- Thin layer chromatography

○ Confirmation :

- Gas chromatography
- UV Spectrophotometry
- IR Spectroscopy
- Mass spectroscopy
- GC-MS
- Ion Detector
- AASP
- FTIR

- Medico legal aspects of Poisons: Important
- Sections:176,177,193,201,202,284,299,300,304A,309,320,324,
- 326 & 328 IPC & sections 39,40 &175 Cr.P.C deals with offences
- relating to administration of poisonous substances, section 270 & 278 IPC deal with adulterated food & drugs.

INTERESTING CASES:

- Case history Hanging:
 - A 20 year woman was found hanging at her residence by her husband. On visceral analysis, phenobarbitone was detected. IO was informed. On interrogation, it was found that the husband suspected the character of his wife & administered phenobarbitone. When she was unconscious he hung her.
- Food Poisoning:
 - A male aged about 30 was having a concubine .So the wife tried to kill him by administering gammaxine in curd rice. After eating the curd rice, husband vomited and became unconscious and hospitalised. His vomit, gastric aspirate and curd rice were sent for chemical analyses. Gammaxine was detected.

Interesting Cases:

- ◉ Unknown poison:
 - ◉ A businessman from Andhra was travelling to Chennai by bus, was offered Frooti- sealed pack by his friendly co-passenger. After everyone got down from the bus, the conductor found him unconscious and he was hospitalised. When the frooti contents were analysed, Diazepam was detected. By using a fine needle the accused had injected Diazepam from the side which was invisible.
 - ◉ The businessman had lost nearly 10 sovereigns of gold jewels.
- ◉ Train Travel:
 - ◉ Four passengers travelling by train were offered food by 2 co-passengers who were husband and wife. After eating, they became unconscious. Money, jewellery were taken away. Datura, a stupefying poison detected during analysis.

◎ Unknown Poison:

Green paste like substance was found in the stomach of a woman. Oduvan detected.

◎ Illegal abortion:

Unknown death of a female during illegal abortion along with viscera, a stick used for abortion was also received at the lab. Oleander was detected.

◎ Anaesthetic death:

A young lady who was admitted for delivery died on the operation table itself. Viscera and blood were analysed and detected Ketamine by TLC and instrumentation method.

◎ LTTE Case:

Several ampules seized from LTTE militants were sent for chemical analyses. Detected potassium cyanide in all the ampules received. Ampules contained about 1.5 gms of KCN.

◎ T.I. CYCLES Case:

Cyanide, which should have been dumped 500 kms inside sea level, was dumped in a pond. The water was consumed by 10 cows in the morning and they died immediately. Viscera was analysed. Detected cyanide.

Case Study

- THE STAFF NURSE ADMINISTERED THE MEDICINE AND SOON AFTER THE LADY DEVELOPED CONVULSIONS AND DIED. THE DOCTOR INFERRED THE DEATH DUE TO TETANUS. PARENTS SUSPECTED THE DEATH AS FOUL PLAY
- AND THE CASE WAS UNDER INVESTIGATION. THE CHEMICAL ANALYSIS PROVED THE PRESENCE OF STRYCHNINE. FURTHER INVESTIGATION PROVED THE HUSBAND TO BE GUILTY OF THE MURDER.